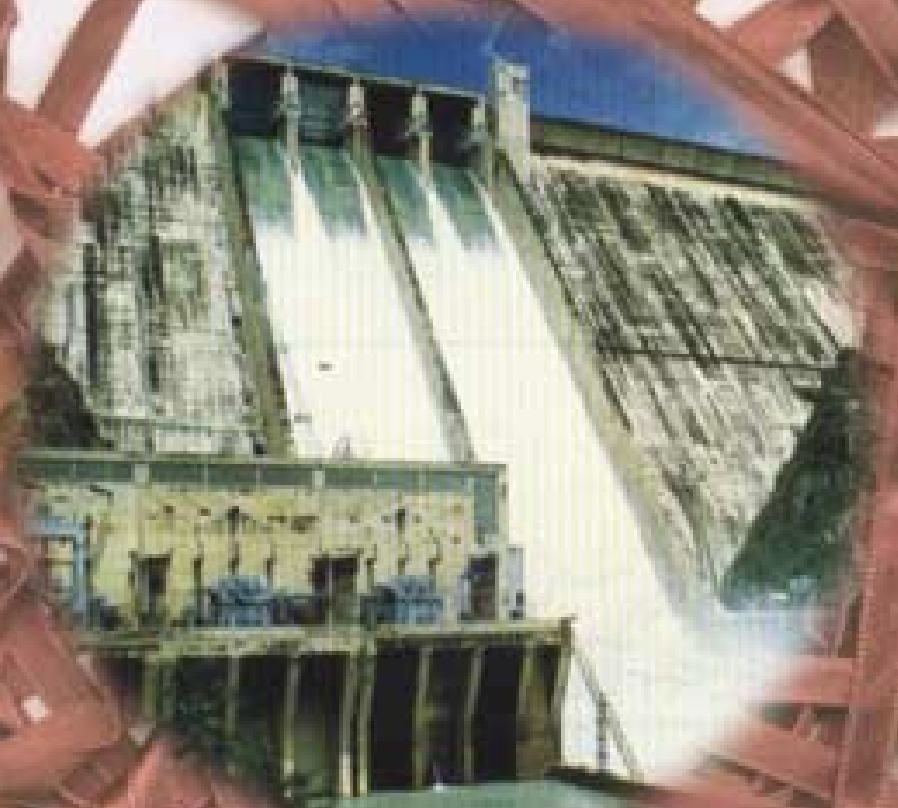
UNRAVELLING BHAKRA

ASSESSING THE TEMPLE OF RESURGENT INDIA



SHRIPAD DHARMADHIKARY
Manthan

MANTHAN ADHYAYAN KENDRA

Manthan Adhyayan Kendra (Manthan Research Centre) is a centre set up to monitor, analyse and research water and energy related issues, with a special focus on developments resulting from the liberalisation, globalisation and privatisation of the economy. The Centre is located at Badwani, a district town in western Madhya Pradesh. While the focus of the work is on water and energy issues, this is in the larger context of equitable, just and sustainable development.

Manthan maintains live links with various people's movements, social activists' organisations and other similar research organisations.

It is an undertaking of the Manthan Research and Social Development Society, a society registered in Madhya Pradesh (No. IND/5753/2001).

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"Bhakra Nangal Project is something tremendous, something stupendous, something which shakes you up when you see it. Bhakra, the new temple of resurgent India, is the symbol of India's progress."

Pandit Jawaharlal Nehru,
during the dedication of the
Bhakra dam to the nation.
22 October 1963

"The time has come", the Walrus said,
"To talk of many things:…

The Walrus and the Carpenter,
Through the Looking Glass and
What Alice Found There

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UNRAVELLING
B H A K R A

ASSESSING THE TEMPLE OF RESURGENT INDIA

Report of a Study by
Manthan Adhyayan Kendra
Badwani (M.P.)

Study Team

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Unravelling Bhakra: Assessing the Temple of Resurgent India

Report of a Study of the Bhakra Nangal Project

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Assessing the Temple of Resurgent India

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Legend *n. 1. A popular story handed down from earlier times which may or may not be true.*

Collins Dictionary

lectern *n.* a stand with a sloping top from which a bible etc. is read.

lecture *n.* a speech giving information about a subject; a lengthy reproof or warning. ● *v.* give a lecture or lectures; reprove at length. □ **lecturer** *n.*

LED *abbr.* light-emitting diode.

led past & p.p. of **lead**[1].

ledge *n.* a narrow horizontal projection or shelf.

ledger *n.* a book used for keeping accounts.

lee *n.* shelter from the wind given by a hill, building, etc.; the sheltered side of such an object.

leech *n.* a small blood-sucking worm.

leek *n.* a vegetable with an onion-like flavour.

leer *v.* look slyly, maliciously, or lustfully. ● *n.* a leering look.

lees *n.pl.* sediment in wine.

leeward *adj.* & *n.* (on) the side away from the wind.

leeway *n.* a degree of freedom of action.

left[1] past & p.p. of **leave**.

left[2] *adj.* & *adv.* of, on, or towards the side of the body which is on the west when one is facing north. ● *n.* **1** the left side or region; the left hand or foot. **2** people supporting socialism or a more extreme form of socialism than others in their group.

left-handed *adj.* using the left hand more easily than the right.

leftovers *n.pl.* things remaining when the rest is finished.

leg *n.* **1** each of the limbs on which a person, animal, etc. stands or moves; part of a garment covering a person's leg; a support of a table, chair, etc. **2** one section of a journey or contest. □ **leg it** *informal* run away.

legacy *n.* (*pl.* **-ies**) something left to someone in a will, or handed down by a predecessor.

legal *adj.* of or based on law; authorized or required by law. □ **legalistic** *adj.*, **legality** *n.*, **legally** *adv.*

legal aid *n.* help from public funds towards the cost of legal action.

legalize *v.* (also **-ise**) make permissible by law. □ **legalization** *n.*

legate *n.* an envoy.

legatee *n.* the recipient of a legacy.

legation *n.* a diplomatic headquarters and staff.

legato *adv.* *Music* smoothly and evenly.

legend *n.* **1** a story handed down from the past; such stories collectively. **2** a very famous person. **3** an inscription on a coin or medal; an explanation of the symbols on a map.

legendary [illegible] legend.

legerdemain [illegible] skilful use of the hands in [illegible] ing; trickery.

leggings *n.pl.* a close-fitting stretchy garment covering the legs.

legible *adj.* clear enough to be deciphered, readable. □ **legibility** *n.*, **legibly** *adv.*

legion *n.* a division of the ancient Roman army; a huge crowd. ● *adj.* very numerous.

legionnaire *n.* a member of a legion.

legionnaires' disease *n.* a form of bacterial pneumonia.

legislate *v.* make laws. □ **legislator** *n.*

legislation *n.* laws collectively.

legislative *adj.* making laws.

legislature *n.* a country's legislative assembly.

legitimate *adj.* **1** in accordance with a law or rule; justifiable. **2** born of parents married to each other. □ **legitimacy** *n.*, **legitimately** *adv.*, **legitimization** *n.*, **legitimize** *v.* (also **-ise**).

legless *adj.* **1** without legs. **2** *informal* drunk.

legume *n.* a plant of the family bearing seeds in pods. □ **leguminous** *adj.*

Evaluating a Legend

THE BHAKRA PROJECT IS A LEGEND IN INDIA. PAEANS HAVE BEEN COMPOSED to it. People, from ordinary citizens to engineers, to the media, to the judges of the Supreme Court eulogies it. Prime Minister Jawaharlal Nehru reportedly accorded to it the status of a temple of secular and modern India. Indeed, the Bhakra project has become an icon in the developmental history of independent India.

How does one look at a legend? Why does one look at a legend?

Bhakra project is accorded overwhelming, at times the sole credit for rescuing India from hunger and famine, and more importantly, helping her regain self-respect, to get out of the demeaning position of having to accept rotten wheat as food aid under the PL 480 program.

Punjab and Haryana are commonly called the granaries of the nation and it is said that the Bhakra project has single-handedly been responsible for this.

The prosperity of Punjab, the huge production of foodgrains in Punjab and Haryana, the surplus food produced by these states that provides support to the rest of the country, are all repeatedly cited as testimony to great benefits of the Bhakra project. So entrenched is this perception of the Bhakra project that Bhakra and Punjab (and to some extent Haryana) are virtually synonymous in the public mind.

Not surprisingly, the Bhakra project is used as the last word in any debate or discussion related to the impacts, benefits and desirability of large dams in the country.

उजला हुआ सवेरा

बना भाखड़ा शक्ति दीप यूँ, उजला हुआ सवेरा।
था ये सपना वतन तेरा।। .....

बना भाखड़ा .....

मिटी सदियों की गरीबी, हुई हर फसल नुमाई।
किया हर कोना यूँ रोशन, घर [2] दिवाली आई।।

नेहरू की ही बदौलत, गूँजी है यह शहनाई।
की भूख दूर सब की, हर लब पे नाम तेरा।।

बना भाखड़ा .....

— ई॰ त्रिलोचन सिंह

(Excerpts from a Poem in BBMB News Bulletin, Special Issue Celebrating 50 Years of India's Independence)

A number of people's struggles, intellectuals, academics, administrators have raised serious and fundamental issues about the impacts, benefits and the desirability of large dams. Bhakra has been used as an unqualified answer to all this.

For a project that is ascribed an icon like status, there is surprisingly little awareness about the actual facts and figures. When someone talks about how the Bhakra project has turned Punjab and Haryana into the granaries of the nation, there are few figures given in support of this. Indeed, there is often little need felt to give such figures. *The contribution of Bhakra is considered self-evident.*

To me, a most interesting revelation of this came from a presentation made recently by a high-ranking engineer from the Ministry of Water Resources of the Government of India. I can do no better than reproduce his slides.

Yesterday

1950s and 60s

- **The nation was unable to grow enough food for a population of just 300 to 400 millions.**
- **Chronic Food Shortages: PL 480, Food imports, Rationing, Guest Control order etc.**

Then

Then

1960s and early 70s Green Revolution

- **Increase in area under irrigation**
- **Intensive Irrigation, using surface and ground water sources**
- **Use of high yielding verity of seeds**
- **Use of fertilizers**

Today

- **Food production is more than sufficient**
- **Plenty of Buffer Stock**
- **Sufficient to withstand consecutive droughts**
- **India is a Food Exporting Nation !**

Confronted with this argument, the opponents of irrigation say "what use is all the buffer stock if a large number of people still have to endure hunger. In saying this they forget that the hunger continues to exists for want of purchasing power. Enabling purchasing power to the poor is important, but that is not the objective of an irrigation project. The objective is to ensure availability. Availability comes first. Unless there is availability, the question of poor having purchasing power does not even arise. Since this is elementary economics, it must be concluded that this aspect is not forgotten but deliberately ignored.

That is it. No words are deemed necessary, no words are given. A photo of *the* dam[1], and the rest needs no substantiation.

A legend, says the Collins Dictionary, is a popular story that may or may not be true. So what is it in the case of the legend that is Bhakra? True, or not true? Or partly true?

This is what we set out to investigate. Investigating the Bhakra project is not just about the past. The Bhakra project is even today used to justify almost all large dam projects in the country. The Government uses it to justify new large dams. The Supreme Court has used it to support its judgements. It is being used to justify the Rivers Linking Project.

Over last two and half decades, the country has seen many intense struggles challenging large dam projects. These struggle have put together extensive evidence of serious problems with such projects. From this body of information, it appears that the problems are not unique to a particular dam, but in general true of most large dam projects. These problems relate not just to the social impacts like displacement or the environmental impacts – serious as they are, but to the efficiency and utility of these projects. The evidence is of a nature that questions the very desirability of the projects, their economics, and their viability. Indeed, this has been so all over the world and large dams are being challenged globally.

Around 1998, the World Commission on Dams (WCD) was constituted. This was a unique endeavour, for this was constituted by and consisted of highly knowledgeable and respected people from all sides of the dams debate – dam builders and operators, equipment supply companies, movements, academics and so on. The WCD came out with its unanimous report in Nov. 2000 that virtually vindicated much of what the people challenging dams had been saying.

Against this background of India's long experience with large dams, the findings of the WCD, and mounting national and international evidence, it was intriguing to hear the unqualified, absolute and lavish praise of the Bhakra project. This raised several question in our minds – was there something different, something unique in the Bhakra project as compared to other projects? Or were there issues that were not coming out? More important than just the project were the reasons put forward for its acclaim – namely – the spectacular performance of Punjab and Haryana in production of foodgrains. What was the role actually played by Bhakra in this? Was this, is this sustainable? Was it replicable? Was India's "self sufficiency" in foodgrains real? How could we reconcile the claimed self-sufficiency and the fact that millions of people in the country are going hungry?

These questions make the study of Bhakra not only important, but of critical contemporary relevance.

WHAT IS TO BE EVALUATED

How does one go about such an evaluation? There are several ways in which one can evaluate a completed dam project. The following are some - not necessarily mutually exclusive – issues that an *ex post facto* evaluation exercise can address.

A. What were the targets in the project plan and what was the actual performance.

B. What were the unintended or unforeseen impacts - positive and negative

[1] For the rare Indian who has not seen this photo – it is a photo of the Bhakra dam

C. What are the claims being made for the project now (as against what was in the proposal) and what is the ground reality.

D. What is the *popular perception* of the project benefits and impacts and how do these compare with the ground reality.

E. Were there other options and alternatives that could have been implemented in the place of the project and were these examined at the time of the project planning.

F. Is the experience replicable? Can the project be a model for similar projects located in a different place and time?

For a project that occupies so much space in the Indian psyche, point D is of crucial import. Hence, comparing the project's performance against the perception about the project at large has been an important part of this exercise.

Given the fact that the Bhakra project is being used to support and justify so many others, point F is also of contemporary relevance.

A study of the Bhakra project has necessarily to look at the agriculture of Punjab and Haryana as the success of agriculture in these states is the source of Bhakra's standing – its "claim to fame" so to say. The agricultural production in Punjab and Haryana is often presented as a surrogate for the benefits of Bhakra Nangal project. Hence, this has been an important part of the study.

It is impossible to talk of the Bhakra project without talking about the green revolution. The two are inseparable in public minds and inextricably intertwined with the agricultural scenario of Punjab and Haryana. Our analysis has considered this. But this study is *not* about the green revolution.

Due to the overwhelming association of Bhakra with foodgrains production, this is the aspect that we chose to focus on. Due to limitations of time and resources, we have not been able to study two important aspects of the project, namely the claimed flood control and drinking water benefits. We hope to fill this lacunae in the future.

DATA AND INFORMATION

The study has endeavoured to collect data and information from as many sources as possible. We have made visits to the field, to areas in Punjab, Haryana and Himachal. We met with farmers, farmers' organisations, and officials – senior and field level workers; we had discussions with social activists, political workers, academics, ordinary citizens; individually and in groups, at private and public meetings. We met the oustees of the project, and the beneficiaries. We looked at published and unpublished literature, at newspapers from the 1950s, at reports and articles. We scanned the archives to look at old Government records. We collected whatever official documents we could.

We are grateful to all those who helped us in these. The Acknowledgements and References is testimony to the long list of those who aided us in the study.

In particular, we have had the most wonderful help from the ordinary people of Punjab and Haryana, from the farmers, from the common citizens. The one group from where we received little response was the Government. We received no response to any of the letters we sent to Punjab and Haryana Governments (Irrigation Department), or to the Central Water Resource Ministry.

We must however, put on record our appreciation of the Bhakra Beas Management Board (BBMB) who gave us some useful information on our personal visit. We believe that they could have given us much more, but still, BBMB gave us the most that we got from any official source. The Punjab and Haryana irrigation departments never responded to our letters, but on personal visits, were very welcoming and hospitable. They were quite miserly with the information though; and in both the states, the reason given for this was the ongoing dispute related to the Sutluj Yamuna Link. There was a palpable distrust and some apprehension in sharing any information about water resources, command areas, irrigation, flows and so on. This point-blank refusal to share even what is the most basic information was very frustrating.

This does not mean that we did not have access to official information – but this was limited to what we obtained unofficially! We would like to strongly protest this situation and would like to go on record saying that it will not harm the government any if it is more open with information and data; it will certainly benefit the citizens immensely.

It is rather an absurdity that the same Government that so zealously "protects" its data and information responds to public scrutiny with an argument that goes along the lines of "but you have ignored this fact" or "you have not looked at this data".

With all the limitations of access to official data, we would like to stress that we still had sufficient and necessary information and basis on which to draw our conclusions.

Our study has also raised certain questions and issues that we have not been able to go into, or could address only to a limited extent. This is essentially due to the limitation of data, time and resources. We hope that some of these will be taken up by others to investigate.

WITHOUT WHOM….

This introduction would be incomplete without an acknowledgement of the role of the people without whom *this study* would have remained incomplete – or never happened.

First and foremost is Arundhati Roy. Her unstinting contribution of resources made possible not only this study, but indeed the setting up and running of the Manthan Adhyayan Kendra itself. But her support goes much beyond that - a friend and comrade in the journey of Manthan.

Secondly, I would like to acknowledge our friends in Haryana – Ashok Garg, Ramesh Singhla, Jagdeep Singh, Jai Bhagwan, Rishi Dangi and others, who went out of their way to organise trips for us during the visits to Haryana and Punjab, who spent days with us, sharing their knowledge and our quest, and who remain committed to working for social change.

Thirdly, I would like to acknowledge Prashant Bhushan, Peter Bosshard, Smita Gupta, Ashish Gupta, Ramaswamy Iyer, L.C. Jain, Sanjay Kak, Ashish Kothari, Patrick McCully, Apoorva Oza, Nandini Oza, Arundhati Roy, Himanshu Thakkar, and Dr. A. Vaidyanathan for taking the time and trouble to review and comment on the draft of this report. Their comments have added considerable value to the study. Needless to add, their taking the trouble to review this report does not construe an endorsement (or rejection) of any part or all of it.

I would like to particularly thank Himanshu Thakkar for his meticulous scrutiny of the draft(s) and the series of lengthy discussion on the same that I had the benefit of, as well as his efforts in digging up important references, figures and information for this study.

I also wish to thank Alok Agrawal and Chittaroopa Palit for their encouragement to me during the study.

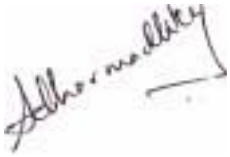
The production of this report would have been impossible without the guidance and help of Tultul, Rajesh Khindri, Rakesh Khatri and Sushil Joshi.

I would also like to place on record the excellent work by the research team – Swathi Sheshadri and Rehmat. The contribution of Himanshu Upadhyaya for some important research input and of Nilesh Sanothiya and Manish Vyas in managing the documentation and data is also acknowledged. Mukesh Jat, who was a part of Manthan team also contributed to this research.

Last, but not the least, is Nandini, my wife and friend, especially for taking care of "everything else" in those last three hectic months when I was racing against time to finish the report. Lest it be overshadowed by these remarks, I would also like to highlight her contribution to the study itself.

Needless to add, I alone remain responsible for the interpretations, conclusions and errors in the report.

With these words, I put in your hands this report.



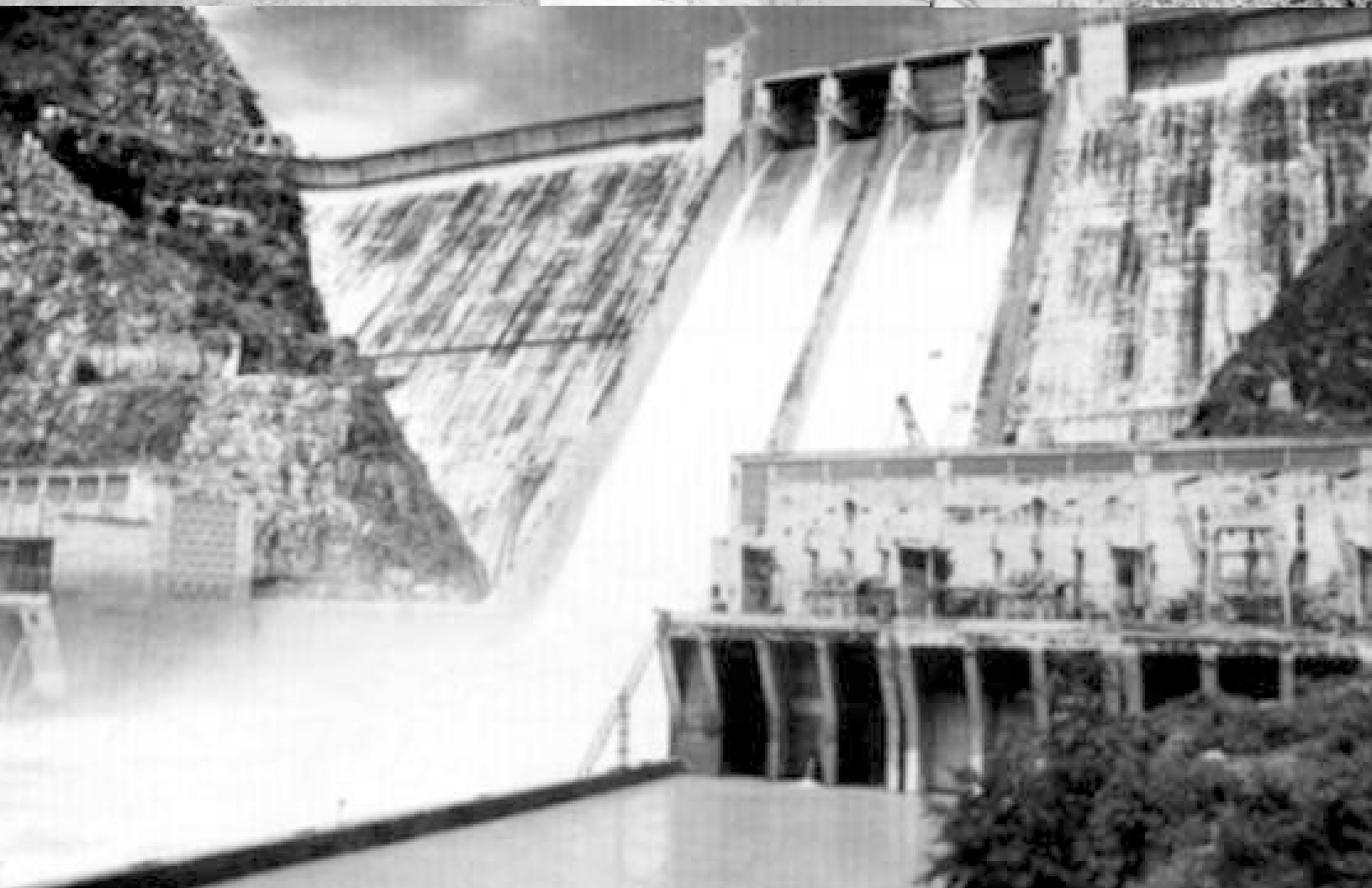
(Shripad Dharmadhikary)
Manthan Adhyayan Kendra

OVERVIEW

A Journey Into the Realm of Bhakra

"As we travel from Panipat to Hansi via Jind, I am riveted at the sight outside. The stunning verdant carpet spread out on both sides of the road - for miles and miles and miles. It is unending. The fresh, half feet tall wheat of a colour that is unbelievably green; the tall lush sugarcane in patches; the bright yellow-topped sarson that suddenly, dazzlingly breaks the sheer monotony of green – it is all the Haryana that we have always heard of - just as all the pictures one has always seen – and more. For miles the land stretches flat on both sides of the road. No colour other than green is seen…. Not a single inch of land is vacant. Numerous tractors cross us – laden heavily with agricultural produce. We pass open godowns which are chock-full of bags of grain. Even to my eyes, used to the lush, fertile areas of the Narmada belt, the sight is breathtaking and unique."

From the Author's diary during visit to Haryana and Punjab in Dec. 2001



A Journey Into the Realm of Bhakra

OUR JOURNEY INTO THE BHAKRA-LAND BEGAN WITH THIS AWESOME DISPLAY of the green revolution in its full visual glory. As we travelled through Haryana, and then Punjab, this sight was to be repeated day after day. As we moved through the country, we heard stories of how the waters had transformed virtual deserts into lush green fields. We saw the big *pucca* houses in villages, the large number of tractors – and not a single bullock cart. We crossed numerous small and big canals as we drove on the excellent road network. The most spectacular sight of the journey was our first view of the Bhakra dam. It was nothing short of stunning. Seen coming up the mountain from the downstream side in the late evening, the wall of the dam rises up steeply, suddenly from the depths of the gorge to a sheer 200 meters, the lights at the top illuminating it. As an engineer, I could only marvel at this testimony to the skills of our profession. We saw at the dam site exhibition the photos of visiting dignitaries like Ho-Chi-Minh, Bulganin, Khruschev – images from the heydays of "socialist" India.

Our physical journey was paralleled by another, a metaphorical, journey – a journey through the facts and figures, through the documents, through the history, geography, science, politics of the project. A journey through the minds and memories of people, a tour that accompanied the people on their experiences of the dam, of the agriculture of the two states. This journey was equally, if not more, fascinating as the physical journey.

The mesmerising display of the green revolution in the fields of Haryana and Punjab is matched by the spectacular statistics of agricultural growth. In Punjab, the foodgrains production went up from 3.389 million tons (m tons) in 1965-66 to 17.221 m tons in 1985-86 – an increase of five times in 20 years, or an annual compounded growth of 8.47% for 20 years running! In 1999-2000 it stood at 25.197 million tons, 12.1% of the all India production. In Haryana, in the same period, foodgrains production increased from 1.985 m tons to 8.147 m tons, a four times increase. In 1999-2000,it stood at 13.065 million tons, or 6.2% of All India.

There is an old saying – I believe it exists in some form or the other in every language – which states "Appearances can be deceptive". Our journey, our fascinating journey into the realm of Bhakra was to prove the truth of this saying many times over, in many different ways. Our journey was a discovery of this, of how long held popular beliefs and perceptions were mostly just that – beliefs. It was also a revelation of the hidden, or not so hidden, but often swept-under-the-carpet side of the story.

The first revelation came with our very first visual encounter with Haryana described above. As we soon found, the lush green fields from Panipat to Hansi had little to do with Bhakra[1]. This area, along with other large areas in Haryana receive waters from the Western Jamuna Canal (WJC) and have been doing so since over 100 years.[2] The WJC is a diversion canal taking off from the Yamuna river near Tajewala. This diversion is from a weir and not a

[1] Throughout this report, unless the context so indicates, or it is specified otherwise, the term "Bhakra" or "Bhakra project" will refer to the entire Bhakra-Nangal project.

[2] The WJC was irrigating small areas as early as the 16th Century – during the rule of Akbar. In 1832 it was remodelled for extensive irrigation.

storage dam. In fact, the gross command area of Bhakra in Haryana is about 30% of the state geographical area. In Punjab, the gross commanded area of Bhakra is about 18.6% of the state area. *Punjab and Haryana are much more than Bhakra*.[3]

It is often said that before Bhakra, Punjab (and Haryana) were just semi-arid, dry regions with little irrigation and / or highly problematic agriculture. We found this to be far from the truth.

As we traced the history of irrigation in the two states, we had to go back to pre-partition India, the pre-partition Punjab. Pre-partition Punjab included not only the Pakistan part of Punjab, but also today's Indian states of Punjab and Haryana. *Punj* (Five) *Aab* (Waters) – the land of the five rivers – Sutluj, Beas, Ravi, Chenab, Jhelum - and of course the mighty Indus whose tributaries these five are – forms an area endowed with the most lavish water resources. While irrigation was being used in the Indus basin since the days of Harappa and Mohen-ja-daro, it really developed during the 19th Century and by the early 1900s, Punjab[4] had an extensive, highly developed irrigation system based on diversions from the major rivers.

A large part of this system was in what is today Pakistan. But the irrigation developed in the Indian part was not small or insignificant. The Western Jamuna Canal,[5] we have seen, was serving large parts in today's state of Haryana. The Upper Bari Doab system from Ravi that serves much of Amritsar and Gurudaspur districts in Punjab was opened in 1859.

The Sirhind Canal, taking off from the Sutluj at Ropar in Punjab, was opened in 1882. It was irrigating, and still does, large areas of Punjab. Apart from these, there was significant irrigation from wells.

Overall, the situation in Punjab (including Haryana[6]) around 1950 - before the Bhakra project - was as follows.

In percentage terms, in 1949-1950, Punjab[7] had 35.3% of its sown area irrigated and the figure for PEPSU (Patiala and East Punjab States Union)[8] was 42.6%. This was the highest in the whole country! Together, PEPSU and Punjab accounted for 13% of the country's irrigated area, while it had 5.89% of the country's total sown area[9]. Thus, it was way ahead in irrigation as compared to the rest of the country – even after losing the lion's share to Pakistan. In absolute terms, the areas irrigated were 4.9 million acres in Punjab and 2.04 m acres in PEPSU.

Similarly, Punjab at that time was the leading producer of wheat, maize and gram in the country.

Against this background, the decision to build Bhakra was a very interesting one. As we explored the planning and decision making process around Bhakra project, we found that the

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[3] Note that the gross command area gives the maximum possible reach of the project.

[4] Punjab here means the Pre-partition Punjab. The readers will do well to keep in mind the following. The British Province of Punjab included much of what is today Indian Punjab, Indian Haryana, small part of Indian Himachal and the Pakistan Punjab. Some areas that are in Punjab or Haryana today were not in the British province of Punjab but were princely states. These included Patiala, Jind, Bhatinda, Faridkot etc. and went by the name PEPSU – Patiala and East Punjab States Union. In 1947, the partition created West Punjab (in Pakistan) and East Punjab (in India) – later called simply Punjab. This Indian Punjab (of 1947) included parts of today's Punjab, today's Haryana and some parts of Himachal. In 1956, PEPSU merged with Indian Punjab. In 1966, this combined Punjab was reorganised into Haryana and Punjab, with a few districts going to Himachal. We will use the following terminology. Pre-partition Punjab for before 1947, Unified Punjab for Punjab between 1947 and 1966 and simply Punjab for post 1966. However, we will use these qualifications *only when the context does not make it clear which Punjab we are referring to*.

[5] Though not a part of the Indus basin

[6] See footnote 4 on what constituted Punjab during various periods.

[7] Punjab at this time also included Shimla and Kangra districts of Himachal, but these had very limited amount of irrigation.

[8] See footnote 4

[9] R.L. Anand; *Punjab Agriculture Facts and Figures*; Economic and Statistical Adviser to Government of Punjab; 1956 Page 57 Table 20

real reasons behind advocating the project had much more to do with the interstate disputes of the (then British) provinces of Sind and Punjab and later India-Pakistan, than the interests of taking water to dry areas.

We learnt that the Bhakra dam was an over designed dam. Even after the Sutluj flows were augmented by the transfer of Beas water to the Bhakra reservoir, the reservoir has not filled up in most of the years.

We found that as in most other dam projects, the figures put forward for areas to be irrigated by the Bhakra project were highly exaggerated. Indeed, even the areas that it could ultimately service, it was able to do so by virtually drying up the river and cutting off areas previously irrigated. *The startling finding was that Bhakra did not add any new areas under irrigation – it only transferred or shifted the irrigation from one set of areas to another - from areas that were already irrigated to other areas.*

The Bhakra project did not produce any dramatic impact on the country's foodgrain situation. Irrigation from the Bhakra-Nangal project began in 1954, increased rapidly, and reached close to its full potential by 1963. Yet, India's foodgrain position had continued to deteriorate, and food imports reached an all time high in 1966. While imports fell subsequently, they rose sharply again and in 1975 touched a high once more.

20 years after irrigation deliveries started from a project that is supposed to have brought food self-sufficiency to India, we were still importing huge quantities of food.

One of the more absorbing and educative part of our journey has been the history of food policy and programs in India.

Independent India's quest for feeding its millions began with a conflict of approaches. In the late 40s and early 50s, there was a lot of focus on land reforms[10] as a necessary component of addressing the food problem. Further, there was emphasis on minor irrigation and the community was seen as both, the vehicle of implementing programs on the ground and as a basis for planning. The sum total was a central place for a decentralised approach. The First Five Year Plan (1951-56) was deemed a success with respect to food production. Rationing, control on interstate movement of foodgrains and all such restraints were removed.

The Second Plan (1956-61) shifted the focus from agriculture to industry and was a disaster in terms of foodgrains production. From the Second to Third Plan and beyond, the focus also was shifting away from the decentralised approach, towards large-scale schemes. Land reforms were not going ahead beyond the abolition of *zamindari*. The strategy of concentrating inputs and resources on selected areas to attain higher production was coming into prominence.

One of the important reasons for this shift was the bias towards interpreting the food problem in terms of "market deficits". The market deficit – the shortfall of market supply over market demand - has little role to play for the millions who are not connected to the market for their food needs. Even for those who depend on the market for food needs, it needs to be emphasised that market demand, and hence "deficit" also depends on the price of foodgrains and purchasing power of the millions. If people do not have purchasing power, their need to fill their stomachs would not be translated into market demand and hence the deficit would be less. The focus on market deficit led to an emphasis on increasing the "procurable surplus" from the farmer to meet the market needs. This approach meant the food problem was defined in terms of the "visible" demand of those who could pay. A corollary was that the approach shifted to an "intensive" and "selective" one, where better endowed areas would produce

[10] The term Land Reforms encompasses a range of measures from abolition of *zamindari*, land to the tiller and land to the tenant, land ceiling and redistribution of land, to the security of tenancy and ensuring reasonable conditions for tenancy etc. It is also used sometimes to include land consolidation.

higher "surpluses" which could be procured for the market,[11] since it was easier to produce and procure more surplus from smaller, better endowed areas. This meant that inputs would have to be concentrated there.

However, there was another approach. In this, it was argued that the real solution was (1) For the producers – increase the security of and access to land (land reforms) and increase the productivity of such lands (2) For the millions of "non-producers" increase their purchasing power through sustainable employment. It was also realised and argued that the only way in which the purchasing power of the millions spread all over the country could be increased, and increased in a non-inflationary manner was if the investments used for (1) were also supporting (2). In other words, a massive, decentralised program that would make use of the country's huge human resources to create infrastructure that would increase the productivity of vast areas of lands.

In today's discourse, this is essentially a wide-spread, decentralised rainwater-harvesting, watershed management, soil-water conservation, groundwater recharge program.

It is often said that if India has to feed its millions, there is no alternative but to build huge dams to "harness" the waters of the rivers. Considerable evidence has now accumulated that a decentralised rain-water harvesting program can improve dramatically the productivity of land even in the most scanty rainfall areas. It is argued that this evidence is *now* available, but at the time of independence, the efficacy of such an approach was not established and hence this was not an option at all.

One of the important things we discovered during the course of our study was that such watershed management, rainwater harvesting programs were not only being carried out in the country, but that impressive results from these had been noted and proposals to implement these country wide had been forcefully put forward. For example, the report of the All India Congress Agrarian Reforms Committee of 1949 had noted the results of the soil-water conservation works in Bijapur and its objectives, which were to " keep all the rain-water that fell on the land as near the place at which it fell" and that such a program "could well be expanded to all of India."

Further, from time to time, various experts had proposed precisely the kind of schemes that today are being undertaken for decentralised rainwater harvesting and watershed management – to be implemented all over the country. *Significantly, a very important advantage presented for these schemes was that of generating employment on a huge scale and using India's wealth of human resources.*

However, for a number of reasons, including the reasons of vested interests in large schemes and the blocking of land reforms by the rural elite, the policies shifted decisively towards the strategy of large projects, selectivity and intensification. But we discovered an important thing – that there were very concrete alternatives being proposed to the large projects-based-strategy even in the early years of Independence.

Around 1967 came the Green Revolution (GR). It must be understood that while the GR *strengthened* the intensification, the strategy of intensification and the advent of GR were two separate phenomena. The GR itself was a virtually unforeseen development. The GR took place primarily with the advent of a new variety of seeds, called High Yielding Varieties (HYV). However, they should more appropriately be called High Response Seeds, since their basic quality was that they could take up and withstand much higher levels of fertilisers than even the "improved" seeds in use till then.

The HYV demanded, and got, huge increases in the inputs. These included not only chemical fertilisers, pesticides, but also machinery, cheap credit, minimum support prices and

[11] The Public Distribution System was to be the means for addressing the issue of distribution, especially the needs of the poor.

procurement, extension services and of course water. It should be emphasised that the performance of the HYV was critically dependent on this whole package. All this involved huge public subsidies, the cost of which was borne by the nation[12].

The spectacular growth in the foodgrains production in Punjab and Haryana came with the advent of the HYV. It is sometimes argued, conceding that the Bhakra project by itself may not have increased production in a dramatic manner, that it was the key in enabling the Green Revolution. It is also said that the Bhakra project helped increase production by allowing hitherto wasteland being brought into cultivation.

We found the ground realities to be quite different. The only substantial increase in the areas cultivated brought about by the Bhakra project lie in the dry belt of Haryana – in the Hissar tracts. But the contribution of this to the foodgrains production was limited. Against this, we need to see the costs – financial, social, ecological and economic – of the project. Further, the agriculture of these very areas now faces serious problems – ecological and economic.

Irrigation was a crucial component of the green revolution. But Bhakra itself has played a limited role. We have already seen that Bhakra commanded areas form less than a third of the area of Haryana and less than a fifth in Punjab. The rest of the canal irrigation in these states is from projects that are over a century old and are based only on diversion structures.

However, far far more important than the canal irrigation – whether from Bhakra or anywhere else – has been the role of groundwater. There is not an iota of doubt that it is the explosive growth in the groundwater use – especially with tubewells, that has been the real driving force behind the green revolution and agricultural production in these two states.

The HYV seeds are highly sensitive to the timing and quantity of watering. It is the tubewells that allowed the farmer to achieve this control. Tubewell productivity is documented to be more than one and half times canal productivity.

The number of tubewells in Punjab jumped from 20,066 to over 450,000 from 1965-66 to 1975-76. In 1997-98, this figure was 910,000. In Haryana, the number of tubewells jumped from 25,311 in 1965-66 to 204,736 in 1975-76, and in year 2000 stood at 583,705.

The areas irrigated by wells/tubewells also increased dramatically. By the late 60s, tubewell irrigated areas equalled and soon outstripped canal irrigated areas in Punjab. In Haryana too, tubewell irrigation grew rapidly till it now equals canal irrigation. This enormous growth in tubewell irrigation is the major factor behind the agricultural production in the two states.

It is often argued that the tubewell irrigation in the two states was made possible by the canals. It is argued that the waters that the tubewells are lifting are essentially the waters that have seeped in from the canal and this is given as a major contribution of Bhakra. But this is widely off the mark. Large part of the water being drawn out by the tubewells in the two states is actually water that is being mined – in other words, water that is not being recharged. This is water that has accumulated over generations or even centuries and is being taken out in a matter of years. Obviously, this is highly unsustainable.

Our calculations show that in Punjab 43-46% of all agricultural production is based on unsustainably mined groundwater. For Haryana, the figure is 35%.[13] This is the production of the two states that has nothing to do with any canal seepage, has nothing to do with canal irrigation and has nothing to do with groundwater recharged normally through rain. In other words, a sizable part of the "miracle" of Punjab and Haryana is purely and eminently unsustainable. And on the verge of collapse as groundwater levels are falling rapidly.

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[12] The point is not about subsidies *per se*. This author at least believes that subsidies will be necessary for agriculture. The issue here was the concentration of the subsidies in limited areas of the country.

[13] Haryana figures for the Year 1998-1999. Punjab figures are for year 1989-90.

It may be added that the figures for Punjab above are for the year 1989-90, when the canal irrigated area was 1.467 m ha and tubewell irrigated area 2.44 m ha. By 2001-02, the canal irrigated area in Punjab had fallen sharply to 0.987 m ha – that is, even less than what it was in 1954 before the Bhakra project - and tubewell area gone up to 3.068 m ha. This means that the percentage of production dependent on the mined groundwater should be even higher today.

This is the shocking reality of the miracle of Punjab and Haryana's agriculture.

What is the contribution of Bhakra? The same calculations show that the production that can be attributable to canal irrigation is about 43% in Punjab- *this includes the recharge of groundwater through canals (17%)*[14]. For Haryana, the figure is 48%.

An analysis of the Command area shows that in Punjab, the areas irrigated by Bhakra are very limited and the even the figure we saw earlier of the GCA (Gross Commanded Area) for Bhakra is misleading. The areas that were proposed to be irrigated by Bhakra were either areas that were already irrigated, or were well-endowed areas. Even these planned areas are irrigated not so much by canal as by tubewells. Most of the canal irrigated areas in Punjab are in the Sirhind area or the UBDC area. Out of the 43% of Punjab's production attributed to canals, we find that about 11% is due to Bhakra canals[15]. In Haryana, since Bhakra canals service about 50% of the total canal irrigated areas, we find that Bhakra is responsible for about 24% of Haryana's production. These are conservative calculations.

What is equally important to note is that Haryana is the senior partner as far as Bhakra is concerned (it has much more area irrigated from Bhakra than Punjab), but in terms of food production Punjab is the senior partner. Punjab's foodgrains production is double that of Haryana, even though the cultivable area of the two states is comparable.

In other words, in the best analysis, contribution of Bhakra to India's foodgrains production and Punjab / Haryana's agricultural prosperity has been limited, and nowhere near what is the perception. Bhakra happened to be in the right place, at the right time, and has been given the credit for things it never did.

However limited the production from Bhakra, the question can be asked – was there any other way to achieve this? In particular, the areas of Hissar tracts in Haryana, which were dry and semi-arid area, with much of the groundwater of poor quality – and today boast of lush green fields – is there any other way that these areas could have been served?

We found that the answers are an emphatic yes – and also that the answers have several dimensions.

There are two ways the question could be posed – was taking the waters of Sutluj to Hissar, Sirsa, Fatehbad, Jind, Kaithal etc. districts in Haryana the only, or even the most optimal, way to meet India's food needs? This is from the point of view of the country. From the point of view of these areas themselves the question is whether there was any other way to meet their developmental needs.

About the needs of the areas themselves: purely in technical terms, we found that it would have been possible for these areas to be irrigated with Sutluj water even without the Bhakra dam. Indeed, such a scheme had also been proposed in the late 19th Century. In fact, many parts of these areas were already being irrigated with the WJC.

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[14] To elaborate – the production attributable to the canal irrigated areas is 26%. This is the direct contribution of canals. However, about 60% of the *recharged* groundwater in Punjab is said to come from the recharge due to canals. We have included this as the indirect contribution of the canals and this works out to be 17% of production. Hence, total contribution of canals – direct and indirect is 43%.

[15] Due to the non-cooperation of the Government, we were not given the exact areas irrigated in each of the systems. We have worked out these figures from the district-wise irrigation data.

There is a larger issue here. What is the appropriate (agricultural) development for this area? From the Second Irrigation Commission (1972) to the new National Water Policy, planners espouse that development of an area should be appropriate to its eco-climatic conditions. But the practice has been to implement the same agricultural model in all zones – growing sugarcane even in deserts[16], so to say. So long as sugarcane cultivation pays much more than say a livestock based economy (which may be more suited to such zones), there is little doubt that the people will demand water to grow sugarcane. The discussion on this issue is crucial to the agricultural strategy in the country, but it is clearly beyond the scope of our work. We would only like to state that in our undertaking, we found ample evidence of the desirability of tailoring development strategies to the eco-climatic and local conditions.

As for the first question – was the Bhakra (or similar projects) the only and optimal strategy to meet the country's foodgrains needs – it was clear that there were real and tangible alternatives, alternatives that could have served the country better. These were the decentralised wide-spread schemes that were being proposed, which would have spread the inputs, resources, investments and the outputs – and put purchasing power in the hands of the people. Such alternatives had been proposed, we found, but had been ignored.

Choosing these alternatives could have also meant avoiding many of the serious social, environmental, financial costs and impacts of the Bhakra project. In evaluating the limited benefits of the Bhakra project, we must not forget this other side of the balance sheet.

One of the most serious issues has been the waterlogging and salinisation in the Bhakra command. What is important is that much of the area in Bhakra command that is in Haryana (and this is the main irrigated area of the project) is underlain with saline and bad quality waters. It is virtually impossible to control waterlogging and salinisation in this situation, unlike in areas with good quality water where pumping can help. The twin dangers of waterlogging and salinisation of the lands lead to sharp decline in productivity, even making the lands totally uncultivable. When we visited the areas affected by waterlogging and salinisation, we were shocked by the impacts. Farmers told us stories of lands going out of production and farmers migrating from the village. We saw costly experiments trying to recover salinised lands which are meeting with only limited success. We saw the Master Plan prepared by the Haryana Government to address the problem of waterlogging- the cost – Rs. 2000 crores.

Waterlogging has also badly affected the infrastructure. A number of houses have fallen, buildings have been affected due to differential sinking of foundations. Long stretches of a National Highway have had to be lifted for the same reason.

All evidence available to us shows that the problem of waterlogging and salinisation will continue to become more serious. This is a classic example of short-term benefits and long-term disastrous impacts.

There have been severe impacts of the dam itself. The river downstream of the dam has become virtually dry. We have not been able to estimate the impacts of this since it is almost 50 years since this has happened and getting baseline data has been very difficult. But meticulous research will be able to get this, and we feel that this will be a very important area for researchers to explore.

There have been no detailed studies of the environmental impacts of the dam except possibly the issue of waterlogging. We feel that these would have been important and should have been done since Bhakra has been projected so much as a model. But we came across many pieces of information which indicate that there have been serious impacts of the project. Diversion of most of the water at Nangal and Ropar has meant serious consequences downstream. Similar

[16] In Kutch, Gujarat, for example, sugarcane is growing in the semi- arid areas, while neighbouring villages have serious problem of even drinking water.

impacts are also seen below Pandoh in Beas basin. The traditional, much sought after fish, *masheer* has virtually disappeared from the reservoir, being replaced by the silver carp which is a low valued fish. There have been several health impacts of the project especially in the reservoir area. About 10% of the live capacity of the reservoir has been lost to siltation and a hump formation in the reservoir is preventing the silt from going into the dead storage. Given the importance attached to the project, it is very important that these be thoroughly investigated.

By far the most poignant moments for us have been when we met the oustees of the project. Almost fifty years have gone by after their displacement. And yet, they have not been fully settled. The communities living on the periphery of the reservoir – literally a reservoir of water – do not have proper supply of drinking water. Those who were settled in the command area of the project, in district of Hissar far away from their homes and culture, were allotted bad quality lands, overgrown with bushes and undergrowth. An entire generation spent its life in backbreaking work to try and make these lands cultivable. Fifty years after displacement their lives are not yet back on track, and they are still fighting to get themselves properly established. Many of them have not got titles to their lands or house plots. Many of the house plots are still under the encroachment of local people. The oustees do not find political representation as they are in the minority, and their grievances are not properly heard for the same reasons. They find themselves cut off from their relatives and culture, and feel like aliens in a strange land even after so many years. They are still dersogatorily called *bilaspuriyas* (as they came from Bilaspur district) by the locals. Since large number of them have small land holdings, they are hard hit by the worsening economy of agriculture.

Their voices still convey the pride they had felt, in the days when the country was just independent, that they had been called on to serve the country through giving their lands and *watan* (homeland). This has been replaced by a deep sense of being betrayed by the nation.

Now there is another set of people who are being pushed headlong towards displacement – economic displacement. These are the farmers of Punjab and Haryana. And therein lies one of the biggest tragedies of this chronicle.

Wherever we went in Haryana or Punjab, we hardly heard exuberant voices extolling the virtues of the project. In Punjab this was understandable since the Bhakra project has little in terms of contribution to the state. In Haryana, we went across the command area of the project. At places people told us about the transformation brought about by the project. Yet, the voices were weighed down by distress; the eyes were full of apprehension about the future. Everywhere we went, people told us that after the first 15-20 years of progress, the problems began. They pointed out to us that much of what is being seen around (the houses, the tractors, the prosperity) is the gift of those early years. And things are crumbling now. There is little doubt about it – there is a deep crisis in the agriculture in the two states.

Ironically, the roots of the crisis lie in the same factors that brought in the much envied, much referred to prosperity.

The groundwater that has been the real driving force behind the agriculture growth is declining rapidly. Farmers with 5 H.P. motors have had to shift to 10 and then 20 H.P. motors, and now have to go for submersible pumps. Canal irrigation is leading to large-scale problems of waterlogging and salinity. Prolonged use of fertilisers and chemicals has dramatically reduced the fertility of the soil, and higher and higher levels of inputs are needed to get the same output. The yields have stagnated, and in some cases – like rice – are going down. Pests have increased, and crops like cotton have been devastated. The two states have been locked into virtual mono-cropping of rice and wheat. Attempts to change the cropping pattern are not working due to a combination of economic, ecological and political reasons. The farmer is caught in a pincer as the costs of inputs are mounting, and the price of the output is not keeping pace. Indebtedness is rising among the farmers and the small farmers are hardest hit.

There is pressure on the Government to cut the subsidies that manage to support much of the system. The crisis is so serious that number of farmers in Punjab have resorted to committing suicide. Suicides of farmers in the state where farming is supposed to be most prosperous in the country is an indicator of the gravity of the situation and an omen.

At one village, we asked to talk to the landless families. We were again and again brought to people with lands. When we repeated our request – we were told that these people have only 1-2 acres of land, and hence are as good as landless. To us, there could be no bigger indicators of the crisis of agriculture than the suicides of farmers and this.

One would have thought that in states considered to be the pinnacle of agricultural achievement and prosperity, in the land of Bhakra, agriculture would be so rich that 1-2 acres would be enough for a person to live well. But it is not so.

There is little doubt that the agriculture and the farmers of the two states are paying a high price for the short burst of prosperity. Agriculture in the state has lost the resilience to take on new challenges. Both the economic, and ecological foundations of the agriculture have become shaky. The system has become highly vulnerable to outside shocks. Ecological shocks are already being felt, as are economic. And the WTO is waiting in the wings to administer blows which will be impossible for this system to take. In both states, farmers, analysts and social activists expressed grave fears that if the minimum support prices were withdrawn under the pressure of WTO, and they were forced to sell at market price, lakhs of farmers would be rendered bankrupt.

This of course, is a part of the larger crisis of agriculture. Punjab and Haryana are the furthest down *this* path to agricultural "prosperity", and hence have reached the end of the path earliest. Others on the same path can but reach the same end. But if the "magnificent" Bhakra project has not protected the two states against this, then this is food for thought. Our study has shown that in this model, there will be a short-lived burst of prosperity, followed by long-term, permanent devastation. Somewhat like a supernova.

Unfortunately, at the official level, there seems to be little understanding of, or willingness to address the root causes. The Punjab Government set up a committee to address the agricultural crisis in the state which gave its report in the year 2002. It is known after its Chair as the Johl Committee. The main thrust of the report is that the problem of Punjab is that of plenty. It is locked into the wheat-rice cycle and produces such abundance that it is difficult to find a market for it. The proposed solution? State subsidy to the farmers to stop growing wheat and rice on about 1 million ha – to be given even if they do not grow anything.

The report exposes one of the most important dimensions of the food problem in India. It reveals the reason behind the fact that even as we trumpet that we are now self-sufficient in food, that we now export food, millions still go hungry in the country. We quote:

> "India has accumulated huge stocks of foodgrains that are not finding market and are proving to be a heavy drain on the state exchequer and the government is obliged to purchase substantial new arrivals at higher and higher prices every season under the system of Minimum Support Prices. Although as per the nutritional requirements of the Indian population, these stocks may not be considered in excess, yet due to the lack of purchasing power with the poor, supply exceeds demand…."

This lack of the purchasing power is the main reason for the perversity of huge food stocks, of exports at subsidised prices even as millions go hungry. And the roots of the lack of purchasing power go deep to the strategy of selectivity, intensification and centralisation. The roots go back to the strategy of the separation of the means to achieve the two objectives of increasing production and the subsequent equitable distribution- the strategy of concentrating inputs, resources and investments in small areas to increase production and then hope that the rest can buy this production. But buy with what? since this approach creates purchasing

capacity only in pockets. Big dams like Bhakra exemplify the unfolding of this strategy on the ground, as they concentrate benefits in selected areas.

Unfortunately, we are not learning from these developments in Punjab; a similar situation is rapidly developing in the economy in the other sectors. Under the policies of globalisation, liberalisation and privatisation, we are having high rates of growth – but without growth in employment. The same mistake – of jobless growth; we should be ready for the same results.

Fortunately, we also found a number of people in Punjab and Haryana thinking along more fundamental lines. And therein lies hope. We found groups worrying about the impacts of the large-scale use of chemicals and pesticides. We found people who are concerned about the soil degradation due to excessive chemical input and are trying to create a shift to organic agriculture. We found people trying to document and revive traditional water resources, tanks and ponds. Villages like Sukho Majri show how local water harvesting, diversity of cropping and use of organic inputs can lead to high yields and minimum debts for the farmers.

When we travelled in Punjab and Haryana, we heard the desperation in the people's voices. Some farmers also told us – when the country needed us, we were there to help the country produce food. Now that we are in trouble – will the country not help us? Even if our report just leads to an answer in affirmative to this question, we will feel that our efforts have not been in vain.

It would be incomplete to end the tale of this journey without a word about the other discoveries we made – almost as a sort of a by product but probably equally valuable.

The first thing we came across, and something that was a constant all along the way has been the wonderful, warm and generous hospitality of the people of Punjab, Haryana and Himachal. And this is not just our friends but everyone. Complete strangers welcomed us into their homes, fed us superbly, and shared their life experiences with us. The latter especially has been a privilege.

We discovered why the simple traditional meal of *makke-ki-roti sarson-da-saag* ranks among the most wonderful food in the world – even though the *makka* may no longer be growing so much, replaced by wheat and rice. We realised the true meaning of the *lassi* and *paratha* – and that what we called by these names back home were poor country cousins.

We found out that music in Punjab is much more than "*balle balle*" or the more recent "*Tunuk Tunuk*" as we were introduced to the mellifluous songs of Asa Singh Mastana, Surinder Kaur and others.

We also came across some not so pleasant facts – the low female: male ratio in Punjab to name one. Or, the striking absence of women in the markets of the small towns of Haryana – an indicator of their role and status.

We found the obsession with "*foreign*" in the Doab region to be just as the stories have it. Almost every family from this region of Punjab seems to have a member abroad. It was also later given to us as a reason why the farming families are able to make ends meet here.

Two stops on our journey are particularly memorable. One was at Khatkad Kalan – a brief stop on the way from Ludhiana to Bhakra, to pay a visit to the birth place and home of Shahid Bhagat Singh. The other was at the Gurudwara at Anandpur Sahib, where, apart from other things, the lunch at the *langaar* reminded us that the generosity and hospitality of the Sikhs is not restricted to individuals but extends to the community.

All these not only made our journey so much more enjoyable and pleasant, it also offered to us insights into famous entrepreneurial spirit of the Punjab (and Haryana) farmer, and the culture and society in which the subject of our study is placed.

Yet, we have come away with a sense of despondency. The crisis we saw in the agriculture is very real, and deep. And it is not just going to be restricted to the two states, but is likely to engulf much of the country. No farmer we met was untouched by it, and no one could refrain from referring to it. Before we embark on the details of this journey of ours in the next chapters, as a reminder of our mission, of what we found, we can do no better than end with two quotes – one, from an official, the other from a farmer.

Report of the S.S. Johl Committee, Government of Punjab, Oct. 2002:

> "On the other side, continuous production of wheat and rice in annual rotation in the irrigated areas of Punjab is having a deleterious effect on soil, water, environment and social fabric of the state. Soils of Punjab have become virtually a laboratory culture that requires higher and higher doses of fertilisers, micronutrients, insecticides and pesticides to produce same level of wheat and /or rice. This has resulted in declining total factor productivity. The situation is becoming very serious day by day which can very soon proved to be economically disastrous, socially untenable and politically unsustainable, which can turn into man-made national calamity if not dealt with judiciously."

Sardar Gurmail Singh, Village Bada, District Ropar:

> "All that you can see around in Punjab [the prosperity] all that you have heard about it, please do not believe it. Things are not what they seem. Punjab is on the brink…"

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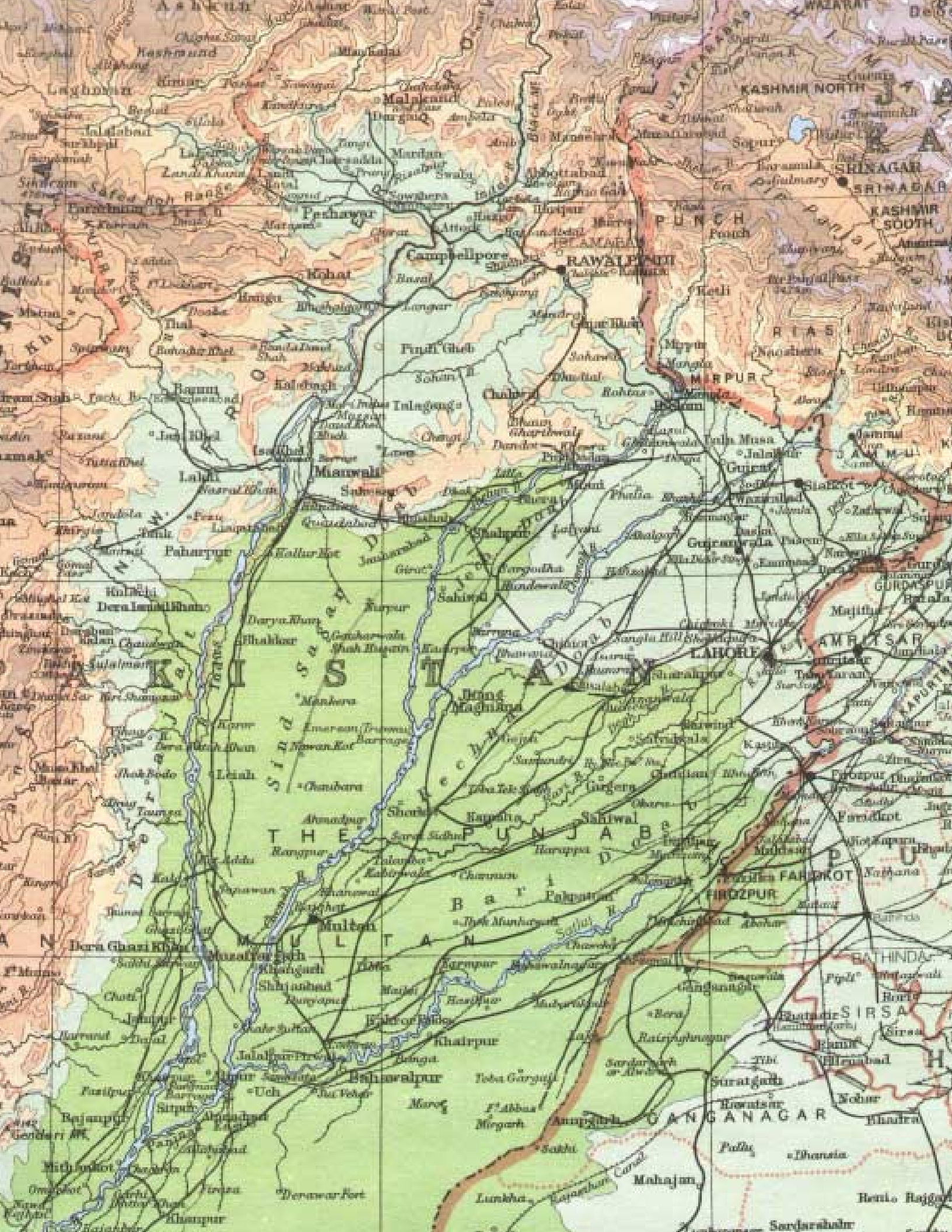
1

The Indus Basin, Irrigation Development and the Bhakra Project

"The Indus Plains offered to man a set of nearly homogeneous physical geographic conditions that eventually allowed him to develop there the largest contiguous irrigation system in the world.....
Nowhere else on earth had nature provided such lavish quantities of water that could be tapped without reservoir storage for gravity distribution."

Alloys Arthur Michel,
The Indus Rivers: A Study of Effects of Partition


KASHMIR NORTH
SRINAGAR
KASHMIR SOUTH
PUNCH
RAWALPINDI
Peshawar
Campbellpore
Kohat
Bannu
Kalabagh
Isakhel
Mianwali
Pindi Gheb
Chakwal
MIRPUR
Gujrat
Sialkot
Gujranwala
Lahore
AMRITSAR
GURDASPUR
Jammu
Jalandhar
Ludhiana
Ferozepur
FARIDKOT
FIROZPUR
BATHINDA
SIRSA
GANGANAGAR
Bahawalpur
Multan
Muzaffargarh
Dera Ghazi Khan
Sukkur
Khairpur
Jacobabad
Sibi
Quetta
Kalat
Mastung
Khuzdar
Panjgur
Gwadar
Pasni
Jiwani
Turbat
Mekran
Kharan
Nushki
Chagai
Dalbandin
Sarawan
Jhalawan
Kachhi
Sind Sagar Doab
Chaj Doab
Rechna Doab
Bari Doab
Sutlej
Ravi
Chenab
Indus
Jhelum
Kabul R.
Swat R.
Kunar R.
Black Mt.
Sulaiman Range
Kirthar Range
Khyber Pass
Bolan Pass
Gomal Pass
Tochi Pass
Kurram Pass
Khaibar Pass
Afghanistan
Baluchistan
Sind
Kashmir
Punjab
Bahawalpur
Khairpur
Jaisalmer
Bikaner
Mahajan
Sardarshahr
Rajgarh
Suratgarh
Hanumangarh
Bhadra
Nohar
Dhanota
Pallu
Lunkha
Rajasthan Canal
Sutlej
Ghaggar
Bara
Chenab
Ravi
Indus
Jhelum
Kabul R.
Swat R.
Kunar R.
Black Mt.
Sulaiman Range
Kirthar Range
Khyber Pass
Bolan Pass
Gomal Pass
Tochi Pass
Kurram Pass
Khaibar Pass
Afghanistan
Baluchistan
Sind
Kashmir
Punjab
Bahawalpur
Khairpur
Jaisalmer
Bikaner
Mahajan
Sardarshahr
Rajgarh
Suratgarh
Hanumangarh
Bhadra
Nohar
Dhanota
Pallu
Lunkha
Rajasthan Canal
Sutlej
Ghaggar
Bara

The Indus Basin, Irrigation Development and the Bhakra Project

THE STUDY OF DEVELOPMENT OF IRRIGATION IN THE INDUS BASIN IS fascinating – to the historian, to the engineer, to the geographer, indeed, to the student of human civilisation. To trace the history of irrigation in the basin is to follow the intricate and rich course of human civilisation on the march – with all its greatness and pettiness, with all its grandeur and simplicity, with all its achievements and all its follies.

Unfortunately, the scope of this study does not allow us too much time and space to lay out for the reader this captivating endeavour in its entirety. However, it does demand an understanding of the Indus Basin and the developments in irrigation on and around the mighty Indus rivers. For Bhakra is squarely and firmly set within this larger framework. We can only hope that this brief introduction will entice the reader into undertaking this journey on her own, a journey that we found so fascinating and enriching.

THE INDUS BASIN

The Indus Basin is roughly 944568 sq. km in area. Out of the total area, about 415434 sq. kms lie in the highlands of Tibet, India, Afghanistan and Pakistan. The rest comprises the Indus plains, one of the most homogenous physiographic regions in the world[1]. The depth of the alluvial deposits in the plains is believed to average a mile or more!

The Indus system ranks among the mightiest river systems in the world. It comprises of the five major left bank tributaries and one major right bank tributary - Kabul. The left bank tributaries are (in order from the South, counterclockwise) Sutluj, Beas, Ravi, Chenab and Jhelum. Before Partition, all these five rivers flowed through Punjab[2], giving it its name – *punj* meaning five and *aab* meaning water.

Some people argue that the Ghaggar (sometimes identified as the ancient river Saraswati – originating in Himachal Pradesh and flowing through Punjab and Haryana before meeting the Hakra in Pakistan) is also a part of the Indus basin, but opinion is divided on this. However, in our study, two rivers other than the Indus rivers play an important part – the Ghagghar and the Jamuna – even though they are not in the Indus basin, and we shall also have a look at these along with the Indus rivers.

THE INDUS RIVERS

Map 1 shows the major rivers of the Indus basin. It would be useful to refer to this as the reader goes through the following text. Since we will be dealing with period before and after Partition, we will indicate, where the context does not make it clear, which areas are in India.

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[1] Michel 1967. For this chapter on the irrigation developments in the Indus Basin, we have primarily relied upon Michel 1967, Dhillon 1980, Dhillon 1985, Govt. of Rajasthan 2002c and some other references.

[2] The reader may recollect that the pre-partition Punjab included today's Indian and Pakistani Punjab.

The Indus

The Indus rises near the Mansarovar in Tibet, it flows through Ladakh, Kashmir, the N.W. Frontier Province, the Punjab (Pakistan) and finally through the Sindh region of Pakistan into the Arabian Sea. At Attock, in Pakistan (NWFP), when it has travelled 1448 kms from the source, the river Kabul meets it from the right. Indus enters the plains here.

From Attock, it flows south, and at Mithankot, about 805 kms from the sea, it receives the Punjnad – the combined waters of the five eastern tributaries – Sutluj, Beas, Ravi, Jhelum and Chenab. The river empties into the Arabian sea through several mouths near Karachi. The total length of the river from source to sea is 2880 kms out of which 1114 kms are in India.

From Mithankot to the sea - the Indus flows a lone "exotic stream" like the Nile below the Atbara junction – that is, it has no perennial tributaries.[3]

The drainage basin of the Indus is estimated to 264178 sq. kms out of which 168335 is in India.

Jhelum

The Jhelum has its origin in Kashmir. In Kashmir, it receives the waters of Lidder, Sind and Poonch. The Wular lake is a sort of delta for the river. From Kashmir, the river flows into Pakistan. It enters the plains of Pakistan near the city of Helium in the Punjab province. About 320 kms down, it joins the Chenab at Trimmu. The river has a total length of 724 kms out of which 402 kms is in India.

Chenab

The Chenab rises in Lahual in Himachal Pradesh. It starts as 2 streams, the Chandra and the Bhaga. These 2 streams meet after traversing 115 miles and 85 miles respectively, and are then called the Chenab. The united stream flows into Kashmir. It flows for 250 kms between steep cliffs and 40 more kilometers before entering Pakistan. It enters Punjab (Pakistan) at Sialkot, near the Marala barrage and flows in the southern direction and is met by the Jhelum at Trimmu. It continues to flow in the southern direction. It later is met by the Ravi and then the Sutluj. After its confluence with Sutluj, which itself has received the Beas by then, the combined river is called Punjnad. The Punjnad itself flows a short distance before meeting the Indus. Its total length is 965 kms out of which 378 is in India.

Ravi

The Ravi rises near the Rohtang pass in the Kulu district of Himachal Pradesh in India. It then enters Punjab (India) near Madhopur, the site of one of the earliest diversion schemes in the Indus basin, flows through Gurudaspur district, to the region between Sialkot and Amritsar districts, forming the international boundary between India and Pakistan. It then enters the Lahore district, Multan district and meets the Chenab at Sidhnai. The river flows a course of about 1100 kms out of which 370 is in India.

Beas

The Beas is shortest of the 5 left bank tributaries of the Indus. It rises near the Rohtang pass of the Kulu district of Himachal Pradesh in India, traverses the Mandi district and then enters the Kangra district. The river meets the Shiwalik hills in the Hoshiarpur district. It enters the plains near Talwara. It then takes a turn in the southern direction, forming the boundary between the Hoshiarpur and Gurdaspur districts of Punjab, India. After this, it forms the boundary between Kapurthala and Amritsar districts of Punjab, India. It then flows in a south-

[3] Michel 1967: Page 36

westerly direction. In the lower reaches, the river moves shifting from year to year through the alluvial valley and meets the Sutluj at Harike in Ferozepur district. Its chief tributaries are the Black (*Siyaah*) Bein and White (*Safed*) Bein. The Beas has a total length of 460 kms, all of it in India. It is the only one out of the major tributaries of Indus to flow entirely in India.

The Beas used to flow all the way to the Chenab above the Panjnad but was captured late in the eighteenth century by the Sutluj near Harike.[4]

Sutlej

The Sutluj rises from the Mansarovar lake in Tibet. It has a very long course through the mountain ranges. It passes through Himachal Pradesh. From the Bilaspur district of Himachal, it enters Punjab (India) in Hoshiarpur district and then on to Ropar. Here it forms the divider between the Jullundhar *doab* and the Sirhind plateau. From here it flows in a south-westerly direction through Ferozepur where it receives the Beas at Harike. It then crosses into Pakistan. It flows on to receive the Chenab waters at Madwaala and joins the Indus at Mithankot in Muzaffargarh district. The total length of the river is 900 miles or 1448 kms, out of which the length from Mansarovar to the Indo-Pakistan border is 1078 kms. Thus, it flows on for about 370 kms in Pakistan before meeting the Chenab, after which the river is called Punjnad.

Their are strong indications that the main channel of the Sutluj has been shifting westwards. It is reported that around 1000 A.D., the Sutluj did not join the Indus system but was a tributary of the river Hakra, and then flowed into the eastern Nara. By 1245 AD, the river shifted towards the North resulting in the drying up of the Hakra river system. Further shifts towards the west occurred during 1593 and 1796.[5]

Table 1.1 summarises the catchment areas and flows of the main Indus rivers.

Table 1.1: Catchment and Runoff of the Indus Rivers at Rim Stations[6]

River	**Gauging Station**	**Catchment Area** (Sq. Km)	**Average Annual Run-off 1922-61** (Million Acre Feet)
Sutluj	Ropar	48044	14.0
Beas	Mandi Plain	16834	13.0
Ravi	Madhopur	8028	7.0
Chenab	Marala	29525	26.0
Jhelum	Mangala	33410	23.0
Kabul	Warsak	67339	17.4
Indus	Attock	264178	93.0

It appears that the figures for Kabul are included in the Indus figures.

To put it in perspective, it may be mentioned that the aggregate mean annual flow of the Indus River and its tributaries, when they emerge from the Himalayan foothills, is about twice that of the Nile and three times that of the Tigris and Euphrates combined.[7]

Ghaggar

As mentioned earlier, the Ghaggar is sometimes identified as the ancient Saraswati, once flowing into the Hakra. The Ghaggar has its origins in the Shimla district in Himachal Pradesh, entering Haryana near Kalka. The river criss-crosses the Punjab-Haryana boundary

[4] Michel 1967: Page 32
[5] Government of Rajasthan 2002c: Page 10
[6] Michel 1967: Page 33
[7] Gulhati 1973 : Page 18

several times. It also cuts across the Bhakra Main Line and then the Ghagghar branch of the Bhakra system. The river is tapped at the Ottu Headworks (weir). The river ultimately disappears into the sand of the Thar desert. There are signs of rejuvenation of the river in the last few decades. It is not a perennial river but has extensive floods in monsoon.

Yamuna

The Yamuna (Jamuna) originates from the Champasar Glacier at an altitude of 4421 m in the state of Uttaranchal. Some say the source of the river is the Saptarishi Kund, a glacial lake. There is a sacred shrine of Yamunotri or Yamnotri, near this source at an altitude of 3235 m.

From Uttaranchal, the river flows into the state of Himachal Pradesh. After passing Paonta Sahib, Yamuna flows along the boundary of Haryana and Uttar Pradesh and after exiting Haryana it enters Delhi, and then Uttar Pradesh again, and continues to flow till it merges with the river Ganga (Ganges) at Sangam or Prayag in Allahbad (Uttar Pradesh). The total length of the river is 1,370 km. Its major tributaries are the Chambal and Betwa rivers.

Yamuna river forms the eastern boundary of Haryana with Uttar Pradesh. Yamuna enters Haryana near the Kalesar forest in Yamunanagar district. It flows south along the districts of Yamunanagar, Karnal, Panipat, Sonipat, and exits Haryana near Hasanpur in district Faridabad. At Tajewala barrage in district Yamunanagar, the waters of the river Yamuna are caught and diverted in the Western Yamuna (Jamuna) Canal for irrigation. The world famous Taj Mahal is situated on the banks of this river in Agra, Uttar Pradesh. This river is also called Yamna, Jamna and Jamuna in different Hindi dialects.[8]

The river, though not a part of the Indus basin, is important because this is one of the major rivers to flow thorough the unified Punjab (The Haryana portion). The Western Jamuna canal (WJC) taking off from the river was one of the earliest such canals and irrigated and still irrigates substantial parts of Haryana. Parts of the WJC areas have been now transferred to the Bhakra system and form part of the Bhakra command.

THE DOABS

The *doabs* are regions that lie between two rivers. The word comes from *do* – meaning two and *aab*, meaning water. As per custom, the names of the *doabs* have been derived from the names of the two concerned rivers. With six major rivers, the Punjab has five *doabs*. They are given below.

Table 1.2: Name and Location of *Doabs*

Sr. No.	Name of Doab	Location
1	Bist Doab	The region between the rivers Beas and the Sutlej covering the districts of Kapurthala, Hoshiarpur, Jullundhar, Nawan Shahr of present day Punjab
2	Bari Doab	The region between the rivers Beas and Ravi covering the districts of Gurdaspur, Amritsar, Lahore and Montgomery. (Gurdaspur and Amritsar are in present day Punjab and Lahore and Montgomery are in Pakistan).
3	Rechna Doab	The region between the rivers Chenab and Ravi.
4	Chaj Doab (Earlier works refer to this as Jech Doab)	The region between the rivers Jhelum and Chenab.
5	Sind Sagar Doab. Also known as the Thal Doab	The region between the rivers Indus and Jhelum.

[8] Govt of Haryana website http://www.haryana-online.com/yamuna.htm
Accessed on Nov. 9, 2004

IRRIGATION IN THE INDUS BASIN

The mighty Indus has been the cradle of the earliest and one of the most advanced of the ancient human settlements. The use of the river and its water to enrich agriculture has been known to the earliest civilisation, and indeed, has been one of the basis of its development.

The history of irrigation development in the basin is a fascinating subject. Here we will restrict the discussion to briefly describing the phases, focussing mainly on developments in the regions that are in India, and developments in regions in Pakistan that have an important bearing on Bhakra.

The irrigation development in the basin can be broadly identified into the following phases:

1. Indus Valley Civilisation phase
2. Aryan Period
3. Early Muslim rulers (Arab, Turks, Afghans), Moghul and Sikh rule
4. British Rule (1819 to 1947)
5. Since 1947 Independent India and Pakistan

INDUS VALLEY CIVILISATION PHASE

During the Indus Valley civilisation, the annual inundation of the flood plain of the river provided enough moisture and silt deposits to raise the crops required by the settlements. This form of irrigation was termed *sailaba*. *Sailaab* literally means flood. Irrigation from wells was in use since the ancient times in the Indus valley where water of good quality was found. There is some difference of opinion as to whether canals were used to take water to lands some distance away from the river.

Excavations at Harrappa, Mohen-jo-daro and other places have established the presence of an advanced civilisation flourishing on the banks of the Indus. These people grew food crops, cotton and kept herds. It is highly likely that such an advanced civilisation that could design and construct well graded drains, as those found at Mohen-jo-daro would, at some point, build some kind of inundation canals to take waters to lands some distance away from the river.

Several well known archaeologists have endorsed the view that the Indus Valley civilisation practised some form of flow irrigation.

Several types of *bunds* used either as storage or deflection structures have also been discovered from this period in the excavations. Evidence has also been found of the use of the simple (but highly effective) water lifting device *Shaduf* [9]in this period.

ARYAN PERIOD

The abandonment of the Mohen-jo-daro and Harrappa started around 1500 B.C. with a shifting of the population to Kathiawar, Eastern Punjab and Northern Rajasthan. Around this time, a distinct and important change in the agricultural practice had occurred – the sowing of two crops in a year. There is also evidence that settlements started occurring at considerable distances from the river.

The inundation canals also came to be recorded around the time of the Greek invasion as it is mentioned that the invading army was thrilled to see such canals. Inundation canals of large capacity and considerable length with efficient distribution systems were evolved.[10]

The technique of inundation canals was in a way taught to human beings by the river itself. In the plains, the sediment laden streams usually flow in beds higher than the level of their

[9] The *shaduf* consisted of two poles, one which is stationery and erect, and the other, hinged on it is allowed to move in the vertical plain. A bucket is suspended at one end of this and at the other end counter balancing weight is suspended. A single person can pull down the empty bucket into the well and then the bucket is lifted by the counter-weight.

[10] Dhillon 1985: Page 13

floodplains. This results from the fact that each time they overflow their banks they deposit the heavier and coarser sediments first, carrying only the finer sands and silts to any distance. By breaching the banks, or the natural levees, and providing shallow channels to direct the floods, it was possible to water the fields on the lower lying portions of the flood plains. Clearly, this was possible only during the high-water periods[11].

An important development of this period is the emergence of tanks as a means of irrigation, though well irrigation remained more common. The construction of tanks came to be considered a meritorious deed. Construction of large size masonry dams was an additional development.

THE ARAB, MUGHAL AND SIKH PERIOD (8TH CENTURY TO 1819 AD)

Irrigation was clearly an established practise by the 8th Century, for the Arab conquerors of Sind differentiated between the irrigated and un-irrigated tracts for levying land tax.

An important step in the development was the firming up of the inundation canal supply by constructing a "headwork". This would be some kind of construction at right angles to the flow of water, which would be strong enough to resist the force of the floods. In the lean season, these headworks would lift the water level to the level of the canal and hence the irrigation could take place in the lean season also. Such a system was called perennial system, for obvious reasons. It must be emphasised that these headworks need not extend all the way across the rivers – even building the head works across a part of the river, or of one of the channels could be enough. Neither were these in any way storage dams. These allowed the floods to pass over their crests.

While perennial irrigation of this manner probably started as early as 300 AD in India with the Grand Anicut in the south, it was to take another 1000 years in the Indus plains.[12] In all probability, the reason was that it was not required.

The Western Jamuna Canal

In 1355, a canal was constructed to off take from the Jamuna with a aim to provide water to the hunting estate of the Emporer Feroz Shah Tughlak in Hissar (in present day Haryana). After his death the canal fell into disuse. In 1568 AD the great Mughal Emperor Akbar decided to restore this canal and even allowed the waters to be used for irrigation. In 1647 AD during the reign of Shah Jehan, the canal was extended to irrigate lands South-West of Delhi and also to supply water to the Red Fort. With the end of the Mughal dynasty, this fell into disuse during the early eighteenth century.[13] This canal is important as this was again revived in the British period for irrigating large parts of Haryana.

The Hansli Canal

Jehangir (ruled 1605-1623) built a 80 km long canal off-taking from the river Ravi to take water to his fortress and hunting ground near Sheikhpura, where he had built a garden and a reservoir at Hiran Minar. This was the first perennial canal on any of the Indus rivers.[14]

Later around 1633, Ali Mardan Khan, celebrated engineer of Shah Jehan, built another canal known as Hansli, off-taking from the left bank of Ravi and this canal carried water to the Shalimar Garden at Lahore. It irrigated a part of the Bari Doab in the process. During the Sikh rule (1763-1849) a branch of this canal was constructed to carry water to the Golden Temple at

[11] Michel 1967: Page 46
[12] Michel 1967: Page 49
[13] Dhillon 1985 Page 14
[14] Michel 1967: Page 49

Amritsar.[15] This was the precursor of the Upper Bari Doab Canal, now irrigating much of Amritsar and Gurudaspur districts.

Other Canals

Similarly, a large number of other canals were built during this phase on the other Indus rivers. On the Beas, the Shah Nehar, an inundation canal, was built around 1744 AD. This was built by private enterprise. It irrigated the area around Mukerian.

On the Sutluj, a number of canals were constructed including Khanwali inundation canal (date unknown), Upper Sohag canal (1827), Lower Sohag Canal (1816 and 1831), Lower Sutluj Inundation Canal (1831). All of these were in the area that is now in Pakistan.

Similarly, a system of inundation canals was constructed on the Chenab taking off from the left bank below its confluence with the Ravi. At one time there were 13 canals in operation but gradually they were amalgamated to four.

On the Indus itself, there was a system of 14 inundation canals.

It is during this period that the use of the Persian wheel and cattle power for lifting water from the wells became important.

THE BRITISH PERIOD 1819-1947

The British entry into the Indus Basin may be dated from 1819 when the Government of India accepted the allegiance of the Sihk rulers, extending the British rule to the tract between Jamuna and Sutluj. Annexation of Sind came in 1843 and it was attached with the Bombay Province. After the death of Maharaja Ranjit Singh in 1839 Punjab was plunged into chaos. In 1846, the Sikhs had to concede the territories between Sutluj and Beas to the British. By 1849, Punjab was formally annexed into the British empire. With this, except for some of the princely states the most fertile and best watered region had come under the British rule.

The development of irrigation in the British times can be seen in terms of two phases. Phase 1 involved the renovation and remodelling of the old canals with some new constructions. Phase 2 involved the construction of new projects. While the works undertaken were huge in range and scale, we will look only at works that are important from our point of view. (See MAP 2).

Phase I

The traces of the earlier canals systems like Jamuna, Hansli and Khanwah were the starting points for this.

Improvement of the Western Jamuna Canal

In 1817, G.R. Blane of the Bengal Engineers was entrusted with the task of restoring the Western Jamuna canal which had stopped in about 1705. The canal was restored by 1821. The enlargement and modification of the canal was taken up in 1832-33. Further remodelling with the construction of a permanent weir at Tajewala was taken up in 1873 and completed in 1879. *The Sirsa branch of the canal was constructed in 1889-95. This is an important development with respect to our study as the Sirsa branch irrigated areas which were later transferred to the Bhakra command.* The WJC was remodelled again in 1940-43 and irrigation extended. The WJC today commands an area of about 1.084 million ha in Haryana. Recently, the old weir at Tajewala has been replaced by a barrage at Hathnikund.

[15] Dhillon 1985 Page 14

Upper Bari Doab Canal

After the occupation of Lahore in 1849, the improvement of the Hansli canal was taken up. However, on detailed investigations it was decided to drop the old alignments and a new canal was built. This canal was the Upper Bari Doab canal (UBDC) which now irrigates large areas of Amritsar and Gurudaspur districts. It was opened in 1859. The permanent headworks at Madhopur were completed in 1879.

Grey Canals in Ferozpur District

This system of inundation canals taking off from the Sutluj was built in 1875-76. There were 11 canals and later 2 more were added. Many decades later, the Bhakra project, by drying up the Sutluj was to cut off the supply to some of these canals.

Other Canals

Apart from these, a large number of canals were either build or repaired or remodelled on all the Indus rivers. Some of these included the Upper Sutluj Inundation Canals like Katora, Khanwah, Upper Sohag and Lower Sohag, the Lower Sutluj Inundation Canals, the Chenab Inundation canals, the Indus Inundation Canals, Canals in the Sind area like Desert Canal, Begari Canal, Sukkur Canal, Garh Canal, Western and Eastern Nara canals and so on.

Canal Colonies

In 1886, the first experiment of the so called Canal Colonies came up in the Sohag canal areas.[16] In this, the Britishers brought in farmers from outside the area to settle crown waste lands which could be made arable due to the canals and established colonies. No doubt, there had been earlier such attempts. In 1818, at the end of the Pindari campaign, the British tried to resettle disbanded regiments in Rohtak and Hissar. But these were not canal colonies as there were no canals. This is probably an important reason for their failure. In the UBDC, the decisive motivation was to settle the sepoys of the defeated Sikh army by giving them grants of land.[17] But the major canal colonies were to come after 1883 with the Sidhnai project and others that followed (see below). With the Lower Chenab Canal, the colonisation process was firmly established. Several new towns came to founded, named after the respective Settlement Officers at that time like Lyallpur, Montgomery etc.

Phase II

The Second Phase of the British period involves the construction of new projects.

Sirhind Canal Project

This is a project on the Sutluj river with a headwork at Ropar. This is a very important project from our point of view as all of the area irrigated by the Project is in the Indian Punjab. This project commands a large area in Punjab even today.

This was the first project to be conceived independently of an existing inundation canal. The scheme involved a treaty between the party States (princely states) of Patiala, Nabha, Jind, Faridkot, Kalsia and Malerkotla, and work was started in 1869 and completed in 1882. The project initially ran into lot of problems due to faulty design but this was later corrected. The major branches of the Sirhind Canal are Abohar, Bhatinda, Kotla, Ghaghhar and Patiala branch. Much later, the Sidhwan branch was added to compensate for the loss of Grey canals due to the Bhakra project.

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[16] Government of Rajasthan 2002c: Page 26
[17] Michel 1967: Page 66

All the perennial schemes introduced in the Punjab till 1882 were built mainly to serve lands already populated. It was only in after 1883 that the Government decided to implement plans to bring water to wastelands and allow them to be settled with surplus populations from the other areas. Famine relief (mainly in the settled areas from where the population pressure could be lessened) and increased revenue from hitherto wastelands were the main motives behind this.[18]

Sidhnai Canal

This was built in 1883 on the Ravi. It was comparatively a small scheme but its importance lay in that it served as an experiment in the migration and settlement of farmers on crown wastelands. Out of a total area of 351,000 acres served 206,000 was crown wasteland. Work was started in 1883 and completed in 1886. The area of this canal lies in Pakistan.

Lower Chenab Canal

This involved the construction of a weir at Khanki about 10 km downstream of Wazirabad (in Pakistan) on the Chenab. This was hugely ambitious project and planned to irrigate 1.1 million acres. It was big success. It was completed in 1892.

Lower Jhelum Canal

A weir similar to that at Khanki was built at Rasul (in Pakistan) on the Jhelum. It was completed in a record time of one year and eight months. (Oct. 1899 to May 1901). The Rasul weir irrigated almost the whole of Chaj doab and its planned irrigation was 787,418 acres (318,792 ha).

Thus, by about 1900, all the major Punjab rivers except Beas has been tapped to support extensive irrigation systems. A summary of the major works and areas irrigated is given below:

Table 1.3: Areas Irrigable from Major Project in Punjab 1903[19]

Name of Works	Area irrigable (Acres)
Western Jamuna Canal	809,000
Upper Bari Doab Canal	849,000
Sirhind Canal	1,170,000
Upper Sutluj (Including the Upper and Lower Sohag)	349,700
Lower Chenab Canal	1,600,000
Sidhnai	195,000
Lower Jhelum Canal	266,500

Note: Lower Chenab and Lower Jhelum canals had not reached their maximum acreage

This was a total of 5.2 m acres of irrigable areas.

After 1900 followed another phase of canal building, one of the important developments of which was the link canals for transfer of water from one river to another. These schemes (all in Pakistan) were the Triple Canal Project and Haveli project. We will not go into the reasons and circumstances which led to these developments. Extensive irrigation development took place during this phase apart from the link canals also.

[18] Michel 1967: Page 75
[19] Quoted in Michel 1967: Page 81

However, we will look at two major projects in this period which are of significance to us. These are the Sukkur project on the Indus in Sind (in Pakistan), and the Sutluj Valley Project in Punjab. (both Pakistan and Indian Punjab).

The Sutluj Valley Project

The Sutluj Valley Project (SVP) was a grand scheme consisting of four new barrages on the Sutluj. It was proposed in the early 1900s but had to await an agreement between the parties concerned – the Government of India, Punjab Government and the States of Bahawalpur and Bikaner. This agreement took place in 1919 and the project was sanctioned in 1921. It was built over the next several years.

The Sutluj Valley Project (SVP) consisted of four barrages and number of canals taking off from these. All the four barrages were downstream of Harike, where the Beas has already been received by the Sutluj. In brief, these were:

1. **Hussainiwala Barrage (Ferozpur):** The only barrage in territories now in India. Canals included Dipalpur (right bank) going to Pakistan, and the two left bank canals serving areas now in India - Bikaner canal serving Bikaner State (also called Gang Canal) and the Eastern Canal (in Ferozpur) which replaced large part of the Grey canal areas.
2. **Suleimanki** Barrage: Three canals
3. **Islam**: Three canals
4. **Punjnad**: (This was below the confluence of Sutluj and Chenab, which means that the water of all the five rivers was included in this.) Two canals off take from this.

The Culturable command area of the SVP was a huge 7.46 million acres or 3.02 million ha. (Most of it, except as indicated above was in areas that are now in Pakistan)[20]

Sukkur Barrage

The other project of our direct interest is the Sukkur project in Sind, then a part of the Bombay province. This project was sanctioned in 1923. It provided for a barrage to be located 3.2 kms downstream of the Sukkur Gorge. Three canals were to take off from the right bank and four from the left bank. The Culturable Command Area was 523,160 acres or 211,723 ha. (All in Pakistan)[21]

An important development during the early 1900s was the setting up of the Irrigation Commission (1901-1903). What was noteworthy was that the work of the Irrigation Commission for the first time represented an attempt to plan on a basin wide basis, with an effort to try and understand the impacts of various projects on others. One direct fallout of this was the coming to fore of the Sind-Punjab water disputes.

Sind is downstream of Punjab and all the waters of the Sind came through Punjab. Sind does not have any of the five major tributary rivers flowing through it – only the Indus. But since the flow of Indus includes the flow of all its tributaries by the time it enters Sind, any abstractions of the flows of these rivers was bound to affect Sind. "To the [Irrigation] Commission were presented the misgivings of Sind, then a part of the Bombay Government, that withdrawals in the Punjab would prejudice existing inundation works and proposed perennial systems along the lower Indus".[22]

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[20] Government of Rajasthan 2002c: 31-33
[21] Government of Rajasthan 2002c: 33
[22] Michel 1967: Page 93

As we shall see in detail later on, the Sind Punjab disputes were to profoundly affect Bhakra project and have a significant bearing on our understanding of the project.

By the early 1940s, the Indus basin system was probably the largest contiguous irrigation system in the world. At the time of Partition, area within the command of the Indus system was 10.5 million ha (26 million acres) – and all of it without any storage dams.[23, 24] Apart from this, another 1.91 million ha (4.73 million acres) was irrigated solely from wells. 0.88 million ha (2.17 million acres) was being cultivated under *sailab* irrigation.[25] This was the vast system against the background of which the Bhakra project came up.

THE BHAKRA-NANGAL PROJECT

We will discuss the details of the planning of the Bhakra Nangal project in a separate chapter. However, we will place before readers the Bhakra project as it stands today, so as to be familiar with its main feature. (See the layout diagram MAP 3)

The Bhakra Nangal project is a complex system of several dams, reservoirs, inter-basin transfer linkages, powerhouses and a vast canal network. Meshed with this (in part of the areas) is the canal network of the Western Jamuna Canal (WJC) in Haryana, and large number of shallow and deep tubewells in the command. The system is complex and has numerous inter-linkages with the Beas and the Jamuna system. It is also integrated with the much older Sirhind system in Punjab which too takes off from the Sutluj. The two systems are supposed to share the deficits or surpluses in the river.

The towering Bhakra dam is built on the river Sutluj near the Bhakra village in Himachal Pradesh, just before it enters into Punjab. The height of the dam from the deepest foundation is 740 feet. A huge storage reservoir, the Govind Sagar stretches out behind it. The reservoir area is 168.35 sq. km. The inflow into the reservoir consists partly of snowmelt, partly of rainfall run-off and partly from the waters of the Beas diverted into the Sutluj.[26] The Bhakra dam has a catchment of 56,980 sq. km. It is not clear if this catchment includes the catchment of Beas from where the waters are diverted into Bhakra. The maximum Reservoir Level is 1680 feet, and at this level the reservoir has a Gross storage of 9340 m cum (7.57 MAF) and a live Storage of 6911 m cum (5.60 MAF)[27]. Sometimes one may read the maximum Reservoir Level given as 1685 feet. The last 5 feet are now used to cushion the floods[28].

The Pandoh dam on the Beas river, (called Beas Unit I) diverts 3.82 MAF of Beas waters annually into the Sutluj. This is the Beas Sutluj Link or the BSL. The dam is at Pandoh which is 21 kms upstream of Mandi and 113 kms upstream of the Pong dam on Beas (called Beas Unit II) at Talwara. Diversions are through an open channel and 2 tunnels with a combined length of 25 kms. The diversions empty into the Govind Sagar / Sutluj river at Dehar, on the right bank of Sutluj near the Slapper bridge, where a powerhouse is built to take advantage of the 150 m fall in the path from Pandoh to Dehar. The Dehar powerhouse has an installed capacity of 990 MW.[29]

The Bhakra dam has two powerhouses, namely the Right Bank and Left Bank. These have an installed capacity of 660 MW[30] and 540 MW respectively.[31] Water released through these powerhouses flows down the Sutluj for about 13 kms to the Nangal barrage at Nangal. Two

[23] Gulhati 1973: Page 39
[24] Out of this 8.5 m ha went to Pakistan and 2.1 m ha came to India. (Gulhati 1973: 59)
[25] Gulhati 1973: Page 43
[26] This diversion was implemented in 1977 with the construction of the Pandoh dam on the Beas
[27] Display at Bhakra Dam Site and BBMB 2002a
[28] Duggal and Garg 2002: Page 68
[29] http://www.rajirrigation.gov.in/4bhakhra.htm#link visited 10 Oct 2004
[30] This figure according to the BBMB website is 785 MW. In fact, different sources give slightly different figures for the capacities of various power stations. This is due to the ongoing uprating etc.
[31] CEA 1997: Page 4, and Display at Bhakra Dam Site

channels take off from the Nangal dam. One is the Nangal Hydel Channel which goes on for 65 kms up to Ropar, from where it is called the Bhakra Main Line. Two power stations are located on the NHC namely, at Ganguwal (77.65 MW installed) and then at Kotla (77.65 MW)[32]. The other channel taking off from the Nangal dam is the Anandpur Sahib hydel channel.

The Bhakra Main Line takes off at Ropar, and then, through several branches serves areas in Punjab, Haryana and Rajasthan. Some parts of the Bhakra command are serviced via the Sirhind system in Punjab. Another canal takes off from Ropar to the North of the Sutluj serving the areas of the Bist *Doab*.

In Haryana, the Bhakra canal has replaced / supplemented in parts the irrigation already in place from the Sirsa Branch of the WJC.

According to the display at the Bhakra dam site, the project benefits include 28.8 lakh ha in new areas irrigated and improvement of irrigation in another 9 lakh ha. It also mentions an annual generation of 6500 Million Units (MU) of electric energy.

About 113 kms downstream of the Pandoh dam on the Beas is the Pong dam. From Pong, the river travels down to meet the Sutluj at Harike Patan. A barrage was constructed at Harike in 1952. The Indira Gandhi Nahar (or the Rajasthan or Raj Canal as it is called) takes off from here, along with the Sirhind feeder. The Raj Canal, as the name suggests goes to Rajasthan. The construction of the Raj Canal cut off several areas at the tail end of the Sirhind system (including some areas that were to be in the Bhakra command). The Sirhind Feeder was constructed to serve these areas from the Harike Barrage. It opened in 1958.

This, in brief is the outline of the Bhakra project. We will examine several of these components in detail in the chapters that follow. ✍

[32] CEA 1997: Page 9

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Planning The Bhakra Project

"Bhakra Dam Project, which has a long history dating as far back as 1908 when the idea was dimly first conceived, remained an unrealised dream for about 40 years. During this period the project was investigated and reshaped a number of times, and with each successive proposal its scope was considerably widened by providing a higher dam with larger storage…"

History of Bhakra Nangal Project, BBMB

The Indus Waters Treaty

September 19, 1960

(Karachi)

The Government of India and the Government of Pakistan, being equally desirous of attaining the most complete and satisfactory utilisation of the waters of the Indus system of rivers and recognising the need, therefore, of fixing and delineating, in a spirit of goodwill and friendship, the rights and obligations of each in relation to the other concerning the use of these waters and of making provision for the settlement, in a cooperative spirit, of all such questions as may hereafter arise in regard to the interpretation or application of the provisions agreed upon herein, have resolved to conclude a Treaty in furtherance of these objectives, and for this purpose have named as their plenipotentiaries:

The Government of India: Shri Jawaharlal Nehru, Prime Minister of India, and The Government of Pakistan: Field Marshal Mohammad Ayub Khan, H.P., H.J., President of Pakistan, who, having communicated to each other their respective Full Powers and having found them in good and due form, have agreed upon the following Articles and An

Article II

Provisions Regarding Eastern Rivers

INTER-DOMINION AGREEMENT BETWEEN THE GOVERNMENT OF INDIA AND THE GOVERNMENT OF PAKISTAN, ON THE CANAL WATER DISPUTE BETWEEN EAST AND WEST PUNJAB

Signed at New Delhi, 4 May 1948

. A dispute has arisen between the East and West Punjab Government regarding the supply by East Punjab of water to the Central Bari oab and the Depalpur canals in West Punjab. The contention of the East Punjab Government is that under the Punjab Partition pportionment of Assets and liabilities) Order, 1947, and the Arbitral Award the proprietary rights in the waters of the rivers in East Punjab st wholly in the East Punjab Government and that the West Punjab Government cannot claim any share of these waters as a right. The est Punjab Government disputes this contention, its view being that the point has conclusively been decided in its favour by implication by Arbitral Award and that in accordance with international law and equity, West Punjab has a right to the waters of the East Punjab rivers. The East Punjab Government has revived the flow of water into these canals on certain conditions of which two are disputed by West jab. One, which arises out of the contention in paragraph 1, is the right to the levey of seigniorage charges for water and the other is the stion of the capital cost of the Madhopur Head Works and carrier channels to be taken into account.

he East and West Punjab Governments are anxious that this question should be settled in a spirit of goodwill and friendship. Without udice to its legal rig atter the East Punjab Government assured the West Punjab Government that it has no intention to old water from We ithout giving it time to tap alternative sources. The West Punjab Government on its part recognize the al anxiety of the Ea Government to discharge the obligations to develop areas where water is scarce and which were under-oped in relation to st Punjab.

Planning the Bhakra Project

IT IS NOT CLEAR WHEN EXACTLY THE IDEA TO HAVE A STORAGE STRUCTURE on the Sutluj was first mooted. It is even less clear as to whether this was in response to any specific need, or was a part of the general progression of irrigation development in the valley.

The earliest reference to the Bhakra project – or rather, the idea of a storage reservoir on the Sutluj – which we have come across, is of 1908. Sir Louis Dane is stated to have mentioned the idea of a storage reservoir on the Sutluj in a note dated 8 November 1908, after a tour from Shimla down the Sutluj from Suni to Bilaspur and over the hills to Nallagadh and Ropar. The idea was elaborated in a note dated Nov 29, 1909 by Mr. Gordon, then Chief Engineer, Punjab Irrigation, who considered a site three kilometres downstream of the present location as more promising.[1]But these references do not mention the reasons advanced by Dane or Gordon. The historical references indicate more that it was a matter of "have a site, will build a dam". Indeed, for many decades after Independence, and even till date, the surveys of river valleys for "development" have consisted essentially of locating good sites to build dams.

A detailed report "*on the site*"[2] was prepared in March 1910. Note that the report itself seems to be essentially on the *site* of the project, including mostly the feasibility of the dam, geology of the site, and the design and estimates for the dams. The cost of the project was considered prohibitive compared to its benefits and further investigations on the site were stopped.

The proposal was revived in 1915. The then Chief Engineer, Mr. F.E. Gwyther prepared a note on 20 February 1915 and concluded that the revenue earning possibilities had been greatly underestimated and were needlessly pessimistic. On the basis of this note, a Project Division was opened in October 1915 and the first detailed and comprehensive project report for a high dam at Bhakra was prepared in 1919. As per this report, the project was to consist of:

1. Bhakra Dam
2. Upper Sirhind Canal
3. Lower Sirhind Canal
4. Western Yamuna Canal Extension

It may be recollected that the Sirhind canal was already in operation since 1882.

The height of the dam at this point was to be 120.40 m (395 ft) and storage was to be 2.58 MAF (3182.38 MCM).[3] The reservoir level was to be 1500 feet[4] (compared to the 1685 feet as built). It was to be purely an irrigation project. According to the BBMB[5]:

> "The project report for the *first time*, highlighted the devastation caused by the famine in the areas covered by it and urged taking up the project even at the risk of reduced revenues and less remuneration". (Emphasis added)

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[1] Government of Rajasthan 2002c: Page 116
[2] *ibid*; Page 116
[3] Compared to what it is today – height 740 feet, storage 7.57 MAF
[4] Handa and Chadha 1953
[5] BBMB 2002a : Page 5

Around this point of time began the phase of the inter-provincial dispute between Punjab and Sind on the waters of the Indus rivers. As we saw in the last chapter, Sind had expressed to the Irrigation Commission in 1901 its concern about the diversions and proposed projects of Punjab and their implications for projects of Sind. By the 1910s, this had reached the level of a dispute. *This dispute was to have far-reaching impacts on the Bhakra project, both, in terms of delaying the project, and in terms of enlarging its scope and capacity*. The dispute is also important in understanding the various developments all the way to post-independence. Hence, we will go into some detail of this dispute.

The Punjab Province was ruled from Lahore, and Sind at that time was part of the Bombay Province. While the 5 major tributaries of Indus flow through Punjab, the Indus flows through Punjab and into Sind. Thus the collective waters of the six rivers flow through Sind before it meets the sea. As Punjab was planning projects on the Indus and tributaries, Sind region was increasingly feeling cheated of its waters as it felt that these projects would withdraw waters from the rivers to its detriment.[6] By the 1900s, Sind started raising objections to construction of weirs and canals in the Punjab region and also proposed a project of its own on the Indus at Sukkur in 1920.

Among the important projects proposed by Punjab were the Sutluj Valley Project (SVP), the Trimmu and the Thal, and of course, Bhakra. The idea of utilising the waters of the Sutluj below Harike was mooted as early as 1854, and in 1903, the First Irrigation Commission recommended a set of weirs on the Sutluj. This was the SVP.[7, 8]

The Sind Government had raised the dispute that Punjab's upstream diversions would affect it adversely. The SVP especially was seen as a major problem by Sind. Punjab, on the other hand argued that the Sukkur project would create rights in favour of Sind and these would jeopardize its own projects.

It may be inferred from various documents that Sind's arguments were acknowledged by the Government of India. The Government of India agreed that *prima facie*, Sind has a case; but also said that data on the flows of the Indus and tributaries was inadequate. In 1920, in what appeared to be an attempt at balancing the two sides, it said that SVP and Sukkur both could go ahead. It also called for proper measurements of the flows of the Indus rivers.

In a note prepared on 10 Dec. 1920, Sir Thomas Ward, the then Inspector General of Irrigation[9]

> "..urged the importance of a full investigation into the supplies of the Indus and its tributaries. 'Prima facie', he stated, 'it is logical to assume that the abstraction of water from the tributaries of the Indus must necessarily diminish the volume passing Sukkur, but it is quite possible that this diminution is to some extent compensated by the seepage back into the river.....Unfortunately, the data available are too meagre to permit of definite conclusions....."

However, Sir Thomas also said that the records as they exist had been examined and the Government of India was satisfied that the SVP could be taken up without prejudicing the irrigation at Sukkur. With this, the Government of India submitted the Sukkur Barrage Project for sanction to the Secretary of State in 1920, noting that[10]:

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[6] This of course is the perpetual and universal concern of a downstream area vis-a-vis the upstream.

[7] Dhillon 1980: Page 54

[8] We have seen in Chapter 1 that the Sutluj Valley Project (SVP) as approved in 1921 consisted of four weirs and an extensive canal system. The weirs were at Hussainiwala near Ferozpur, Sulemanki, Jamlera (Islam) and Punjnad, the last being below the junction of the Sutluj with Chenab

It may be recollected that all these projects are downstream of the confluence of Sutluj and Beas and hence Sutluj here includes the flow of both these rivers. The Sutluj is called Punjnad after its confluence with Chenab.

[9] Quoted in Michel 1967: Page 118

[10] *ibid*

> "The data available are insufficient to enable an accurate determination to be made of the effect on the discharge of Indus at Sukkur of the withdrawals proposed by the Sutluj Valley Projects...but... the shortage at Sukkur was not likely to be greater than could be surmounted by care and economy in distribution. 'We consider, therefore, that both the Sukkur and Sutluj Valley schemes can be safely constructed at the same time....'"

However, this position only *appeared* to be a balanced one, as in the process, Sir Thomas also stated, what was of course a logical conclusion[11]:

> "It will obviously be necessary, once construction commences on the Sukkur scheme, for any future projects put forward by the Punjab to be very carefully examined in relation to the possible effects of further withdrawal from the tributaries of Indus upon the rights to irrigation from the Sukkur canals..."

One of the Punjab projects was of course Bhakra, and we will come back to the implication of Sir Thomas's rider further on.

Interestingly, the SVP itself was a subject of dispute between Punjab and the State[12] of Bahawalpur on sharing of the Sutluj waters. In 1906, the State of Bikaner, a non-riparian state also staked its claim for a share of the water. These disputes held up the SVP till 1919 though a number of projects were proposed in the interim. Ultimately, the SVP was sanctioned on 15 Dec. 1921, after an accord had been signed among the various parties in 1920.[13]

While Sind was concerned about the impact of Punjab's projects on Sukkur, what is far more relevant to our discussion is the impact that the proposed abstractions at Bhakra would have had on the SVP. Remember that the Bhakra was upstream of SVP. As both the Bhakra and the SVP were projects of the same Government (Punjab), this matter did not become a "dispute", though clearly, there was to be a significant impact.

A note was prepared by W.F. Holms, Chief Engineer, Irrigation Works, Punjab on the Sutluj Valley Projects in 1917. Among other things, the note says: [14]

> "13. Since the 1913 Sutluj Valley Project was prepared, the prospects of a Dam[15] on Sutluj have become bright and a preliminary project is now being drawn up, which contemplates the irrigation of large tracts south of the present irrigation limits of the Sirhind and Western Jumna Canals.
>
> "The proposals are for the storage of about 2,500,000 foot acres .....
>
> "The distribution of Sutluj cum Beas water between Sutluj Valley and Bhakra systems will be doubtless later on form the subject of considerable discussion, and *if the latter project is ever carried out the supplies available for the Sutluj Valley Canals will be to some extent modified*, but not to such an extent as to vitiate any of the proposals now made" (Emphasis added)

The note then goes on to propose the *restrictions* on withdrawals and storages *at Bhakra* so as not to jeopardize the SVP. A few important points need to be noted here. One, that while the note stated that the Bhakra would not "vitiate" the SVP, it clearly talked about an impact. Second, this note talked about the impact of Bhakra on the SVP (or vice versa) in a very polite tone since both the projects were under the same Government. Sind of course was to take

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[11] *ibid*

[12] In accordance with the customary usage, we shall refer the British ruled provinces as Provinces and the princely states as States.

[13] Dhillon 1985: Page 28

[14] Government of Punjab 1917: '*Sutluj Valley Project – Note dated 21 May 1917 by W.F. Holms, Chief Engineer, Irrigation Works, Punjab on the Sutluj Valley Projects'*, Public Works Department, Irrigation Branch, Punjab, Lahore

[15] Dam with a "D" capital in the original!

much stronger note of the Bhakra and voice its opinion in a far more strident tone. Third, the Bhakra project as was proposed then was much smaller in scope than present, and hence, the impact of the current project on the SVP would have been far more. Fourth, the states of Bahawalpur and Bikaner were to take much stronger note of impact of Bhakra on SVP.

So we had three projects - Bhakra, SVP, and Sukkur – in order as we go down the Sutluj. The upstream withdrawals could jeopardise or affect the downstream projects; on the other hand, if the downstream projects were built earlier, they could create rights in favour of the downstream so as to restrict the upstream development. Sanctioning of Sukkur had already done this, as we saw.

Let us go back to events in the 1920s. As recommended by the Government of India, both the Sukkur and SVP were sanctioned at this time. Punjab decided to shelve the 1919 Bhakra project in favour of the SVP. While we are not able to ascertain the precise reasons why Punjab chose to push for SVP rather than the Bharka, it seems that the objections of Sind were most important in this. The SVP was sanctioned on 15 December 1921. Sukkur Project was sanctioned in April 1923 and construction was completed in 1932.

Learning of the sanction of the Sukkur Project in April 1923, Punjab saw it as a victory for Sind, feeling that this would create rights for Sind and hence restrict its own future withdrawals.[16] As Michel says: [17]

> "Punjab apparently concluded that Sind had won the first round. At any rate, it wanted to stake its claim in no uncertain manner, and therefore entered a protest to the restriction of further withdrawals from both, the Indus and the upstream tributaries.
>
> "The Government of Bombay, on the other hand, strongly objected to this attitude on the part of the Punjab Government. They laid stress upon the statement of Sir Thomas Ward that all future Punjab schemes would have to be examined carefully in relation to the possible effects at Sukkur. They complained that they had not been consulted when the Sutluj Valley Project was under consideration...."

This phase is a very critical phase as the dispute heated up and affected the design of several projects. When Sukkur was sanctioned in 1923,

> "(S)evere limitations were placed on the withdrawals upstream. Consequently, the 1924 [Thal Canal Project of Punjab] was revised to lower the capacity of the off-taking canals to 191.1 cumecs from 454.3.....
>
> "Punjab Government was forced, mainly by pressures by Zamindars to repeal, in 1929, the Sind Sagar Coloniszation Act of 1901 and the land was handed back to the original owners."[18]

Such developments are sure to have affected Punjab's strategy vis-a-vis Sind, and as is the response in such a case, Punjab seems to have reacted by increasing the scope and capacities of its proposed project. For example, the Irrigation Commission of 1901-03 had considered the Thal project unpromising. So Punjab had put it aside. In 1919, it was again submitted, and clearly the motivation seems to be stake a claim on the Indus waters above Sukkur. From 1923 onwards, Punjab was using three of its proposed projects in this endeavour to claim rights on the water over Sind – Bhakra, Thal and Trimmu.

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[16] It may be noted that since Sukkur was on the Indus at a point after all the five tributaries have been received by the Indus, withdrawals *on any of the five rivers or the Indus itself* by Punjab could be objected to by Sind as impacting Sukkur.

[17] Michel 1967: Page 119. A significant part of our description of the Sind-Punjab disputes and the subsequent events relies on the excellent narrative given by Alloy Arthur Michel.

[18] Dhillon 1985: Page 31

As Michel points out for this period[19]:

> "From 1923 on, then, the Punjab Government was in effect attacking Sind on three fronts, Bhakra, Thal and Trimmu, whichever seemed the most promising at the moment..."

One way of "attacking" was to enlarge the scope of its proposed projects, so as to try and show that it had much more need of the water, that it could command much more area, and hence its share should be higher.

This practise of inflating storage capacities and proposed commanded areas, or even proposing entirely new projects and massive "requirements" so as to strengthen one's case in a water dispute is a regular and well known practice– even though this means that the project design is governed by criteria other than the rationale of irrigation needs and possibilities.

For example, in the dispute between M.P. and Gujarat on the Narmada waters, each state greatly exaggerated its needs and the areas it could command. In the post-partition dispute with India on the Indus basin rivers, Pakistan's preliminary outline plan submitted to the World Bank entailed a demand for 506 MAF of water – almost three times the total supply of the Indus system.[20] Such tactics were used on the Indian side as well. Paul Singh Dhillon, formerly Chief Engineer, Irrigation works, Punjab, writes about it thus[21]:

> "The hypothesis of Ghagghar basin being a part of the Indus basin, a pet child of Gulhati, had to be adopted in the national interest in the context of negotiations with Pakistan for the division of waters of the Indus system so as to magnify the Indian part of the Indus basin and thereby prop up what, at that time, appeared to be our sagging requirements of these waters. This was necessary to strengthen our bargaining position in the said negotiations."[22]

Gulhati himself summarises the prevalence of this practice, talking about the post-partition dispute over the Indus water between India and Pakistan[23]:

> "The fight over the Indus waters was conducted on several fronts, only one but the most important of these was negotiations… Each side engaged itself, within its own border, in the construction of new works of development from the Indus and its tributaries. Some of these works had been planned before partition, others were embarked upon in attempts to secure prior right of use, to intimidate the other party, to counteract the likely effect of new works undertaken by the other party or to thwart proposals of schemes of the other party by confronting it with a fait accompli."

Clearly, such practises did not originate with the partition, but were part and parcel of the tactics used by planners from much earlier on. The (upward) revisions in the Bhakra project undertaken by Punjab after the first scheme seem clearly to be a part of this "attack" or tactics - more to stake its claims on the waters of the Sutluj vis-a-vis Sind than on reasons of merits.

Even though the Bhakra scheme had been shelved in 1919, a series of investigations were continued at the site, focussing mainly on the geological aspects. In 1927, a Committee was formed to report on the proposed Bhakra site and this Committee recommended a 500 ft (152.40 m) high dam, as against the 1919 proposal of 395 feet. The Committee is reported to have "brought to the notice the advantages of a 152.4 m high dam over the previously

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[19] Michel 1967: Page 121
[20] Government of Rajasthan 2002c: Page 113
[21] Dhillon 1983: Page 6
[22] This has now come to haunt the state of Punjab as this is now being used by Rajasthan and Haryana to claim that they are Indus basin states, and Punjab is asserting that the former are not Indus basin states and hence cannot claim any share of the Indus rivers.
[23] Gulhati 1973: 12

proposed 120.4 m.... contemplated in the 1919 project."[24] The storage with the new proposed height was to be 4.75 MAF, up from about 2.5 MAF of the 1919 project.[25]

This is how a modern day politician from Pakistan describes the developments of this period[26]:

> "In the meantime the (undivided) Punjab authorities who seem to have made mass manufacture of schemes and projects for taking away as much water from the Indus system as possible their permanent occupation or rather an eternal passion, which continues till to-day and promises to continue as long as there is even a single cusec of water left in the system, for going down-stream to the lower riparian, produced yet another massive project for the purpose, the Bhakra Dam project."[27]

Clearly, Punjab was engaging Sind with the Bhakra project. Michel reports thus about the 1927 Committee Recommendations[28]:

> "In its 1929 report, the Indus Discharge Commission agreed that the data were still insufficient to draw any conclusions about the Thal project, but suggested that a limited [supply] might be made available for Trimmu. Not content with this small gain, *Punjab again resumed the offensive on the Bhakra front. The committee of experts to which the Bhakra scheme had been referred had ....greatly enlarged the scheme* to encompass a 500 foot high dam. Confronted with this sizable attack, Sind...." (Emphasis added)

These events point clearly to the up-scaling of the Bhakra project not for any merits, but to create grounds for negotiations with Sind on the water disputes. Lest the issue of dates be raised (Committee's report came in 1927 and the Indus Discharge Commission in 1929), it should be pointed out that these processes were going on simultaneously and the enlargement of the projects was not in response to any specific committee's report but represented a pre-emptive measure in response to the broad trend of events.

It may be pointed out that the impacts of the increase in storage and height of the Bhakra on the SVP (as against on the Sukkur project) do not seem to figure in the discussions. Again, this is presumably because the projects belonged to the same state. There are indications, however, that by 1935 the State of Bahawalpur and indeed Punjab itself too felt the need to allocate waters from the (proposed) Bhakra dam for the SVP. It may be recalled that the stated purpose and justification of Bhakra was to take waters to tracts South of Sirhind and above the Western Jamuna areas.

Coming back to the late 1920s, in reaction to the "sizable attack" of a 500 foot high dam, Sind argued that the high Bhakra dam (of 500 feet), by reducing the volume of water in the annual floods of the Sutluj-Panjanad-Indus, would lead to higher deposits of silt in the Mithankot-Sukkur stretch, raise the level of bed of Indus and silt or cut-off inundation canals. It also argued that even if the Bhakra dam did not reduce the volume of water available at Sukkur, it would lower the flood in the Sutluj-Panjanad-Indus, and have a deleterious effect upon the canals in its areas. [29]

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[24] BBMB 2002a: Page 5

[25] Michel 1967: Page 122

[26] Rasul Bux Palijo, undated: '*The Sindh-Punjab Water Dispute - 1859-2002'*, South Asia Centre for Peace and Human Development. Palijo is a well known writer and scholar, politician and lawyer of Supreme Court of Pakistan and the president of Awami Tehreek – a political party. Article made available to this author by a researcher.

[27] It may be pointed out that the Sind-Punjab dispute of those days never really ended with the partition but has carried on till today as a dispute between the two provinces of Pakistan. The dispute even today raises intense passions and much of Sind politics hovers around water and Punjab. So strong are the feelings that even academics use strong and emotive language when dealing with this. The feelings of being an injured and maltreated party are strong and there are obvious deep scars and unhealed wounds in the minds of people of Sind.

[28] Michel 1967: Page 122

[29] Michel 1967: Page 122

Unfortunately for Sind, these arguments were mutually contradictory, and when they were submitted to the two engineers H.W. Nicholson (From Punjab) and W.L.C. Trench (from Sind) by the Indus Discharge Commission,

> ".....they were forced to agree that the inundation canals above Sukkur would not be adversely affected..... [As we shall later see, this did not mean that Sukkur itself would not be affected and it is not clear to us why Sind did not hold out the argument of impact on Sukkur in addition to the argument of impact on the canals above Sukkur].....After some further argument, the Government of Bombay withdrew its objections to the Bhakra project on March 27, 1934. But instead of proceeding with the construction at once, Punjab proceeded to redesign Bhakra once again and meanwhile to press the Thal and Trimmu projects!"[30]

Michel does not explain this action of Punjab in not proceeding with Bhakra. But a logical interpretation is that Bhakra (and especially an inflated Bhakra) was *not* really what Punjab wanted. This would be the case if Bhakra were inflated mainly to help Punjab negotiate the water-sharing dispute with Sind. Gulhati (1973: 37) says that the Bhakra project, as then conceived with a live storage of 4.75 MAF, was not proceeded with even though there was an agreement between Bombay and Punjab in 1934 because the reservoir would submerge lands in Bilaspur, an independent princely State at that time, and it had not been possible to secure the agreement of the ruler of the State for this. This, in fact, bolsters the interpretation that Punjab was increasing the height and scope of Bhakra mainly as a negotiating tool – for otherwise how could it design, and also put up for an agreement with Sind (Bombay) this higher dam without securing the clearance from the Raja of Bilaspur? Whatever may be the reasons, Bhakra was put aside at that point, and Punjab pressed for Thal and Trimmu.

However, Thal and Trimmu too became (already were) embroiled in the water disputes with Sind, and finally the Government of India appointed a committee in 1935 on the "Distribution of Waters of the Indus" to recommend an allocation that be "acceptable and equitable to all parties". This committee was called "The Indus Committee 1935", or the "Anderson Committee", after the name of the Chair. The findings of this Committee represented a compromise in which all parties got something. Punjab got the final authorisation to proceed with the Thal and Trimmu project.[31]

We have seen that in 1934 Punjab chose not to proceed with Bhakra even though Sind (Government of Bombay) had withdrawn its objections. At this point, we have two contradictory sets of information. Michel says that in 1939, Punjab redesigned the Bhakra project for a third time, this time calling for a *smaller* reservoir (4 MAF) but *more use of Sutluj waters for the SVP*. [32], [33]

BBMB on the other hand, says that investigations on the 1927 recommendations for the Bhakra project were started in 1932. In 1939, a Detailed Project Report was taken up by Dr. A.N.Khosla, then Superintending Engineer. This proposed a dam of height 500 ft, with storage of 4.75 MAF (5859 MCM) and a maximum reservoir level of 1600 ft.[34] Provision was made for generating hydropower.[35]

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[30] Michel 1967: Page 123
[31] Michel 1967 Page 124
[32] Michel 1967 Page 129
[33] It may be recollected that we had pointed out above that there had been murmurs from 1935 onwards of allowing more waters for SVP as against being diverted to the proposed Bhakra areas.
[34] It is not clear how Khosla prepared the DPR for 1600 feet reservoir level. If the project had not been able to proceed earlier due to the objections of the Raja of Bilaspur, these would have remained valid even for this particular design. Handa (1953) points out that the Reservoir level had to be restrained at 1580 feet due to objections of the Raja.
[35] BBMB 2002a: Page 6

It is also mentioned by IGNB[36] that the Punjab Government was to start construction on the Bhakra project in 1939 but this had to be abandoned due to the start of the Second World War. Michel however presents a different picture.

According to Michel[37], Sind once again raised the dispute with regards to Bhakra. Sind could argue that even though it had agreed to the project in 1934, Punjab had not acted on it, and with the Anderson Committee's report and the revision of the project once again, Sind was in its rights to re-open the dispute.

Whatever may have been the progression of events, what is certain is that the dispute reared its head once again. In October 1939, Sind requested the Governor-General to appoint a Commission under the provisions of the new Government of India Act, essentially reiterating that Punjab's projects would adversely affect its own irrigation.[38]

By this time, there were several important developments. In 1935, the Government of India Act had been passed and became effective in 1937. Under this act, water, irrigation, drainage, storage all came under the direct control of the Provincial Government (as against the Government of India). Secondly, the Government of Sind had come into being in 1937 and Sind was now a province by itself. Thus, with Sind and Punjab being independent provinces, both with direct control and authority over their water resources, the complaint could not be referred merely to a committee. Instead, a special, quasi-judicial commission called the Indus Commission was convened in September 1941, under the chairmanship of Jst. B.N. Rau with two engineers as members. [39] Bhakra was one of the major points of complaint by Sind. The Commission in particular noted Sind's complaint that the Bhakra project, now with a smaller storage of 4 MAF, would still burden Sind's inundation canals, and in conjunction with other projects would affect Sukkur also.

The Commission submitted its report in July 1942.

Of particular interest to us is the Commission's noting that Punjab had assigned priority to the Sutluj Valley Projects for water from Bhakra.[40] Thus, the Bhakra project was being proposed and justified on the grounds of supply to the arid and semi-arid areas of Sirsa and Hissar, but in operational terms, the priority was to be given to areas already being served by SVP. Indeed, this point is reinforced by the remarks of Gulhati, who says that while in 1920s, the Sutluj waters surplus over Sirhind system's requirements had been wholly reserved for Bhakra project, in 1942, the Punjab Government altered this to the advantage of the Sutluj Valley Canals.[41]

To compensate Sind for the impacts of Bhakra on its projects, the Commission recommended that two new barrages would need to be built in Sind at Kotri and Gudu and Punjab should pay for the same.[42]

Neither Punjab nor Sind accepted the recommendations of the Commission and both appealed to the Government of India against them. For us, the relevant point is that it was eminently clear from the proceedings of the Commission that the Bhakra project would have significant impact on the downstream projects – the SVP, the inundation canals in Sind and the Sukkur project. *In other words, irrigation in significant parts of the new areas to be commanded by the Bhakra would have been transfer of areas already irrigated. Or, if this existing irrigation were to be maintained, then Bhakra would not perform to the level of claims made by it.*

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[36] Government of Rajasthan 2002c: Page 95
[37] Michel 1967 Page 129
[38] Gulhati 1973: 38
[39] This was the precursor of today's water dispute tribunals.
[40] Michel 1967: Page 131
[41] Gulhati 1973: 68. Also see Page 357 which states that "...Bhakra-Nangal project...had earlier been formulated giving first priorities on the available river supplies to the Sutluj Valley Canals.."
[42] Michel 1967: Page 132; Also Dhillon 1985 Page 35

Ultimately it is the former that happened, as we shall see.

While the matter was referred to the Government of India and to London, a draft agreement was prepared between the Chief Engineers of Sind and Punjab. But political events rapidly overtook them. The War was ending, and the winds of Independence had started blowing with greater and greater certainty. Partition was also looming ahead.

PARTITION

On the eve of Partition, the Indus basin had one of the most extensive and complex irrigation systems in the world. It consisted of a large number of canals taking off from weirs, barrages or just inundation canals, and lakhs of hectares of irrigated areas. Well irrigation was also present in significant areas. This system cut across boundaries of provinces and States, of language, and religion. It was as tightly knit together as it was complex.

A detailed look at the history of the events that led to the Partition shows that the irrigation system was not a very significant consideration in deciding the dividing line. In the western side of the country, i.e. in the Punjab, the partition sliced through the irrigation system, rupturing it, leading ultimately to a massive disruption that was to change its very face and nature.

While the systems of irrigation from the three so called "western rivers" – Indus, Jhelum and Chenab remained more or less intact, some systems of the three "eastern rivers" – Sutluj, Beas and Ravi were badly split up, with some headworks remaining in one country and the commands in another; with command areas themselves being split and so on.

In particular, the Ferozpur Headworks on the Sutluj (the first of the SVP) remained in India, while its right bank irrigation system served through the Dipalpur canal went to Pakistan. More important, while other headworks of the SVP went to Pakistan, India being the upstream state was now in a position to control the Sutluj river if it so wished.[43]

The haste with which Partition was carried out, and the terrible events surrounding it, left little time for a proper division of assets between the two new countries. The mechanisms that were set up during the partition for this, namely the Partition Council and the Arbitral Tribunal, were to continue to function till March 31, 1948. This date was to be the terminal date of the "Standstill Agreement" signed on Dec. 18, 1947, which provided, among other things, that the Pre-Partition allocation of waters in the irrigation system would be maintained. There was provision to negotiate, before the terminal date, an agreement for periods beyond it.

POST PARTITION EVENTS

On 1 April 1948, East Punjab (Indian Punjab) shut off supplies to the Pakistan portions of the Lahore and Main branches of the UBDC on the Ravi.[44] Why India took such a step *at this time* is not really relevant to our enquiry. Michel[45] speculates on some reasons – the export duty imposed by Pakistan on jute leaving East Bengal was one possible reason. The looming shadow of Pakistan's actions in Kashmir was another one. Whatever may be the reasons, it is certain that the step was an inevitable one; it was only a matter of time before India would have done this.[46] That it was done immediately on the day after the Standstill Agreement

[43] Of course at the time of Partition it did not have the physical armamentarium to do so. This is where Bhakra became important.

[44] The Dipalpur canal from Ferozpur Headworks was already closed, being non-perennial, but it appears that this too was "shut off".

[45] Michel 1967: Page 196

[46] Indeed, Michel states that "perhaps, most directly, the canal closures of April 1948 were an assertion of India's claim to all the water in all the rivers that flow through her territory." This statement is certainly a logical one and subsequent events support it.

ended did imply some (serious) immediate consequences for Pakistan[47], which could possibly have been avoided had the step been taken through a more negotiated route; but the long-term unfolding of events was unlikely to have been different, given the geo-politics of the region and the events leading to the creation of the state of Pakistan.

East Punjab's action triggered off another water dispute – this time between India and Pakistan, encompassing all the tributaries of the Indus, but especially the Ravi, Beas and Sutluj. This dispute came to be popularly known as the "Canal Water Dispute". While the scope of the India-Pakistan dispute was huge, its sum was that India was the upstream state and in a position to control – divert for own use or disrupt, withhold as it wanted – supplies to large parts of areas served by the current and proposed irrigation systems in Pakistan – especially on the "eastern rivers" but if it came to that, also on the Chenab and even Jhelum. (To re-iterate our earlier remark, India had only limited physical capacity to so immediately, but had now got to a position where over the years it could create this physical capacity). Pakistan was hardly in such a position with respect to any of the rivers.[48] The action at UBDC was merely a hint of what could lie ahead for Pakistan.

Apparently this step was taken by the East Punjab Government on its own, and Prime Minister Nehru was livid on hearing of it. Subsequently, the canal supplies were restored[49] but the action of the East Punjab Government triggered off a full-blown dispute that was to occupy centre stage in Indo-Pak relations, and took over 12 years to settle.

This dispute was to re-play many of the arguments we have already seen in the case of the Sind-Punjab dispute of the pre-partition era. This is not surprising, for we can see that the Indian Punjab inherited a part of the case of the Punjab province, and Pakistan landed with part of the case of Punjab, and all of the case of Bahawalpur and Sind. In particular, by controlling the Sutluj (and Beas) possibly at Bhakra , India was in a position to affect both, the SVP and the Sukkur project. As Gulhati says[50]:

> "West Punjab and Pakistan saw the danger signal [of the April 1948 closure], and even after water supplies had been restored to these canals and the two Dominion Governments has worked out a mutually satisfactory agreement, at least for the time being, Pakistan was highly suspicious of Indian intentions. ....Not only West Punjab but Bahawalpur and Sind were also seriously concerned.....The fact that the Indian part of the Indus basin was water-thirsty only increased Pakistan's fears. East Punjab was going ahead with the Bhakra Nangal Project and, unless the operation of the new canals of this system, when ready, was severely regulated, the canals taking off the Sutluj River lower down in West Punjab and Bahawalpur might not get adequate supply."

Thus, a new dimension in the old Sind-Punjab water dispute was opened up by Partition. Till then, the dispute was between Sukkur/Sind and the projects of Punjab. With Partition, the SVP was pitted against Bhakra directly for the first time.

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[47] For e.g., the city of Lahore was deprived of the main source of municipal waters. About 5.5% of Pakistan's sown area was also affected. (Michel 1967:196)

[48] There were some minor exceptions – for example, five miles upstream of Ferozpur, the Radcliffe Award had specified the Lahore District boundary rather than the Sutluj river as the partition line, and this gave Pakistan control of both the sides of the Sutluj here. This was one of the reasons for India to later build the Harike Barrage.

[49] Through an agreement first signed on 18th April 1948 between the Chief Engineers of the two states, to come into effect when subsequently ratified as an Inter Dominion Agreement signed by India and Pakistan on 4 May 1948. This agreement later was to become highly controversial.

[50] Gulhati 1973: 60

The Indo-Pak dispute was to go on for a long time. The course of the dispute makes for a fascinating study; but not all of it is relevant here.[51] What are important are the conditions of the resolution of the dispute. The dispute was ultimately resolved with the "good offices" of the World Bank, and a not too small "helping hand" from the USA, with the signing of the Indus Water Treaty in 1960. The important provisions of the treaty were:

1. All the waters of the Eastern Rivers [Ravi, Beas, Sutluj] shall be available for the unrestricted use of India
2. There was to be a transition period of ten years –upto 31 March 1970 – when India was to release waters of the Eastern rivers for use in Pakistan. This provision was essentially to allow Pakistan time to create replacement for the waters of Eastern rivers that was being used in Pakistan. There was provision to extend the period by another three years, but then Pakistan would be subject to water charges for the water released by India.
3. Pakistan was to have unrestricted use of all the waters of the western rivers [Indus, Jhelum, Chenab], with some exceptions (India was allowed to develop hydropower on these – essentially a non-consumptive use - plus some consumptive use also)
4. Both the countries were obligated to let flow unhindered and not permit any interference with "each others" rivers.
5. Pakistan was to construct and bring into operation with due regard to expedition and economy, that part of a system of work which will accomplish the replacement, from the Western Rivers and other sources, of water supplies for irrigation canals in Pakistan which, on 15th August 1947, were dependent on water supplies from the Eastern Rivers.
6. India was to pay a fixed sum of Pound Sterling 62,060,000 (US $ 175 million)to be paid in ten annual instalments towards the cost of the replacement system in Pakistan detailed above.

Apart from the formal provisions of the Treaty there were several other formal and informal sets of understandings between Pakistan and the World Bank, Pakistan and the USA, and so on. In these, the Bank and several countries undertook to support financially the construction of the "replacement" work. Pakistan had argued that the "replacement" should not be limited to replacing only the actual uses existing at the time of Partition, but should also cover "allocations" that were not being used till then, and "development" i.e. new allocations of water. India of course did not accept this and hence the Indus Treaty covered only the actual uses. The agreements with the Bank and other countries covered the rest[52]. The Treaty with India was, of course, not conditional on the other agreements.

The Treaty was more or less an acknowledgment of the ground realities. Indeed, a general agreement on the broad contours of the treaty including the division of the rivers had been reached much before the Treaty itself was signed. The principle too had been clearly laid down in the Inter Dominion agreement of 4 May 1948, which had been reached pursuant to the canal closure in April 1948. It was under this agreement that the canals had been subsequently opened.[53] It is unlikely that the final shape of the Indus treaty could have been anything substantially different that what it was. For one, Pakistan was hardly likely to trust India to

[51] For an extremely fascinating, detailed and eminently readable account of the dispute, see Gulhati 1973. Gulhati, a senior experienced irrigation engineer, was a key member of the Indian delegation during the dispute from 1948 till its resolution in 1960. He also headed the Indian side for much of the time.

[52] This was signed as the Indus Basin Development Fund agreement between Pakistan and several others countries and the World Bank immediately after the Indus Basin Treaty was signed.

[53] Interestingly, though the canals were opened as a result of this agreement, Pakistan refused to accept this as an agreement and kept calling it a "Document".

deliver to it supplies from the Eastern rivers on a long term basis. Not only that, it was not likely to allow India to have the power to threaten it with closure of supplies.[54, 55] India too was unlikely to let go of the waters of the rivers that were flowing through its territory, especially as a large part of the Western rivers were more or less lost to her.

India itself appears to have been acting according to this belief – and the principle enunciated in the 14 May 1948 Agreement - at least as far as Sutluj was concerned. We have seen how it stopped the flow at Madhopur into the UBDC and Ferozpur into the Diplapur canals in April 1948. In the same year[56], India started work on the Harike barrage at the confluence of the Sutluj and Beas.[57] This was the point where India could wield full control on the waters of the two rivers, as there was no point above this where the rivers passed through Pakistan. On the Bhakra, as we will see below, India went in for another revision of the project, increasing the storage greatly.[58]

We are now ready with all the background to understand the developments at Bhakra after 1939.

Developments were taking place on the Bhakra project through the period even as other negotiations, the Rau Commission, the partition were happening.

We have already mentioned the DPR taken up by A.N. Khosla in 1939 which put the height of the dam at 500 feet, (Maximum Reservoir Level) MRL at 1600 feet and storage at 4.75 MAF. In 1944, the Chief Engineer of the US Bureau of Reclamation was requested by the Punjab Government to examine the site and report on the feasibility of the construction of such a high dam. BBMB also mentions a 1945-46 Project report with the maximum reservoir elevation of 1580 feet. The limitation on the MRL was imposed by the Draft Agreement of 1945 between the Punjab Government and the Raja of Bilaspur.[59]

In 1947 came the partition, and it completely changed the Bhakra project. Well before the Indus Treaty was signed in 1960, it seemed that India had already decided to take over the full flow of the Sutluj. Independence and the merging of the princely state of Bilaspur into India removed the restriction imposed by the agreement with the Raja. The Bhakra dam was redesigned once again in 1948 with a MRL of 1680 feet, later on raised further to 1685 feet.[60] *In one year, the proposed reservoir level of the dam was raised by 105 feet and the storage increased 1.6 times.* The restraint imposed by the Raja of Bilaspur was removed and Bilaspur town also came under the submergence zone.[61]

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[54] This having been said, we should also point out that there are instances in International arena where international rivers have been shared with the upstream state respecting the rights of the downstream state.

[55] It may be noted, however, that through much of the dispute, Pakistan fought aggressively to continue to gets its share of the eastern rivers.

[56] There is some confusion on the date. Gulhati mentions that *decision to construct* this barrage was taken by Dec. 1949. Michel says work was started in 1948 and completed in 1952. However, which date is correct is not material to our arguments and makes little difference in the understanding of the situation.

[57] One of the triggers apparently also was that West Punjab (Pakistan) had started to dig a new supply channel on the right bank of Sutluj, above Ferozpur Headworks, in its territory in 1948. Pakistan called this a precautionary measure. India replied that it too would then have to take "precautionary measures" and would have to tap the Sutluj further upstream. See also footnote 48.

[58] It must be mentioned here, though, that the actual course of the dispute was very difficult, long drawn out, and a bitterly contested battle. It was by no means sure that India would indeed get the full waters of the Sutluj, let alone the Eastern rivers. Yet, she went ahead unabated spending crores of rupees on all the construction in preparation for the use of Sutluj. She could have landed in a rather tricky situation if, after having spent all this money, the Treaty had left her without the rights to some of the waters. Clearly, this was either a gamble, or she was prepared to defy the international pressures if such a situation arose. More likely, it was like a self-fulfilling prophecy – by constructing all these works, India made her claim on these rivers stronger – or rather, more and more difficult to reject.

[59] Meanwhile, work had already started on the Nangal barrage in 1946.

[60] BBMB 2002a: Page 7.

[61] Apparently, the decision to increase the height of the Bhakra dam was not entirely unanimous. A note prepared by Himanshu Thakker, SANDRP says that "The ministry of Finance then opined that due to the uncertainty about

As finally built, the Bhakra dam is 740 feet high above the deepest foundation, with the maximum Reservoir Level of 1680 feet[62]. The gross storage is 7.57 MAF and the live storage 5.60 MAF.

In forty years, from the first proposal to the time the project finally got built, the capacity of the dam went up three times from 2.5 MAF to 7.57 MAF.

What do all these changes in the Bhakra project and the events from 1920s to partition signify? Three very important conclusions can be drawn. All three are hallmarks of planning of large dams, and we see that Bhakra has not been different.

Firstly, Bhakra project was used by the (then) Punjab Government in its fight with Sind for the water rights. In the process, the scope and the storage of the Bharka project was increased mainly to enable Punjab to gain negotiating strength rather than on grounds of need of irrigation.

Secondly, the project was proposed and justified on the basis of the need to irrigate semi-arid areas (of Sirsa and Hissar), but the priority actually was to provide waters to areas already well irrigated, namely those of the SVP.

Last and not the least, the irrigation by Bhakra has been made possible essentially by transferring irrigation from lands downstream that were already being irrigated – *and being irrigated without the dam*. In other words, if the Bhakra project had to meet its obligations to the areas downstream - like the SVP– then the scope and areas covered by it would have been significantly smaller. This was true of the smaller Bhakra project (of 1939 with storage of 4.75 MAF) and even truer of the current Bhakra (with its storage of 7.57 MAF)[63].

The numbers make this crystal clear. The Cultivable Command Area of the SVP was 3.02 million ha. If we exclude from this the area of the Bikaner canal (which was irrigating in India) and the areas irrigated from Punjnad headworks which also received Chenab waters, *the CCA of the SVP in Pakistan was 2.21 m ha.*[64] This area eventually was completely cut off after the partition. *The proposed CCA of the Bhakra project was 2.37 m ha. It is almost an exact transfer*.

If we recollect the discussions, then it is clear that the Bhakra project of 1939 was to impact the SVP, the Sukkur project and other inundation canals before Sukkur. We can do no better than to quote Michel[65]:

> "..the pre-Partition Punjab would hardly have been allowed to proceed with the Bhakra project without paying to Sind at least some of the costs of one or two new barrages (at Gudu and Kotri-Hyderabad) on the lower Indus.[Recollect that the Indus Commission had ordered this]. Pre-partition Punjab would have been subject to limitations on the size of Bhakra and on its operation – limits reflecting the

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India's share in Sutlej waters and the interests of Sutlej Valley, investment of such a huge amount on the [Bhakra] project was not advisable. NV Gadgil was then India's Union Minister for Works, Mines and Power. ……Sain claims that though the Finance representative wanted to defer the project, it was due to his and AN Khosla's presence at the meeting that the government decided "to continue the works on the Project"." (Thakker, Himanshu (2005): *Bhakra Project: Who, When, Where, Why, How? - Many questions, few answers*, draft note, Work in Progress. Used with permission.)

[62] The Maximum Reservoir Level is 1685 feet, but now the last 5 feet are left for absorbing floods and so for the storage purposes, the Maximum Level is 1680 feet. Storage at 1685 feet is 7.80 MAF

[63] It is important to note that today's Bhakra would have had a much bigger impact on the SVP and Sukkur than envisaged in 1947, for two reasons. One of course is that the storage at Bhakra today is much more than that proposed in 1939 project (7.57 MAF against 4.75 MAF). Thus, Bhakra would deprive the downstream projects of more of Sutluj waters. But it would also deprive the downstream projects of the Beas waters, since about 3.82 MAF of Beas waters is diverted into Bhakra reservoir from Pandoh. Remember that the SVP, Sukkur etc. were dependent on both the Sutluj and Beas since they were downstream of the confluence of the two rivers.

[64] Government of Rajasthan 2002c : Page 31-32

[65] Michel 1967 Page 200

> requirements not only of Sind but of the Sutluj Valley Project below Ferozpur. After Partition, East Punjab was relieved of any of these requirements…..”

As we have seen, this is exactly what happened. Much of the irrigation at Bhakra today is irrigation transferred from areas downstream depriving them of their then existing water use *and* their future water rights. It may be noted that all of these existing water uses were being carried out without a storage dam. Thus, the dam was needed not so much to create new irrigation, but more to transfer the existing irrigation from one area to another.[66]

It is argued that the dam became necessary, even in pre-Partition days, because the diversions without storage dams were leading to shortages in *rabi* and late *kharif* at the SVP. Hence, the dam was necessary to carry over excess monsoon waters to the winter season. This is the justification given for many large dams. We will deal with this aspect later on. However, one aspect of this argument is important to understand. This argument is a part of the belief that any water of the river that is not “extracted” out or “diverted” from it for human use is water going “waste”. Indeed, dam building in India has been governed by this basic attitude; even today, this is used as the strongest argument to support construction of large dams. Bhakra was no exception.

During the post partition Indo-Pak water dispute on the Indus, the first and one of the most important inputs had come from David Lilienthal, the (once) Chairman and member of the famous Tennessee Valley Authority, the same TVA that was an inspiration and a model for dam builders in India. Included as a part of his suggestions is this piece[67]:

> “The urgent problem is how to store up now wasted waters, so that they can be fed down and distributed by engineering works and canals, and used by both countries, rather than permitted to flow to the sea unused.”

The post-partition changes in Bhakra represent an even more extreme expression of this philosophy. It stretched this argument to the limit, increasing the size of the project not only to prevent the waters from flowing “waste” to the sea, but to prevent the water from flowing down into Pakistan, into a legitimate part of the river itself[68].

One could argue of course, that the political situation at that point (and even today) did not leave any option. There is some merit in the argument, as also the fact that the ultimate agreement gave all of Sutluj waters to India. Moreover, it would indeed be too much to expect India to honour the rights of Pakistan downstream when this is not done for people in our own country in other river valley projects.[69]

But is it crucial to understand that much of today’s irrigation from Bhakra is possible only by depriving a large part of the riverine community of their water rights. It is akin to say stopping completely the flow of Ganga at Patna, or diverting away all of the Narmada at Hoshangabad, leaving the rest of the downstream “without a river”, so to say. When Bhakra project is held up as a model in this country, and used to justify other large dam projects, we would do well to recollect this peculiar nature of the Bharka Project. ✍

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[66] It is not our intention here to pass judgement over India or her position before or during the Treaty negotiations. We are only trying to show what happened in physical terms. Indeed, if our narrative gives a picture of India as the more aggressive party in the negotiations, engaging in belligerent takeover tactics, it is a false picture, and possible due to the fact that we have not presented the entire events of the treaty negotiations. In reality, Pakistan appears to be the more stubborn and difficult party, deliberately not keeping its part of the agreements (related to the transition arrangements). India, on the other hand was the more reasonable party, and could even be characterised sometimes as being too reasonable. It may well do here to recollect that in terms of the final agreement, Pakistan got about 140 MAF water while India got 34 MAF.

[67] Quoted in Michel 1967: Page 222

[68] Not that the sea is an illegitimate body for the river to flow in, even though the arguments of those pushing large dams make it appear so.

[69] Nor for that matter, has Pakistan itself seem to have honoured the downstream rights in the course of its own river development schemes.

Table 2.1: Summary of Bhakra Dam Project Proposals Over the Years[70]

Year of Proposal	Height of the Dam	Reservoir Level	Storage	Remarks
1908				Idea of a storage dam mooted for the first time.
1910				Punjab Irrigation Department prepared an estimate and design for a dam. But found it unremunerative.
1919	395 feet	1500 feet	2.58 MAF	First Detailed project report prepared. Irrigation only.
1927	500 feet		4.75 MAF	Committee Recommends new parameters for the project. Irrigation only.
1939			4.00 MAF	No details available. BBMB does not mention this, but Michel (1967) does.
1939	500 feet	1600 feet	4.75 MAF	Detailed Project Report prepared by Dr. A.N. Khosla. Hydropower component (5x40 MW) introduced for the first time.
1945-46		1580 feet		Project Report prepared with this reservoir level after agreement with Raja of Bilaspur.
1948		1680 feet / 1685 feet		Post Independence, the Raja of Bilaspur reportedly agreed to the increased height, as a "proof of his patriotism"[71].
1951	680 feet			Revised Project
1954				Re-planned on basis of World Bank proposal[72]
As Built	740 feet	1680 / 1685 feet	7.57 / 7.80 MAF respectively	

[70] Except when mentioned otherwise, the information is from BBMB 2002a
[71] Indian Journal of River Valley Development, Bhakra Nangal Number, Vol. VI, 1956. Page 5
[72] Gulhati 1973: 359

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3

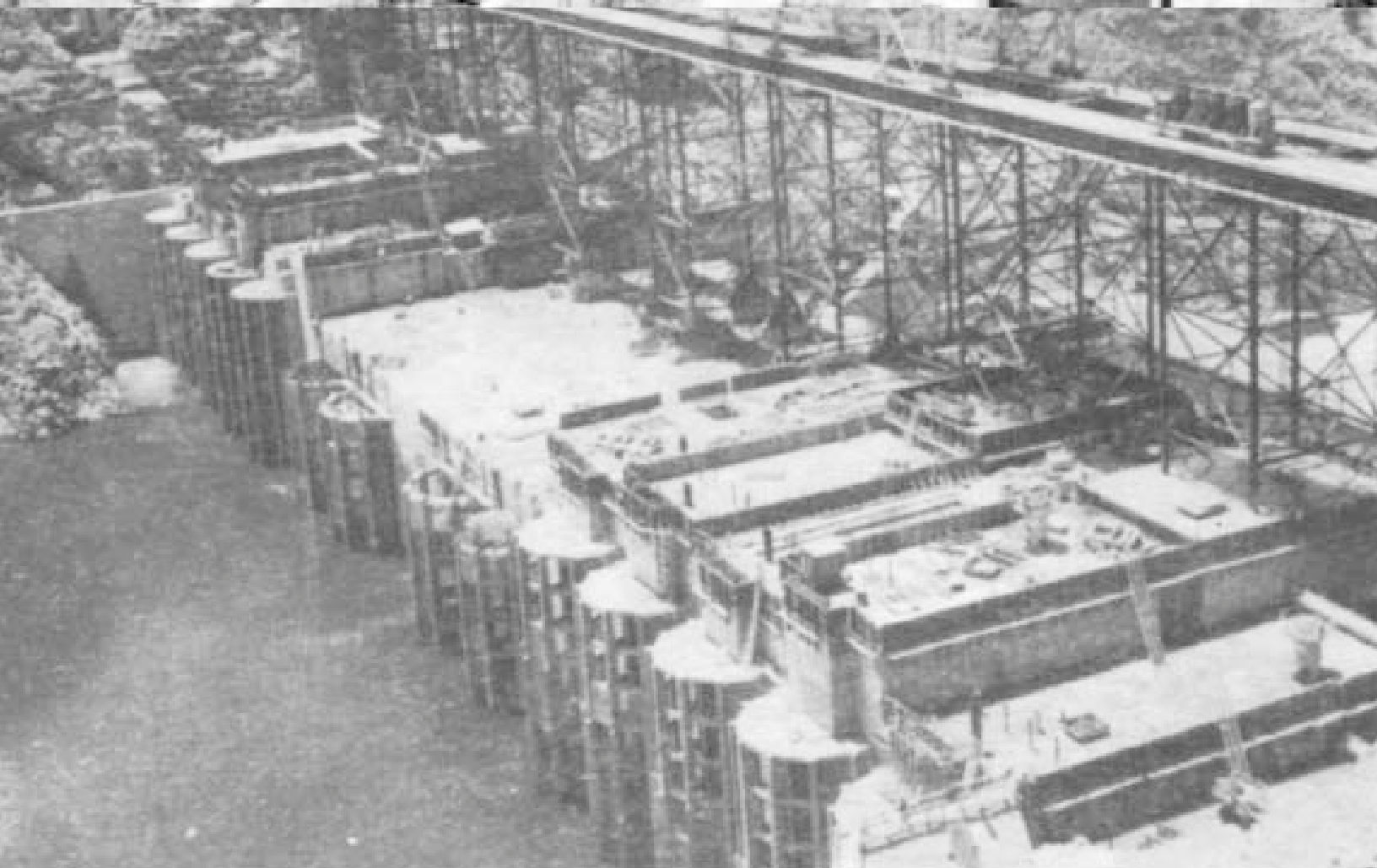
Bhakra Nangal Project: The Final Project Design and Related Developments

"The Bhakra Nangal project was the largest single investment scheme in the First Five Year Plan.....

"The investment on the project is not only large relatively to the rate of total investment in the economy, but is also seemingly capital intensive.....

"In the case of the Bhakra Nangal project, several aspects of it would strike one, even at a first glance, as raising issues of considerable importance from the economic point of view. For instance.... the outlay on the project is large and the period of construction long (even by the standards of other comparable "overhead" investments); the reliance on machinery is similarly very great, and the scope for use of manpower relatively limited....."

K.N. Raj,
Some Economic Aspects of the Bhakra Nangal Project, 1960



Bhakra Nangal Project
The Final Project Design and Related Developments

IN THE LAST CHAPTER, WE LOOKED AT THE HISTORICAL EVOLUTION OF THE Bhakra project and the implications of the events shaping it. We saw that immediately after partition, the project was reworked, substantially increasing its storage capacity and height. One of the reasons for this was the increased availability of water (which India had assumed). Certain other justifications for the project were also added. Earlier, the project was essentially being justified on the grounds of taking water to the semi-arid areas. To this were added the following important reasons[1]:

1. In the Partition of Punjab, about 80% of the irrigation system of pre-partition Punjab went to Pakistan, together with some of the most fertile agricultural areas of the country. This needed some remedial measures given the situation with food and raw materials.
2. Punjab was faced with the problem of resettling of about 5 million people displaced as a result of the partition.

Let us now look at the final project that emerged in more detail.[2]

The Project that emerged in 1951 was a much enlarged one as compared to the original proposal. Investigations and changes in the project continued even beyond 1951 and the final project emerged in 1953. Work however, had already begun on the project from 1946 at the Nangal barrage. One of the important decisions taken was that the canal system would be built ahead of the dam itself, so that irrigation could commence at the earliest.

The main features of the project now were (*See MAP 3 for a schematic layout of the project*):

1. The Bhakra Dam and Govind Sagar Reservoir
2. The Right Bank and Left Bank Power houses at the dam
3. The Nangal Barrage 12.9 km[3] downstream of the Dam
4. The Nangal Hydel Channel (NHC)–taking off from the Nangal Barrage. This hydel channel continues for 65.3 kms till Ropar from where it becomes the Bhakra Main Line, the main delivery canal for areas in Haryana.
5. The power houses on the NHC at Ganguwal and Kotla
6. The Canal System – Old System Refurbished and Renovated for the Project
    a. Remodelling of the Ropar Headworks
    b. Remodelling of the Sirhind Canal

[1] Raj 1960: Page 48
[2] Our information about the final project design is taken mostly from Raj 1960, BBMB 1988, BBMB 2002a, and Indian Journal of Power and River Valley Development, Special Issues on Bhakra 1953 and 1956
[3] Some mention this as 16 km, some as 20!

7. The New Canal Systems
    a. The Bist Doab System serving areas on the right bank of Sutluj
    b. The Bhakra Main Line and its branches
8. The transmission and distribution network

Much later, waters from the Beas river were diverted into the Govind Sagar reservoir to augment the supplies at Bhakra. A dam was built at Pandoh on the Beas to transfer annually, 3.82 MAF (mean annual) of Beas water into the Govind Sagar through a series of open channels and tunnels.

Many parts of the areas to be irrigated by the Bhakra project were areas that were already irrigated or were well endowed with water resources. Some were areas which were irrigated and would lose their irrigation as the river would dry up due to the Bhakra project, and hence these were incorporated into the Bhakra command. Most of the areas in Punjab fell into these categories. We will look at the command area in more detail in the next chapter.

At this point we note that total command area of the project was 6.620 m acres (2.68 m ha). This was the Gross Command Area and the Culturable area within this (the Culturable Command Area) was 5.861 m acres (2.37 m ha).[4] The annual irrigation was to be 3.602 m acres or 1.46 m ha.[5] The information is summarised below.

Table 3.1: Bhakra Project : Irrigation Benefits
(All in m ha)

Gross Commanded Area	2.68
Culturable (Cultivable) Commanded Area	2.37
Annual Irrigation (Proposed)	1.46

Apart from this, improvement of irrigation in the Sirhind canal areas was also proposed.

The agricultural benefits envisaged from the canal system were as follows[6]:

Foodgrains:	1.13	million tons
Sugar Cane	5.0	lakh tons
Pulses and Oilseeds:	1.0	lakh tons
Dry and green fodder	15.0	lakh tons
Cotton	8.0	lakh tons

EXAGGERATED CLAIMS

The first thing we find is that the claims made for the irrigation were significantly overstated. The water required for meeting this proposed irrigation was assessed by the project as 8.365 MAF. But not all of this was needed from storage. As the BBMB said[7]

> "..the whole supply was not required from storage. Studies showed that, on the average, it would be possible to feed the canals direct from the flow of the river from 21 May to 20 Sept. Net supplies required …. were ..5.255 MAF"

In addition, the following supplies were required:

---

[4] BBMB 1988. Publication by Information and Publicity Cell, Bhakra Beas Management Board, Chandigadh, on Occasion of the Silver Jubilee of Bhakra Dam. From Chapter XIX - Canal System
[5] Annual Irrigation figures from Raj 1960: Page 95
[6] Sinha, K. K and P.K. Menon (Eds) (1956): '*Bhakra-Nangal Number of Indian Journal of Power and River Valley Development*', Calcutta, Vol. VI, Mid Year Special Issue, 1956. Page75
[7] BBMB (1988): Page 249

Supplies for improving irrigation on Sirhind areas : 0.825 MAF

Supplies for improving capacity factors in Sirhind areas: 0.127 MAF

All this totalled to 6.207 MAF. Thus, to meet the total water requirement of 8.365 MAF per annum storage needed was 6.2 MAF.

But here was a major flaw in the project design. The project report itself admitted that even when the Bhakra reservoir would be full to its normal full level of 1680 feet, net utilisable storage would be 5.625 MAF[8]. Thus, even at complete filling, there would be a shortage of 0.582 MAF – 9.4%. However, the reservoir was not expected to fill in every year, and according to the BBMB:

> "… the mean storage available from Bhakra reservoir was calculated to be 4.631 MAF against a requirement of 6.207 MAF resulting in a shortage of about 25.4 %"[9]

In other words, there would be an *average* annual shortfall of 25%!

As K.N. Raj states it [10]:

> "….it has been estimated by the project designer, from records that are available of rainfall and of the river discharges at Bhakra since 1909, that only in a few years will the water available be adequate to fill the reservoir to full capacity and that, over a period, the mean storage available is likely to be only around 4.6 million acre feet. This means that, *compared to the requirements, there will be a shortage of 9 percent even in years when the reservoir is full, and about 25 percent on an average over a longer period.* (Emphasis in the original)
>
> "This was recognised even at the time the amended project design was drawn up in 1953. It was clearly stated then that "too large an area" had been included in the project. In years of low rainfall, the shortage might be as high as 53 percent and this, it was said would cause "distress" conditions. To save the irrigation side of the project from consequences of a failure of rains, the proposal then made…was that supplies made available from Bhakra reservoir should be supplemented by diversions of supplies from the Ravi and Beas…..[thus] *the irrigation facilities which have been promised appear to be in excess of what can actually be provided.*" (Emphasis in the original)

In short – there simply wasn't enough water to provide for the claimed benefits – a fact known to the planners.

Thus, the Bhakra project was not immune from another of the hallmarks of large dam projects – claimed project benefits being highly exaggerated, even beyond what is technically feasible, and this being done knowingly[11]. It may also be pointed that though the designers had proposed at the design stage itself the need to supplement the Bhakra waters with Ravi and Beas waters, there was no provision made in the project for the investment necessary.

In his conclusions, Raj says that: [12]

> "The extension of the project beyond what was technically feasible raises the possibility of large variations in the supplies provided by the irrigation system, with the further likely consequences… It would seem, therefore, that it might have been more worthwhile to provide assured supplies of water to smaller area ….."

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[8] BBMB (1988): Page 249
[9] BBMB (1988): Page 249
[10] Raj 1960: Page 53-54
[11] For example the water availability in the Narmada river is about 18% less than that assumed as a basis for planning the large dam projects in the basin.
[12] Raj 1960: Page 128

Of course, this would have meant less political support for the dam and would have marred its appeal. It would have impacted the economic analysis of the project too, if one had been carried out. Indeed, this is a characteristic of most large dam projects that they promise benefits in excess of the technical possibilities to make the project acceptable economically and politically.

A Question of the Development Paradigm

Before we go further into the developments at the project, we will digress a little to look at another important aspect of the project – the resources used– or, to use the words that K.N. Raj uses – the social costs of the project.

An important feature of the project was that it used large amounts of critically short foreign exchange, there was extensive use of machinery and lesser use of labour, especially unskilled labour.

The total cost estimated in the project report was 150.9 crores rupees – a sizable sum of money in those days. K.N. Raj analyses the components of this[13]:

> "…machinery and equipment, as well as construction materials….accounted for the larger part of the estimated cost of investment….The scope for employment of labour on any significant scale, particularly of unskilled labour, was confined mainly to the …investment on distribution of water for irrigation.
>
> "…in case of the Bhakra dam…the scope for utilisation of unskilled manpower is almost negligible..
>
> "The entire expenditure on labour, skilled and unskilled, in the project may, there be placed at somewhere around 45 crores. It must be remembered, however, that nearly 40% of this goes …to supervisory and foreign technical personnel."

Pointing out that the expenditure on unskilled labour was only one-seventh of the total project expenditure, while expenditure which requires foreign exchange (a very precious commodity then) was 40-45%, he states:

> "Thus, the construction of the project calls to a large extent for resources which are relatively scarce in the economy, involving by implication higher social cost, and offers limited scope for the use of manpower which the economy has in greater abundance".

This has been one of the most persistent and strong criticisms not only of India's dam building program, but also of the overall development paradigm – that it is capital intensive in a capital short economy and makes relatively far lesser use of the massive human resources. Even today, this remains a very important issue, with the argument that a watershed management, rainwater harvesting program working on a vastly decentralised scale makes much better social sense, since it will use resources that are (even today) relatively abundant as compared to capital, machinery and money.

What is important about the conclusion presented by K.N. Raj above is that it is not merely an issue of the Bhakra project – it was an issue of how to proceed with India's (irrigation) development. No doubt – it could be argued, rightly, that to build a dam like Bhakra, one would need huge amount of machinery as compared to labour. But that precisely was the point. Should irrigation development be based on such projects that need resources that are critically short in the economy (even today and certainly at that time) – or should it be based on the use of resources that we have an abundance of – namely, human resources?

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[13] Raj 1960: Page 36-47

While K.N. Raj limited his comments to the "social costs" of the Bhakra project[14] – others were talking, and were to raise issues about the social cost of this entire approach.

They were suggesting an approach based on the massive human resources that the country had. They were proposing a massive deployment of our human resources all over the country to create minor irrigation schemes, rainwater harvesting schemes, improving productivity of the soil – and thus increasing food output. A key point about this approach was that such an approach, with deployment of massive human resources would lead to huge employment generation and would put purchasing power in the hands of millions of people. We will see the significance of this in more detail later as we investigate the food security implications of the Bhakra project.

At this point, it is important to note that these issues were being raised even in the early days following independence.

DEVELOPMENTS AT THE PROJECT

Having looked at the final project report and some of its implications, we now go back to the chronology. Work at the Nangal site had already started in 1946. Work had started on the diversion tunnels in 1948. In 1952, the Nangal dam and the head regulator were completed.

In 1954 the Nangal hydel channel and the network of Bhakra canals was declared open and irrigation from the Bhakra-Nangal project started. This is an important date for us as this will be useful when we look at the contribution made by the project in meeting India's food production needs.

Note that at this time, work on the dam was still going on, and the impoundment at Bhakra started in 1958.[15] However, the project had given priority to the canal network and irrigation developed rapidly. The dam was completed in 1963 and was dedicated to the Nation by the then Prime Minister Shri Jawaharlal Nehru on 22 October 1963. According to the BBMB[16], "The irrigation and power demands had fully developed by the time Bhakra dam was completed in 1963".

Table 3.2 shows the development of irrigation from the Bhakra project from inception to 1963-64.[17]

Table 3.2: Development of Irrigation from the Bhakra-Nangal Project

Year	Area Irrigated		Year	Area Irrigated	
	Acres	Ha		Acres	Ha
1951-52	16170	6547	1958-59	1712020	693126
1952-53	46320	18753	1959-60	1818000	736032
1953-54	46320	18753	1960-61	1700000	688259
1954-55	868890	351777	1961-62	1909000	772874
1955-56	1033411	418385	1962-63	2321000	939676
1957-58	1303000	527530	1963-64	2480000	1004049

[14] In fact, says "…the real social costs are very high in the case of this project – higher perhaps, relatively to the output, than in any other similar irrigation-cum- power project – undertaken recently in India." (Page 126)
[15] BBMB 2002a: Page 10-14
[16] BBMB 1988: Page 1
[17] Personal communication by Dr. G.S. Dhillon, from his forthcoming publication. Govt. of Punjab 1959 also gives the same figures, but of course it deals with data only till 1958. It should be noted that till 1958, there was no storage at Bhakra and irrigation till then essentially was in *kharif*.

If we compare with the project report, we see that the total irrigation planned from the project was 3.602 m acres or 1.46 m ha. So in 1963-64 about 68% of the planned irrigation had been achieved. Given the overestimation of the areas to be irrigated in the project report, it was not likely that irrigation would increase much beyond this, except through diversions from Beas and Ravi. Thus, by 1963-64 irrigation from the project was virtually fully developed. Again this is an important date for us when we look at the food production.

We have seen that in 1948 the construction of a barrage at Harike was started. It was completed in 1952. The irrigation in the Indian part of the SVP – namely the Gang canal (Bikaner canal taking water to Rajasthan) and the Eastern canals (in Ferozpur) was shifted to Harike. A new canal called the Ferozpur feeder was constructed to take the water from the new barrage at Harike to these canals. For these canals, this did not represent any change of source of water.

In 1958, the work on Indira Gandhi Nahar (IGNP) or the Raj canal (for Rajasthan) was also started. The IGNP also takes off from Harike. The alignment of the IGNP was such that it cut through the tail ends of the Sirhind system. Due to this, and to relieve the shortage of the waters in the Bhakra command (a natural consequence of exaggeration of the promised irrigation), it was proposed to transfer areas cut off by the Raj canal to Harike. A separate feeder canal was constructed from Harike to supply water to these areas of the Sirhind system. This canal, called the Sirhind Feeder was opened in 1958. Since Harike is just downstream of the confluence of the Beas and Sutluj, what this meant was that these areas were effectively shifted from Sutluj to Beas waters[18].

Thus, part of the areas that were to be irrigated from the Bhakra project (and some being irrigated by Sutluj waters from the Sirhind system earlier) were transferred to the Harike, and Beas.[19]

Meanwhile, there was another proposal also being mooted to use the Beas waters to cover the shortage at Bhakra - to divert the Beas directly into the Sutluj *above* the Bhakra reservoir. This was the Beas Project Unit –I with a diversion of 3.82 MAF of water from the Beas at Pandoh into the Govind Sagar reservoir.

The concept of the Beas- Sutluj Link (BSL) for diverting some portion of Beas into Sutluj was conceived by Dr. A.N. Khosla. The preliminary investigation for the BSL was started in 1956. The project went through several investigations and changes. Interestingly, one of the proposals (1957) that would have needed a large storage dam at Suketi was objected to by the Himachal Government as it would submerge the Balh valley and hence it had to be abandoned.[20] The construction work on the BSL started in 1965 and the first diversion into Sutluj took place in 1977 – on a rather charming date - 7 July 1977 or 7-7-77.

With the BSL we are in 1977 and the long progression of additions / developments at the Bhakra project have come to an end. [21] We will now look at the command area of the project in detail in the next Chapter. ✍

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[18] And also to the Ravi waters to the extent these were made available from the Madhopur Beas link later on.

[19] Apparently, what triggered the push for going ahead with the Sirhind feeder was not just the water shortages due to excessive initial promises, but that the power requirements from the project too went up much more than initially estimated and this necessitated changing the pattern of reservoir releases to meet these needs. This had a direct adverse impact on the irrigation releases. Apparently, this is what triggered the decision to go for the Sirhind Feeder, even though proposals to supplement Bhakra with Ravi and Beas were made initially to offset the excessive promises of the project. (Raj 1960 : Page 61-66) It may be pointed out that in a multi-purpose project, there is a significant trade-off between the power and irrigation benefits.

[20] BBMB 2002a: Pages 30-31

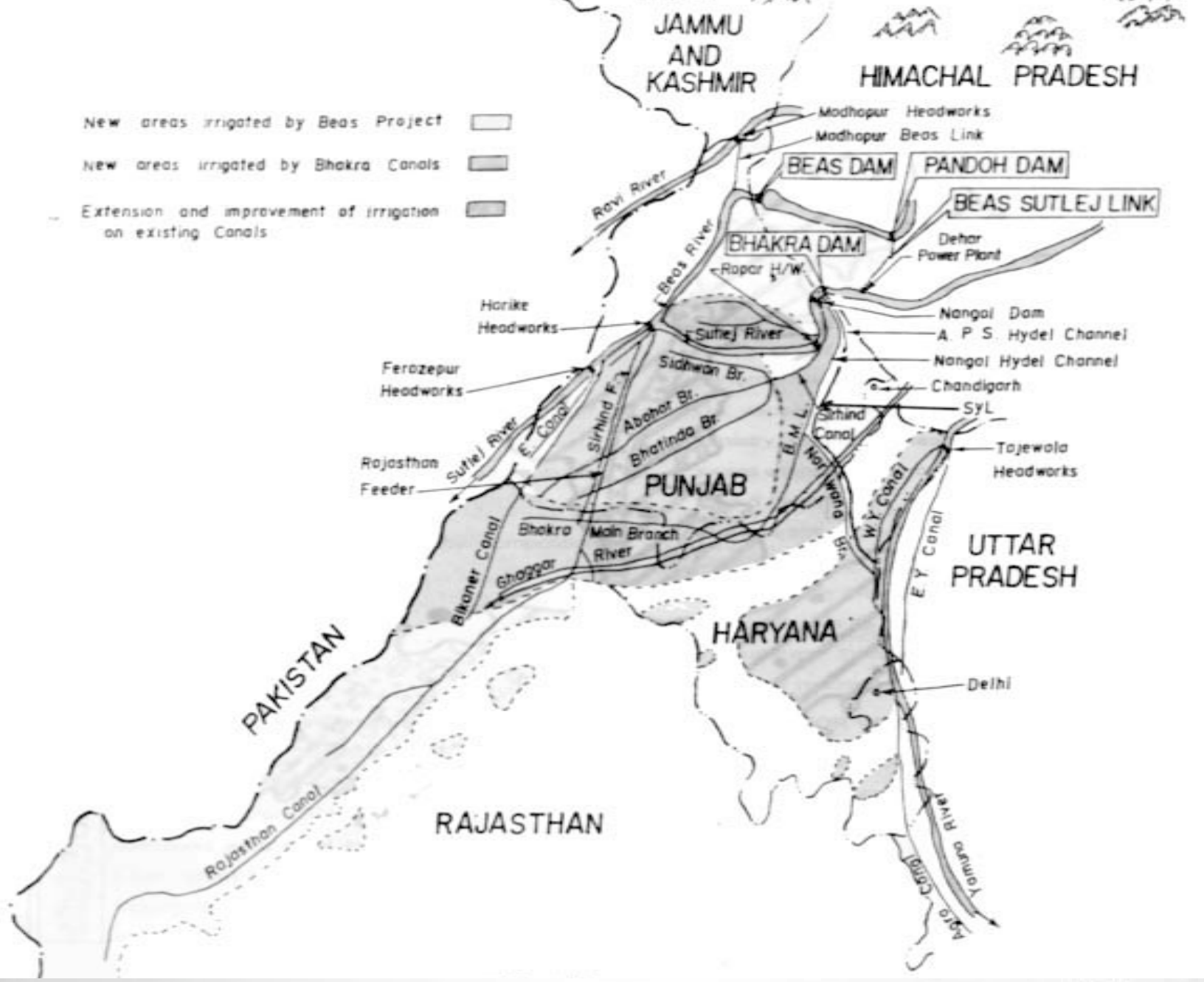
[21] We have not gone in to the Ravi, its interconnections with the Beas system and the entire Ravi-Beas water dispute as its direct significance to our enquiry is limited.

4

Bhakra Project: An Analysis of the Command

"The Bhakra Canal system was planned to cater the irrigation requirements of the arid and dry areas in Hissar district and adjoining areas of Rohtak and Karnal districts and Bikaner State which are proverbially famine stricken."

Indian Journal of Power and River Valley Development
Bhakra Nangal Special Issue, 1956


New areas irrigated by Beas Project
New areas irrigated by Bhakra Canals
Extension and improvement of irrigation on existing Canals
JAMMU AND KASHMIR
HIMACHAL PRADESH
Madhopur Headworks
Madhopur Beas Link
BEAS DAM
PANDOH DAM
BEAS SUTLEJ LINK
Ravi River
Beas River
BHAKRA DAM
Ropar H/W
Dehar Power Plant
Harike Headworks
Sutlej River
Nangal Dam
A. P. S. Hydel Channel
Nangal Hydel Channel
Ferozepur Headworks
Sidhwan Br.
Chandigarh
SYL
Sirhind Canal
Abohar Br.
Bhatinda Br.
Sirhind F.
F. Canal
B.M.L.
Narwana Br.
Tajewala Headworks
Rajasthan Feeder
PUNJAB
W.Y. Canal
E.Y. Canal
Bhakra Main Branch
Ghaggar River
Bikaner Canal
UTTAR PRADESH
HARYANA
PAKISTAN
Delhi
Yamuna River
Agra Canal
Rajasthan Canal
RAJASTHAN

Bhakra Project
An Analysis of the Command

A BOARD OVERLOOKING THE DEEP AND BREATHTAKING GORGE JUST BELOW the imposing Bhakra dam states, under the title "Benefits":

New Areas Irrigated	28.8	lakh ha
Area Where Irrigation Improved	9.0	lakh ha
Energy	6500.0	MU/Year

It does not state if this is the annual irrigation, or the gross command area or the cultivable command area.

BBMB[1] gives similar figures but puts the new areas at 26 lakh ha instead of 28.8.

There are three important elements in understanding the command. The first is the "Gross" or "Geographical" command area – the GCA. This includes all the areas where the canals reach. These areas will include roads, settlements, uncultivable areas and so on. Hence, another important term is the Cultivable Command Area - CCA. As the name suggests, this includes the cultivable areas within the GCA. Clearly, in terms of agriculture, this is the more relevant parameter. This does not mean that every year all of this area would be irrigated. Normally, only a part of the CCA is irrigated every year. The ratio of the area actually irrigated annually by the project to the CCA is called the Intensity of Irrigation.

Obviously, the Irrigation Intensity could vary from year to year, depending on the water available in the river in the given year. More generally, the Intensity of Irrigation is determined as part of the project goals. Many times, the goal is to spread the benefits across as wide an area as possible, and hence a much larger area than can be annually irrigated in a average year is included in the GCA/CCA.

The 1953 Project Report fixed the following for Bhakra Project[2]:

Gross Commanded Area:	26.8	lakh ha
Cultivable Commanded Area:	23.7	lakh ha
Annual Irrigation[3]:	14.6	lakh ha

The Bhakra Command area was divided into 3 zones. The project had fixed relatively low irrigation intensities for all the three zones. The justification was that there was need to spread the benefits as much as possible; hence, irrigation was to be protective in nature and not intensive.

We now look at the state-wise figures for the GCA, CCA and Annual Irrigation[4].

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[1] BBMB 2002a: Page 50
[2] BBMB (1988) and also Raj 1960
[3] Figure of annual Irrigation is as quoted by K.N. Raj in Raj 1960. This figure appears to be on the higher side; calculations show that the irrigation intensities that lead to this figure are higher than what the project had provided, quoted in the same reference.

GROSS COMMAND AREA

The state-wise figures for the GCA are as follows[5]:

Table 4.1: Statewise Gross Command Area of Bhakra Project

State	GCA (million ha)	% of total Bhakra GCA in State
Rajasthan	0.438	16%
Haryana	1.309	49%
Punjab	0.934	35%
Total	2.680	

Thus, we see that Rajasthan has only a limited area of the Bhakra command, while Punjab and Haryana together have about 84% of the Bhakra GCA.

Looking within the state - the GCA of Bhakra as percentage of state area - we have the following figures:

Table 4.2: Bhakra Gross Command Area as Percent of State Area

State	Geographical Area (m Ha)	Bhakra GCA (m Ha)	Bhakra GCA as % to State Area
Haryana	4.421	1.309	29.6%
Punjab	5.033	0.934	18.6%

The Bhakra gross command forms only 30% of the total area of Haryana and in Punjab it is 18.6%. This gives the maximum reach of the project in the two states. Clearly, Punjab and Haryana are much more than Bhakra. Note that this is the Gross Commanded Area and not the cultivable commanded area or the annual irrigation. Thus, the actual area benefited by the project will be a smaller portion of this.

CULTIVABLE COMMAND AREA

Again, none of the documents that we have had access to give the break up of the CCA statewise. The closest is BBMB 1988 that gives us the disaggregating in terms of Rajasthan, Punjab and PEPSU. We have however, used the details of the canal systems and other information to derive the best estimates as follows.

The state wise distribution of the CCA is as follows[6]:

Table 4.3: Statewise Cultivable Command Area of Bhakra Project

State	CCA (Million ha)	% of Bhakra CCA in state
Rajasthan	0.372	16%
Haryana	1.160	49%
Punjab	0.840	35%
Total	**2.373**	

[4] It is amazing that for a project that is so much a pubic icon, it has been difficult to get even some of these basic figures. Published documents do not give all the figures. For example, the BBMB document (BBMB 1988) gives the GCA and CCA, but divided into Rajasthan, Punjab and PEPSU. Also, it does not give annual irrigation figures. Government authorities refused to give figures to us. Due to such problems, we have had to calculate some of the figures from the details of the canal systems and maps.

[5] Figure for Rajasthan and Total from BBMB 1988, for Punjab and Haryana derived by us as explained above.

[6] Figures for Rajasthan and Total from BBMB 1988 and for Haryana and Punjab derived by us.

Thus, 49% of the project's cultivable command area is in Haryana, 35% in Punjab and 16% in Rajasthan.

Looking within the state to see how much of the state cultivable area is covered by the Bhakra command, we see the following:

Table 4.4: Bhakra Cultivable Command Area as Percent of State Cultivable Area

State	Total Cultivable Area of the State (m Ha)	Bhakra CCA in the State (m Ha)	Bhakra CCA in State as % of State Cultivable Area
Rajasthan	25.66	0.372	1.45%
Haryana	3.80	1.160	31%
Punjab	4.30	0.840	20%
Total		**2.373**	

Thus, 20% of the total cultivable area in Punjab is covered by Bhakra and the same is 31% in Haryana.

ANNUAL IRRIGATION

The state-wise annual irrigation from the Bhakra project is given below.

Table 4.5: Statewise Annual Irrigation in the Bhakra Project

	m Acres	m Ha
Punjab	1.36	0.551
Haryana	1.67	0.676
Rajasthan	0.57	0.231
Total	**3.60**	**1.460**

Source: Gulhati 1973: 457

Given that the project had a CCA of 2.373 m ha, the overall intensity of irrigation in the project design works out to be 61.5%. Note that this is the annual irrigation as was proposed by the project. The actual performance could be different and we will see what this has been.

SPREAD OF THE COMMAND

Let us now look at exactly where the Bhakra Command lies in the three states. MAPS 4,5 and 6 show the Bhakra commanded areas in Punjab, Haryana and Rajasthan[7].

It is straightforward to identify the Bhakra Command in Haryana and Rajasthan. In Haryana, while the Bhakra command areas are clearly demarcated from the Western Jamuna command, there is provision for give and take of water between parts of these commands in years when either one of the system has surplus and the other is in deficit. But this is a small proportion of the total and we can for all practical purposes treat them as separate commands. It may be noted that the whole of the Sirsa branch of the WJC – irrigating areas in Haryana since 1895 – was transferred to the Bhakra Command.

In Punjab, the areas covered by the Bhakra project are scattered over the state. The main areas that the project proposed to cover in the state included the *Bist Doab* areas north of Sutluj, the Grey canal areas earlier receiving irrigation from Phillaur, some areas in Faridkot and Muktasar, and areas in Patiala, Fatehgadh Sahib and Rupnagar districts. In addition, some new

[7] Source: Maps of canals commands from Irrigation Department in Punjab and Haryana respectively. Also, Indian Journal of Power and River Valley Development, Special Bhakra Number 1956

areas were added in the Sirhind canal system as a part of the project. There was provision for improvement to irrigation in the Sirhind system but these areas are not included in the above figures of new areas irrigated.

Let us now look at the command areas in terms of districts.

Rajasthan

The Bhakra command in Rajasthan is limited to two districts – namely, Ganganagar and Hanumangadh. The basic data for these districts is as follows (Figures pertain to year 2000-01):

Table 4.6: Bhakra Command Area in Rajasthan - Basic District Data

(Area In Ha)

	Geographi -cal Area	Cultivable Area	Net Sown Area	Gross Sown Area	% Net Irrigated to Net Sown Area	% Gross Irrigated to Gross Sown Area
Ganganagar	1092960	962773	666010	906759	82.15%	86.78%
Hanumangadh	970315	897483	647185	882697	49.39%	62.29%

Source: Agricultural Statistics 2000-01, Government of Rajasthan. (Government of Rajasthan 2002b)

Table 4.7: Bhakra Command Districts in Rajasthan -Irrigation Data

Gross Irrigated area In Ha

	Area Served By Bhakra Canal	Total Canal Irrigated Area	Total Tubewell Irrigated Area	Total Irrigated Area	Bhakra Irrigated Area as % of Total Canal Area	Bhakra Irrigated Area as % of Total Irrigated
Ganganagar	113105	785514	1345	786859	14.40%	14.37%
Hanumangadh	395577	541879	7666	549853	73.00%	71.94%

Source: Agricultural Statistics 2000-01, Government of Rajasthan. (Government of Rajasthan 2002b)

Punjab and Haryana

Since district wise distribution of the command area was not available to us for these two states, we have estimated it from the detailed maps of the irrigation departments of the two states that we had obtained, co-relating it with other information we had.

Haryana

Table 4.8: Districts in Bhakra Command in Haryana

Sr.No.	District	Area of the District in Bhakra Command[8]	Remaining Area of District Served By (If Served By any other Canal)
1	Sirsa	Full	
2	Fatehabad	Full	
3	Kaithal	Full	
4	Hisar	60%	Western Yamuna Canal
5	Jind	50%	Western Yamuna Canal

[8] Estimated by us from various maps and other information. Command here means Gross Command.

Sr.No.	District	Area of the District in Bhakra Command[8]	Remaining Area of District Served By (If Served By any other Canal)
6	Kurukshetra	50%	Uncommanded
7	Karnal	5%	Western Yamuna Canal
8	Ambala	5%	Uncommanded
9	Bhiwani	2%	Lift Commands from WJC

Districts out of Bhakra Command in Haryana

1. Panchkula
2. Yamunanagar
3. Sonipat
4 Panipat
5. Rohtak
6. Jhajjar
7. Gurgaon
8. Faridabad
9. Mahendragadh
10. Rewari

Punjab

In Punjab, it has been difficult to estimate the Bhakra areas in each district, as we do not have requisite detailed maps. We give below the areas for combined Bhakra and Sirhind systems in Punjab. Since both are served from the Sutluj, and are supposed to operate as one system, it also makes some sense to look at these together.

Table 4.9 : Districts in Bhakra and Sirhind Command in Punjab

Sr. No.	District	Area of District in Bhakra or Sirhind Command	Remaining Area of District Served By (If Served By any other Canal)
1	Moga	Full	
2	Bhatinda	Full	
3	Sangrur	Full	
4	Mansa	Full	
5	Fatehgarh Sahib	Full	
6	Patiala	85%	
7	Muktsar	40%	Harike - Sirhind Feeder
8	Faridkot	66%	Harike - Sirhind Feeder
9	Firozepur	25%	Harike - Sirhind Feeder & Ferozpur Feeder
10	Ludhiana	Full	
11	Nawashashr	Full	
12	Kapurthala	Phagwara tehsil + 20% of Remaining Kapurthala (Hence 29.2% of the total district)	
13	Jullundhar	66%	
14	Rupnagar	33%	

Maps show that out of the above 14 districts, Bhatinda and Mansa are completely out of Bhakra command. The remaining districts (other than Bhatinda and Mansa) are severed partly by Sirhind and partly by Bhakra.

Punjab Districts Not in Either the Bhakra or Sirhind Command

1. Amritsar
2. Gurdaspur
3. Hoshiarpur

ACTUAL IRRIGATION

Let us look at the actual irrigation as against the planned irrigation in the Bhakra command.

Punjab

The detailed time series giving annual irrigation in the command was not available to us[9]. However, available figures show that in case of Punjab, the annual irrigation from Bhakra has been much lesser than the planned irrigation. Over the years, the canals have come to play a very limited role in the Bharka irrigated districts. In most of these districts, groundwater is the major contributor to irrigation.

As late as in 1975 (that is, 20 years after irrigation from Bhakra-Nangal had started), the Comptroller and Auditor General (CAG) of India in his report had noted that in Punjab the actual utilisation of irrigation *in the Bhakra command* was on average 285 thousand ha as against the planned 433 thousand Ha. The CAG report further states the "main reason for non-utilisation …was reported to be the installation of a large number of private tubewells."[10] *Over the years, it appears that this has fallen further!*[11]

According to the figures obtained by us from Punjab irrigation department, the total (canal) irrigation in the Bist Doab and Bhakra Main Line systems in Punjab in year 2001 was 169 thousand ha – i.e. about 30% of the CCA.

Table 4.10 gives figures for the total net area irrigated and net area irrigated by canals in the state for the year 2001-02, for those districts that are either in the Bhakra or Sirhind command.

This table shows that in Punjab, within the Bhakra and Sirhind areas, canal irrigation is significant mainly in districts Bhatinda, Mansa, Sangrur and Ferozpur **–** *all served essentially from either Sirhind or Harike.* It is important to note that all these districts were already irrigated by the Sirhind and Eastern canal (in case of Firozpur) many decades prior to Bharka project. *In the districts having Bhakra command, like Patiala, Fatehgadh Sahib, Jullundhar, Kapurthala the percent net area irrigated from canals ranges from 1.5% to about 19% .*

Indeed the Bhakra project had only limited benefits to Punjab. This is also because most of the irrigation from the Bhakra in Punjab went to areas that were already irrigated or were-endowed.

When we spoke to a senior retired Chief Engineer from the Punjab Irrigation Dept., he told us that Punjab had hardly benefited from the Bharka project. Only 5% of the water in the Bharka system went to Punjab – rest all to Haryana.[12] The figures also bear this out. The Net Area Irrigated by canals (which would indicate new areas coming under canal irrigation) hardly showed any change in Punjab from 1953-54 (1.397 m ha) to 1978-79 (1.388 m Ha). Even after

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[9] Irrigation figures given in the Statistical Abstracts are reported district-wise and not project wise.

[10] CAG 1977: Page 108. Supplementary Report of the CAG General of India for 1975-76. Figures of irrigation are for 5 years average 1971-72 to 1975-76

[11] Indeed, the net area irrigated by canals in Punjab has declined sharply from a high of 1.576 m ha in 1990-91 to just 987,000 ha in 2001-2002 – this is even less than the canal irrigated area in Punjab in 1953-54 which was 1.4 m ha.

[12] That is – 5% of the BML. The Sirhind system was already receiving waters of the Sutluj since decades. He did not indicate how much water went to the Bist-Doab areas.

this, the figures increased only marginally. This is a clear indicator that few new areas came under canal irrigation in this period.[13]

Indeed the equation Punjab= Bhakra is wide of the mark. Bhakra is of small significance in Punjab.

Table 4.10: Canal Irrigation in Punjab
(in Districts of Bhakra and Sirhind Commands) 2001-02

S.N.	Name of District	Total Net Area Irrigated in Year 2001-02 (000 Ha)	Net Area Irrigated by Canal in Year 2001-02 (000 Ha)	Net Area Irrigated by Canal as % to Total Net Irrigation
1	Kapurthala	136.2	12.0	8.8%
2	Jullundhur	237.5	7.0	2.9%
3	Nawanshahar	84.6	3.0	3.5%
4	Ludhiana	305.3	6.1	2.0%
5	Ferozepore	473.5	144.8	30.6%
6	Faridkot	130.5	25.7	19.7%
7	Moga	199.5	11.3	5.7%
8	Muktsar	217.5	4.3	2.0%
9	Bhatinda	294.9	229.5	77.8%
10	Mansa	199.2	152.1	76.4%
11	Sangrur	455.5	140.2	30.8%
12	Patiala	290.7	9.5	3.3%
13	Sirhind (Fatehgarh Sahib)	103.5	1.6	1.5%
14	Rupnagar	104.9	16.4	15.6%
Total for 14 Districts		**3233.3**	**763.5**	
Total Punjab		**4057**	**987**	**24.33**

Source - Punjab Statistical Abstracts 2003

Haryana

In Haryana, the picture is different. Canal irrigation is a major source of irrigation in many of the Bhakra commanded districts, especially Hissar, Sirsa, Fatehbad.

The area irrigated in the Bhakra command in Haryana in the 5 years 1971-72 to 1975-76, was an average of 790 thousand ha, exceeding the planned irrigation of 636 thousand ha[14].

Table 4.11 gives the total net area irrigated and net area irrigated by canals in Haryana for the districts in Bhakra command.

It must be noted that in several districts, Bhakra is not the only source of canals. In Hissar, Jind and Karnal, large areas are irrigated from the Western Yamuna canal. Only 2% of Bhiwani is in the command of Bhakra and most of its irrigation is from various lift irrigation schemes. Only 5% of Karnal is in the Bhakra command and much bigger area is in the WJC.

[13] Of course, another way for the net area irrigated by canal to remain the same and yet for new areas to come under irrigation is that new areas replace areas that were earlier under canal irrigation. This phenomenon may have occurred in Punjab, but the significance of this is limited.

[14] CAG 1977: Page 109

Table 4.11: Canal Irrigation in Haryana in Bhakra Districts 1998-99

Important Note: Last three columns refer to areas irrigated by all sources and all canal systems, not just Bhakra.

S.N.	Name of District	% of District in Bhakra Command	Total Net Area Irrigated in Year 1998-99 (000 Ha)	Net Area Irrigated by Canal in Year 1998-99 (000 Ha)	Net Area Irrigated by Canal as % to Total Net Irrigation
1	Hissar	60%	252	243	96.43
2	Bhiwani	2%	212	129	60.85
3	Sirsa	100%	309	262	84.79
4	Fatehabad	100%	196	136	69.39
5	Karnal	5%	206	42	20.39
6	Kurukshetra	50%	148	8	5.41
7	Kaithal	100%	197	100	50.76
8	Ambala	5%	94	14	14.89
9	Jind	50%	217	129	59.45
	Total 9 Districts		**1831.0**	**1063.0**	
	Total Haryana		2842	1433	50.42

Source - Haryana Statistical Abstract 1999-2000

Note: Column 3 – "% of District in Bhakra Command" estimated by the author from maps and other data.

The areas that have significant irrigation from the Bhakra project are the districts of Hissar, Sirsa and Fatehbad and to some extent Kaithal and Jind. The three districts of Hissar, Sirsa and Fatehbad carry about 543,000 ha of the net area irrigated by Bharka in Haryana. We estimate that the net area irrigated by Bhakra canals in Haryana is about 717,680 ha[15]. Thus, the share of these three districts is 75% in the total Bhakra irrigated area in Haryana.[16]

Rajasthan

In Rajasthan, the annual irrigation expected from the project was 231 thousand ha and according to the CAG report[17], this was exceeded in the years 1971-72 to 1975-76, though it does not mention by how much. In 1993-94, the actual achievement was "of an order of 300,000 ha at 80% intensity" as against the planned 230,931 ha at 62% intensity[18].

GEO-CLIMATIC FEATURES OF THE COMMAND

Let us now look at the nature of the command area. The Bhakra Command was divided into three zones – I, II and III. The characteristics of these zones were as follows[19]:

Zone I: This zone consisted of areas "which lie(s) near the hills and receive(s) good rainfall during the monsoons as well as during the winter months". The areas are Bist Doab areas (north of Sutluj) and areas South of Patiala.

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[15] Estimated on a pro rata basis as per % of district area in command. This is for the year 1998-1999.

[16] We may mention here that while the above figures pertain to a particular year, the broad picture does not change much over the years.

[17] CAG 1977: Page 110

[18] Government of Rajasthan 2002c: Page 120. At least part of this excess coverage appears to have been achieved by lowering the delta, i.e. the amount of water delivered per hectare. (*op cit* Page 134)

[19] From BBMB 1988: Page 245 and Raj 1960: Page 49

Zone II: These were areas adjoining both sides of Sutluj, which were receiving liberal supplies from inundation canals. The irrigation to these areas would be cut-off as the construction of the dam would dry up the river below Ropar. Hence, areas in Zone II were essentially replacement irrigation.

Zone III: These were the dry and arid tracts, essentially of Hissar and Rohtak districts. The rainfall in these areas was meagre, (250 to 380 mm), and spring levels were low.

Thus, it was the third zone that was the real critical zone. Most areas in Punjab consisted of Zone I & II. Zone III areas were only 15% of the total Bhakra command in the state – another reason why it is said that Punjab had only limited benefits from the project.

In Haryana, on the other hand most of the areas were in Zone III. In Rajasthan, all of the command was in Zone III.

For Punjab, the break up was as follows:

Zone-wise Bhakra Gross Command Area in Punjab (Acres)[20]

Zone I	1304390	57%
Zone II	666870	29%
Zone III	334733	15%

In Haryana, the figures were:

Zone-wise Bhakra Gross Command Area in Haryana (Acres)[21]

Zone I	460720	14%
Zone II	0	0%
Zone III	2772793	86%

CONDITIONS IN COMMAND PRIOR TO BHAKRA

It is often said that prior to the Bharka project, Punjab and Haryana were backward, semi-arid areas with very uncertain agriculture. B.G. Verghese says:

> "…there is little doubt that the green revolution has transformed Punjab and Haryana and that this would not have been possible but for Bhakra-Pong. Deprived of their water Punjab and Haryana would have remained semi-arid tracts except for some modest and uncertain inundation irrigation…"[22]

This picture of Punjab and Haryana as backward, semi-arid regions is far from the truth.

Just before partition, the province of Punjab and the other princely states (in the Indus basin) like Bahawalpur, PEPSU contained one of the largest, most advanced, and prosperous irrigation systems in the world, based entirely on the inundation canals, barrages and wells.[23]

Partition gave the lion's share of this to West Punjab (in Pakistan), with about 20% of it coming to Indian side. Even then, this was by no means an insignificant system. In 1949-1950, Punjab[24] had 35.3% of its sown area irrigated and the figure for PEPSU was 42.6%. This was the highest in the whole country! Together, PEPSU and Punjab accounted for 13% of the

[20] Estimated by the author from various figures including details of canals in BBMB 1988
[21] Calculated from the total in BBMB 1988 and Punjab Figures estimated by the author
[22] Verghese B.G. (1994*): "Minus Bhakra" in "Winning the Future: From Bhakra to Narmada, Tehri, Rajasthan Canal*"; Konark Publishers.
[23] It will be helpful to recollect for the following discussion that the post-partition Punjab included most of today's Haryana and some districts of H.P. PEPSU was later to merge with Punjab (in 1956) and form later on districts of Punjab and Haryana. (i.e. Punjab of 1950+PEPSU=today's Punjab+today's Haryana +few districts of H.P.)
[24] Punjab at this time also included Shimla and Kangra districts, but these had very limited amount of irrigation.

country's irrigated area, while it had 5.89% of the country's total sown area[25]. Thus, it was way ahead of irrigation as compared to the rest of the country – even after losing the lion's share to Pakistan. In absolute terms, the areas irrigated were 4.9 million acres in Punjab and 2.04 m acres in PEPSU.

By 1953-54, the year in which irrigation from Bhakra began, the irrigated area in Punjab (including PEPSU and Haryana areas) had gone up to 7.47 m acres[26].

Table 4.12 gives the areas already irrigated in 1953-54 in various districts of Punjab (including Haryana and PEPSU) on the eve of the Bhakra project. From this, let us look at the irrigation status in 1953-54 of some of the Bhakra command areas in (today's) Punjab.

- Bist Doab - About 61.5% of the Net Sown Area was under irrigation in the Bist Doab areas – districts of Jullandar and Nawanshahar – all of it by wells.
- For the Patiala and Fatehgadh Sahib areas, the same figure was 45.5 %. The then Patiala district had an area of 327000 acres under irrigation.
- Ferozpur, which included areas of Faridkot and Muktasar districts, was the most heavily irrigated with about 74.8% of the Net Area Sown under irrigation.

We have already seen that the Zone II areas were all in Punjab, and consisted of areas already well irrigated. It is seen from the table that even much of the Zone I area in Punjab, like Bist Doab, Patiala etc. was well irrigated even before the project.

From the same table, let us now look at Haryana. As far as Haryana was concerned, even the semi-arid districts of Haryana, namely Hissar tracts, the area irrigated was 566000 acres – 20.8% of the Net Area Sown. In fact, in Haryana, significant areas in these tracts were being irrigated by the Sirsa branch of the Western Jamuna canal. These areas were completely transferred to the Bhakra command.[27]

Thus, even before the Bhakra irrigation began, many of the areas in the command were irrigated. Certainly, there were parts (for e.g.in the Hissar tract) which were still semi-arid and without irrigation. But these formed limited part of the whole of Punjab and Haryana and it is a gross exaggeration to say that all of Punjab and Haryana was essentially semi-arid with uncertain irrigation prior to Bhakra.

This is also reflected in the agricultural production and performance of the two states.

In terms of the agriculture, it is difficult to call Punjab of 1950s backward as compared to the rest of the country. Apart from the irrigated areas we have seen above, net sown area of Punjab in 1949-50 was 51.4% of its total geographical area. For PEPSU, this figure was 64.1%. While the PEPSU figure was the highest for any state in the country, Punjab figure too compared well with other states.[28] Area sown more than once for Punjab was 2.1 m acres for the same year.

➔

[25] R.L. Anand; *Punjab Agriculture Facts and Figures*; Economic and Statistical Adviser to Government of Punjab; 1956 Page 57 Table 20 (Anand 1956)
[26] Statistical Abstract Punjab 1960
[27] A GCA of about 800,000 acres at least.
[28] Anand 1956: Page 31 Table 1

Table 4.12: Net & Gross Area Irrigated in Unified Punjab (Including PEPSU) on Eve of Bhakra Project

District as in 1953-54	Includes Following districts of Today	NIA in 1953-54 (000 Acres)			% to Net Area Sown (000 Acres)	Gross Irrigated Area (000 Acres)
		Canals	Wells	Total		
Hissar	Hissar, Sirsa, Bhiwani, Fathebad	556	8	566	22.8	543
Rohtak	Rohtak, Sonipat, Jhajjar	355	104	459	40.2	576
Gurgaon	Gurgaon, Rewari, Faridabad	97	115	217	19.7	228
Karnal	Karnal, Kurukshetra, Panipat, Kaithal	288	207	497	46.7	555
Ambala	Ambala, Rupnagar, Panchkula, Yamunanagar	4	45	64	8.6	78
Simla						
Kangra				113		182
Hoshiarpur	Hoshiarpur, Nawanshahar	29	58	91	12.8	112
Jallandhar	Jullandhar, Nawanshahar	0	369	369	61.5	455
Ludhiana	Ludhiana	80	318	398	63.9	449
Ferozpur	Ferozpur, Moga, Muktasar, Faridkot	1245	179	1424	74.8	1336
Amritsar	Amritsar	488	289	780	92.6	1028
Gurdaspur	Gurdaspur	104	157	289	50.9	302
Patiala	Patiala, Fathegadh Sahib	51	252	327	45.9	401
Sangrur	Sangrur, Jind	735	294	1029	60.6	954
Bhatinda	Bhatinda, Mansa	690	12	702	53.4	660
Kapurthala	Kapurthala	0	119	119	54.6	158
Mahendragadh	Mahendragadh	0	34	34	5	33
		4722	**2560**	**7478**	**44.3**	**8050**
	In Th. Ha	1912	1036	3028		3259

Source: *SA of Punjab 1960 Table 4.5 & 4.6*

Note: *The break up of the districts of 1953-54 into new districts was not so clean as may seem from the above list. Many of the new districts were formed from parts from more than one older districts. Many new districts formed after 1953 themselves further broke up, and parts of various districts were reorganised into new ones. However, the above break up more or less represents the major divisions and constituents.*

The figures of agricultural production also show that Punjab could be by no means considered backward. Wheat was the most important crop of the state. In 1953-54, Punjab had 13.6 percent of the wheat area of India, second only to U.P. Meanwhile, its production was about 20% of the country's production - 1.299 m tons. Similarly, in 1951-52 Maize area in Punjab was 9.1% of total maize area in India. The production in the same year was 13% of all India production.[29] As far as gram was concerned, Punjab had 13.6% of the country's area, while its production was 20.5% of the All India.[30]

This is not to say that there was no scope for improvement – or for concern. In the Hissar district, for example, crops had failed in 35.3% of the sown area between 1949-54[31]. But it is to point out that the picture that is presented, that before Bhakra, Punjab was dry, backward area is far from true. Compared to the rest of the country, Punjab (and PEPSU) had quite high proportion of irrigated areas, high proportion of geographical area cultivated, higher yields than national average, and contributed substantially to the national food grain production.

Like other states, Punjab too had areas that were scarcity prone that had less rainfall, were arid or semi-arid. That did not make the whole state dry and backward.

Hissar was the main scarcity prone district. Hissar of 1950s, comprising of today's Hissar, Bhiwani, Sira and Fathebad districts – is described as follows[32]:

> "Situated ….on the fringe of Rajasthan, it partakes of the features of a desert; dry hot weather, dust-storms, and shifting monsoon sand-dunes. The normal annual rainfall is 14 inches of which 11 inches occurs in the monsoon months….
>
> "Agriculture in Hissar has been described very aptly as 'gamble in rains'……"

This was the Hissar in 1950s. Large parts of it (today's Hissar, Sirsa and Fathebad district) are in the Bhakra command. It is this part of the Bhakra command that had some areas that were desert like, with sand dunes or brush like vegetation; these are the areas that may be responsible for the picture of Bhakra "transforming deserts into granary". But the picture portrayed is that of whole of Punjab (of the 50s) being backward, dry and a desert.

Even this Hissar, with its low rainfall and low irrigation at that time was still the second largest producer of food grains in all the districts of Punjab, next only to Ferozpur[33].

An interesting insight into the vegetation and ecology of the then Hissar area can be had for this comment:

> "Around 1888 lions were hunted by the then rulers in Hisar. Record to this effect is available."[34]

This is the picture of the Bhakra command. The most striking fact to emerge from the examination is that contrary to public perception, Bhakra has had a very limited role to play in Punjab. In the public minds, the equation "Punjab=Bhakra" is firmly entrenched; yet, the facts on the grounds are entirely different.

It's main irrigation can be said to be in Haryana especially in the districts of Hissar, Sirsa, Fatehbad. What this means in terms of food production and agricultural prosperity is what we will examine in the subsequent chapters. ✍

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[29] Anand 1956: Page 68, 70. Note that these figures are for Punjab that *does not* include PEPSU.
[30] Source Anand 1956 for Punjab and Ministry of Agriculture, Govt. of India for All India figures.
[31] Anand 1956: Page 51. The failure rate was the highest in Hissar in the whole state of unified Punjab.
[32] Anand 1956: Page 4-5
[33] Anand 1956 Page 71
[34] Haryana State Biodiversity Strategy and Action Plan Year 2001; Chapter on Wildlife and Animal Life Para 4.3; URL: http://www.w3.org/TR/REC-html40 Visited 13 June 2002

Table 4.13: Summary of Major Features of Irrigation from the Bhakra-Nangal Project As Per the 1953 Project Design[35]

	Region I	**Region II**	**Region III**
Areas	Bist Doab, Samarala-Rajpura, Patiala and Kaithal-Pehowa	Adjoining the Sutluj on both sides of the river; Mainly Grey canals through the new Sidhwan Branch; also in Sirhind areas	The dry arid areas of Hissar, and Rohtak districts and areas on the borders of Rajasthan; Faridkot; Rajasthan all areas;
Type of Irrigation	Restricted Perennial (Rabi only)	Non-Perennial (April to October)	Perennial
Gross Commanded Area (acres)	17,65,110	6,66,870	41,88,782
Cultivable Commanded Area (acres)	15,88,599	6,00,183	36,72,798
Annual Irrigation (million acres)	0.715	0.21	2.677[36]
Intensity of Irrigation	45%	35%	62%
Water Allowance (Cusecs / 1000 acres)	2.25	3.750	2.75
Total Water Required (MAF)	1.534	0.683	6.148

[35] From Raj 1960, BBMB 1988, CAG 1977, Indian Journal of Power & River Valley Development 1956

[36] This figure seems to be on the higher side; the given irrigation intensity of 62% and the CCA for this zone gives the annual irrigation at 2.277 m acres and not 2.677. But the total annual irrigation figures from Raj match the figures given by Anand 1956: Page 52

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5

Food Production, Food Security and Bhakra: 1950-1966

"Punjab, Haryana and Andhra Pradesh have emerged as the granaries of the nation growing more than two-thirds of the total rice crop of the country as a result of the irrigation benefits reaped from the Bhakra Nangal and the Nagarjun Sagar Dam.

"Dams built in Punjab and Haryana turned these states into the food baskets of the country and have helped make India self sufficient in foodgrain production.

Facts on the Sardar Sarovar Project
Issued by the Shree Delhi Gujarati Samaj in July 1999, under the heading "THE TRUTH".

"Complex problems require complex solutions."

Vishwanath Pratap Singh,
taking charge as India's Prime Minister in 1989

Hunger deaths in

The fourth straight year of drought in Rajasthan has

community of hunter gatherers. The some seeds they

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त्येक दिन भूख से होने
रें आ रही हैं। वरिष्ठ
हा कि कोंधमाल जिले
हाल ही में भूख से एक
सदस्य मारे गए हैं।
यद्यपि समचा प्रदेश

ीसा में भूख से २०० लोगों
के मरने का आ

स्थिति की गंभीरत
एक हजार करोड़
माँग की है। पूर्व र
तथ्यान्वेषी दल ने
में कुपोषण की भ
नजदीक से महसूस
स्वास्थ्य सेवाएँ पूरी तरह नाकाम है।

Food Production, Food Security and Bhakra 1950-1966

THERE ARE SOME VERY SIMPLISTIC BELIEFS PREVALENT IN INDIA ABOUT THE food problem. The most common theme is that India was a virtual beggar, depending on alms and imports for meeting its food needs; then came the large dams, food production increased dramatically, and India is now self-sufficient in food.

In this simplistic view, Punjab, Haryana and Bhakra have a central place. The equation is rather uncomplicated. India's food problem has been solved mainly due to Punjab and Haryana – which have now become the granaries of the nation – and Punjab and Haryana have been able to achieve this due to Bhakra. In other words

Food Self-Sufficiency = Punjab & Haryana = Bhakra.

Another argument made persistently - which is a sort of generalisation of the above - is that to address its food problem, India has no options other than large dams. It had never *had* any other options and it does not have any other options.

The reality of food production in India is vastly more complex than this one-dimensional analysis, if it may be at all called as such. Many many other projects, programs and factors have played a part in the struggle to feed India's people than just Bhakra. The claim of self-sufficiency itself is highly questionable. Before we look at all these, let us start with a quick look at the Bhakra project and some of the events in the first decade and half after independence.

For a project that is today projected as the saviour of the nation from the food crisis, for a project credited with converting Punjab into a granary of the nation, it is astonishing how cursorily the food production aspect was treated in the project development. According to K.N. Raj[1]:

> "In the various project reports of the Bhakra Nangal, there are no precise or detailed estimates of the likely increases in agricultural production on account of the project. *In general terms it has been stated* (in the Project Report of 1953) that about 60 per cent of the area brought under irrigation (i.e. about 2.05 million acres) was likely to be put under food crops and that…..it would be possible to produce 15 maunds per acre making a total of 1.13 million tons of foodgrains per year." (Emphasis added)

Note that this is not 1.13 m tons of *additional* production but a *total* of 1.13 m tons from the areas to be irrigated. To estimate the contribution of the project, we will need to subtract the production before the project in these areas from 1.13 m tons.

This should not be too surprising of course, to those now familiar with the history of the project's planning and with what the real factors were behind the project.

[1] Raj 1960: Page 90

In 1948, India's first Prime Minister had urged for food self-sufficiency by 1951 for the country.[2]

The irrigation from the Bhakra-Nangal project began in 1953-54, when about 46,000 acres were irrigated. In 1955-56, the last year of the First Plan, the irrigation from the project was about 1 million acres. (418,000 ha). By the time the second plan ended (in 1960-61) Bhakra was irrigating 1.7 m acres and by 1963-64 this had reached 2.48 m acres. For all practical purposes, this was the full development of the irrigation from the project.

Yet, throughout this period, the country was importing foodgrains (See Table 5.1) Indeed, the controls on food, which had been removed during the course of the First Plan – essentially before the project irrigation deliveries began - were back during the Second Plan. The imports also went up sharply. Table 5.1 shows the imports of cereals from 1951 to 1972. The figures are self-explanatory. What this shows is that even in 1972, 18 years after irrigation from Bhakra-Nangal had commenced, India was miles away from food self-sufficiency

Table 5.1 : Gross Production Of Cereals, And Net Imports On Government Account, Adjusted For Year-End Stocks Of Foodgrains With Government

Year	Gross Production of Cereals ('000 tons)	Net Imports Adjusted for Changes in Govt Stocks of Foodgrains ('000 Tons)	Imports as % of Total Production
1951	45,814	4212	9.2
1952	46,480	3308	7.1
1953	51,950	2518	4.8
1954	61,204	632	1.0
1955	59,091	1342	2.3
1956	57,630	1991	3.5
1957	60,306	2770	4.6
1958	56,524	3485	6.2
1959	65,586	3366	5.1
1960	65,253	3724	5.7
1961	69,592	3658	5.3
1962	70,687	3994	5.7
1963	68,789	4573	6.6
1964	70,615	7506	10.6
1965	76,954	6384	8.3
1966	62,403	10,199	16.3
1967	65,884	8925	13.5
1968	82,950	3652	4.4
1969	83,595	3384	4.0
1970	87,810	2457	2.8
1971	96,604	-541	-0.6
1972	93,598	4986	5.3

Source: Shenoy 1974: Page 148

The gap was huge. Shenoy[3] estimates the food deficit in 1972 at 20.3% of the (net) domestic production for the year for cereals, and the same for pulses is estimated at 52.7%. He adds "this figure is a gross understatement of the actual deficit if it is viewed independent of the presumption regarding the availability of other items of food."

[2] Shenoy, B.R 1974: '*PL 480 and India's Food Problem'*, Affiliated East-West Press, New Delhi: Para 5.65 Page 168

[3] Shenoy 1974: Page 155

For a project claimed as liberator of India from food dependency, it is a telling commentary that foodgrains imports and deficits remained high even with 18 years of project operation.

It may be mentioned here that imports are only one measure of food scarcity or of food self-sufficiency. Food prices are another measure. But both these pertain to essentially those who meet their food needs from the market. Absence of imports does not mean self-sufficiency.

There is another interesting sidelight to this discussion. It is often said that India was facing the ignominy of accepting aid from the USA under PL 480 and Bhakra Nangal rescued us from the same. It may come as a surprise to many people that PL 480 was not even in existence when work on the Bhakra project had started. The *US Agricultural Trade Development And Assistance Act, 1954*, being the 480th Public Law enacted by the 83rd Congress, is commonly referred to as PL 480- short for Public Law 480 [4]. As is obvious, it only came into existence in 1954 – when even the irrigation from Bhakra had already commenced. India initiated imports under PL 480 in 1956-57 – and continued to import foodgrains under PL 480 for the next 15 years – till 1972. The PL 480 imports were stopped in 1972 but it was clear that this was a premature step and India was not anywhere near self-sufficiency[5].

Again, it may be noted that for a project that is said to have rescued us from the humiliation of the PL 480 – PL 480 imports started *after* the project had commenced and continued for 15 years into the life of the project.

With these few statements, we now look at the first decade and a half in some detail. In the first 15 years after Independence, foodgrains production in the country went up from 50.82 m tons in 1950-51 to 72.35 m tons in 1965-66. What were the factors behind this growth? What attempts were made to address the food question in this period? What were the policies of food and agriculture and how did they evolve?

A FEW WORDS ABOUT THE TERMINOLOGY AND ISSUES

India's food problem is a vast and extremely complicated issue; and many of the strands that were present in the debates around the 1940s-50s remain unresolved even till date - as does the problem of food. *Millions even today go hungry to bed*. It is an issue that has been intensely discussed, debated, argued since decades. It is not our intention to present this debate here in detail. However, it is important to try and understand the issues, concerns and options that existed in the early years.

There is little doubt that the 40s and 50s were times of serious food problem in the country. The nature and details of this problem were complex – there were issues of production, of availability, of foreign exchange, of distribution and equity. The 1940s were a time of shortages, rationing, and controls. It must be remembered that these were the times of war – the World War II had begun in 1939. Food controls and rationing was in place even in the land of the Colonial masters[6]. The mid-40s brought in the winds of independence, the trauma of partition and finally freedom. These were times of changing political boundaries – partition on one hand, amalgamation of the princely states on the other. Statistics, figures were prominent by their absence. It is no wonder that when India's First Five Year Plan was formulated, there was little idea of the precise magnitude of the food problem.

One indication of this magnitude is the so-called food deficit. The deficit, as a layperson would understand – is the difference between the (per capita) requirement of the population and the actual (per capita) availability. This is sometimes termed as the "nutritional deficit".

[4] Shenoy 1974: Page 1
[5] Shenoy 1974: Page 256-257
[6] Indeed, in England, this rationing included not only food but cloth, sugar and so on.

The "requirement" is itself very difficult to measure, given the vast diversity in the consumption patterns of population in India. The range of foods that constitute the food basket in the country - various kinds of cereals, pulses, meat, dairy products, other food items, makes it very difficult to reduce them to a "standard" requirement.

Availability is more than just production: it is production and net imports, adjusted for wastage, seed requirement, stock and so on. Moreover, to calculate per capita availability the population figures are converted into effective population to adjust for different consumption levels of different age groups. (Children eat less than adults and so on). The per capita availability is then calculated from these figures.

Of course, the per capita availability thus calculated is only an average, notional figure and hides the gross inequities in the distribution of the available food.

Thus, while conceptually the notion of food deficit is simple, in practice it is very difficult to measure it.

Another indicator often used for the food deficit is the level of food imports – signifying what is called the "market deficit". The market deficit measures the shortage of market supply over market demand. There are several important issues here.

The market demand is strongly related to the price of foodgrains in the market. Or, to put it the other way round, to the purchasing power of the people. In other words, if the prices of food are very high in the market, there may be lesser "demand" for it, even though people may actually need the food. This is because they are not able to buy the food at the prices prevailing. Thus, the market demand can be quite different from the physical need for food.

It is possible that the domestic supply to the market may not be sufficient to meet the market demand. One way of meeting this is imports. Thus, the level of imports can be an important indicator of market deficit.

It should be pointed out that the market deficit relates essentially to those who obtain their requirement from the markets. This is the group of non-producers (of food). There is another category - that of food producers, farmers, for example - who do not depend on the market.[7] Hence, their needs are not translated into market demands. However, if the production is not enough to meet these needs, there will be a deficit. Since they are not participating in the market, this deficit is not translated into a market deficit. Especially in the times when data and statistics on food production were hard to come by, the production, consumption and deficit of the producers were difficult to estimate. In a way, this deficit is an "invisible" deficit. In contrast, since market demand is a "visible" demand. It should be noted that needs of even some of those who depend on the market may be "invisible" as the high prices push them out of the market and their needs are not expressed as market demands.

There is a related concept of "marketable surplus". The producers who grow more than their own needs will then sell their produce. This is broadly their marketable surplus – the "surplus" of production over their requirements. It is this marketable surplus that will feed the requirement of the market demand. Much of India's food policy has focussed on increasing this marketable surplus so that the demand of the non-producers can be met without resorting to imports. It may be pointed out that the marketable surplus is a complex function of many factors. For example, if the farmer has had to raise loans to meet his working expenses, loans that need to be paid back immediately on harvest, it is possible that he may be forced to sell more of his produce, and may not be able to meet his own needs fully. In this case, the "surplus" that comes to the market is not a real surplus.

[7] At least, not largely or totally. For example, marginal farmers may have to depend on the market for some part of the year, so the division of the groups is not always black and white.

Lastly, and this can't be emphasised enough – adequate food "availability" or absence of imports (as expressed at the national level) does not imply that everyone has equal access to this food. Thus, there is the issue of the distribution and access to food, or food security.

This is what the First Plan document states, and it is worth quoting it at some length[8]:

> "4. A major question that arises in this context is as to the precise measure of the 'deficit' in foodgrains the country must provide for. For this purpose, it is necessary to assess the trends in production and to see how they compare with requirements. We have given careful consideration to this question, but we find that *on the basis of available data, it is not possible to reach any definite conclusions on this point.*
>
> "…. it is clear that *an estimate of the ' deficit' arrived at on the basis of an average norm of requirements for the entire country is apt to prove wide of the mark.*
>
> "5. Apart from the fact that it is not possible from available data to say how much precisely is the total food production in the country, there is also some doubt whether these data could safely be used for framing a judgment as to whether or at what rate food production in the country has been increasing. *There is a view that foodgrains production is, in fact, significantly larger than is indicated by official figures……*
>
> "(T)he aim of policy must be to increase domestic production, to secure an increase in the marketable surplus, to distribute the same as equitably as possible, and to eliminate by the end of the Plan period the need to import foodgrains. It might be well to stress in this connection that the need to import from abroad is related more directly to the marketable surplus available for meeting the requirements of non-food producers than to total production, and that the problem is not merely one of increasing production but also of mobilising more effectively the surpluses which become available with the producers." (Emphasis added)

The last words on the "policy" throw light on the complexity of the issue. As the planning commission states, the "deficit" was practically impossible to estimate. Various discussions of that time show that imports were taken as an important indicator of the deficit in foodgrains; but imports relate mainly to the market deficit, which is an entirely different notion than that of food deficit. Moreover, it is, as the Planning Commission says, a measure that is mainly applicable to non-food producers. In a country like India, where even today, millions produce for self-consumption and not for the market, the market deficit is a notion that is not so relevant for these people. In the 50s, this was even more so.

Further, considering that millions of non-food producers were the poor, the price of food grains was an important parameter in terms of whether their need of food was actually expressed in terms of the market demand.

What does this mean for food security? Firstly, to address the food needs of the "producers" it was necessary to put into their hands the resources for producing food, and improve /develop resources they already had – for example, to improve productivity of their lands - so that they were not driven to the market for food. A key component of this would be land reforms. Access to land, and this means access with security of tenure, is the critical objective of a land reforms program. Unless this is in place, producers would not only hesitate to invest in land improvement, but would be driven to join the class of non-producers.

The second important conclusion was that for non-producers, increasing food production in concentrated pockets without increasing the capacity of people to purchase the same would not alleviate the food problem. Unfortunately, the country ultimately chose to follow a program of

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[8] Chapter 11: *Food Policy for the Plan*; First Five Year Plan, 1951-1956 Downloaded from the website of Planning Commission, Government of India:
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/1st/1planch11.html , Accessed: Nov 25, 2002

high capital, technology driven agricultural expansion which expanded the production in selected areas, without spreading the purchasing power in the hands of millions. We shall come back to this when we examine the various options that were presented to address the food problem.

Here is an issue that has been of key importance in the food (and water) policy debates in the country. India's food policy at times has urged for concentration of inputs in selected parts of the country. The idea is to obtain large increases in production by intensification of inputs in better off areas. This means that the farmers in these areas will be in a position to provide more marketable surplus. On the other hand is the policy of spreading the inputs extensively so that there is small or reasonable increase in the production, which will enable the farmers to fulfil their own and local needs much better, but may not necessarily yield large marketable surpluses. Various words have been used to describe this – centralisation vs. decentralisation, selectivity, concentration, intensification[9] and so on. We will see this debate in detail in the discussions that follow.

In spite of all the difficulties with the data, the First Plan did put a number to the food deficit - around 6-7% or, at best 5% of the production. It also stated, "For the immediate future, relative scarcity of foodgrains has to be regarded as a datum". We can accept this and look at what was being done to address this, keeping in mind, however, that foodgrains production is only one aspect of the problem of food access.

As Ian Stone states[10], drawing from the work of A.K. Sen[11]:

> "(T)he evidence is clear that neither foodgrain production nor food availability is the key determinant of famine, as studies of the 1943 Bengal famine plainly show…
>
> "The food supply in 1943 was around 5% lower than the average of the preceding five years and an estimated 13% higher than in 1941, when there was no famine"

Famine is an extreme form or manifestation of lack of food security. The complex relationship between food production, access to means of production, and other factors that actually define food security and the occurrence or not of famine have been extensively analysed by many experts. What we would like to stress here is that food production is only one determinant in whether people actually get to eat or not. *How the food is produced, who produces it and where, at what costs, and who owns or controls the means of productions are as crucial parameters as the actual production itself.*

Keeping this important qualification in mind, we come back to the late 1940s when newly independent India was grappling with its policy choices. Because of the nature of our enquiry, we will be focussing our discussion on the aspects related to water and irrigation and their role/contribution in food production and food security.

What were / are the means of increasing foodgrains production?

There are three main strategies to increasing foodgrains production.

1. Bringing in more area under cultivation. In other words, increasing the Net Area Sown (or Cultivated). As area not yet under cultivation is brought under the plough, this can increase the agricultural production. Of course, if the same area was being used for something else (for example if it was forest land, or grazing land), then one loses the benefits from the earlier use.

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[9] As such, intensification would mean increasing the inputs used, and this need not imply concentration of resources in pockets. However, in a situation where the resources are limited, intensification would necessarily also mean concentration.

[10] Stone, Ian. 1984: '*Canal Irrigation in British India: Perspectives On Technological Change In A Peasant Economy*', Cambridge University Press, Cambridge

[11] Sen, A. K. 1977: *'Starvation and Exchange Entitlements: A General Approach and Its Application to the Great Bengal Famine'*, Cambridge Journal of Economics, 1: 1, Pp. 33-59. (Quoted in Stone 1984 as above)

2. Multiple cropping – in other words, increasing the Gross Sown Area. By taking more than one crop a year where only one crop grew, the agricultural production can be increased.
3. Increasing the yield of the crops.

There are many factors that play a vital role in all the three. Water is a crucial input for all these – though it may not always be the one that is the bottleneck. There are a number of ways in which water can be provided to increase areas under cultivation, or for multiple cropping or to increase yields. However, many times this is ignored and it is made out that only large dams and storage structures with canal irrigation can provide this water.

It is said that if we are to provide sufficient food for our (increasing) population, we have no option but to build large dams to store and divert all the flows of the rivers that are going "waste" to the sea. Linking of rivers to draw away "excess" from some rivers to feed the "deficits" of others is being justified on the same grounds. This TINA[12] factor is repeatedly emphasised in debates. This argument is made even more forcefully for the period just after Independence. It is said that for the country confronted with the huge problems of poverty and hunger, there was little choice but to go for large dams like the Bhakra. *There were no alternatives.*

This picture is far from the truth.

It is remarkable that in the 40s and 50s, when planners were confronted with the same type of problems as far as food security was concerned, the TINA factor was notable by its absence. It is significant that the various options suggested then to address the food problem included, in substantial measure, decentralised, community based plans and projects, land reforms, minor irrigation and so on. While major and medium schemes were also there, there was great emphasis on the decentralised and small works.

Indeed, the ideological as well as the practical base of planning at that time revolved around "cooperation" and "community", with the community as both, the vehicle of development as well as the unit of planning. This meant decentralisation. Emphasis was placed on land reforms, minor irrigation, and community development programs as the major strategies for food production.

Of course, there was strong opposition to this too; from people who genuinely believed that other strategies were necessary, but more importantly from strong vested interests. To give one example, the land reforms program met with strong resistance from the landed elites. Over the years, these conflicts were to play out in policy and implementation arena. Ultimately, the focus and policies decisively shifted towards large-scale centralisation.

As we trace out these processes in this chapter, several major reasons appear responsible for this shift. These include – strong opposition to land reforms, the difficulties of trying to implement a decentralised program, the unwillingness of the bureaucracy to "let go", the bias towards "market deficit", higher possibilities of "pay-offs" in large projects etc. Eventually, the programs moved to large scale projects and high capital input and technology based agriculture rather than strong land reforms, community water management and productivity improvement schemes.

Which of the strategies prevailed certainly has had a vital impact on what followed. *But what is equally important is that there were other strategies.* There were other approaches, other alternatives offered, proposed and even attempted right from in the early years. To us, this aspect is very important as it challenges directly the propaganda that there was, and is no alternative, that Indian policy makers had no choice. With these introductory remarks, we now look at the actual plans, policies and programs.

[12] There Is No Alternative

THE PRE-PLAN YEARS

In 1943 the Government of India launched the Grow More Food program.

The Grow More Food (GMF) program came out of the First Food Production Conference[13] of all the States and Provinces of India, held on 6 April 1942. This conference made a recommendation for increasing food production and this became the basis for the GMF campaign[14].

What did this campaign consist of? Between 1943-47, this campaign focussed on

(a) Switch from cash crops, mainly cotton, to food.
(b) Intensive cultivation through irrigation, better seeds, manure etc.
(c) Extensive cultivation by expanding cultivated area.

There were no specific targets.[15] From our point of view, we should note that irrigation formed an important part of the GMF. But irrigation did not mean only large projects.

The Report of the Foodgrains Policy Committee, headed by Sir Theodore Gregory, set up by the Government of India in 1944, had some interesting comments on the irrigation aspects[16]:

> "Committee recognises that major irrigation projects are not possible of execution under the present emergency conditions but they were impressed by the evidence of Sir William Stampe, Irrigation Advisor to GoI, who pointed out that apart from major projects, it was practicable to improve and extend irrigation facilities to increase production within a short time. Amongst such projects may be mentioned .. tubewells, and pumping of water from river beds…Then there are such projects as the sinking of open percolation wells, excavation of tanks and regulation of the flow of water in small streams and *nallas* ….They would not only add materially to the immediate needs of the increased production, but they would confer a permanent benefit on agriculture…"

However, implementation attempts during this time were confined largely to enacting legislation and taking executive action to transfer lands from cash crops to food crops and carrying propaganda for the adoption of more intensive methods of cultivation.[17]

1943 was the year of the terrible Bengal famine. Tragic as it was, the Bengal Famine is also often mis-represented in arguing for large dams and irrigation projects - as an example of the possible consequences of not building large dams[18]. In reality, the Bengal Famine is an important example of how factors other than the food production can have dramatic impact on food security and access.

In 1941 Burma came under the war, and imports of rice from Burma to India stopped. The production of rice in 1942-43 was 7 m tonnes, as against normal of 8.1 m tonnes. 135,000 tonnes used to be imported, (but due to war in Burma) this was not possible. So the shortfall was 1.2 m tons or 15%. Yet, the impacts were far out of proportion to the 15% shortfall. What were the factors that resulted in this aggravation?

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[13] Government of India 1944a
[14] Report of the Grow More Food Enquiry Committee (V.T. Krishnamachari Committee)1952: Page 9 (Government of India 1952)
[15] Government of India 1952: Page 9
[16] Government of India 1944a: Page 23
[17] Foodgrains Enquiry Committee Report, 1957 Page 26 (Government of India 1957a)
[18] See for example this presentation made to the World Commission on Dams : "If we are compelled to stop storage projects for water resources development, the present scenario of self sufficiency in food production would evaporate soon and the problem of meeting the food and fibre needs would overtake us. We may, God forbid, have another Bengal Famine, which has faded into memory. We may have to go with a begging bowl all over the World for giving us just 2-3 million tonnes wheat again, as happened in 1960s." (Visvanathan 2000)

First was the so called "denial policy" of the Government. This was a war time strategy to prevent food stocks from falling into enemy hands. Under this, food stocks were removed from the area. This was further exacerbated by the withdrawal of boats from the area, again as a part of the war strategy. This was compounded by hoarding and black marketing, and the price of rice shot up to 10 times the pre-war level. It was all this taken together that resulted in the terrible Bengal Famine.[19]

The Report of the Foodgrains Policy Committee, headed by Sir Theodore Gregory set up of the Government of India in 1944 had similar conclusions[20]:

> "We are forced to the conclusion, therefore that certain specific areas apart, the food crisis in India does not derive from an absolute decline in the volume of internal, physical production…."

We have dwelt on this at length to emphasise that access to food (which is what really counts in the end) is much more than mere production of food.

In 1947 came the Partition. Apart from the horrendous human tragedy, of particularly serious long term impact was the loss of foodgrains producing land of Punjab. India received 82% of the pre-partition population, but only 75% of the cereal production.[21]

In September 1947, the Government of India appointed the Foodgrains Policy Committee under the Chairmanship of Purushottamdas Thakurdas. The broad recommendations of this committee were[22]:

(a) Greater attention to minor irrigation works, development of local manurial resource, improved seeds etc
(b) Production of fertilisers
(c) Survey of groundwater resources
(d) Reclamation of cultivable waste

The Committee also suggested an organisational set up based on village *panchayats* and co-operative societies. The Committee made the important point that the data regarding requirement and production of food grains were very sketchy.[23] It suggested a target of 10 m tonnes additional production in 5 years. As a part of this, in 1947-48, the GMF program was extended by 5 years. A target of additional 4 m tonnes of food was introduced.

In 1948, the Government invited Lord Boyd Orr to help in this matter. He called for a new objective of self-sufficiency by 1952 and put the target date deficit at 4.8 m tonnes of foodgrains.[24] (Over 1947-48). What would surprise, possibly also delight the votaries of people's participation in development is that one of the key suggestions at this time was that "non-official" committees be also set up. Some committees were set up, like *krushi samiti*, irrigation committee etc. but "no systematic attempts have been made to rouse local initiative".[25]

In 1949 came the report of the Congress Agrarian Reforms Committee.[26] This recommended very strongly complete and comprehensive land reforms as a pre-requisite for improvement in

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[19] Speech of Food Member, Governor General's Council and Other Papers, Presented by Secretary of State for India to Parliament by Command of His Majesty Oct. 1943 (His Majesty's Government 1943: Page 28).
[20] Government of India 1944a: Page 10
[21] Government of India 1952: Page 5 . The figures for wheat and rice were 65% and 68% respectively.
[22] As recounted in Government of India 1952: Page 9
[23] Interim Report – Foodgrains Policy Committee (Purushottamdas Thakurdas Committee) (Government of India 1947)
[24] Government of India 1952: Page 10
[25] Government of India 1952: Page 14
[26] AICC 1949: '*Report of the Congress Agrarian Reforms Committee'*, All India Congress Committee, New Delhi,

agricultural production and efficiency. It advocated radical measures to go far beyond mere abolition of the *zamindari* system and said "land must belong to the tiller"[27].

The AICC Committee also quoted (and adopted) the recommendations of the Foodgrains Policy Committee that the country must aim to increase annual production of foodgrains by 10 m tonnes.

> "Out of these 10 million tons, 4 million could be raised from the areas to be irrigated by the multi-purpose projects which would begin to operate within a period of 10-15 years. 3 million tons could be raised within the next five years through intensive cultivation, better manuring, use of improved seeds etc. The balance 3 million tons, according to the committee should come from the culturable waste lands to be reclaimed within a certain period."[28]

Thus, out of 10 m tons, only 40% was expected to come from multi-purpose projects, that too over 10-15 years.

What is more interesting is that the AICC committee made it a point to note the report of one Dr. Schuhart on the soil and water conservation works of Bijapur, and stressed on his important findings, which the committee quotes verbatim in its report. We cite the same here[29]:

> "The objective of the programme of soil and water conservation was to keep all the rain-water that fell on the land as near the place at which it fell as was possible to do and then to conduct excess rain-water into a farm pond which could be used for fish production, for stocking water and in some instances for the irrigation of farm gardens….all these plans were worked out with the farmer himself.
>
> "With some modifications dictated by rainfall, erosiveness of soil and other local factor, the soil and water conservations programme as started at Bijapur could well be expanded to all of India…"[30]

This is effectively the same rainwater harvesting, watershed management program that is now proving so effective in countering drought and is emerging rapidly as an alternative approach to water management. We will find that suggestions for large-scale implementation of such programs have been repeatedly made from the 40s onwards. For example, the Grow More Food Enquiry Committee of 1952 also noted the work at Bijapur and reports the "valuable work ..being done on such [contour bunding] schemes in Sholapur and Bijapur districts of Bombay State" and notes that they have "special importance in the country".[31]

In the "Minute of Dissent" two of the AICC Committee members also note that[32]

> "It is bad economy to over-develop irrigational facilities in any area and trust to the ability of modern transport facilities to provide food-stuffs at famine prices to famine stricken areas….it serves both strategic purposes and uniform development of country to develop and pursue regionally balanced scheme of irrigational … projects……"

In 1948, the target of food self-sufficiency by 1951 was placed before the country. The Grow More Food campaign received a fresh impetus due to this. According to the Report of the Foodgrains Enquiry Committee:

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[27] It also recommended series of measures on agricultural credit, abolishing of money lending, on the issue of landless labourers and so on.
[28] AICC 1949: Page 155
[29] AICC 1949: Page 158-159
[30] The report describes the program in more detail.
[31] Government of India 1952: Page 32
[32] AICC 1949: Page 188; the two members were Shri O.P. R. Reddiar, Ex Premier Madras and N.G. Ranga, President, All-India Kisan Congress

> "The main steps taken for achieving the target were the undertaking of permanent works and recurring supply schemes e.g. minor irrigation works, land reclamation and the supply of fertilisers, manures and improved seeds."[33]

The Foodgrains Enquiry Committee report continues[34],

> "These programmes for extensive and intensive cultivation, however, tended at first to be rather thinly spread all over the country as there was a general demand from all localities for schemes. Thus, even when the programmes were implemented effectively, *and yielded benefits in the shape of additional production, these did not make a contribution to the solution of the food problem by increasing marketed surplus substantially*....." (Emphasis added)

This part of the report is very revealing because this shows the clear and even excessive focus on the marketable surplus rather than the production of food. The benefits of "additional production" "did not make a contribution to the solution of the food problem". Was this bias to shape the food and agricultural policy over the years? Subsequent events show that this *was* what happened. What does this indicate? The requirements and needs of the "producers" or the "local consumption" are not visible; the marketed surpluses on the other hand, were very visible. When one looks at the section of the society that is primarily catered to by the "market surplus" and the class of producers, the reasons for this bias become clearer, as do its implications.

This "limitation" of the spread-out nature of the Grow More Food (GMF) program led the Government to introduce an important change in the campaign.

In 1950-51, just as the First Plan was to begin, the GMF was reviewed and some important changes were made.. These included[35]:

(a) Concentration of seeds and manures in areas of assured rainfall/ irrigation
(b) Selection of compact areas considered suitable for increasing minor irrigation, land improvements
(c) Construction of tubewells

Interestingly, the states objected, saying that over insistence on concentration of the GMF program was likely to lead to discontent in areas left out. This led to some dilution of the concentration. This debate over concentration or de-centralisation was one of the important themes over the years in the processes around India's food (and irrigation) policy.

In the event, in 1950-51 attempts were made to concentrate GMF efforts in compact areas called "intensive cultivation areas". The primary aim was to augment the marketed surplus. [36]

Around the same time as the intensive cultivation scheme was being formulated, the difficulties of importing cotton and jute from Pakistan led the Government to formulate the Grow More Jute and Grow More Cotton program and the three programs were integrated into an "Integrated Production Program" announced in 1950.[37]

The Report of the Foodgrains Enquiry Committee on this aspect again highlights the bias towards market and the implicit defining of "self sufficiency" in terms of adequate "procurement". It states[38]:

> "The experience of implementing the integrated production programme, however, showed that even the ideal of relative food self-sufficiency was in itself not capable of

[33] Government of India 1957a: Page 26
[34] Government of India 1957a: Page 26
[35] Govt. of India 1952: 19
[36] Government of India 1957a: Page 26-27
[37] Government of India 1957a: Page 27
[38] *op cit* Page 28

> easy achievement because in practice it turned out to be "moving target" in a country where the masses of the population where under-fed and even a small increase of production and of income led to a substantial increase in consumption. The basic assumption of fairly stable level of food consumption which was implicit in the earlier self-sufficiency scheme was itself not valid because it was not possible even in a regime of rationing as it obtained at that time to control the consumption of large sections of the population especially the millions of producer-consumers in the country…… Even the additional production achieved was not reflected in actual procurement as it was dispersed over large areas. The dependence on imports, therefore, continued. Moreover, the actual quantum of physical resources e.g., fertilisers and improved seeds which are distributed under the campaign was not large enough to cover more than a small portion of the total cultivated area under foodgrains."

In a way, the producer-consumer was blamed for not allowing the marketable surplus to increase – as he was consuming much of the increased production. Clearly, the increase in the consumption of the producer was not seen as much of a contribution to "self-sufficiency" or a national gain. The non-availability of inputs in sufficient quantities was also a bottleneck.

The Government of India, therefore, set up in February 1952 the Grow More Food Enquiry Committee headed by V.T. Krishnamachari to examine the working of the Grow More Food campaign. The committee, which submitted its report in June 1952 came to the conclusion that, on the whole, the Grow More Food campaign had not achieved results expected of it. It had not aroused expected enthusiasm or effect in the countryside. The committee observed: "The problem of food production was a much wider one than the mere elimination of food imports…."[39]

Among the more important recommendations of the Committee were (a) setting up of a country wide extension organisation (b) the acceleration of the minor irrigation programme and (c) the provision of adequate rural credit.

It is significant that the main recommendations focussed on minor irrigation and extension service. Indeed, what clearly emerges from the analysis of the policies and plans of these years is the central place given to minor irrigation and small schemes. Certainly, there was a role envisaged for the large projects, but this was limited. One possible reason could be the immediate term nature of the planning in the GMF and related programs. The Report of the Grow More Food Policy Committee of the Government of Bombay notes:

> "As the object of the GMF was to add to production of food within a period of 5 years ending 1951-52, none of the new major irrigation schemes were considered part of the GMF campaign."[40]

Yet, this was only part of the explanation. The discussions show that land reforms, minor irrigation, community based programs, cooperation and host of other small schemes formed a major plank of the approach to address the food problem. This was clear from the programs undertaken in the Five Year Plans also.

THE FIRST PLAN 1951-56

The recommendations of the GMF Enquiry Committee were incorporated into the First Plan.

The Government of India launched it's "most ambitious attempts to come to grips with her agrarian problems"[41] in the form of the Community Development Program in 1952. This model pilot program covering comprehensive development of agriculture, animal husbandry,

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[39] Government of India 1957a: Page 27
[40] Government of Bombay 1952: Page 59

public health and co-operation was developed into the Community Projects".[43] Indeed, the Community Development programs included items like, seeds, fertilisers, pesticides, implements, composts, irrigation, land reclamation, bunding and terracing, and many others.[44] The key was the decentralised planning and implementation.

India's Five Year Plans[42]

First Plan	1951-56
Second Plan	1956-61
Third Plan	1961-66
Plan Holiday (Annual Plans)	1966, 1967, 1968
Fourth Plan	1969-74
Fifth Plan	1974-79
Sixth Plan	1980-85
Seventh Plan	1985-90
Eight Plan	1992-97
Ninth Plan	1997-2002
Tenth Plan	2002-2007

Source: *India's Five Year Plans*; Academic Foundation, New Delhi 2003

A significant aspect of the community development approach was:

> "The Grow More Food campaign was of direct benefit to the cultivators who owned the land. ….The Community Project, on the other hand, had a wider appeal…….From point of view of food production, however, there was a fundamental difference between the old intensive cultivation areas[45] and the new community projects. The objective of the former was to facilitate the procurement of surplus foodgrains. …..the emphasis in the community projects shifted from increasing agricultural production and marketable surplus in selected areas to increasing the general level of production and well being in the country as a whole."[46]

Unfortunately, this shift was to go back after a decade of so, as we shall see.

The First Plan envisaged an increase of 7.6 m tons of foodgrains in the annual production. This was to come from two parts – the initially approved program of the state governments, and a supplementary program. The break-up of the program-wise addition of the states' programs was as shown in the table.[48]

	(In million tons)
Major irrigation works	2.01
Minor irrigation works	1.78
Land reclamation and development	1.51
Manure and fertilizers	0.65
Improved seeds	0.56
Total	6.51[47]

The State Government program was to yield 6 m tons addition to the annual production. The Supplementary program was to add 1.6 m tons. The supplementary program consisted totally of minor irrigation, tubewells, intensive area development, Grow More Food program and

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[41] Michel 1967: Page 436

[42] The first Five-year Plan was launched in 1951 and two subsequent five-year plans were formulated till 1965, when there was a break because of the Indo-Pakistan Conflict. Two successive years of drought, devaluation of the currency, a general rise in prices and erosion of resources disrupted the planning process and after three Annual Plans between 1966 and 1969, the fourth Five-year plan was started in 1969.

The Eighth Plan could not take off in 1990 due to the fast changing political situation at the Centre and the years 1990-91 and 1991-92 were treated as Annual Plans. The Eighth Plan was finally launched in 1992 after the initiation of structural adjustment policies.

[43] Government of India 1957a: Page 27

[44] Mishra, O.P 1978: '*The Economic Philosophy Pt. Jawaharlal Nehru'*, Chugh Publications: Page 145-146

[45] Recollect that these were the areas where, in 1950-51, there was attempt at concentrating the GMF, with the aim of increasing marketed surplus.

[46] Government of India 1957a: Page 29

[47] The discrepancy of 0.5 m tons is in the original report and is taken care of by the Plan by first including this and then stating that food production to the tune of 0.5 m tons will be affected due to diversion to commercial crops.

[48] Chapter 14: Program *For Agriculture*; First Five Year Plan, 1951-1956: Para 7
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/1st/1planch14.html
Accessed: Nov 25, 2002

community development. In short, all small or decentralised projects. *Thus, only 26.4 % of the foodgrains addition in the First Plan was expected to come from major projects.*

Even in terms of irrigation, it was planned that an area of 11.2 m acres would be added to the irrigated area with the help of minor schemes. These were to cost a total of Rs. 77 crores.[49] The major projects on the other hand, entailed an expenditure of Rs. 558 crores in the five years of the plan and were expected to irrigate 8.5 m acres of land.[50] It is seen that the irrigation from major projects was very expensive.

All these show very clearly that in these years, considerable emphasis was placed on minor irrigation and decentralised works for meeting the food production targets. And rather than there being no alternatives to large dams, many decentralised schemes were being advocated to meet food production needs.

The First Plan was termed a success and the foodgrains production targets were exceeded. The Plan had envisaged adding 7.6 m tons to the annual production of 54 m tons of the base year (1949-50). Thus, the target was 61.6 m tons. The production at the end of Plan was 65 m tons. Incidentally, the greatest increase had come from the millets.[51] During the course of the First Plan, the performance on the food front led to the almost complete dismantling of controls. Rationing was ended, the ban on interstate transport of foodgrains relaxed. Imports were at the lowest, and even limited exports were allowed. On 26th January 1955, the Essential Supplies (Temporary Powers) Act 1946 lapsed, and inter-zonal restrictions on movements of wheat disappeared, and with it, the last vestiges of control.[52]

However, the major irrigation projects showed a miserable performance. The actual expenditure on these was 432 crores but they could create irrigation of only 4 m acres as against the target of 8.5 m acres[53]. The following table gives the details:

Table 5.2: First Plan Targets – How They Were Met [54]

Program	Achievement as % of	
	Physical Targets	Financial Expenditure
Major Irrigation	47	92
Minor Irrigation	91	63
Land Reclamation	77	75
Fertilisers and Manures	50	59
Improved Seeds	55	56

THE SECOND PLAN 1956-61

Irrigation from the Bhakra project was established around the time the Second Plan started. In fact, irrigation from the project had begun in 1953-54 when about 46,000 acres were irrigated. By the last year of the First Plan, the irrigation from the project was about 1 million acres. (418,000 ha). By the time the second plan ended (in 1960-61) Bhakra was irrigating 1.7 m acres and by 1963-64 this had reached 2.48 m acres.

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[49] Chapter 26: *Irrigation and Power*; First Five Year Plan 1951-1956 Para 47
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/1st/1planch26.html
Accessed: Nov 25, 2002
This 11.2 m acres included 8.2 m acres in the states and 3 m acres in the supplementary plan.

[50] First Five Year Plan, Chapter 26 Para 46

[51] Chapter 13: *Program For Agriculture*; Second Five Year Plan, 1956-1961 Para 2
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/2nd/2planch13.html Accessed: Dec. 15, 2002

[52] Government of India 1957a: Pages 20-25

[53] Government of India 1957a: Page 30

[54] Government of India 1957a: Page 104

What was happening on the foodgrains front when the project that is supposed to have single-handedly ended India's food problem started delivering its benefits?

In overall terms, the Second Plan (1956-61) failed to meet its targets of foodgrains production, though there was growth in the foodgrains output. Against a target of 80.2 m tons, in 1960-61, the foodgrains production was 76 m tons.[55] The Index of Foodgrains production, which was 91 in 1950-51, and 115 in 1955-56, was 132 in 1960-61.

While controls on food grains had been removed by the time the First plan ended, the Second Plan saw some of these returning.

In terms of irrigation, the following were the targets set by the Second Plan and the achievements.

Table 5.3: Second Plan Irrigation Targets and Achievements

	Second Plan Targets (million acres)[56]	**Achievements** (million acres)[57]
Major and medium Projects	12	6.9
Minor Irrigation	9	9.0

Source: For Targets: Second Plan. Chap 17 Irrigation : Para 13
For Achievement: Third Plan, Chapter 19, Agriculture Para 4

The Second Plan gave much more stress on industry as against agriculture. While only 4% of the First Plan outlay was on industries and minerals, it was as high as 20% in the second plan. Meanwhile, the proportion of outlay on agriculture and community development and major and medium irrigation was reduced from 31% in First Plan to 20% in the Second. The year 1957-58 was unfavourable and foodgrains production went down to 62.5 m tons. Imports remained consistently high during the plan period. Possibly alarmed by all this, or due to other reasons, the Government of India invited the Ford Foundation to come and assist it in addressing the food problem. The Ford team came to India in January 1959, and submitted its report in April of the same year. The Report, *India's Food Crisis and Steps to Meet It* was published by the Government of India.[58] This report was to prove to be an important milestone as it was this report that led to the Intensive Agricultural Districts Program (IADP) otherwise called the pilot projects - which led to the enshrinement of the strategy of concentration and intensification.

The very fact that the Government had to invite this team was an indication that the food problem persisted in all its severity. The Ford team, which also had intensive discussion with Indian experts, officials, villagers and others, said[59]:

> "India is facing a crisis in food production. More specifically, it is a crisis in *food-grain production…*
>
> "If food-grain production increases no faster than indicated by the present trend, the gap between supply and needs in 1965-66 will be about 28 million tons.

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[55] Chapter 3: *Ten Years of Planning - First and Second Plans*; Third Five Year Plan, 1961-1966; Para 11
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/3rd/3planch3.html
Accessed: Nov. 12, 2002

[56] Chapter 17: *Irrigation;* Second Five Year Plan, 1956-61: Para 13
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/2nd/2planch17.html
Accessed: Dec. 15, 2002

[57] Chapter 19: *Agriculture;* Third Five Year Plan, 1961-66: Para 4
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/3rd/3planch19.html
Accessed: Nov. 12, 2002

[58] Government of India 1959a: *India's Food Crisis and Steps to Meet It – Report by the Ford Foundation Team*; Government of India, New Delhi.

[59] Government of India 1959a: Pages 11,12,14

> " *'Business as usual' will not achieve the food production targets. The steps necessary to mobilize the nation for action must be clearly outlined*". (Emphasis as in the original, throughout).

The team was obviously aware of the projects like Bhakra which were already functioning, and yet was clear that the present trends of food-grain production would not suffice to bridge the gap between the demand and supply. In other words, by themselves, projects like Bhakra were not going to be able to meet the goals of food-self sufficiency.

The team came out with very comprehensive recommendations in its 259-page report. What is interesting is that the team was not enamoured by the large-scale projects that were going on, and were indeed gaining currency with the Indian planners. Taken together, the package proposed by the team was nothing short of a completely different paradigm of agricultural growth – one that was to be based on decentralised, local schemes. The team, no doubt out of deference to the Indian planners, did not rule out large projects; but as we shall see, its emphasis was quite different.

The recommendations of the team are important for two reasons. Firstly, they show that to achieve growth in food production requires a large variety of measures – not just dams or irrigation; and that these measures in combination are critical in tackling the food problem. Secondly, while it is projected that India had no option but to go for large dams if it was to meet the food needs of its population, the report shows that there was indeed a comprehensive alternative (approach), which was better in several respects.

So what were the main recommendations of the team? The team highlighted the following proposals in its note titled "The Crucial Decisions" right at the front of the report. We quote (Emphasis as in original, through out)[60]:

> "3. **The Need for Emergency Action**:…. A 110 m ton target, however, can be realised only if an all out emergency food production program is undertaken. Food production must be given the highest priority.
>
> "4. **The Need for Stabilisation of Farm Prices**: Unless the cultivator is assured of a floor price for his food grains, he will be unwilling to invest in fertilisers, better implements, improved seeds…..
>
> Recommended are:
>
> (a) A guaranteed minimum price announced in advance…
> (b) A market within bullock-cart distance that will pay the guaranteed price…
> (c) Suitable local storage….
>
> "5. **A Public Works Program for Increasing Food Production and Village Employment**: The unemployed and underemployed in the villages represent a waste of resources that should be used to produce more food. ….*The team recommends a public works programme for projects requiring primarily hand labour, such a contour bunding, land levelling, surface drainage, irrigation wells and tanks.* Such work will contribute directly to increasing food production, provide income for needy people and will not be inflationary."

We pause here for a moment to understand the implications of this recommendation. This recommendation is nothing short of a massive program of watershed management, decentralised rainwater harvesting, soil water conservation that is now being talked about so much. It should be pointed out that the team had recognised the three most crucial benefits of such a program – one, that it would meet the needs of food-production, two, that it would

[60] Government of India 1959a: Pages 3-7

provide massive employment, and three, it would put purchasing power in the hands of the millions. The last is very important, as it is the lack of purchasing power in the hands of people that has resulted in the gross perversity of packed godowns and hungry people.

Coming back to the recommendations:

> "6. **Priorities for Chemical Fertilisers**: Fuller use of manures, composts, and green manures is recommended. But at the very best, these can substitute only a small fraction of chemical fertilisers needed to meet the Third Plan food targets…
>
> "7. **Intensified Irrigation and Drainage Programme**: India is using only a small portion of its potential water supply, which is one of the largest in the world…… Better water management is needed.
>
>> The Team believes that *India can make greater and more immediate gains in food production by intensifying expenditure of time and effort on water management than by constructing large scale irrigation projects* which take years to develop. The Team recommends that the Third Plan allocate substantial fund for technical assistance to aid cultivators in making better use of available water. Provision must also be made for more comprehensive approach with coordination of all relevant departments. The Team also recommends that more emphasis be placed on irrigation projects which will yield rapid returns in food production, such as tube wells and shallow masonry wells.
>>
>> Millions of acres could be reclaimed and made more productive by drainage improvement. …..."

This recommendation also clearly brought out not just the method favoured by the team vis-à-vis irrigation, but also showed that there was a comprehensive alternative approach being presented.

> "8. **Selection of Certain Crops and Certain Areas for More intensive Efforts**: …*The Team recommends that those selected crops and those selected areas in each State should be chosen which have the greatest increase potentialities*…… Attention to other areas should not be reduced. But, in the national interest, the Team believes that increased effort should be immediately directed to the most responsive areas."

This recommendation was to lead to the Intensive Agricultural District Program.

> "9. **Security of Land Tenure and Land Consolidation**: Assurance of stability of tenure can contribute substantially to food production. The Teams recommendation is that land ceilings and other land reforms should be settled as quickly as possible…..Firm plans should be developed immediately to schedule the completion of consolidation of fragmented holding….
>
> "10. **Immediate Large-Scale Credit Through Cooperatives**: The present marketing, supply and credit services are major deterrents to increasing food production. Eighty five percent of credit is now supplied by money lenders and other individuals…Strong cooperatives can break these bonds….
>
> "11**. Progressive Reduction of Cattle Numbers**: The excessive animal population competes with people for the products of the land. The Team recognises the limitations imposed by beliefs concerning cattle slaughter. Other ways of dealing with the problem are possible."

What is repeatedly emphasised in the report is not only the "hardware" aspects – water and soil conservation, seeds, fertilisers, but also the "software" aspects – community mobilisation, credit and support prices, employment, coordination in works, training and so on. Another

important aspect that is stressed is that it is only a combination of all these factors that will yield the best and optimum result. This highlights that it is not just one factor like irrigation or dams that can address the food problem.[61]

Let us look in more detail at the report and the issue at hand, namely, Bhakra and projects like it. The Team, as mentioned earlier, has placed great emphasis on decentralised works. No doubt, it has mentioned *storage* projects, but a overall reading of the report clearly shows that the focus of the team was on the community based works; For example, it says[62] that "continued emphasis, therefore should be given to development of irrigation water supply through storage reservoirs and direct diversion from rivers and streams….", but after this mention, it spends the next three pages discussing implementation of wells, tanks, improvement of conveyance, proper water management bunding and terracing and so on. In the Chapter on Water Supply too, it says that[63] "In a country such as India, where much of the river flow is seasonal this requires storage either above ground or below the ground ...." .The recommendation of storage below the ground is an important indicator of its emphasis on soil water conservations schemes.

It is instructive to look at some of the recommendations of the team in detail, as it further exemplifies a decentralised approach.

> "*Contour bunding and terracing offer an immediate way to make possible tremendous increases in food production on many crores*[64] *of acres of non-irrigated arable soils*."[65] (Emphasis in original)

The report continues(Emphasis in original, throughout):

> "Although land is relatively scarce, the labour supply is abundant, and there are great potentialities for increasing production per acre…
>
> "There are many ways in which labour can be combined with relatively small capital outlays for fertilizers, pesticides, minor irrigation works, drainage and improved equipment. *From the effective combination of all these resources will come the increased food supply which India needs.* [66]
>
> "Sufficient capital must also be provided to permit the most effective use of the abundant labour resources. Chemical fertilizers, pesticides, improved seeds and other materials will have to be made available…Investments will have to be made in fertilizer plants, in tubewells and other minor irrigation works ….In this connection, it is important to note that *the ratio of capital expenditure to added output will be much less in food production than in most other enterprises, and that the increase in output will generally come more quickly from investments in food production than from investments in heavy industry or very large irrigation projects."* [67]

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[61] Certainly, the Team had its critics. Eminent economist Daniel Thorner wrote a scathing response to the Team Report in the Economic Weekly. ("*Ploughing the Plan Under – Ford Team Report on Food 'Crisis'* EW Special Number July 1959.) The main thrust of his criticism is that the Ford team created an artificial food "crisis" in turn creating a panic scenario – a "statistically contrived food crisis". This, he says, was the only way the Team could push for a complete turnaround of India's Plan thrust on industry back to agriculture – what he terms "Lathes into Ploughshares". His questioning of Ford's projections of foodgrains requirements and other figures appear to be on strong grounds. As far as we are concerned, however, what is important is that he had nowhere rejected the approach that the Team has suggested for meeting food targets. He takes issue at the targets, and the resultant shift in the focus of planning.

[62] Government of India 1959a: Page 46

[63] Government of India 1959a: Page 142

[64] On a different note, it is interesting to see the use of the term "crore" in an American Report. A possible explanation could be that the team worked closely with Indian officials.

[65] Government of India 1959a: Page 49

[66] Government of India 1959a: Page 16

[67] Government of India 1959a: Page 17

> "Equally important, improvement programmes should be tailored to fit the conditions faced by individual cultivators, village by village, block by block, and area by area……"[68]

Against this background, it is very instructive to note the views propagated by the irrigation establishment in the country. While the GMF program, the five years plans, the government policies all gave minor irrigation a significant, even equal place in addressing the food problem, the irrigation establishment was asserting that only large dams and storage projects could address India's food problems. We will digress a little to look at this important aspect.

In 1958, Kanwar Sain, often called the doyen of irrigation engineering in the country, presented a "Master Plan for Integrated Water Development" in the country. (Sain 1958). Sain, who was then the Chairman of the Central Water & Power Commission and the President of the Institution of Engineers (India), had made this presentation in larger context of the food problem of the country. Indeed, Sain had been engaged with this problem for the previous decade at least, for he refers to his presentations of 1947 on the same issue also.

This *Master Plan* makes no mention whatsoever of any means other than large dams to meet the food production needs. Nothing else is even on its horizon. Indeed, the whole Master Plan is nothing but a plan trying to show how only large dams can solve India's food problem.

The presentation says[69]:

> "In 1947, the author...emphasised the need for growing more food more quickly. Two big hurdles were mentioned by him in the effective utilisation of water potential i.e. – the need for expensive storage reservoirs and ...difficulties of financing them.
>
> "Due to mal-distribution of water and seasonal variations, construction of storage reservoirs was the only solution to evolve a satisfactory method of utilising flood waters."

Several such quotes reflect the approach that the only way to address the food problem in the country and to harness its water resources is large scale dams and storages.

When the Five Year Plans, the GMF program, the Ford foundation Report – all were not just talking about but also giving a central place to minor irrigation and other means of meeting food production targets, it is remarkable that Sain's plan for integrated water development – made specifically for increasing food production - should find no mention of these. One can understand that he may have felt these to be secondary. But what can account for their complete absence? One can only speculate on this – but this speculation may not be without a basis.

Large dams have huge costs and impacts. Many of these impacts were recognised even 50 years ago. Given all these costs and impacts, large dams would need very very strong reasons to justify their being built. Indeed, even if there was some indication that alternatives existed, it was possible that large dams would not be given preference. Hence, apart from downplaying the impacts, one important thing that large dam proponents needed to do was to somehow project their inevitability – assert that large dams and only large dams could solve India's food problem. It would have been difficult to push large dams without this aura of TINA. This seems to be the most plausible explanation of why Sain does not even mention any of the other measures for addressing water and food problems. It may be pointed out that such an attitude still persists in large sections of the irrigation establishment.

After these developments towards the end of the Second Plan, we come to the Third Plan.

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[68] Government of India 1959a: Page 18
[69] Sain 1958: Page 605

THE THIRD PLAN (1961-66)

The Third Plan (1961-66) did incorporate many of the recommendations of the Ford Team, at least in terms of stating them as a part of the agricultural strategy.[70] However, in terms of the allocations, out of a total allocation of Rs. 1281 crores for agriculture, about Rs. 599 crores was allocated to major and medium schemes, thus, effectively rejecting the core theme of the Ford team recommendations. The vast decentralised works suggested by the Team were also not included.

One of the recommendations of the Ford team that *was* adopted was the "selection of certain crops and certain areas for more intensive efforts". This was incorporated into the Third Plan as the Intensive Agricultural Districts Program (IADP). This program was important as this was to seed the decisive shift towards the policy of intensification and concentration of inputs and resource. We will come to the developments on this soon.

Tables 5.4 and 5.5 give the Third Plan outlays on agricultural production and targets for irrigation respectively.

Table 5.4: Outlays on Agricultural Production in Third Plan
(Rs. crores)

Agricultural Production	226 .07
Minor Irrigation	176.76
Soil Conservation	72.73
Cooperation	80.10
Community Development (Agricultural Programmes) .	126.00
Major And Medium Irrigation	599 .34
Total	1281 .00

Source: Para 7 Chapter 19 Agriculture, Third Plan

Table 5.5: Targets of Agricultural Programmes Third Plan

Programme	Target
Irrigation (in million acres):	
1. Major and Medium Irrigation (gross) .	12.8
2. Minor Irrigation (gross) .	12.8
(a) Agriculture	9.5
(b) Community Development .	3.3
Total	25.6

Source: Para 10 Chapter 19 Agriculture, Third Plan

Let us look at what happened on the food front during this period. The second plan foodgrains targets had not been met, and imports of foodgrains were high. The Third Plan was to prove

[70] For example, the Approach to the Third Plan noted: "The Third Plan envisages concentrated effort in agriculture on a scale calling for the participation of millions of peasant families of agricultural workers in village production plans and in large scale programmes of irrigation, soil conservation, dry farming, afforestation and the development of local manurial resources…" Chapter 4, *Approach to the Third Five Year Plan*, Third Five Year Plan:Para 4
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/3rd/3planch4.html
Accessed: Nov. 12, 2002

even more of a disaster as far as foodgrains was concerned. The Third Plan had set a target of foodgrains production of 100 m tons by 1965-66, starting from a base of 76 m tons in 1960-61.[71] However, except for years 1964-65, the production remained consistently below that achieved in the last year of the second plan. At the end of the Third Plan (1965-66), the foodgrains production was 72.35 m tons[72]. Foodgrains (cereals) imports reached sky-high to 10 m tons in 1966.

This is how the Fourth Plan document describes it[73]:

> "7.10. Agricultural production has followed an erratic trend. After relative stagnation in the first three years of the Third Plan, there was a marked increase in 1964-65 when the output of practically crops (sic) reached new record levels. The aggregate index of production in this year was 159.4 (1949-50= 100) about 12 per cent higher than in 1960-61. The subsequent two years witnessed a precipitous fall of production on account of unprecedented drought, in 1965-66 food grains production fell by 20 per cent."

This then was broadly the picture at the national level from the First to the Third Plan.

DEVELOPMENTS IN PUNJAB AND HARYANA

Let us now briefly digress to look at what was happening in Punjab and Haryana during this period.

Figure 5.1 shows the area under cultivation of foodgrains and production of foodgrains for unified Punjab[74] (today's Punjab and Haryana) as a percentage of all India during 1950-51 to 1962-63.

In 1950-51, unified Punjab had about 6.13% of India's area under foodgrains and it was producing 6.85% of the country's foodgrains output. What is interesting is all through the next 12 years this ratio remained more or less constant or increased marginally. What this means is that the food production in Punjab and Haryana showed no extraordinary increase over the all India performance. Thus, 10 years after Bhakra-Nangal project had become operational, agriculture in Punjab and Haryana had not shown any exceptional performance. Bhakra had not done anything dramatic in 10 years.

In terms of actual production, the production of foodgrains in (unified) Punjab increased from 3.483 m tons to 5.932 m tons from 1950-51 to 1962-63. The area under foodgrains in Punjab during this period went up from 5.96 m ha to 7.27 m ha. Thus, while the area increased 1.217 times, the foodgrains production increased 1.7 times. The same figures for all India were 1.21 and 1.57.

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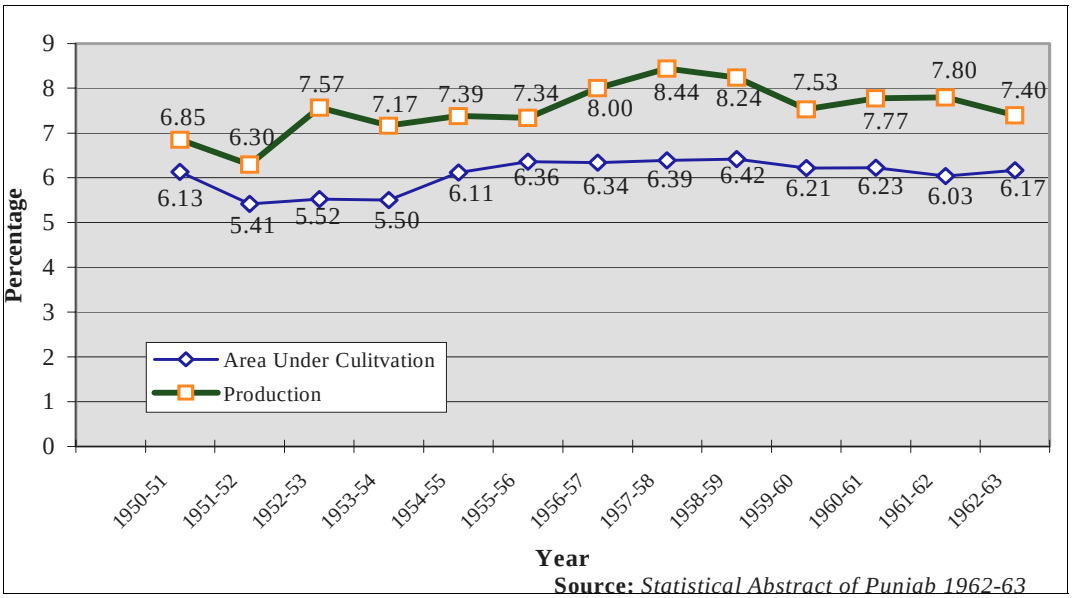
[71] Chapter 19: *Agriculture*, Third Five Year Plan: Para 33
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/3rd/3planch19.html
Accessed: Nov. 12, 2002

[72] Figures from Statistics At a Glance, Ministry of Agriculture, Government of India; at
http://agricoop.nic.in/statistics2003/chap4a.htm#chap45a
Accessed on Oct. 7, 2004.

[73] Chapter 7: *Agriculture*, Fourth Five Year Plan: Para 7.10
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/4th/4planch7.html
Accessed: Dec. 17, 2003

[74] This includes Haryana, Punjab and PEPSU territories

Figure 5.1: Production and Area Under Cultivation of Foodgrains as a Percentage of All India for Unified Punjab and Haryana



Source: *Statistical Abstract of Punjab 1962-63*

The rather ordinary performance of the two states in this period is seen clearly when we look at the contribution in the later years. Figure 5.2 at Annexure I to this Chapter presents the graph 5.1 extended to year 2001.

The Third Plan introduced the Intensive Agricultural District Program (IADP) in 1961 at the recommendation of the Ford team. One district was to be chosen in each state – districts "which have the greatest increase potentialities".[75]

These meant the districts most highly endowed in natural resources – including "assured water supply"[76] and most highly developed infrastructure.

It was started in three districts and eventually extended to another thirteen. As mentioned earlier, this program was to provide the seed for the new strategy.[77]

While many a times the proponents and advocates who herald Green Revolution proposes a link between mega irrigation projects and green revolution, a closer scrutiny will reveal that while selecting areas for implementing Intensive Agricultural District Programme, it was kept in mind that the area should have well developed assured water supply, it didn't specifically meant that the area should have been under the command of mega irrigation projects.

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[75] Chapter 19 *Agriculture*, Third Five Year Plan: Para 32

[76] Government of India (undated); *Report on the Intensive Agricultural District Programme 1961-63*; Expert Committee on Assessment and Evaluation, Ministry of Food and Agriculture, Government of India. Page 6 [Year of Publication appears to be 1964]

[77] The IADP is many times thought of as the pre-cursor of the Green Revolution. This is not accurate, for, though the Green Revolution built on and demanded the strategy of intensification, this strategy itself had evolved independently and before the Green Revolution, of which the IADP was an important milestone. Possibly because the IADP was started in Ludhiana, a district that was at the forefront of the Green Revolution, and because the start of Green Revolution dovetailed into the final years of the IADP, it seemed to be a natural evolution. This was an incorrect picture, though both shared the strategy of intensification and concentration. We will talk of this more in the next Chapter.

The district chosen in Punjab was Ludhiana. While Ludhiana was in the command of Sirhind / Bhakra, actual irrigation in the district was overwhelmingly from wells and tubewells. (Still is) In 1962-63, Ludhiana had a 49% of its net sown area irrigated – a total of 332000 acres. Out of these, 271000 were irrigated by wells and only 61000 by canals[78] (18.37%).

THE STRATEGY SHIFT: SOME REASONS

The IADP was to be an important point of divergence for Indian's food and agricultural policy. On one hand, the policy was claiming to be based on community development as the key to agricultural development. On the other hand, the basic logic of IADP was to focus on the areas well-endowed – in terms of water, soil, infrastructure, and within these well-endowed areas on the better off farmers. In general it represented a more technology driven approach.

Dasgupta (1977: 247) says

> "The cornerstone of the new agricultural strategy of 1963, was its selective approach: selective of areas endowed with a favourable infrastructure, and within these areas the selection of 'progressive farmers' (who were usually larger farmers) for the distribution of inputs... The selective approach of the new agricultural strategy stood counter to the declared objectives of the community development or co-operative movement of involving the masses in rural development. It presented a technical solution to the country's food problem and bypassed the institutional issues. Rather than smashing or even weakening the village power structures through land reforms and other measures, attempt was made to enlist their support to the exclusion of the rest of the village population."

Indeed, it seems that by the time the Third Plan was over, Indian planners and implementers had almost given up on the community and co-operative based approach. The absence of land reforms, the bureaucratic machinery and lack of political will to implement the community based model amounted to a virtual renegation of the vision of the early years of Independence - a vision focussed on the community driven development.

The problems of a bureaucracy implementing the community development were seen early on.

The Congress Agrarian Committee (1951: 44) had remarked while emphasising the role of village community in ensuring the agricultural development and food security:

> "Indian agriculture will remain spread out, manned by millions of persons, and to make the social will effectively felt by the people in distant parts, the village community is the one and only instrument. The intimacy of touch, without which no reform or no legislation can produce any effect, can be secured only through village community... The present food scarcity in spite of 'Grow More Food Campaign', in spite of committees and commissions, and our wandering about with a begging bowl have proved to the hilt the complete failure of the centralised bureaucratic method."

The Grow More Food Enquiry Committee in 1952 reported that the program "had not aroused expected enthusiasm or effect in the countryside."[79]

One of the greatest political satires of Hindi literature, the brilliant, hard hitting and side-splittingly funny classic *Raag Durbari* brings this out in its own inimitable style. This excerpt talks about how the Grow More Food campaign was undertaken in Shivpalgunj, the village in which the novel is set.[80]

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[78] Statistical Abstract of Punjab 1962-63
[79] Government of India 1957a: Page 28
[80] Shukla, Srilal 1968: '*Raag Darbari*', Rajkamal Prakashan, New Delhi: Page 57-58

> ''उन दिनों गांव में लेक्चर का मुख्य विषय खेती था। इसका यह अर्थ कदापि नहीं कि पहले कुछ और था। वास्तव में पिछले कई सालों से गाँव वालों को फुसलाकर बताया जा रहा था कि भारतवर्ष एक खेतिहर देश हैं। गाँववाले इस बात का विरोध नहीं करते थे, पर प्रत्येक वक्ता शुरू से ही यह मानकर चलता था कि गाँववाले इस बात का विरोध करेंगे। इसलिए वे एक के बाद दूसरा तर्क ढूँढकर लाते थे और यह साबित करने में लगे रहते थे कि भारतवर्ष एक खेतिहर देश है। इसके बाद वे यह बताते थे कि खेती की उन्नति ही देश की उन्नति है। फिर आगे की बात बताने के पहले ही प्रायः दोपहर के खाने का वक्त हो जाता.....कभी–कभी कुछ वक्तागण आगे की बात भी बता ले जाते थे और तब मालूम होता कि उनकी आगे की और पीछे की बात में कोई फ़र्क नहीं था, क्योंकि घूम–फिरकर बात यही रहती थी कि भारत एक खेतिहर देश है, तुम खेतिहर हो तुमको अच्छी खेती करनी चाहिए, अधिक अन्न उपजाना चाहिए। प्रत्येक वक्ता इसी सन्देह में गिरफ़्तार रहता था कि काश्तकार अधिक अन्न नहीं पैदा करना चाहते।''
>
> ''लेक्चरों की कमी विज्ञापनों से पूरी की जाती थी और एक तरह से शिवपालगंज में दीवारों पर चिपके या लिखे हुए विज्ञापन वहाँ की समस्याओं और उनके समाधानों का सच्चा परिचय देते थे। मिसाल के लिए, समस्या थी कि भारतवर्ष एक खेतिहर देश है और किसान बदमाशी के कारण अधिक अन्न नहीं उपजाते। इसका समाधान यह था कि किसानों के आगे लेक्चर दिया जाये और उन्हें अच्छी–अच्छी तस्वीरें दिखायी जायें। उनके द्वारा उन्हें बताया जाय कि तुम अगर अपने लिए अन्न नहीं पैदा करना चाहते तो देश के लिए करो। इसी से जगह–जगह पोस्टर चिपके हुए थे जो काश्तकारों से देश के लिए अधिक अन्न पैदा कराना चाहते थे। लेक्चरों और तस्वीरों का मिला–जुला असर काश्तकारों पर बड़े ज़ोर से पड़ता था और भोले–से–भोला काश्तकार भी मानने लगता था कि हो–न–हो, इसके पीछे भी कोई चाल है।''
>
> ''शिवपालगंज में उन दिनों एक ऐसा विज्ञापन खासतौर से मशहूर हो रहा था जिसमें एक तंदुरूस्त काश्तकार सिर पर अंगोछा बाँधे, कानों में बालियाँ लटकाये और बदन पर मिर्जई पहने गेहूँ की ऊँची फसल को हँसिए से काट रहा था। एक औरत उसके पीछे खड़ी हुई, अपने–आपसे बहुत खुश, कृषि–विभाग के अफ़सरोंवाली हँसी हँस रही थी। नीचे और ऊपर अंग्रेजी और हिंदी अक्षरों में लिखा था, ''अधिक अन्न उपजाओ।'' मिर्जई और बाली वाले काश्तकारों में जो अंग्रेजी के विद्वान थे, उन्हें अंग्रेजी इबारत से और जो हिन्दी के विद्वान थे, उन्हें हिन्दी से परास्त करने की बात सोची गयी थी, और जो दो में से एक भी भाषा नहीं जानते थे, वे भी कम–से–कम आदमी और औरत की तस्वीर देखते ही वे उसकी ओर पीठ फेरकर दीवानों की तरह अधिक अन्न उपजाना शुरू कर देंगे।''

Writing about the Indian efforts to implement its food and agricultural programs, Michel observed that[81]:

> "India's most ambitious attempts to come to grips with her agrarian problems took the form of the community development program which was inaugurated in October 1952…….
>
> "(It)… was launched with a great deal of enthusiasm…But even by 1957 it had become apparent that all was not going well. ….the program was becoming a top-down or super-imposed affair. Too many village level workers were assuming the role of managers or even petty dictators…."

It was then attempted to put in place the *Panchayati Raj* system with the village *panchayats* as the primary vehicles of development. The Third Plan documents states[82]:

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[81] Michel 1967: Page 436-439
[82] Chapter 4 *Approach to the Third Five Year Plan*, Third Plan : Para 4

> "With the establishment of democratic institutions at the district, block and village levels, responsibility and initiative in economic and social development in rural areas will rest increasingly with popular organisations—with *Zila Parishads, Panchayat Samitis* and Village *Panchayats* and with co-operatives. In the pattern of rural development, service cooperatives are to be organised on the basis of the village community as the primary unit. …
>
> "The Third Plan envisages concentrated effort in agriculture on a scale calling for the participation of millions of peasant families of agricultural workers in village production plans and in large scale programmes of irrigation, soil conservation, dry farming, afforestation …."

While this was stated on one hand, on the other side, it seems that the ground was also being laid to move away from this. The Third Plan document says[83]:

> "The principal advantages of minor irrigation works are that they can be executed quickly, entail small outlays and there is only a short lag between their completion and the realisation of benefits. Moreover, they can be undertaken at the initiative of individuals and small groups and offer scope for participation by the community. *Yet, it has been observed that minor irrigation programmes are tending increasingly to develop as programmes for small-scale irrigation works executed by Government agencies with little voluntary labour or participation by the people.* It is of the utmost importance that for the greater part minor irrigation should be developed in all States as essentially a community programme in which local contributions in money and labour are specially stressed. *When the scale of the minor irrigation programme becomes large, it involves problems of organisation, investigation and utilisation which may in some ways be even more difficult than those which arise in the case of larger irrigation works."* (Emphasis added)

Given the hugely complicated logistics, planning and management of the decentralised approach, the contradictions inherent in the centralised management of a decentralised program, not to say the problems of taking harsh decisions like land reforms that would upset the elites – it is hardly surprising that the Government started finding it easier to implement the large-scale projects than the community driven decentralised ones. This was true in general not just of the minor irrigation schemes, but also of the whole community based/ driven programs.

Further, the bias towards marketable surplus – inherent in many ways in the nature of the Indian ruling class - also was driving the food policy away from the community based to one that would enhance the "visible" component of the food production. This was an important reason for the shift towards projects that concentrated efforts in limited areas through technology and capital intensive programs.

It was not only the huge logistics, or the focus towards market, or a bureaucracy that was not able / willing to be "servant of the people" or too many interests preventing full land reforms; the larger projects offered huge possibilities for corruption. The deterioration in the system was rapid[84].

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[83] Chapter 19 *Agriculture*, Third Five Year Plan: Para 12

[84] When we spoke to the oustees of the Bhakra project who faced displacement in the late 40s and early 50s, they told us forcefully that there was no corruption in the payment of compensation – whatever the other problems there may have been. Yet, corruption was to grow to be a huge menace in public life and public work in a big way soon. Well known theatre personality Gursharan Singh described the downfall with great feeling and frustration to us in Chandigadh. He was a cement technologist and was in the research laboratory at Bhakra from 1951 to 1962. He talked about how there was great enthusiasm and feeling of national pride at that time. But this, he said was till about 1958-59- after that, the corruption increased hugely, and the wave of national pride also subsided.

Both, the push and pull factors were against the community and decentralised approach. Thus, in spite of the strong and numerous recommendations in favour of decentralised, community drive approach, the Third plan did not adopt the same, choosing to focus instead on large-scale projects.[85]

1961 - THE PACKAGE PROGRAM AND NEW AGRICULTURAL STRATEGY

We have seen above that the IADP was introduced in selected districts of the country in 1960-61 as a part of the recommendation of the Ford Team.

The Recommendation of the Agricultural Production Team (Ford Team) to focus on selected districts was considered by a high-level Inter-Ministries Committee of the Government of India in June 1959 and was accepted in principle. To give precise shape to the recommendations, a second team of agricultural experts, sponsored by the Ford Foundation visited India in October 1959. This team, in consultation with the experts of the Central and State governments outlined a program for the intensive and coordinated approach to agricultural production in their report titled "Suggestions for 10 Point Pilot Programme to Increase Food Production".[86]

The Intensive Agricultural District Programme, popularly know as the "Package Program" was developed from this.

> "It envisages the selection of favourable areas with maximum irrigation facilities and minimum of natural hazards, providing simultaneously all the essential elements, such as full supplies, credit etc. needed to increase agricultural production…..
>
> "In the districts selected…all the elements required for increasing production are to be simultaneously provided….
>
> "The means through which production increases are sought to be achieved.. …include many of the known methods and practises. What is *new* in the programme is the *collective application* of these in optimum doses, backed by adequate technical guidance and financial resources…."[87] (Emphasis added)

Ford Foundation agreed to fund parts of the scheme provided it was taken up in one district each in seven states – four predominantly rice growing, two wheat growing and one millet growing. The outline scheme was considered at a meeting of the Agricultural Secretaries of these states held on 27th October 1959 and was generally accepted for implementation. The Government of India approved it on 11 June 1960. It was made a part of the Third Plan.

This program - formulated as a Five Year project - was initially started in 7 districts in the country and then extended to a total of 15 – one in each state.

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[85] It may however, be mentioned that unlike popular belief, small and minor irrigation continued to play a major role in the country, and even today the position is the same. In 1950-51, total area irrigated (net) in the country was 51.5 m acres, out of which 29.5 was by minor and 22 from major irrigation. For 1960-61, the figures were total 70 m acres, minor 39 m acres and major 31 m acres. (Third Plan, Chapter 24, Irrigation). However, increasingly minor irrigation has come to mean tubewell extraction based on groundwater. The wide spread community driven water harvesting schemes that included soil, water and vegetation management did not get the kind of place suggested. In 1990-91, tubewells accounted for 30% of the irrigation in the country, and along with wells for 51%. (http://planningcommission.nic.in/data/stat/statistics3.pdf Accessed on Nov.10, 2004)

[86] Government of India (undated); *Report on the Intensive Agricultural District Programme 1961-63*; Expert Committee on Assessment and Evaluation, Ministry of Food and Agriculture, Government of India. Page 2

[87] Government of India (undated); *Report on the Intensive Agricultural District Programme 1961-63*; Expert Committee on Assessment and Evaluation, Ministry of Food and Agriculture, Government of India. Page 3-4 The same document later describes this "package concept" as the "distinctive feature" of the IADP (Page 197)

The first seven districts and states are shown in the table.

District	State
Thanjavur	Madras
West Godavari	Andhra Pradesh
Shahabad	Bihar
Raipur	Madhya Pradesh
Aligadh	Uttar Pradesh
Ludhiana	Punjab
Pali	Rajasthan

The IADP signified a major departure in the stated policy of the Government of India from that of widespread community based approach to a concentrated, intensification approach. This approach came to be called the New Agricultural Strategy.

In terms of practises and technologies, the IADP did not introduce anything very new. What was unique about the IADP was the concentration of inputs in a few selected areas – which were already well endowed, and the *package* aspect. The Ford team, and numerous other experts had emphasised that the practices available even at that time – improved seeds, fertilisers, agricultural machinery etc. – would give the best result when applied as a combination rather than separately. The IADP tried to do precisely this. However, in concentrating on selected districts, an important part of the Ford Team's recommendation seems to have been lost sight of – "Attention to other areas should not be reduced".

The IADP – and its basic premise - did not go unchallenged. For example, Dantawala, during a series of Lectures on 22-24 March 1960 had this to say in context of the Ford Team recommendation that led to the IADP [88]:

> "A careful analysis of production performance has revealed that a certain limited number of districts makes a major contribution to increased agricultural production. It was therefore felt that for achieving quick results – which the 'crisis' calls for – it may be advisable to concentrate efforts on such areas as have shown the largest potential...[However]...It is a problem not merely of production but also welfare. As such, our efforts have to be steady and pervasive rather than spectacular and selective. A critical minimum program of co-operative service and extension has to be operated in all areas. Besides, it is a moot point whether for the purpose of increasing aggregate production, resources in short supply yield better results when applied extensively or intensively."

In fact, Dantawala points out that the Ford Team also realised it. Thus, the Ford team recommendation of the concentration on selected districts was only a small part of a much larger plan.

The IADP was effective only to a limited extent. The Government of India Report on the IADP had taken notice of this early on when it had noted "crop-cutting experiments do not show any startling increases in production"[89].

In 1966, at the end of the programme, the Government of India set up an *Expert Committee on Assessment and Evaluation of the Intensive Agricultural District Program*, headed by S.R. Sen. This Committee found

> "…the basic concept of the Programme has proved to be essentially sound. ….the results do not show uniform success in all the districts, in most cases, the failure could

[88] Dantawala 1961: Page 31. M.L. Dantawala then was the Head of the Department of Economics at the University of Bombay, and he had been called by the Indian Council of World Affairs to deliver 3 lectures on "India's Food Problem".

[89] Government of India (undated); *Report on the Intensive Agricultural District Programme 1961-63*; Expert Committee on Assessment and Evaluation, Ministry of Food and Agriculture, Government of India. Page 204

> be attributed to the shortcomings of the administrative system and inadequate supply of the essential inputs." [90]

In more detail:

> "…the Programme has been able to achieve substantial increase in agricultural production in almost all the districts [but]…..an analysis of the per unit yield obtained for the important food crops in the IADP districts shows that only in three districts, the yields have gone up appreciably while in the remaining districts they are more or less static. …… the performance of many of the control blocks (selected for the comparative assessment of the impact of the Programme) has turned out to be better compared to the yields obtained in the IADP districts."[91]

Ludhiana was one of the districts that performed better than the control district, especially in wheat.

In spite of the mixed results of the program and the criticism of the selective approach, the Government decided to extend the program.

The Fourth Plan Document Notes[92]:

> "7.2. The first stage of the new strategy pertained to the Intensive Agricultural District Programme. It was started in 1960-61 in three districts and was subsequently extended by stages to another thirteen. *While the performance varied*, it clearly demonstrated both, the value of the "package" approach and the advantage of concentrating effort in specific areas. In 1964-65 and subsequent years, a modified version of the same approach was extended to several other parts of the country in the form of the Intensive Agricultural Area Programme." (Emphasis added)

The IADP was extended to more than a 100 districts in the form of the IAAP, with a proposed selection of 32 million acres (13 m ha) under foodgrains in these districts for special attention along the lines of the package program.

With the IADP, we come to the end of an important phase in India's agricultural and foodgrains production. These first 15 years of planned development saw many ups and downs in the production of food grains. The First Plan raised hopes that food self-sufficiency was around the corner; the Second and Third plan periods dashed the hopes to ground. The stated policy included community based and community development approach, land reforms, minor irrigation and so on, but the political will behind this and its implementation on the ground left much to be desired. The Third Plan period saw a shift of the policy towards selectivity, and a beginning of an increasing reliance on high technology, high capital approach to increasing food production.

Food production did increase over this period, though in a manner fluctuating between highs and lows. Food imports reached their peak in 1966. In over 10 years of functioning, the Bhakra project had done little that it is now attributed with. There was nothing dramatic about the performance of the foodgrains production – nothing *revolutionary*. Indeed, that there was nothing remarkable about this period is signalled by the term that came to be commonly used for the next phase – the Green Revolution. Collins dictionary defines "revolution" as "far reaching and drastic change". We look at what this entailed, in the next chapter. ✍

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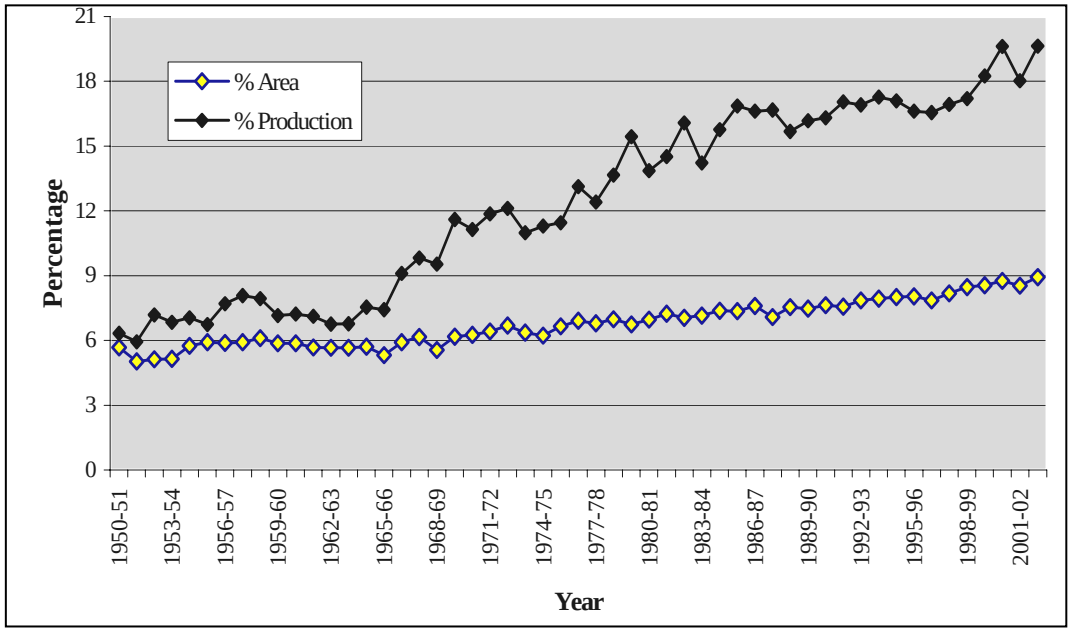
[90] Anon 1966b: '*IADP: What Holds it Down Official Paper – Report of the Expert Committee on Assessment and Evaluation of the Intensive Agricultural District Programme, Government of India, 1966'*, in Economic and Political Weekly, Sept. 17, 1966

[91] Anon 1966b

[92] Chapter 7 *Agriculture*, Fourth Five Year Plan, 1969-74: Para 7.2
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/4th/4planch7.html
Accessed: Dec. 17, 2003

CHAPTER 5: ANNEXURE I

Figure 5.2: Production and Area Under Cultivation of Foodgrains as a Percentage of All India for Punjab and Haryana



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6

Food Production and Bhakra Phase II – The Green Revolution

"Until the early sixties no social scientist had suspected the possibility of a Green Revolution; …the Green Revolution in India not only took place rapidly but also came in quite unexpectedly."

Pratap Aggarwal
The Green Revolution and Rural Labour, 1973


मॉडल
2002
मलैया
सीड ड्रील

Food Production and Bhakra
Phase II – The Green Revolution

1966 AND BEYOND

THIS PHASE BEGAN WITH A DECISION TO EXTEND THE IADP TO OTHER PARTS of the country. We have already seen that the IADP itself gave mixed results. There was little reason to believe that the extension would produce anything different. Indeed, there was apprehension that the extension to other districts would result in decline in the performance, since the best and most well endowed districts had already been selected in the First Phase – the IADP. Further, one of the key factors identified for the mixed performance of the IADP was the shortage of inputs. With the extension, this shortage was likely to worsen.

However, the next few years brought something else. There was a rapid increase in the foodgrains production from the low of 72.35 m tons in 1965-66 to a bumper, never before harvest of 108.42 m tons in 1970-71. Imports declined to 2 m tons in 1971.

So dramatic was this increase that a new term entered the lexicon – the Green Revolution.

It is crucial to understand this period and the factors that resulted in this "green revolution", for the Bhakra project is overwhelmingly credited, or associated with the Green Revolution. Yet, we see that the Green Revolution came into being around 12 years after the irrigation from the Bhakra Nangal project had begun.

At the core of the Green Revolution was a new breed of seeds. Improved and better seeds had always been a part of the attempt to increase agricultural productivity and production in India. However, in 1965, new varieties of seeds imported from Mexico were launched in India. So dramatic was the performance of these seeds – popularly known as High Yielding Varieties (HYV) that they were widely called the "miracle seeds".[1]

These seeds can more accurately be described as High Response Seeds. The traditional seeds had a problem – they responded poorly to chemical fertilisers. In response to high doses, they grew rapidly beyond the desired height and tended to lodge easily. Thus, they could accept only limited doses of fertilisers and this limited their yield. The new dwarf varieties got around this problem, and hence could take up much higher levels of fertilisers. This high responsiveness of the seeds to fertilisers was responsible for their "miraculously" high yields.

The yields were dramatic indeed. The following illustrates this.

> "In 1966-67, the average yield of local wheat varieties was 2,108 pounds per acre, a little less than 10 quintals. During the same year, those farmers who adopted the Mexican varieties…achieved an average yield of 4,235 pounds per acres, about 20 quintals or exactly twice the first amount. …On the average, therefore, Ludhiana farmers who adopted the high-yielding varieties in 1966-67 doubled their output, and

[1] The seeds were introduced in some areas a little earlier.

> in one swoop, increased their net income by over 70 percent."[2] [Since the input costs also went up]

So powerful was this phenomenon and the associated demonstration effect that in Ludhiana, between 1966-67 and 1967-68, the area growing the Mexican variety of wheat jumped from 18,000 acres to 245,000 acres and in the next year covered virtually all the wheat growing area – 420,000 acres out of 450,000 acres.[3]

The Fourth Plan Document notes this development:

> "7.3. While both the Intensive Agricultural District and Intensive Agricultural Area Programmes were concerned with the promotion of intensive agriculture, they operated within the limitations set by existing crop varieties which had relatively low response to fertilisers. A major change occurred with the introduction of the high-yielding varieties. …. Hybrid seeds began to be widely adopted by 1963…… On the eve of the Fourth Plan[4], the coverage estimated was 9.2 million hectares.
>
> 7.4. The high yielding varieties programme has so far been taken up for five crops, namely, wheat, paddy, bajra, maize and jowar. Among these crops, the most striking success has been achieved in wheat. In some of the dwarf varieties, a yield of 5 tonnes per hectare has been recorded in farmers' fields as against a normal yield of about 2 tonnes in irrigated areas……"[5]

The HYV seeds brought in a whole new set of practices along with them – rather they demanded it, for these were pre-requisites to their productivity and performance. First of all, these seeds required very high inputs of fertilisers – for this was the key to higher yield. Secondly, since these varieties were more susceptible to pests they needed much higher levels of pesticides and plant protection measures. The high inputs meant that the farmer needed more money to purchase the same – and hence there was need for much higher agricultural credit. The higher investment also meant increased risks for the farmers, and to help the farmer avoid this risk, the mechanism of minimum support price and full assured procurement had to be put in place.

Another important development took place with these seeds. Many of these seeds were developed with shorter growing period. This was a key to allow multiple cropping. Sometimes, it is believed that water was the only constraint to allow double cropping (i.e. two crops a year). However, in many cases, the bottleneck has been that the first crop is of long duration and this does not leave time for the next crop to grow. The new seeds with shorter growing periods allowed multiple cropping to take place. This, however, also brought in demands like need to rapidly harvest and clear fields for the second sowing. This was part of the reason for agriculture machinery.

Last, but not the least – was water. The new varieties were highly sensitive to water and needed water at critical times. The quantity (too less or too much both were bad) and the timing were crucial. We will analyse this factor in detail later on.

Thus, the HYV, to perform to its fullest, need a package of measures – chemical fertilisers, pesticides, machinery, assured and controlled water, credit, MSP, procurement etc.

With the coming of HYV, there was considerable optimism in the country and it was felt that at last the goal of food self-sufficiency was in sight. However, the HYV program was not

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[2] Frankel R. F 1971: '*India's Green Revolution: Economic Gains and Political Costs*', Princeton University Press, Princeton, New Jersey : Page 24

[3] Frankel 1971: Page 24

[4] i.e. 1968

[5] Chapter 7 *Agriculture*, Fourth Five Year Plan; Planning Commission of India 1969
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/4th/4planch7.html
Accessed: Dec. 17, 2003

without problems. There were two major worries that were expressed at the time. One was the relative failure of the HYV program among non-wheat crops; the second related to the growing inequality in the countryside largely because of early adoption of new varieties by larger farmers and the institutional bottlenecks that were preventing the small farmers from participating in the program.[6]

More important was the doubt whether the HYV led growth really marked the end of food problems. As Dasgupta notes[7]:

> "Despite the impressive performance of the new varieties in some regions, there was no solid statistical foundation for the uncontrolled optimism of the government in early seventies…As the Agricultural Price Commission ..in 1970-71 noted…… there seems little basis here for the inference that the foodgrain output of the country in recent years has moved away to a higher growth path…."

An interesting observation by Dasgupta is that in 1970-71 (the year the APC made its above observation)[8]

> "…most of the 8.3 m tons increase of that year came from states poorly endowed with irrigation water and which had not been subjected to the new technology: Rajasthan (4 m tons), Bihar, M.P. and Gujarat (another 2.7 m tons). In contrast, the production increase in Punjab, the heartland of the new technology was no more that a hundred thousand tons in that year….
>
> "Taking the entire HYV period into account, including the latest and the best year [1975-76] the rate of growth in food production (at 2.5 per cent a year) is less than the historical growth rates during the pre-HYV period with a less advanced technology."

The period 1972-75 saw once again production go down sharply and imports went up to 7.41 m tons in 1975.

If this was the experience with the food production after the introduction of the HYV seeds, it is an important question as to what led this being called the green "revolution". This itself would be a fascinating study of how public perceptions are shaped; however, to go into it at this point would be a distraction. It would be safe to hazard a guess that the initial performance in wheat seems to have been so dramatic that some enterprising journalist or a *babu* coined the word "green revolution". Whether the performance in the rest of the sector was indeed much different from previous years become a bypassed question even as the term stuck.

The initial performance of the HYV seeds had a profound impact on the agriculture strategy. There was a gap of three years between the end of the Third Plan and the beginning of the Fourth Plan. The HYV seeds came in during this gap. The Fourth Plan Document notes[9] (emphasis added):

> "The eight years between the commencement of the Third Plan and the Fourth have been years of great significance for Indian agriculture……The farmer responded favourably to a combination of good prices, high-yielding seeds and adequate fertilisers. He took to improved farm practices as readily as to non -traditional farm input. Ground water was put to intensive use. Institutional credit was sought to be expanded. *In view of the urgency of the need, it was decided to direct state effort in the first instance to those areas which were best endowed for food production. This was the basis of what has come to be known as the new strategy of agricultural development.*

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[6] See, for example, Dasgupta, Biplab 1977b: *'India's Green Revolution'*, in Economic and Political Weekly Annual number February 1977

[7] Dasgupta 1977b

[8] Dasgupta 1977b

[9] Chapter 7 *Agriculture*, Fourth Five Year Plan

> "7.2. The first stage of the new strategy pertained to the Intensive Agricultural District Programme…..While the performance varied, it clearly demonstrated both the value of the "package" approach and the advantage of concentrating effort in specific areas….
>
> "7.5. The new strategy is concerned not only with higher yield but with greater intensity of cropping. Entirely new crop rotations have been made possible by the development of short duration varieties….
>
> **"**7.6. In recent years, new emphasis has come to be attached to the role of agricultural technology as a major input of agricultural production….
>
> **"**7.7. In view of the importance assumed by inputs and services such as improved seeds, chemical fertilisers, plant protection, implements and machinery, irrigation facilities and agricultural credit, several new public institutions were promoted and provided with funds to lend support to agricultural production programmes."

These essentially outlined the elements of the new strategy. At the core of this was the approach of selecting the best endowed areas so as to maximise production. An important aspect of this was the expectation that such an approach would allow maximum procurement of surpluses. Hence, note the reference in the first paragraph in the quote above to the "good prices". This was an essential part of the new strategy, and was to have profound implications, which we will see in detail later. We may just mention here two important issues.

The first issue was that if the policy aim was to maximise production in selected areas, then this raised the problem of transferring the surplus production to people in rest of the country. This required that either the people in the other parts were able to purchase the production (hence had to have purchasing power), or the Government would have to subsidise this.

The second issue was related to the "endowments" of the well endowed areas. We shall look at this specifically in terms of water and irrigation. Clearly, some areas are naturally well endowed – like the high rainfall areas. In the other areas, endowment can be created by creating irrigation or water retention capacity. Thus, the irrigation and water policy can decisively influence which areas *become* "well endowed". If there is a policy that encourages large centralised projects that benefit selected parts, then these become the better off parts and the concentration of agricultural inputs would follow. If the water policy encourages the wide-spread decentralised water harvesting schemes that we have seen mentioned earlier, this means that the "well endowed" areas would be spread out extensively all over the country. If the agricultural efforts follow this spread out pattern, then the issue of distribution could be considerably eased.

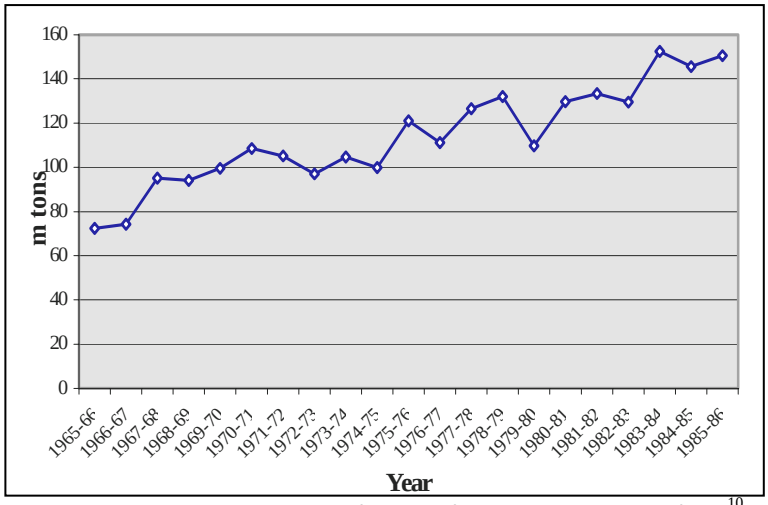
We will come back to these issues later on.

What did the next couple of decades after the introduction of the HYV bring?

Figure 6.1 shows that the food production increased steadily in these two decades, albeit with occasional fluctuations.

There was an almost exact doubling of food production in these 20 years – an annual compounded growth rate of about 3.73 %. It may be pointed out that the area under foodgrains in the same period went up from 115.1 m ha to 128.02 m ha. The percentage of this area under irrigation went up from 20.9% to 31.4 %.

Figure 6.1: Foodgrains Production All India from 1965-66 to 1985-86



Source: *Web site of Ministry of Agriculture, Government of India*[10]

There were several serious issues raised in the context of the green revolution –some of them raised in the early years itself, some as experience accumulated. Some of the important concerns included:

1. The rather lacklustre performance of the non-wheat crops: This was a concern in the early years of the GR but some of this was addressed with the developments that followed subsequently especially in rice.
2. Inequities that would follow: This was a concern since the new strategy of intensive cultivation required high inputs and had a higher risk – and so there was concern that the big farmers would benefit much more and the small farmers would not gain so much, or be even left out altogether.
3. There were serious issues of regional imbalance raised – this was part of the ongoing debate of concentrated versus decentralised agricultural strategy.
4. Serious concern was raised at the ecological consequences of the new strategy – it is interesting that these were raised in the seventies itself.[11]
5. The heavy mechanisation involved in the new strategy led to the question of whether this would displace labour and lead to massive unemployment.

We will not go into these issues at this point – and it may also be pointed out that there is a vast amount of literature on all these issues concerning the Green Revolution. It is also not our brief here to critically analyse the Green Revolution phenomenon. What is important for us is whether this really led to the *lasting and sustainable* increase in foodgrain production, and what was the role played by the Bhakra project in the same. We will look at the above concerns of the Green Revolution to the extent that they pertain to our enquiry.

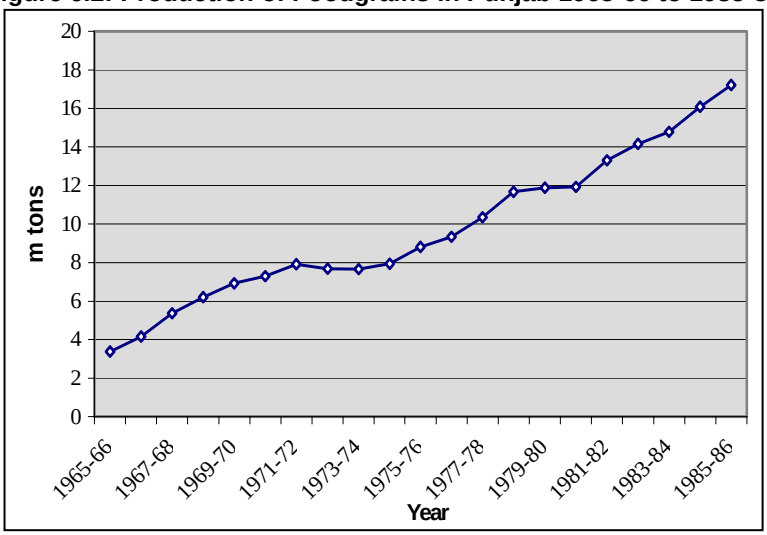
It may be pointed out here that while the Green Revolution needed intensification, the two were separate things. The strategy of intensification, as expressed in the IADP, was in place before the GR. This should also be called the strategy of selectivity or concentration, as the idea was to concentrate inputs into selected areas. The Green Revolution came with the advent of the new HYV seeds, and needed intensification of inputs to succeed.

[10] http://agricoop.nic.in/statistics2003/chap4a.htm#chap45a Accessed 7 Oct 2004
[11] See for example, Dasgupta 1977a

PUNJAB AND HARYANA

Let us shift our attention now to Punjab and Haryana. What was the performance in Punjab and Haryana in the same period? The Figures 6.2 and 6.3 illustrate the same.

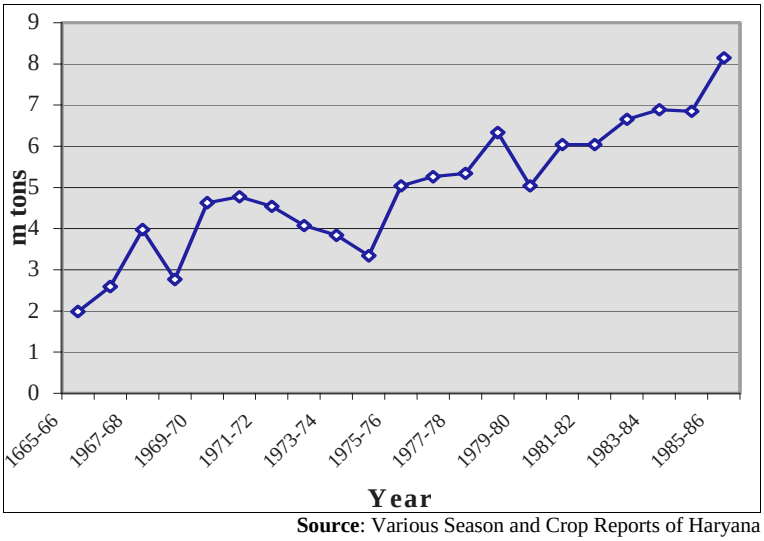
Figure 6.2: Production of Foodgrains in Punjab 1965-66 to 1985-86



Source: Various Statistical Abstracts Punjab

In Punjab, the foodgrains production went up from 3.389 million tons (m tons) in 1965-66 to 17.221 m tons in 1985-86 – an increase of five times in 20 years, or an annual compounded growth of 8.47% for 20 years running! Thus, production grew at a much faster rate than All-India. Here certainly were signs of a "revolutionary" change.

Figure 6.3: Production of Foodgrains in Haryana 1965-66 to 1985-86



Source: Various Season and Crop Reports of Haryana

As can be seen, the trend in Haryana is somewhat uneven, yet, over the period there is a substantial increase. In Haryana, in the same period (1965-66 to 1985-86), foodgrains production increased from 1.985 m tons to 8.147 m tons, a four times increase. The area under foodgrains increased in this period from 3.52 m ha to 4.0434 m ha.

In the year 1985-86, Punjab and Haryana produced about 25 m tons of foodgrains – roughly about 16% of the all India production. At this time, the area under foodgrains for the two states was 9.4304 m ha – roughly about 7.4 % of the All India area under foodgrains.

Looking at these figures one can understand why Punjab and Haryana are referred to as the granary of India. This is said to be the real green revolution that has transformed India from a food importing nation to one that is self-sufficient and has brought immense prosperity to the two states of Punjab and Haryana. This is said to be the self-evident contribution of Bhakra.

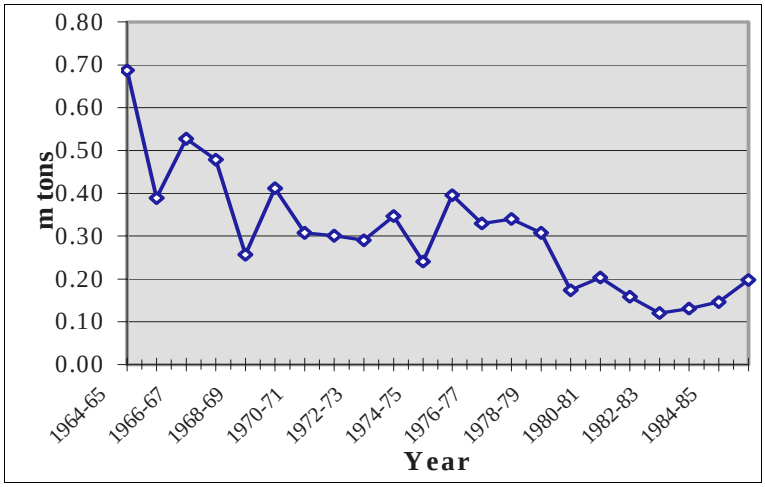
Of course, the performance of specific crops showed mixed results. One serious and important casualty of this performance was pulses. Figure 6.4 shows the production of pulses in Punjab in the same period.

The production of pulses fell in Punjab from 0.687 m tons at the start of the period (in 1964-65) to about 0.198 m tons – that is, to a third of the production in 1964-65.

In Haryana, the course of production of pulses was more erratic, but even here, the production in 1985-86 was 0.687 m tons, which was higher than what it was in 1965-66, 0.408 m tons, but much lesser than the highest ever in 1967-68 – 1.316 m tons. In general, even after this, the production of pulses has continued to fall sharply in the two states.

Similarly, the performance of the other crops too was either bad or lacklustre. For example - the area and production of maize has fallen in Punjab – in the land of *makka ki roti*!

Figure 6.4: Production of Pulses in Punjab 1964-65 to 1985-86



Source: Various Statistical Abstracts of Punjab

It would not be an exaggeration to say that the Green Revolution in Punjab and Haryana – or in the whole country for that matter - is essentially the wheat-rice revolution. But in the euphoria of the performance of wheat and to some extent rice, other crops seem to have been forgotten.

What were the reasons for this performance of Punjab and Haryana as compared to the rest of the country? In particular, was it due to the Bhakra Nangal project?

Was the Green Revolution implemented more extensively in Punjab and Haryana than in other parts of the country? Or did it perform better? Or both?

THE GREEN REVOLUTION IN PUNJAB AND HARYANA

One indicator of the spread of the Green Revolution was the area covered under the HYV seeds program. In this respect, Punjab was far ahead of the country and so was Haryana. Tables 6.1 and 6.2 show the percentage of cropped area under wheat and rice that was covered by HYV over the years.

Table 6.1 Percentage of Cropped Area Under HYV in Punjab
(From 1966-67 to 1990-91[12])

	Rice		Wheat	
Year	All India	Punjab	All India	Punjab
1966-67	3%		4%	
1967-68		5%		35%
1970-71	15%	33%	36%	69%
1980-81	45%	93%	72%	98%
1985-86	57%		83%	
1990-91	64%	95%	87%	100%

The comparison of Punjab with the All India figures brings out the difference starkly. By the second or third year after the introduction of the HYV seeds for wheat, over 35% of Punjab's wheat area was covered by it, as compared to 4% for the whole country. By 1970-71 the same figures were 69% and 36%. Similar was the story in rice, especially when we account for the late developments of the rice HYV seeds.[13]

Table 6.2: Percentage of Cropped Area Under HYV in Haryana
(From 1966-67 to 1990-91[14])

	Rice		Wheat	
Year	All India	Haryana	All India	Haryana
1966-67	3%		4%	
1967-68		1.8%		11.9%
1970-71	15%	11.1%	36%	55.8%
1980-81	45%	85.6%	72%	92.0%
1985-86	57%	84.8%	83%	94.8%
1990-91	64%	72.5%	87%	98.9%

Similarly, if we look at the consumption of fertilisers, in 1965-66, Punjab was using about 6% of total fertilisers consumed in the country. This increased to 10.2% in 1975-76 and by 1980-81 it was 13.8%.

The two states seemed to have been the selected ones in the new agricultural strategy of selectivity. The Green Revolution was implemented more extensively in Punjab and Haryana as compared to the other parts of the country. It also seems to have delivered better results as compared to other parts of the country.

Part of the reasons lie in the social, human, infrastructural and geographical factors. Aggrawal[15] discusses some of these important factors which he says have led directly or indirectly to the transformation in the State of Punjab. While his research is located in the

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[12] Source: For all India HYV areas - http://planningcommission.nic.in/data/stat/statistics3.pdf, For All India Sown area, Ministry of Agriculture http://agricoop.nic.in/statistics2003/chap4a.htm#chap45a, and for Punjab data, various statistical abstracts of Punjab.

[13] A word about why we have compared only rice and wheat and not other crops may be in order here. The entire Green Revolution has been essentially about wheat and rice. For all-India, wheat and rice acreage under HYV has been about 75% of the total area under HYV for all major crops put together. This figure has remained more or less constant right from 1966-67 to 1995-96.

[14] Source: All India figures, same as for Punjab. Haryana figures from various statistical abstracts of Haryana.

[15] Aggarwal, Pratap C. (1973b): '*The Green Revolution and Rural Labour'*, Shri Ram Centre for Industrial Relations and Human Resources, New Delhi. Page 103 - 120

Ludhiana district, many of the factors are identified by him as relevant for the entire state (and some even for Haryana). Some of these crucial antecedents, as he calls them include:

1. Better facilities of roads and transport
2. Higher availability of electricity – in fact, Maharashtra and West Bengal had higher per capita availability, but the electricity in Punjab was "more evenly distributed".
3. Land Reforms
    a. A (comparatively) more even distribution of land. In this, like other states too, there were problems of enforcing the land ceiling, but "considerable degree of levelling in size holdings has been achieved by taking advantage of the dislocations caused by the partition".
    b. Elimination to considerable degree the intermediaries between the state and the cultivators, giving of ownership rights to many tenants and making tenancy more secure.
    c. Consolidation of holdings – Punjab and Haryana had quite early on achieved almost complete consolidation of holdings.
4. A very favourable land-person ration compared to other parts of the country.

Before we go on to other factors, it needs to be mentioned that land reforms is a very important key to better productivity. As Hanumantha Rao[16] states:

> "The Farm Management Studies conducted in various parts of the country have shown that output per acre is generally higher among the smaller farms and that it shows a significant decline with the increase in farm size. That this should be so is understandable in view of the prevailing labour intensive techniques and when there is an abundance of labour among smaller farms. Also, large farmers encounter supervisory and managerial bottlenecks as they have to operate with a large number of paid labourers. The logical implication of these findings is that output and productivity can be maximised if ceilings on land holdings are imposed at a sufficiently low level and surplus land distributed…."

What he does not mention here is the impact of such a measure on the distribution of income, which is a crucial aspect of equitable development.

Rao does recognise that smaller farms may "lag behind the larger ones in regard to the application of technologically new seeds and insecticides etc., due to their low investible surplus" but adds that "Since smallness of size as such does not offer any technical hindrance to the application of modern inputs, the provision of credit to the smaller farmers ..should meet the ends of growth."

Coming back to the factors affecting the growth in Punjab analysed by Aggarwal:

5. Indigenisation of technology – Aggarwal points out that the existence of a thriving small scale industry in Ludhiana led to a much better assimilation and indigenisation of technology and led to a much faster spread of agricultural machinery.
6. Social and human factors, including the highly entrepreneurial nature of the farmers.
7. The implementation of the IADP before the GR phase in Ludhiana district.

The last, but in no manner the least, was of course, irrigation. We have taken note earlier that water is a crucial input for all the three strategies for increasing food production – namely,

[16] Rao Hanumantha C.H. 1965: '*Agricultural Growth and Stagnation in India'*; in Economic and Political Weekly February 27, 1965

bringing in new areas under cultivation, multiple cropping, and increasing yields. For the new HYV seeds, assured supply of water was even more crucial.

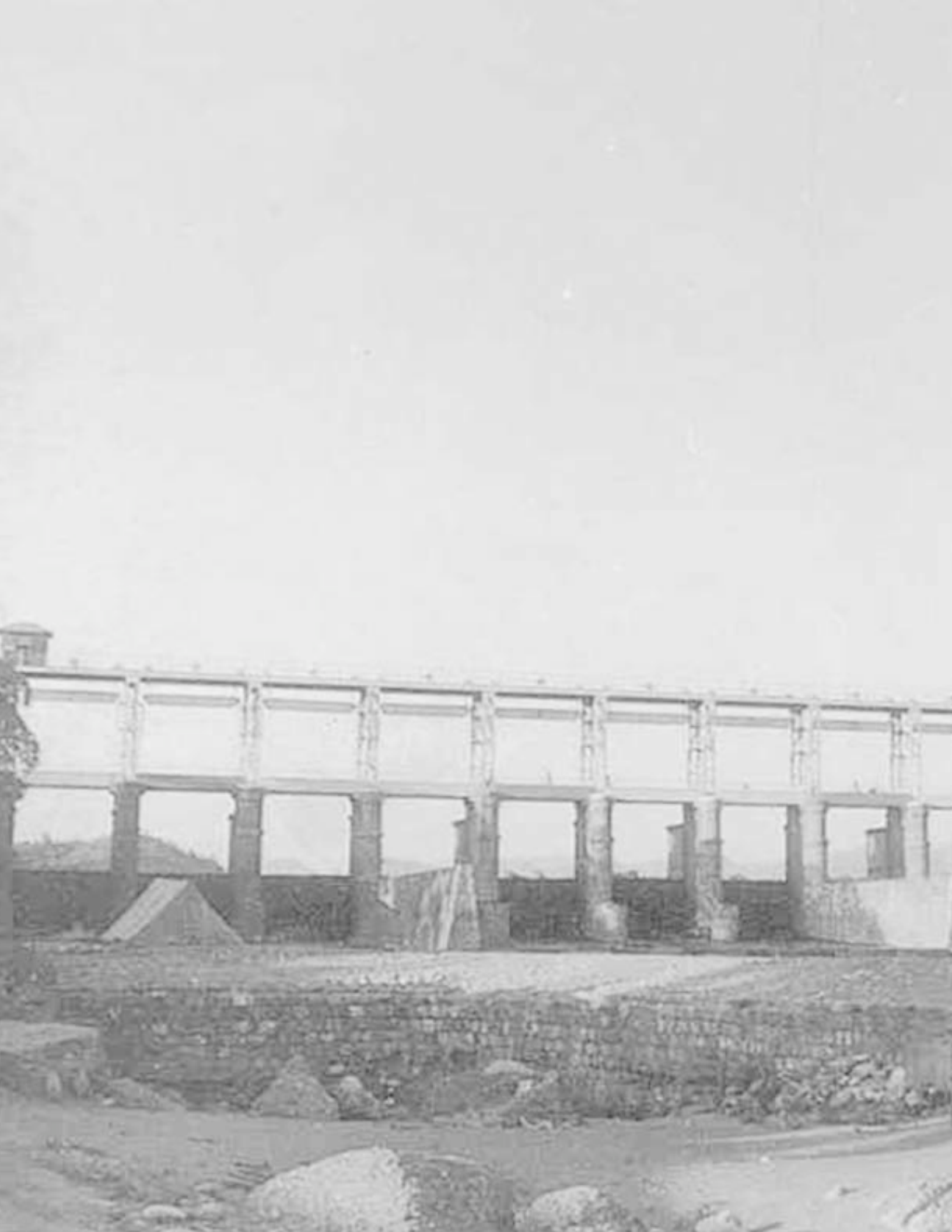
Bhakra is often presented as the main factor behind the dramatic growth of agriculture in Punjab and Haryana by facilitatating – indeed, making possible, all the above three.

Readers may do well to remember in this context that neither irrigation nor the Green Revolution came to Punjab (and Haryana) with the Bhakra project. The GR came 12 years after the irrigation from Bhakra project started. If irrigation is said to have enabled the Green Revolution, then we must recollect that irrigation in large areas had already come to Punjab and Haryana many decades before the Bhakra.

We now look at the role of irrigation in general and Bhakra in particular in the Green Revolution and food production in Punjab and Haryana in the next chapter. ✍

7

Role of Bhakra In Food Production



Role of Bhakra In Food Production

WE SAW THAT THE SPREAD OF GREEN REVOLUTION AS INDICATED BY THE areas covered with HYV was high in Punjab and Haryana as compared to the rest of the country. We saw several factors that were partly responsible for the performance of the Green Revolution in the two states. We now analyse the role of one of the crucial factor – one which is the chief mandate of our enquiry – the role of water and irrigation in general and Bhakra in particular.

We start by noting that the contribution of Punjab and Haryana to foodgrains production in the country is not equal. In this matter, Haryana has been the "junior partner" to Punjab, even though they are comparable in terms of geographical areas (Punjab is about 5.038 m ha and Haryana is 4.4 m ha) and cultivable areas (Punjab 4.3 m ha and Haryana 3.79 m ha). Some figures given below illustrate the point.

Table 7.1: Wheat Production in Punjab and Haryana (m Tons)

Year	Haryana	Punjab	Prod. of Wheat in Haryana as % of All India	Prod. of Wheat in Punjab as % of All India
1960-61	0.814	1.742	7.4%	15.8%
1970-71	2.342	5.145	9.8%	21.6%
1980-81	3.490	7.677	9.6%	21.1%
1990-91	6.436	12.159	11.7%	22.1%
1999-00	9.650	15.910	12.6%	20.8%

Table 7.2: Rice Production in Punjab and Haryana (m Tons)

Year	Haryana	Punjab	Prod. of Rice in Haryana as % of All India	Prod. of Rice in Punjab as % of All India
1960-61	0.175	0.229	0.51%	0.7%
1970-71	0.460	0.688	1.09%	1.6%
1980-81	1.259	3.233	2.35%	6.0%
1990-91	1.834	6.510	2.47%	8.8%
1999-00	2.583	8.716	2.88%	9.7%

Table 7.3: Total Foodgrains Production in Punjab and Haryana

Year	Haryana	Punjab	Prod. Of Total Foodgrains in Haryana as % of All India	Prod. of Total Foodgrains in Punjab as % of All India
1960-61	2.755	3.162	3.4%	3.9%
1970-71	4.771	7.305	4.4%	6.7%
1980-81	6.036	11.921	4.7%	9.2%
1990-91	9.559	19.222	5.4%	10.9%
1999-00	13.065	25.197	6.3%	12.0%

It is seen clearly from this that for rice, wheat and for all foodgrains taken together, whether it is the absolute amounts or the percentage of all India production, Punjab's contribution has been about twice that of Haryana. When we analyse this in terms of the role of the Bhakra project, we need to remember that the major irrigation of the Bharka project has been in Haryana.[1]

We have noted earlier that there are three broad strategies for expanding the food production.

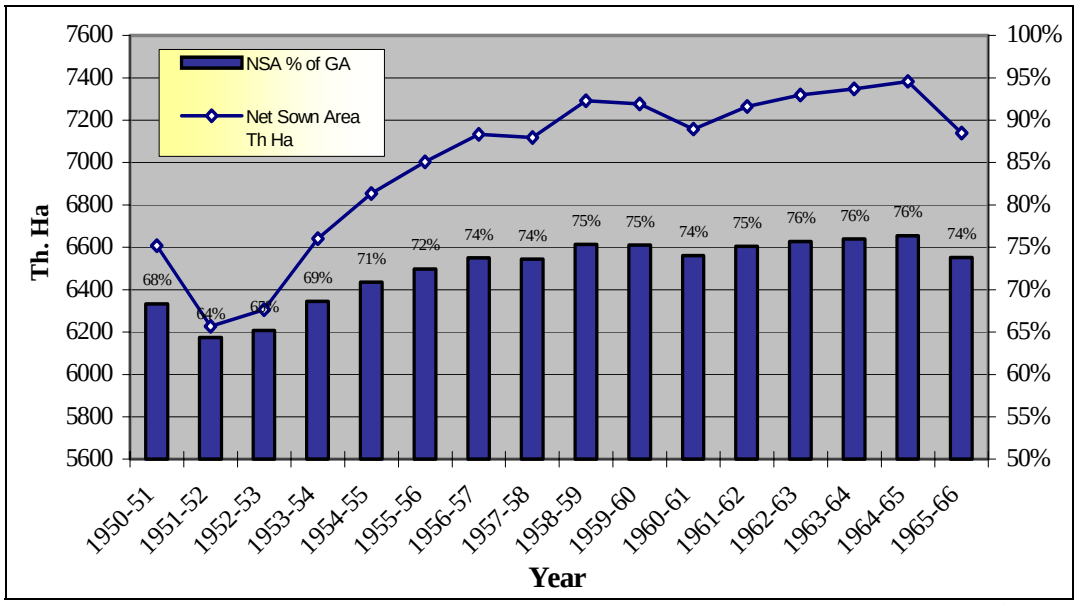
1. Bringing in new areas under cultivation – i.e. increasing the net sown area
2. Multiple cropping – increasing the gross sown area
3. Increasing the per hectare yield.

Water is one of the several – but a crucial - input for all these three. For the new HYV seeds, assured supply of water was even more crucial. It is said that Bharka played the crucial role in all these three factors. In particular, two important claims are made for the project. *One, that it brought in vast amounts of new areas under cultivation and made possible multiple cropping in much of the cultivated area. Secondly, it enabled the Green Revolution, which was essentially about increasing the yields.*

INCREASE IN SOWN AREA

The following graph shows the Net Sown Area (NSA) and Net Sown Area as a percentage of the geographical area in unified Punjab[2] from 1950-51 to the date of reorganisation.

Figure 7.1: Net Area Sown in Unified Punjab from 1950-51 to 1965-66



Source: Various Statistical Abstracts of Punjab
Note: NSA= Net Sown Area, GA= Geographical Area

It is seen from the graph that there was an increase in the net area sown of about 531.5 thousand hectares from 1950-51 to 1965-66. This increase was quite sharp from 1951-52 to

[1] Another interesting thing to note from the above tables is that while in 1960, wheat and rice together formed about 36% of total foodgrains in Haryana and 62% in Punjab, by 1990-91, most other corps had gone – and wheat and rice together formed 86% of all foodgrains production in Haryana and 97% in Punjab.

[2] The figures have been adjusted for the districts of Kangra and Simla which were at that time part of Punjab.

about 1958-59 and then was quite uneven. After 1958-59, the Net Sown area remained more or less the same – around 75% of the total area.

Was the irrigation that had commenced from Bhakra responsible for this? We need to look into the districts for this.

An analysis of the district-wise growth gives some very interesting results. If we look at the figures of net area sown and net area irrigated for the period 1953-54 and 1958-59 (where the increase was sharpest), we find that the maximum increase has been in the (then) district Hissar where the NSA went up by 187000 ha and the net irrigated area by 275000 ha. Next was Patiala with 144000 ha increase in NSA, but irrigation increasing only marginally by 15,000 ha. Hissar includes areas which received irrigation from the Bhakra project. We also have districts like Ferozpur where the net sown area went up by 77000 ha but the net area irrigated *decreased* by 116000 ha! Bhatinda too had similar figures.

Part of the reason seems to be that districts like Ferozpur and Bhatinda were already irrigated to a good extent, and Bhakra did not bring new areas under irrigation in these districts. Hissar and Patiala were districts in which new areas were irrigated with the irrigation from Bhakra[3].

Even in the (then) Hissar district, while it was clear that some of the new areas being brought under cultivation were due to the irrigation from the Bhakra project, it should be noted that parts of the district received irrigation from the Western Jamuna Canal.[4]

Thus, while there is little doubt that irrigation from Bhakra contributed to bringing in new areas under cultivation, this was limited to few parts of the two states.

Overall, in these years (53-54 to 58-59), for the whole unified Punjab, the Net Sown Area went up by 645000 ha while the Net Area Irrigated decreased by 47000 ha. !

Table 7.4: Net and Gross Sown Area in Haryana 1950-51 to 1998-99

(Area in m Ha)

Haryana Geographical Area - 4.389
Haryana Cultivable Area - 3.800

Year	Net Sown Area (NSA)	Gross Sown Area (GSA)	NSA as % of Cultivable Area	GSA As % to Net Sown (Cropping Intensity)
1950-51	2.983	3.47	78.5%	1.16
1955-56	3.300	4.504	86.8%	1.37
1962-63	3.471	4.614	91.3%	1.33
1966-67	3.423	4.599	90.1%	1.34
1974-75	3.519	4.842	92.6%	1.38
1985-86	3.613	5.601	95.1%	1.55
1998-99	3.692	6.214	97.2 %	1.68

What is trend for the years after the bifurcation? The following table gives the NSA and Gross Sown areas for the two states for selected years. The ratio of Gross Sown Area to Net Sown area, also know as the Cropping Intensity, is a measure of the amount of areas under double or multiple cropping.

[3] It also appears that Patiala was an area where large tracts of land were cleared to reclaim land to resettle the Partition refugees. This could be one reason for the large increase in the net area sown in this region, though whether this reason operated even during 1953-54 to 1958-59 is not clear.

[4] In Hissar, the net irrigated area increased by 43000 ha from 1950-51 to 1952-53 i.e. before the irrigation from Bhakra had started.

From the figures given above, it is seen that over 90% cultivable areas had been brought under the plough in Haryana by 1962-63. After that, there has been only a small increase of about 221000 ha in the next 36 years.

Table 7.5: Net and Gross Sown Area in Punjab 1950-51 to 1996-97

(Area in m Ha)

Punjab Geographical Area	5.038
Punjab Cultivable Area	4.300

Year	Net Area Sown (NSA)	Gross Area Sown (GSA)	NSA as % of Cultivable Area	GSA As % to Net Sown (Cropping Intensity)
1950-51	3.544	4.170	82.4%	1.18
1955-56	3.615	4.567	84.1%	1.26
1962-63	3.833	4.981	89.1%	1.30
1966-67	3.87	5.171	90.0%	1.34
1974-75	4.092	5.904	95.2%	1.44
1984-85	4.189	7.013	97.4%	1.67
1996-97	4.223	7.808	98.2%	1.85

In Punjab, the expansion of area under cultivation took place at a high rate till 1966-67 (326000 ha in 16 years) and after that, in the next 30 years at a slower rate – about 353000 ha added in the period.

While area under cultivation can be increased by bringing in new land under cultivation, this has an obvious physical limit. Multiple cropping – two or more crops on the same land in a year - allows this limit to be broken. *Double or multiple cropping has added millions of hectares to the total cropped area in the two states.*

The Gross Sown Area (same as total cropped area) – which consists of the net sown area and the areas double or multiple cropped - showed a major growth in both the states and this appears to have been more or less a steady growth over the years.

In Haryana, the Gross Sown Area (GSA) went up by 1.13 *million* ha from 1950-51 to 1966-67 and in the next 32 years by about 1.615 m ha. In Punjab, the increase was 1.001 m ha till 1966-67 and then 2.637 m ha in the next 30 years.

The cropping intensity in both these states is much higher than the All-India cropping intensity – and has been so right from the early years. The cropping intensity in Punjab and Haryana in 1955-56 was 1.26 and 1.37 respectively when the All India figure was 1.14. By 1985-86, the same figures were 1.67 for Punjab and 1.55 for Haryana and 1.27 for All India.[5]

This spectacular rise in the *total cropped area* is one important reason behind the rise in agricultural production in these two states. What made this possible?

There are several factors that can help bring in new areas under cultivation or multiple cropping. For example, we saw in the earlier chapter that the new varieties of seeds, through a shorter maturing period, made possible double cropping where the longer growing period earlier was not allowing it. Water is one crucial input, and we will focus here only on the role of water and irrigation. Bhakra is said to be major force behind this spectacular growth in the total cropped area in Punjab and Haryana.

[5] The figure for Punjab is for 1984-85; Source for All India Cropping Intensity is Planning Commission Data, from http://planningcommission.nic.in/data/stat/statistics3.pdf
Accessed on Nov.10, 2004

But Punjab and Haryana are much more than Bhakra as we have noted from the earlier chapters. The areas commanded and irrigated by Bhakra form a limited part of these two states. Let us recollect these figures.

The cultivable area commanded by Bhakra is 20% of the total cultivable area of Punjab. For Haryana, the same figure is 31% . The other major systems in the two states include Western Jamuna Canal, the various lift commands in Haryana, the UBDC, the Sirhind (in Punjab).

However, there is another component and that is the groundwater based irrigation. In Punjab, many districts while having areas being shown as part of the Bhakra command receive little irrigation from the canal. For example, Patiala district, while being in the Bhakra command had, in year 2001-02 only 9.5 thousand ha irrigated by canals while tubewell based irrigation is 281.2 thousand ha.

What is not often understood is that vast areas of Punjab and Haryana are irrigated not by canal (whether Bhakra or others), but by groundwater. If we look at the figures for the areas actually irrigated and not just commanded – we have the following figures for Punjab for the year 2001-2002.

Net Area Irrigated By Canals –	987,000	ha
Net Area Irrigated by Tubewells –	3,068,000	ha

Thus, only 24% of Punjab's irrigated area is served by canals – and this includes not only the Bhakra canals but also other canal systems.

The figures for Haryana for the year 1998-99 are as follows:

Net Area Irrigated By Canals –	1,433,000	ha
Net Area Irrigated by Tubewells –	1,395,000	ha

Thus, in Haryana, about 50% of the irrigated area was served by canals. Note that the canal irrigated area includes significant areas irrigated by the Western Jamuna Canal and other canals.

It is clear that vast areas were brought under cropping in the two states, first, by bringing as much land as possible under cultivation, and then increasing the multiple cropping hugely. This has been one of the key factors in the increase in the food grain production in the two states.

There is little doubt that irrigation has played a very important role in this. However, in Punjab and Haryana, and especially in Punjab, this role has been played essentially by groundwater based irrigation and canal irrigation has contributed to only a limited extent. Within the canal irrigation, Bhakra is only a part.[6]

One fact illustrates this sharply. In Punjab, from 1990 to 2001-02 the Total Cropped Area (same as gross sown area) increased from 7.501 m ha to 7.941 m ha – an increase of 440,000 ha. Yet, the Net Area Irrigated by canals decreased in this period from 1.576 m ha to just 0.987 m ha – a decrease of 589,000 ha! And Net area irrigated by tubewells increased form 2.233 m Ha to 3.068 m Ha – an increase of 837,000 ha.[7]

---

[6] There are some important issues related to the ground water use. One is that the estimate of the areas irrigated by tubewells is generally an underestimate since areas with conjunctive use are reported as canal irrigated areas. There is another aspect often argued that the groundwater irrigation has been made possible only because of the canals, through seepage, provided the groundwater. Hence, much of groundwater irrigation should be counted as benefit of canal. We will estimate this contribution in the next chapter and see that it is a small one.

[7] If we look at the coefficient of correlation for the Gross Cropped Area and Area Irrigated by Canals and Tubewells respectively, we see the same reflected in the values.
Coeff. Of Correlation for: (Cont. next page)

To credit the "success" of Punjab and Haryana to Bhakra and Bhakra alone is absurd – but that is the general perception. The figures above show how unfounded this assumption is.

If we assume that the contribution to the (increase in area and hence) food production is roughly in proportion to the extent of irrigation from each source, then we see the following.

In Punjab, the increase in area has come essentially and overwhelmingly from the groundwater based irrigation. Canal irrigation is about 24% of total irrigation, and within this, Bhakra would be a small proportion (if we recollect the discussions in the chapter on Command Area). We would say that contribution of Bhakra to Punjab's food production is limited.

In Haryana, the groundwater and canal irrigation have played an equal role. If we assume that the Bhakra system provides about 50% of the canal irrigation, then its net contribution to foodgrains production would be about 25% of the state total. (Since total canals itself constitute 50% of the irrigation source). Even in the Bhakra commanded areas, there has been a huge explosion in the ground water use. It is mainly the areas with saline or bad quality groundwater that are still mainly depended on the canal irrigation as the major source. These include primarily the districts of Hissar, Sirsa, Fatehbad, Jind and to some extent Kaithal. It is in these districts the Bhakra canal irrigation has had a major impact in terms of bringing in new areas under cultivation and in increasing multiple cropping. We have seen that Bhakra irrigation is primarily concentrated on the three districts of Hissar, Sirsa and Fatehbad which account for about 75% of Bhakra's irrigation in the state. The food production in these three districts is about 25% of the state total.

Considering that the Punjab produces twice as much food as Haryana, we can see that Bhakra has played a very limited role in the food production from these two states considered together.[8]

INCREASING THE YIELDS

Let us now come to the third component of increasing the agricultural production – increase in the per hectare yield. We have seen that the Green Revolution was sparked off by the HYV seeds which had a much higher yield than the best seeds available till then.

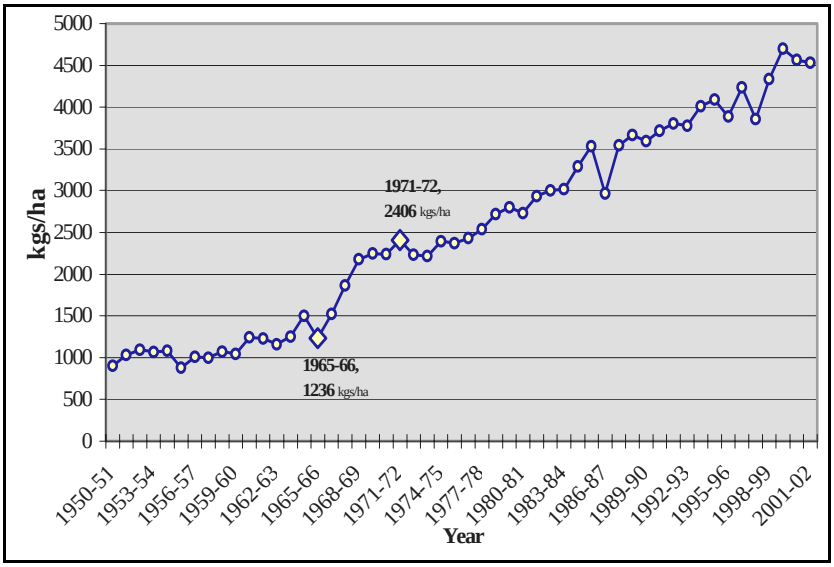
The graph in Figure 7.2 illustrates this. The yield for wheat which was increasing slowly till 1966 shot up sharply and then continued rising. The *average* yield of wheat doubled in just 6 years after 1965-66 from 1236 kg/ha to 2400 kg/ha.

It is this spectacular increase in the yields of wheat, followed later by rice that led to the green revolution. Unfortunately, this has remained more or less confined to these two crops. This growth in the yield has been a major contributor to the dramatic foodgrains output of Punjab and Haryana. We have already seen that there were large number of inputs that were necessary to achieve these yields – including fertilisers, machinery, and so on. Water was a crucial input. In fact, the new seeds required an "assured" supply of water.

Haryana	
GSA and Net Area Irrigated by Canal	0.8184
GSA and Net Area Irrigated by TW	0.8410
(For Years 1960-61 to 1998-99)	
Punjab	
GSA and Net Area Irrigated by Canal	0.391
GSA and Net Area Irrigated by TW	0.969
(For Years 1955-56, 1960-61 to 2001-02)	

[8] We have not attempted to put any numbers to this contribution at this stage but have limited ourselves to indicative estimates. We will bring in some more data in the next chapter and estimate the contribution quantitatively.

Figure 7.2: Yield of Wheat in Punjab from 1950-51 to 2001-02



This is a key to understanding the green revolution in the two states. While canal irrigation certainly was helpful with the new seeds, it could hardly provide the kind of assured supply required by them. Increasingly, the farmers in Punjab, and then in Haryana turned to groundwater irrigation.

The Fourth Plan document – which came out in 1969 – after just a few years of experience of the HYV seeds has noted this phenomenon.

> "11.8. Minor Schemes.—Minor irrigation scheme include all ground water development projects as well as surface water projects. Most deep tubewell schemes are community-based; open wells and shallow tube-wells, however, are usually constructed and owned by individuals. *In either case, ground water provides the farmer with just the type of 'instant' and controlled irrigation which the new high-yielding varieties of seed demand.* This fact, coupled with the increasing extension of electricity to rural areas, explains the expansion which has taken place in recent years in the development of ground water resources. The expansion has taken place not only in areas which are without any other source of irrigation but also in alluvial tracts already commanded by existing canal systems; … The remarkable development of ground water resources during recent years was stimulated by the droughts of 1965-66 and 1966-67 which also happened to coincide with the development of high-yielding varieties *which perform best under conditions of controlled and timely irrigation*."[9] (Emphasis added)

Tubewell based groundwater irrigation has grown exponentially since then. This has been the turning point in the agricultural development of the two states. There is little doubt that it has been groundwater that has been, and remains, the driving force behind the spectacular agricultural growth in the two states.

It is not only that HYVs perform their best with controlled and timely irrigation that has led to the boom in tubewell irrigation. There are several other factors too. We examine this phenomenon, its various dimensions and its implications separately in the next chapter.

[9] Chapter 11 *Irrigation and Flood Control*; Fourth Five Year Plan; Planning Commission
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/4th/4planch11.html
Accessed: Dec. 17, 2003

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8

Groundwater- The Real Driving Force

"Particularly in northern India (especially the northwest), the development of tubewell irrigation,……..has been the main driving force behind irrigation expansion and productivity improvements over the past several decades."

India: Irrigation Sector Review (Vol II),
The World Bank 20 Dec 1991

"…. majority of districts of Punjab and Haryana rely heavily on groundwater, but have limited stocks of the resource".

The Socio-Ecology of Groundwater in India
Aditi Deb Roy and Tushaar Shah, IWMI-Tata Program

"Even though the villages here get waters from the canal, we still have to rely on the tubewells; without it we cannot grow the crops we are growing."

Santokh Singh, Farmer,
Village Kotli Khakhyan Dist. Nawanshahar
(Part of Bhakra Command)

"Even though the ground water is saline here, people have still sunk in tubewells because the wheat-rice cycle is just not possible on canal waters."

Agricultural Development Officer,
Hansi, Dist. Hissar, Haryana
(Bhakra Command Area)

Groundwater
The Real Driving Force

FROM THE FARMER TO THE WORLD BANK, FROM RESEARCHER TO POLITICAL activist, all agree that the real driving force behind the growth in irrigation, production and productivity in Punjab and Haryana has been the explosive growth in tubewell based groundwater extraction. Even in many of the areas served by canals, tubewell irrigation is not just a supplementary source, but has assumed the primary role.

Indeed, farmers we met told us that the mainstay of the farming in Punjab and Haryana – the wheat/rice cycle – is impossible with only canal waters. Paddy in particular is just not possible without heavy extraction of groundwater. Indeed, such is the imperative to use groundwater that even in areas that are underlain with saline waters, people still sink in tubewells for irrigation. For example, farmers in Hansi in Haryana told us that they have no choice but to draw upon groundwater.

Yet, it is not only Paddy that is not possible with just canal waters. Almost every factor that has led to the growth in agriculture in Punjab and Haryana is largely dependent on the groundwater based irrigation.

The intensive cultivation, with massive inputs of chemicals and fertilisers, combined with HYV seeds plus a variety of other factors like support price, input subsidies, mechanisation and so on - in short the Green Revolution - was what led to the growth of agriculture in Punjab and Haryana. Much of this would not have been possible - or least - the results would have been far less spectacular with only canal irrigation.

EXPANSION OF THE TUBEWELL IRRIGATION

There has been a dramatic growth in the areas irrigated by tubewells in both the states; this growth has been especially high after 1965-66.

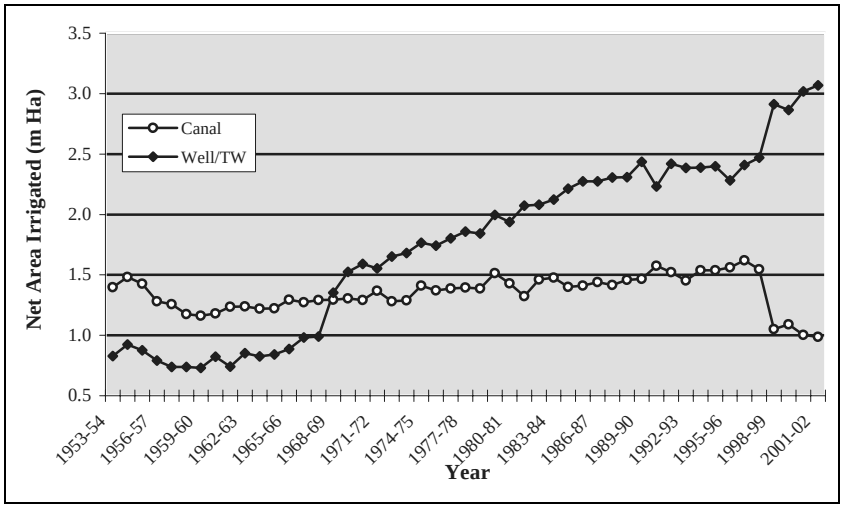
By the late 60s, tubewell[1] irrigated areas had equalled and soon outstripped canal irrigated areas in Punjab. (See Figure 8.1). In Haryana too, the tubewell irrigation grew rapidly till it now equals the canal irrigation (Figure 8.2).[2]

➔

[1] This includes the small area irrigated by wells. The Statistical Abstracts give only the combined areas for tubewells and wells.

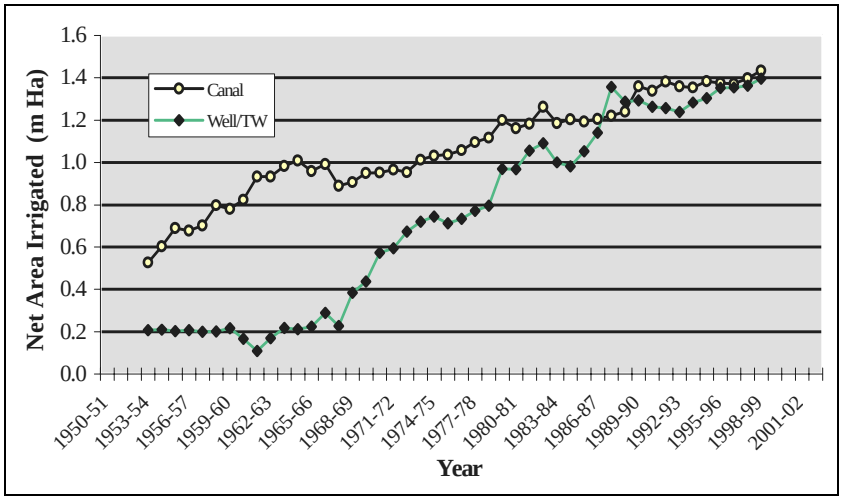
[2] The data for this figure is taken from the various statistical abstracts for Punjab and Haryana. The figures refer to the Net Areas Irrigated. Statistical Abstracts of both Punjab and Haryana do not give the break up by source of the gross areas irrigated.

Figure 8.1: Net Area Irrigated by Source[3] in Punjab



Source: *Various Statistical Abstracts of Punjab*

Figure 8.2: Net Area Irrigated by Source[4] in Haryana



Source: *Various Statistical Abstracts of Haryana*

The same figures in tabular form are given in Tables 8.1 and 8.2.

Table 8.1: Net Area Irrigated by Source: Punjab
('000 ha)

	1965-66	1975-76	1997-98	2001-02
Canals	1289	1366	1356	987
Tubewells	887	1742	2356	3068

[3] We give only canals and tubewells here. The "Other" sources are negligible
[4] We give only canals and tubewells here. The "Other" sources are negligible

The number of tubewells in Punjab jumped from 20,066 to over 450,000 from 1965-66 to 1975-76. In 1997-98, this figure was 910,000. In Haryana, the number of tubewells jumped from 25,311 in 1965-66 to 204,736 in 1975-76, and in 2000 stood at 583,705.

Table 8.2: Net Area Irrigated by Source: Haryana
('000 ha)

	1965-66	1975-76	1993-94	1998-99
Canals	960	1036	1353	1433
Tubewells	224	682	1283	1395

It should be added that the figures for areas irrigated by tubewells are conservative estimates while the canal irrigated areas are estimates on the higher side. This is due to the particular way of collecting these statistics in both the states.[5] Lands that are irrigated by both canal and tubewells are classified as canal irrigated – even if they receive only one watering from canal and rest from tubewell. In fact, even if the farmer makes the use of the watercourse to take tubewell water from the well to his field, it is still counted as canal waters!

We have already seen that the HYV seeds performed much better with a controlled water supply and this was a key factor behind spread of tubewell irrigation. There were some other important factors also. Let us quickly look at these.

CANAL WATERS ARE LIMITED

Farmers at many places told us that the quantity of water that they get from the canals is very limited. The timing too is such that crops would go for long periods without water. For example, in village Mahas, Dist. Patiala, Punjab, served by the Kotla Branch, the canal runs for 7 days and then is closed for 15 days. Due to this, only about 10% of the irrigation in the village is from canals and 90% by tubewells. In village Simla, District Kaithal Haryana, the canal runs for only 7 days in 42 days. The villagers told us here that due to this, they have to use tubewells, even though the groundwater is saline.

This situation is not surprising since the Bhakra canals were *meant* to be used for protective irrigation, and not for intensive cultivation.

As per the original plans, Bhakra project was to have a maximum irrigation intensity of 62%. The irrigation intensity – which means the percentage of the culturable command area that is irrigated in a year – was fixed by the project for all the three zones. This was 45% in Zone I, 35% in Zone II and 62 % in Zone III. This means that the highest an area would be irrigated in any given year was to be 62%.

In their detailed study of the Sirsa Circle of Bhakra command area, Bastiaanssen et al. state that[6]:

> "Because the reference evaporation is 1,721 mm/yr, or 4.7 mm/day, average canal water deliveries (1.5 mm/day) are sufficient for only about of third of each farmers cultivable command area."

More generally about the whole Bhakra system, they point out that[7]:

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[5] Related to us by revenue officials, irrigation department staff and *jiledars*

[6] Bastiaanssen, W. G. M., D. J. Molden, S. Thiruvengadachari, A. A. M. F. R. Smit, L. Mutuwatte, and G. Jayasinghe (1999): '*Remote sensing and hydrologic models for performance assessment in Sirsa Irrigation Circle*', *India,* Research Report 27: International Water Management Institute, Colombo, Sri Lanka : Page 11 Accessed from: www.iwmi.cgiar.org/pubs/PUB027/REPORT27.PDF On 2 Feb 2003

[7] *ibid* Page 2

> "The canal systems in Haryana were designed to serve the greatest number of farmers possible by distributing a limited supply of water over a large area. The major objective of irrigation development at that time was to prevent crop failure and avoid famine."
>
> "The Bhakra canal system was designed for an irrigation intensity of 62% of the cultivable command area" (Reidinger 1971[8])

Intensive farming with such allowances was not possible.

This limitation of canal irrigation was recognised early on. For example, this issue was important enough to merit a discussion in the Conference of Chief Ministers in 1967. The "Proceedings of Conference of Chief Ministers, Ministers of Agriculture and Irrigation, New Delhi 7 July 1967" notes [9]:

> "On many irrigation projects, particularly in the North, the intensity of irrigation, i.e. the ratio of area irrigated by the project to the total culturable command area is considerably less than 100%. ….Supply pattern of this type is not conducivt (sic) to scientific irrigated agriculture for maximum production in a given area. *The deficiency also stands in the way of double or more intensive cropping on the same area during the same year*….The possibility of providing supplemental irrigation in the command of low-intensity irrigation canals like the ones …in Punjab …therefore needs to be explored." (Emphasis added)

Similarly, about 10 years later, the "Irrigation, Floods and Waterlogging Statistics" brought out by Government of Punjab for 1978-79 noted[10]:

> "While canal water supply may be inadequate and uncertain, tubewells and pumping sets provide assured supply of water…..
>
> "Main factor behind the increase in irrigation facilities is the installation of more and more tubewells and pumping sets in the State".

What this means is that the intensive cultivation in Punjab and Haryana would not have been possible with the Bhakra irrigation canals. *They were not designed to do so*.

AMOUNT OF CANAL DELIVERIES DECLINING

Another complaint that farmers made to us everywhere we went is that the waters coming in the canals have gone down over the years[11]. Two reasons seem possible, from our study and observations:

A. General deterioration in the canal system leading to heavier losses. The lack of maintenance of the canals has been noted by several writers and commentators. On the other hand, there have been, according to the Government of Punjab and Haryana continuous attempts to renovate, line and in general maintain the canals. In particular, loans from the World Bank have come in for this purpose. Clearly these do not seem to have been enough.

We were told by the irrigation officials in Haryana that intensities of irrigation in the Bhakra command had gone down by at least 10%, but again no details were forthcoming.

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[8] Reidinger, R.B. 1971: '*Canal Irrigation And Institutions In North India*', PhD Thesis, Department of Economics, Duke University, Quoted in *Bastiaanssen et al.* 1999

[9] Government of India 1967: '*Proceedings of Conference of Chief Ministers, Ministers of Agriculture and Irrigation, New Delhi 7 July 1967*', Ministry of Food and Agriculture, Government of India, New Delhi.: Page 77

[10] Government of Punjab 1981a: '*Irrigation, Floods and Waterlogging Statistics of Punjab 1978-79'*, Economic Advisor to the Government of Punjab, Government of Punjab, Chandigarh,. Page 7 & 9

[11] We have also seen the sharp fall in canal irrigated areas in Punjab since 1990-91

According to a study carried out Dr. Prem Vashishtha (Vashishtha 2003) in the Bhakra (and Yamuna) command in Haryana:

> "Most farmers complain that keeping the present cropping pattern in view, the overall release of water in canal is much less than their requirement. Some unscrupulous elements do not hesitate to lift water from canal though unlawful means. This phenomenon is rampant."

The study also found other technical and managerial problems leading to less water availability, like growth of weeds in water channels, defective slope of channels etc.

B. Another important reason for the decrease in the canal waters could be the siltation in the Bhakra reservoir. By 1975, the Bhakra reservoir had lost 2.5% of its live capacity and 16.42% of its dead storage to siltation.[12] In year 2000, about 10% of the live storage and 31% of the dead storage was silted up[13].

In view of the inadequate, unreliable and limited supplies of canal waters, the farmers were forced to go in for tubewells - as a supplementary source of irrigation, at least initially.

CROPPING PATTERN DEMANDS EXCESSIVE WATER

However, there is another, far more important factor that overrides this reason for the use of tubewells. That is, there is no way in which the canal waters can support the intensive cropping patterns of Punjab and Haryana - especially crops like paddy.

It should be noted that Paddy was not a traditional crop of Punjab or Haryana.[14] That paddy cannot be grown on the canal waters alone (in these states) is noted by a number of academic studies, and repeated to us by farmers everywhere. Hence, farmers had to go in extensively for tubewells based irrigation. In the process, a supplementary source of irrigation emerged as the dominant one. It is ironic that the reason rice was introduced in some parts was to control the waterlogging due to canal irrigation. As the Committee set up by the Punjab Government notes:[15]

> "Initially, the rice cultivation was taken up in the 50s to reclaim waterlogged soils because rice is the only crop that can be grown under waterlogged conditions…..Cultivation of rice was however extended to other areas due to higher profitability and availability of water at shallow depths, which was exploited by installation of ..pumps…"

But due to the profitability and the policies, this did not remain confined to areas with good groundwater availability. How the policies compelled the farmers to go in for tubewells is clear from what an agricultural officer told us in Hansi:

> "Support price was available only for wheat/rice and these were the only remunerative crops. But the canal waters were inadequate for these. So the farmers went in for tubewells, knowing fully well that the groundwater was saline. This has resulted in the land becoming salinised."

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[12] Central Board of Irrigation and Power, as quoted by Singh 1997: Page 140-1, quoted in Thakkar 1999 Irrigation Options paper done for the World Commission on Dams

[13] Duggal *et al*, 2002

[14] Area under rice in Punjab in 1955-56 was 0.149 m ha as against 2.489 m ha in 2001-02. In Haryana, it was 0.078 m ha in 1955-56 and 1.028 m ha in 2001-02

[15] Punjab, Government of 2002: '*Agricultural Production Pattern Adjustment Programme in Punjab for Productivity and Growth (Report of the Johl Committee)*', A Report by Chief Minister's Advisory Committee on Agriculture Policy and Restructuring, Submitted to the Government of Punjab, October 2002: Page 12

In other words, what this means is that a principal "glory" of agriculture in Punjab and Haryana – namely, rice[16] – is based on extensive and massive groundwater based irrigation.

INCREASE IN YIELDS DUE TO GROUNDWATER IRRIGATION

The high levels of productivity in Punjab and Haryana are due to the Green Revolution package including HYV seeds, high inputs of fertilisers and pesticides etc. However, the performance of these seeds is very sensitive to the timing of watering, and the high productivity of agriculture in Punjab and Haryana would not have been possible without groundwater.

> "Now it is groundwater which is playing a critical role in our agriculture transformation, ever since the advent of high yielding variety (HYV) seeds. In fact, innumerable research investigations have highlighted a close relationship between the success of HYV programme in an area and the use of groundwater irrigation -- especially individual-owned wells and well fitted with power pumps….
>
> "The HYV seeds, unlike the earlier or *desi* seeds perform well only when pampered with requisite inputs and care. In view of their exacting demands for water, ensuring timely irrigation for them is impossible unless a farmer has control on the source of irrigation….a condition easily fulfilled by groundwater as compared to surface water…"
>
> B.D. Dhawan[17]

This is also reflected in the fact that yields from wells/ tubewell based irrigation are generally much higher than canal based irrigation. This is the experience of farmers all over the country. The World Bank Irrigation Sector Review for India states:

> "An important conclusion is that land irrigated from private wells has notably higher productivity than from canals, which can also be readily observed in field visits. The principal reason for this that farmers with wells have much better control over water than is possible through canal irrigation." (World Bank 1991:7)

The table given in the same document gives the figures as follows:

Table 8.3: Land Productivity Per Net Irrigated Hectare By Source of Irrigation
(Tons/Ha in foodgrain Energy Equivalent)

	Wells (Private)	Canal Irrigation	Ratio of Productivity of Wells:Canal*
Punjab	5.5	3.2	1.72
Haryana	5.7	2.4	2.375

* The last column is calculated by this author from the second and third column figures

CONTRIBUTION OF GROUNDWATER

Considering that the yield from tubewell irrigated areas is much more than canal irrigated areas, we can see that the impact of the increased tubewell irrigation would be huge. We now try and quantify this impact.

[16] Rice forms about 30% of the total foodgrains in the two states (in 2001-02). In 1975-76, it was only 15%.
[17] Dhawan 1977: '*India's Groundwater Resources*'; in Economic and Political Weekly, March 1977 Page A-18

It is a complex task to try and segregate the contribution of groundwater and canal irrigation in terms of crop production. First of all, much of the command area has conjunctive water use - i.e. it receives water from both canal and tubewells. However, we can get around this because the tubewell areas reported in the Statistical Abstracts are purely tubewell irrigated areas. The canal areas reported include purely canal irrigated areas *and* areas with conjunctive use. Using these figures will give us a conservative estimate of the contribution of groundwater.[18]

Secondly, various crops respond in different manner to irrigation. Calculating at the aggregate levels, we lose these finer distinctions.

Then of course, there is the difference in climate, soil condition, land holdings and so on. Again, calculating at the aggregate level will not be able to consider this.

There is also the difference between individual farmers - in their skills, effort, land holdings - all of which influence the yields and the response of crops at the micro level.

In spite of all these differences, it is still possible to get a broad picture.

We have calculated the contribution to crop production in Punjab and Haryana from the following:

- Unirrigated Areas
- Areas Irrigated from Canal and Other sources
- Areas Irrigated by groundwater

In doing this, we have taken that the productivity of tubewell irrigated areas is 1.7 times the canal irrigated areas, and the productivity of irrigated areas overall (i.e. both canal and tubewell areas) is 2.5 times the productivity of unirrigated areas[19].

Based on these ratios of productivity, and knowing the figures of the acreage under each of the above, we can calculate how much of the total state production comes from each of these areas.[20]

The methodology of the calculations is given in Annexure I to this chapter.

From these calculations, we find the following.

For Punjab, a full 71.8% of production is from groundwater irrigated areas (which means tubewell based irrigation), about 25.7 % attributable to canal areas and other sources, and about 2.5% to unirrigated areas.

For Haryana, we get similar figures.

SOME IMPORTANT CONSIDERATIONS

There are two important arguments put forward in this context.. The first argument is that much of the groundwater comes from the seepage from canal waters, and hence the benefits should be counted as indirect benefits of the canals.

The second argument is that the tubewells are run by the electricity from large dams like Bhakra and hence this should be counted as a contribution of large dams.

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[18] See Also ADDITIONAL NOTE 8.1 with this chapter.

[19] The ratio of productivity of tubewell and canal irrigated areas are from sources already quoted above. The ratio of productivity of irrigated vs unirrigated areas is from Rangachari, R., Sengupta, N., Iyer, R.R., Banerji, P., and Singh, S. (2000): Page 24 .

[20] Note that we have refrained from saying that this is the production *due to canals or groundwater*, but instead say that this is the production *from canal or groundwater areas*. The reason is that the rainfall does not figure in these calculations. What our calculations give us is the production from each of these *areas*. The figure we get, say for production from canal irrigated area will be the production due to the canal and rainfall water. Thus, in all the three categories rainfall will be a common factor.

Groundwater As Indirect Benefit Of Canals

Let us look at the first argument; namely, that it is the canals that have made the tubewell irrigation possible.

There is certainly some truth in the contention that canal seepage recharges groundwater; and this means

a) more wells can be run in the area
b) each well can run for more time.

The issue however is the *extent* of this contribution. There is limited study of the extent of groundwater recharge from canals.

Prof. B.D. Dhawan estimates that for Punjab, about 50-70% of all groundwater recharge comes from the recharge from canals[21]. His calculations are aggregated estimates for the whole state. He says that the total recharge in Punjab is of the order of 1.81 ha-m. (14.66 MAF). If average rainfall is taken as 600 mm, at 25% infiltration rate over 5 m ha of geographical area, the total rainfall infiltration is 0.75 ha-m (6.08 MAF). This is 41% of the total recharge. The rest must come from canals - about 60%.

Surendar Singh (1991)[22] too gives a figure of 60%, based on estimates prepared by Directorate of Water Resources, and Groundwater Cell of Department Of Agriculture of the Punjab Government.

However, there are several problems with these calculations and their interpretation. For one, these do not consider the direct seepage from the rivers - Beas, Sutlej and Ravi. This also does not consider the fact that a large part of canal seepage that occurs in areas underlain with saline waters is lost - since the seepage itself is rendered saline. Today, Punjab and Haryana can be divided into roughly two zones - one in which the water tables are declining, and the other in which the water tables are rising. The water tables are rising in the latter areas *precisely because the infiltration here is not being pumped out* - the quality is not good enough. What this means is that even if there is groundwater recharge due to canals in these areas, large portions of it will not be useful.

Dhawan himself qualifies the beneficial effect of canal seepage thus:

> "Innumerable scholars have drawn pointed attention to the marked superiority of private tubewells over other means of irrigation, namely canals, traditional dugwells ….How prior development of canal irrigation in north-western India has facilitated the rise of private tubewells needs due recognition. Here, two aspects are noteworthy. On the one hand, there occurs improvement in the availability of groundwater through the seeped-in canal waters. *In low rainfall regions not underlain with brackish waters***,** the improvement in groundwater regime has two beneficial consequences…reduction in water lifting cost (and) ….added scope for sustaining many more tubewells….."(Dhawan 1989: 96) (Emphasis added)

Another issue with these calculations is that some of the seepage attributed to canals may not be from canals. To clarify, in the Punjab Government figures groundwater recharge has three major components - rainfall recharge, seepage from canals and recharge from surface water infiltration (SWI)[23] (meaning - the irrigation waters applied to the field that seep into the groundwater). According to Surendar Singh, the canal seepage for Punjab state as a whole is 25% of the total recharge, and SWI is 34%. But at least half the surface water application

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[21] Dhawan 1989: Page 93
[22] Surendar Singh 1991: '*Some Aspects of Groundwater Balance in Punjab'*, Economic and Political Weekly; 28 Dec. 1991
[23] Singh 1991

comes from tubewells - hence, not all of this infiltration can be attributed to canals. (Dhawan's figure of 60% will include SWI)

Then, Dhawan also points out, the large amount of seepage from canals in Punjab is because the canals in Punjab carry about 10 MAF of waters of the share of Rajasthan and Haryana. Thus, the amounts of infiltration in other states will not be to this extent.

Implication of Canal Waters Recharging Groundwater

For the moment, let us take the figure of 60% as given by Prof. Dhawan - that is - 60% of the groundwater recharge is due to the canals. What are the implications of this? Does this mean that 60% of the production attributed to groundwater should actually be considered the indirect benefit of canals?

This would be a highly inaccurate. Why?

For, total ground water used for irrigation does not consist only of two components - naturally recharged groundwater and recharge by canals. There is a third component - the unsustainable mining of groundwater- extraction of groundwater that is not being recharged, groundwater that has accumulated since generations. In other words, the contribution to the groundwater *irrigation* (as against groundwater recharge) comes from three components:

1. The recharge from rainfall, rivers, streams and other sources
2. The recharge from canals (Including SWI)
3. The mining of groundwater reserves accumulated over generations

We were able to obtain a comprehensive estimate for this from Dr. G.S. Dhillon, former Chief Engineer of Punjab Irrigation Department[24]. He gave us the following estimate of water use in agriculture in Punjab.

Total water used by the current[25] cropping pattern =	34 MAF
Available from Canals =	12-14 MAF
From Groundwater Recharge (net of recharge in saline areas, in areas like Kandi where extraction is not possible) =	8 MAF
Rest Being Mined from Groundwater	14-12 MAF

What this means is that about 35-40% of the total water for agriculture in Punjab comes from *unsustainable mining of groundwater! To the matter in perspective – more than twice the live storage of Bhakra dam is mined from groundwater every year in Punjab.*

If we take into consideration that groundwater is much more productive than canal waters, and assume Dhawan's figures that only 40% of the groundwater recharge is from rainfall, the break up of the contribution to agriculture from various sources that we get is given in Table 8.4.

The startling conclusion is that - even if we assume 60% of groundwater recharge comes from canals, and we count this as a part of the benefits of canals - the contribution of canal irrigation to total production in Punjab is about 43% - while 43% of the total production comes from areas with completely unsustainable mining of groundwater.[26]

[24] Personal Discussion. Dr. Dhillon was a member a committee set up by the Punjab Agricultural University to study this. It included 4 other experts.
[25] These figures pertain to 1988-90
[26] If we use figures given in the Johl Committee Report, (Government of Punjab 2002), then the contribution from mining of ground water comes to 35%, the contribution of total canals (including canals direct and canal

Table 8.4: Contribution of Various Sources to Agricultural Production - Punjab

	Percentage Contribution to Production
Unirrigated Areas	2.52%
Canal Waters Direct (12-14 MAF)	25.7%
Canal Waters Indirect (infiltration into groundwater - 4.8 MAF)	17.23%
Groundwater Direct (Rainfall Recharge) (3.2 MAF)	11.48%
Groundwater Mining (Unsustainable 14-12 MAF)	43.07%

The figures for water usage in agriculture in Haryana are similar. According to the booklet produced by The Director of Extention Education, CCS Haryana Agricultural University under the World Bank project[27]:

> "The total consumptive use of the state for the prevalent cropping pattern, has been estimated to be 3.39 M ha-m and the net irrigation requirement at the field level comes out to be 2.40 M ha-m. The availability of canal and ground waters at field head is 0.6507 ha-m and 0.6813 M ha-m respectively."

The same information in tabular form is given below:

	In Million ha-m	**In MAF**
Total consumptive use of the state for agriculture for the prevalent cropping pattern	3.39	27.46
Net irrigation requirement (net of rainfall)	2.40	19.44
Groundwater Availability	0.6813	5.52
Canal Water Availability	0.6507	5.27
Total Available	1.332	10.79
Deficit	**1.068**	**8.65**

While it is not explicitly stated in the document whether this deficit is met or not - but since it talks about the consumptive requirement of the *prevalent* cropping pattern, it is clear that the deficit must be being met from somewhere - this somewhere is clearly the mining of groundwater. This conclusion is also supported by the observation that the groundwater level is falling in many parts of the state. *Haryana is mining groundwater more than the total storage of the Bhakra dam every year.*

➔

infiltration) remains the same, and contribution of rainfall recharge goes up to 19%. This is hardly any less serious a situation.

[27] Kumar *et al* 2000: Page 15

A similar calculation for Haryana as for Punjab gives the following:

Table 8.5: Contribution of Various Sources to Agricultural Production - Haryana

	% Contribution
Unirrigated Area	9.23 %
Canal Waters Direct (5.27 MAF)	34.4 %
Canal Waters Indirect (infiltration into groundwater – 3.312 MAF)	13.18 %
Groundwater Direct (Rainfall Recharge - 2.208 MAF)	8.78 %
Groundwater Mining (Unsustainable 8.65 MAF)	34.41 %

We find that 34% of the production comes from areas with unsustainable mining of ground water and over 9% from unirrigated areas! Sustainable groundwater contributes 8.78 % and, with the most liberal assumption that 60% of recharge of groundwater comes from canal we still find that canal indirect contribution is only 13.18% and direct contribution 34.4 - a total of 47.58 %. We may note that Dhawan's figure of 60% recharge coming from groundwater is for Punjab and this will certainly be much lesser in Haryana, but we have taken conservative figures.

Running the Pumps – Power from the Dam

Before we analyse this contribution further, let us look at the aspect of power generation from the Bhakra project.

It is often argued that it is the power from the Bhakra dam that made it possible to run the tubewells.

The total power generation from Bhakra project is about 6500 MU (Million Units) per year, as per the board at the dam site.

According to Central Electricity Authority[28], the power generation from the Bhakra Left and Right Bank power houses was 5628 MU in 1995-96 and 1166 MU at Ganguwal and Kotla. So we can take the figure of 6500 as a fairly good representation. Even if we assume that all this power is used for running tubewells (not a valid assumption), the number of tubewells it can run is around 370,000.[29] Even in 1975-76, the number of tubewells in Punjab and Haryana was 450000 and 204736 respectively - total of 654736. Even by this period, the entire electricity from Bhakra could have run only about 56% of the tubewells at best. No wonder, 65,000 and 304,000 of these tubewells in Haryana and Punjab respectively were being run on diesel.

Journals have noted the severe power crisis during this period and have discussed the impacts of this on the agricultural production.

> "..precisely because of the current shortage of power and diesel oil, the Governments of Punjab and Haryana have been thinking of drastically lowering their wheat production targets for the current year…"[30]

In 1990-91, the number of tubewells in the two states had gone up to 497571 in Haryana and 800000 in Punjab. This is a total of 1,297,571. Thus, the power from Bhakra was sufficient to run about 28% of these[31].

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[28] CEA1999: *Review of Performance of Hydropower Stations 1995-96*; Central Electricity Authority, Ministry of Power, Government of India. Page 31

[29] We have estimated this, assuming 15% T&D loss, average 10 HP motor, running 10 hours a day for 200 days a year.

[30] Anon 1974b: '*End of Wheat Bonanza*?', Economic and Political Weekly, March 9, 1974, Vol. IX, No. 10, March 9, 1974: 393

[31] In fact, about 350,000 were running on diesel.

If we go back to our earlier calculations of the contribution of canals to the agricultural production, we have included the recharging of the groundwater due to canal seepage in the benefits attributable to the canals. In both Haryana and Punjab, the canal recharged groundwater constituted about 24% *each* of the total groundwater pumped out. Since these would not be used till they were pumped out, clearly the energy used to pump these waters out has already been considered within the benefit of the canals. In other words, the power generation benefits have more or less been fully subsumed when we attribute part of the groundwater benefits to the canals.

CONTRIBUTION OF BHAKRA

Out of the several contributors to the agricultural production, the contribution of the areas with mined groundwater, and of the recharge from rainwater is clearly not attributable to canals. This is 43% (34.41% + 8.78%) in Haryana and 54.48% (43% + 11.48%) in Punjab.

Sometimes the argument is made out as if virtually all the groundwater irrigation is attributable to the canals. The reasoning given for this is that Punjab and Haryana are dry areas with poor rainfall. This is grossly incorrect as we saw.

For one, there are many parts in the two states with good to fair rainfall. Secondly, in many of the drier areas the groundwater is saline, so the benefit of recharge there is lost. Most important to note, however, is that the ongoing recharge by canals has already been fully accounted in the above calculations and has been already counted as the (indirect) benefit of the canals.

The waters which are being mined are from the recharge from natural sources since centuries, and recharge from canals that took place before pumping was introduced on a large scale.

This *recharging of groundwater was already taking place much before Bhakra canals*, due to the diversions canals that were in place in Punjab and Haryana since late 19th century.

We have already noted the extensive irrigation in Punjab and Haryana from these early irrigation systems. In many places the recharge from these had led to the problem of waterlogging – testimony to the recharging of groundwater due to these canals.

The Johl Committee Report states[32]:

> "Ground water reservoir, which is now being exploited for agriculture production has been built up over the centuries particularly since the mid nineteenth century…"

The World Bank has noted in its India's Irrigation Sector Review of 1991[33]:

> "The success story of the agricultural development in the northwest ….. *was made possible by the major development of surface irrigation in the 19th and early 20th centuries.* Subsequent developments -- the rapid spread under the green revolution of HYVs, fertiliser usage and groundwater development (based on water provisions to groundwater provided by irrigation and used conjunctively with surface irrigation) -- could not have taken place if the irrigation infrastructure had not been there and functioning well." (Emphasis added)

The other two parts – direct irrigation from canals and the seepage due to canals – are attributed to canals. This is 47.58% (34.4 + 13.18) in Haryana and 42.93% (25.7% + 17.23 %) in Punjab[34].

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[32] Government of Punjab 2002: Page 12
[33] World Bank 1991b: Page 48
[34] To remind readers, this is the proportion from canal irrigated *areas* – the contribution of rainfall is included in this.

What is the proportion of Bhakra in this? We can approximate this in terms of the proportion of the Bhakra irrigation in the total canal irrigation.

In Punjab, this is very small part. In absence of official figures due to the refusal of officials to give us the detailed figures, we can only estimate this from the Statistical abstracts. We estimate the irrigation from Bhakra canals in Punjab will not be more than 25% of the canal areas (in 1989-90). Thus, if the total contribution of the canals to production in Punjab is 43%, then from Bhakra it would be about 11%. This is in all likelihood an overestimate, as our method of estimating irrigation from Bhakra canals is liberal.

For Haryana, if we take the total Bhakra irrigation as 50% of the canal irrigation, then the contribution of Bhakra will be about 24% to the state production.

To Summarise[35]:

Contribution of Bhakra to agricultural production in	
Punjab	11%
Haryana	24%

We emphasise that this includes the contribution due to recharge of groundwater by canals. We should also recollect that as far as food production is concerned, Punjab contributes twice as much as Haryana.

We would like to caution that these figures should not be used as precise numbers; they are more in the nature of broad indicative estimates.[36]

OFFICIAL ESTIMATES

What are the official estimates? The Bhakra Beas Management Board, BBMB estimates the agricultural benefits of the project to be (the Table below is quoted from BBMB) [37]:

Annual Increase in Food Production

Project	**Annual Increase**			
	Foodgrains	Cotton	Pulses, Vegetables Oil, Fodder etc.	Sugarcane
Bhakra Nangal	1.57 m tons	0.185 m tons	0.440 m tons	0.365 m tons
Beas Sutluj Link	0.224 m tons	0.051 m tons	0.965 m tons	0.031 m tons

How do these compare with our estimates?

Note that the BBMB figures are for the whole project – i.e. for all the three states of Punjab, Haryana, Rajasthan taken together. For the moment, let us assume that all the above additional production is just in Haryana and Punjab. If we look at the total food production of Punjab and Haryana (in 1999-00), it was 38.26 m tons. *Thus, according to the above figures of BBMB,*

[35] See also ADDITONAL NOTE 8.1 with this Chapter.

[36] We have not included here the estimates of the food production in Rajasthan due to the Bhakra project as Rajasthan areas form a small part of the Bhakra CCA and the main focus of our enquiry have been Punjab and Haryana. For the sake of records, we may mention that our estimate of the contribution of Bhakra project to foodgrain production in Rajasthan is about 0.46 m tons. Note that this is the total production from Bhakra irrigated areas, and not the *additional* production due to the project.

[37] BBMB 2002a: Page 50

contribution of Bhakra and BSL together is 4.688 %.[38] (This percentage will be even smaller if we deduct production in Rajasthan from the figures given in the table.)

What does all this mean? It means that the spectacular growth of agriculture in Punjab and Haryana was driven by the explosive growth in groundwater irrigation, and this did not depend on the Bhakra project! Contribution of Bhakra was rather modest, especially in Punjab.

One cannot escape the startling conclusion that much of Punjab and Haryana's growth could have still been possible even if the Bhakra dam had not been built. (Though possibly it would be as much unsustainable).

As Punjab raced from its pre-independence irrigation base to the HYV era with the explosive growth of tubewell based irrigation and increasingly unsustainable mining of groundwater, leading to spectacular increase in agricultural production, Bhakra happened to be there – in the right place, at the right time; being attributed with things it did not do, being credited with an achievement that was essentially due to something else. ✍

[38] Our estimates and the BBMB estimates may look different, but actually there may not be much difference between them. If we see our estimates for contribution of Bhakra, it is 11% in Punjab and 24% for Haryana. Considering that Haryana produces half the food that Punjab does, the weighted contribution of Bhakra in the food production of the two states taken together is 15%. Our estimates are for the *total* production from the Bhakra areas, while BBMB figures are mentioned as *additional output* due to Bhakra.

Note also that our estimates are liberal towards contribution of Bhakra

ADDITIONAL NOTE 8.1

CHAPTER 8: GROUNDWATER THE REAL DRIVING FORCE

In calculating the role of canal and groundwater in the agricultural and food production, there are two important aspects that we have to bear in mind:

1. Some of the groundwater use is made possible due to the groundwater recharge by canals. This has to be legitimately counted as a (indirect) benefit of the canals.
2. Some of the areas are irrigated solely by canals, some are irrigated solely by tubewells. It is fairly straightforward to attribute the production from these areas to canals and tubewells respectively. Part of the area irrigated is irrigated conjunctively by canals and tubewells. It is very complicated to allocate the production from these areas to canal or tubewells.

The first of these aspects, namely the fact that some of the groundwater is due to the recharge of the canals – we have already taken into consideration in the main chapter and have calculated the extent of this. The second issue, also taken into consideration in the main chapter is discussed in some detail here. We also calculate the contributions of canal and groundwater using an alternate methodology.

ISSUE OF CONJUNCTIVELY IRRIGATED AREAS

The Statistical Abstracts of both the states – Punjab and Haryana, give the following parameters for irrigated areas:

Net irrigated area
Gross irrigated area
Net area irrigated by source (namely by canal, tubewell and so on).

However, the gross area irrigated by source is not given.

Clearly, there is a problem as to how to classify the areas that are conjunctively irrigated – i.e. – irrigated by both canals and tubewells. Should these be called as canal irrigated, or tubewell irrigated? Or should a third category be created called “Conjunctively Irrigated”? As of today, the third category is not there, so we have to make do with only the two categories.

Moreover, conjunctively irrigated areas may have differing contributing from canal and groundwater. On some farms, one watering may be by canal and say four waterings by tubewell. In some cases, it may be the reverse. Others may be in between. Thus, the problem of how to deal with the issue of conjunctively irrigated areas is a difficult one.

We recognised this issue early on in the study as an important one, and explored how we could handle it in absence of data reporting on conjunctively irrigated areas.

The key to handling this issue is to see how the data is collected on the ground.

We have been cautioned that canal areas are often under-reported because the farmers want to avoid paying the water charges. On the other hand, we have also been told that precisely for these reasons, for the reasons of notching up revenue collection targets, revenue officials over-report canal areas. For example, *jiledars* told us in Haryana that even if the watercourse in the farm was used to carry tubewell water, the land was designated as canal irrigated. Thus, there seem to be factors which tend to downplay, and factors which tend to hike up the areas irrigated by canals.

In our field visits in Punjab and Haryana, we made detailed enquires about how the data is recorded and classified. In particular, we asked how an area is classified as “canal irrigated” or

"tubewell irrigated". We were told, unambiguously, that an area, even if it gets one watering from canal and all the rest from tubewell, is classified as canal irrigated. Indeed, as mentioned above, even if the land does not get canal water but the watercourse is used to carry tubewell water, this is designated as canal area.

What does this mean? *This means that effectively, all the conjunctively irrigated area is classified under canal affected area.* The contribution of canals to agricultural production, calculated with the current figures then creates a bias in favour of canals, since much of the tubewell irrigation benefit that occurs on the conjunctively irrigated areas gets attributed to the canals.

However, allowing this bias helps us address the problem of lack of data on conjunctively irrigated area.

This is precisely what we have done in the calculations in the main chapter. *With this, we have been able to address the issue of lack of separate data on conjunctively irrigated areas; however, it should be noted that our conclusions then overestimate the benefits of canals and underestimate the contribution of groundwater.*

METHOD II FOR CALCULATING THE CONTRIBUTION OF CANALS AND TUBEWELLS

There is another way to address the problem of lack of separate data for conjunctively irrigated areas. That is to estimate the contribution of canals and groundwater only on the basis of how much they contribute to the consumptive use by crops. The consumptive use by the crops, as the name suggests, is the water directly taken up and used by the crops. We have the following estimates for the same.

Haryana

	In MAF	**In Percentage**
Total consumptive use of the state for agriculture for the prevalent cropping pattern	27.46	
This is met from:		
Rainfall	8.02	29.21%
Groundwater Availability	5.52	20.10%
Canal Water Availability	5.27	19.19%
Mining of Groundwater	**8.65**	**31.50%**

Source: Kumar *et al* 2000: Page 15

This means that in Haryana, mining of groundwater meets 31.5% of the crop requirement and rainfall meets another 29.21%. Groundwater (sustainable) meets 20.1% of the crop requirement. If we take that 60% of this is recharged from canals, then direct groundwater meets 8.04% of crop requirement and recharge due to canal meets 12.06%. Canals directly meet 19.19%.

Thus, canals can be said to be responsible for (19.19+12.06) 31.25% of crop production in the state.

The method used in the main chapter allows us to account for the higher productivity of tubewell water over canal water, but does not allow us to separate the contribution of rainfall. The second method allows us to separate the contribution of rainfall, avoids the question of the lack of data on conjunctively irrigated areas, but does not allow for the higher productivity of tubewell areas.

Thus, both the methods over-estimate the contribution of canals.

Punjab

We have a data problem with Punjab since the figures for consumptive use of water by crops do not include the rainfall figures. Figures available with us from two separate sources both give the consumptive use of crops net of rainfall. However, if make an assumption that about 20% of the rainfall goes towards the consumptive use of crops, then we get the following figures.

	MAF	**Percent**
Total Consumptive Use	38.86096	
Met by:		
Rainfall	4.86096	13%
Canal Direct	14	36%
Canal Indirect	4.8	12%
Groundwater Direct	3.2	8%
Groundwater Mined	12	31%

Source: For Rainfall: Dhawan 1989
For Others Figures Dhillon, Personal Communication
Data pertains to 1989-90

Thus, 31% of the total consumptive use of crops is met from completely unsustainable mining of groundwater, and 13% by rainfall. Canals (including infiltration) meet about 48% of the crop consumptive use. Note that this data is for the year when the net area irrigated by canals in Punjab was high. Subsequently, this has dropped sharply and groundwater extractions gone up.

Also recollect that these calculations will over estimate the contribution of canals, and understate that of groundwater for reasons given above in Haryana section.

If we now estimate the contribution of Bhakra in this, using the figures from the main chapter of how much of canal irrigation in these two states comes from Bhakra, we get the following:

Contribution of Bhakra project to the agricultural production in:	**Percentage**
Haryana	15.62%
Punjab	12%

Based on Calculations as per Method II

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CHAPTER 8 : ANNEXURE I

Note on Calculations for the Contribution of Canals and Groundwater areas to food production

METHODOLOGY

1. Productivity of irrigated areas is taken as 2.5 times the productivity of unirrigated areas.
2. Productivity of tubewell irrigated areas is taken as 1.7 times that of canal irrigated areas.
3. Assuming that tubewell and canal irrigated areas are in a 1:1 ratio in the total irrigated area, we get the following ratios for productivity of various sources.

   Unirrigated: Canal+ Others: Tubewell == 540:1000:1700

4. Using the figures of net area irrigated by different sources, the gross area irrigated, and the productivity ratios for each of the above, we can get the proportion contributed by each source.

C = Constant

P = total production

Y_{source} – yield from a particular source

P_{source} – Production from a particular source

A_{source} – Area irrigated by a particular source

$$P = Y_{canal} * A_{canal} + Y_{tubewell} * A_{Tubewell} + Y_{unirigated} * A_{unirrigated}$$

$$= 1000*C * A_{canal} + 1700*C * A_{Tubewell} + 540*C* A_{unirrigated}$$

This gives us the *proportional contribution* of each source in the total production. Then, the contribution of the tubewell area is further divided into three – from normal recharge, from canal recharge, and from mined groundwater – in ratio of these three, which is known to us.

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9

Without Bhakra!

"There is little doubt that India's agricultural economy, and therefore the country as a whole would have been incomparably better off if the number of high cost river valley projects had been initially kept down to one or two, and the funds so released were devoted to a great many more small and quick maturing irrigation projects. ….. As it happened, India virtually settled for what could give her only the lowest output for very high capital input – with high dams, large investments, slow completion, slipshod irrigation, and indifference to inputs…"

Sudhir Sen,
First Chief Executive Officer of the
Damodar Valley Corporation*

Without Bhakra!

WE SAW THAT WHILE PUNJAB AND HARYANA HAVE HAD SPECTACULAR growth in foodgrains production, a very limited part of this can be attributed to the Bhakra project itself. The areas that have been served by the project are mainly in Haryana including the areas of Hissar, Sirsa, Fatehbad, and to some extent Jind where the groundwater irrigation is limited and irrigation from Bharka canals has been the main source of irrigation. More generally, the growth has been based on an unsustainable extraction of groundwater or on decades old canal systems based on diversion schemes.

Given this, it is evident that many of the developments in Punjab and Haryana would have been on similar lines as today even if the Bhakra project had not come up. We explore this in some detail in this chapter.[1]

What would the scenario have been without Bhakra? This question is one of the most frequently posed questions in context of the debate on large dams. *Interestingly, this question is mostly posed as an answer!* In other words, this question is most often posed as an argument to justify or argue for the construction of large dams.

It would be instructive to look at what Ramaswamy Iyer, former Secretary, Ministry of Water Resources, Government of India has to write on this aspect[2]:

> "A point made by some supporters of such projects is: yes, doing things has a cost; but there is also the 'cost of not doing'. This argument is often reinforced by the rhetorical question: where would the country have been without Bhakra –Nangal? Many find this line of argument persuasive. However, this is not a new or additional argument, but only a familiar one in a different form. 'The cost of not doing' means merely that in the absence of the project, certain benefits would not be available. This is nothing more than the old argument that the benefits justify the costs; …..Further, it is fallacious to equate the non-undertaking of a large project with 'not doing'. The choice is not between 'doing a project' and 'not doing anything'; there are other things (such as demand management, conservation, local water harvesting etc.) that can be done. As for the question of what we would have done without Bhakra-Nangal, it is a hypothetical one to which only a speculative answer can be given…."

We know from our look into the circumstances in the 1940s, 50s and 60s that indeed there were several other options that the country could have taken at that time.

Iyer continues:

> "We know the Bhakra Nangal 'scenario' because that is what actually happened; we do not know what the alternative history would have been if it had not come into existence. However, we need not readily assume that there would have been an absence of development on the agricultural front. Understandably, data and information are available only in respect of the routes (of large projects) actually

[1] This exploration of the "Without Bhakra" scenario in this Chapter is done only with respect to the irrigation aspect.
[2] Iyer 2003: Pages 132-133

> taken, and not in respect of the alternative routes that have not been explored. All that one can do is to point to the successful instances of watershed development and social transformations, and say that there is no reason why these cannot be replicated in large numbers."

We saw that even in the 40s and 50s, there were people pointing to such alternative routes.

The question of "without Bhakra" has several aspects pertaining to the choices at various levels:

1. What could have been the probable developments in Punjab, Haryana[3] and the country if Bhakra had not been built?
2. Whether the districts irrigated from Bhakra (mainly those in Haryana) could have been irrigated or otherwise developed without the Bhakra project?
3. At the larger level of addressing the food production and food security in the country, was Bhakra –and taking waters to the dry regions of Haryana - the optimal option? Were there any other options? What would have been the consequences of these options?
4. What have been the costs paid for the food production in Punjab and Haryana, and in particular for the benefits from Bhakra?

OPTIONS IN PUNJAB AND HARYANA

Let us start with the second question. Unlike the popular belief, the answer to the question is "yes" - the districts getting irrigation from Bhakra had other options.

New Areas to be Irrigated and Additional Water for Old Areas

We have already seen that the Partition made possible for the waters that were being used for the SVP in Pakistan to be released for use in India. With this, it would have been possible to extend the Sirhind canal system to areas in Haryana as well as provide for additional irrigation in Sirhind areas – which is what the Bhakra project did. If it was felt that instead of extending Sirhind system, new canals should be built to serve Haryana, that could have been done. In fact, it should be noted that even as part of the Bhakra project a new canal system was built originating from the Sutluj (the BML from Nangal). Whether the water comes into this canal from the dam or directly from the Sutluj – it could still serve the areas. Indeed, we will recollect from our discussion of the Sind-Punjab disputes that if the Partition had not taken place, it is unlikely that Bhakra would have been able to irrigate the areas it did. In a way, the irrigation in the Bhakra system was made possible more by the Partition and shifting of waters from the SVP than the Bhakra dam itself.

There were other technical possibilities as well - for example, a canal from somewhere between Ropar and Harike to bring water directly to the districts of Hissar, Sirsa, Fathebad. Such a canal –to irrigate areas in Sirsa and Hissar - was already proposed in a detailed report drawn up By John Benton in July 1905.[4] It was dropped for reasons unknown, possibly because SVP was given a higher priority.

A similar possibility of taking waters to Haryana from Harike barrage was noted by the then Chairman of Central Water Commission in 1975, in his report on the Reference to him of the Ravi-Beas dispute between Punjab and Haryana.[5]

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[3] We leave out Rajasthan since it forms a limited part of the Bhakra command. However, most of the discussions for Punjab and Haryana will apply to Rajasthan too.

[4] Government of Punjab (1917): Page 49

[5] Quoted in Dhillon 1983: Page 45

Thus, there is no doubt that large new areas in the two states of Punjab and Haryana could have been irrigated without the Bhakra project, and supplies to existing commands increased.

One point raised in this context is that such new irrigation would have been restricted to monsoon only and it would not have been possible to supply the new areas in the winter season without the storage provided by Bhakra. Not only this, but it is also said that Bhakra provided a high quality of irrigation. Thus, the quality[6] of irrigation available today would not have been possible without the project.

Three specific advantages are claimed for Bhakra.

1. The project brought new areas under irrigation, and increased the amount of water supplied to areas already irrigated.
2. The project, by providing storage in the dam, made it possible to carryover surplus waters from the monsoon (when the river flows were much higher) to the lean flow seasons. This made it possible to irrigate areas in the non-monsoon season, allowing two crops to be taken.
3. The dam provided regulation, thus allowing delivery of water to the crops when it was needed. It may be pointed out that the timing of water delivery is critical to the efficacy of irrigation and for crop productivity.

We have already seen that most of the extra water – to irrigate new areas, and for additional supplies to already irrigated areas – was made possible as India was released from the obligations to the SVP and other downstream users after the Partition. Let us look at the other issues.

Carryover from Monsoon to Winter

It is often argued that the Bhakra dam was necessary to and helped store excess monsoon runoff of the Sutluj for use in winter and summer, when river flows were less. Without the dam, it was said, the irrigation to the new areas would have remained limited to the monsoon months.

This of course is the specific case of the more generalised justification of large dams in the country. The typical argument for any large dam in a country like India is that the dam is necessary for carrying over water from the monsoon period, when the flows are vastly in excess, to the winter period when the flows are less. Figures normally mentioned are that about 80-90% of the total precipitation occurs in the three monsoon months and hence this needs to be stored in large dams to be used in the winter season.

Let us look at this argument carefully, for this is the core of the justification for the dam.

The need for storage to carry over flows from monsoon to winter comes in *when there is a mismatch between the irrigation requirements and the river flows.* The flow is concentrated in the monsoon months, while irrigation requirement may be more in the winter months when the flow is less.

In this context, we first note that in contrast to the figures presented for many of the peninsular rivers, the flow in Sutluj was more evenly spread-out, partly because it is also fed by snow-melt. The following table gives the flow of Sutluj over the year.

[6] The quantum, timing and reliability of water delivered is what is broadly referred to as the *quality of irrigation*.

Table 9.1: Mean Flow in Sutluj
[At Rim Station, 25 Year Mean (1921-22 to 1945-46)]

Period	Flow (MAF)	Percentage of Total Flow
April-June	3.2	24%
Jul- Sept.	8.4	62%
Oct. -Dec	1.2	9%
Jan.-March	0.8	6%
Annual	13.6	100%

Source: Gulhati 1973: 452

Thus, the summer months of April to June carry about 24% of the run off and the monsoon months carry 62%.

Let us now look at how much was surplus in the river for carrying over to low flow months. The following table presents the irrigation requirement at Bhakra and the river flows in Sutluj for the filling and depletion periods.

Table 9.2: Dependable Flow in Sutluj River and Irrigation Requirements at Bhakra

	Period[7]	**Irrigation Requirement** (MAF)	**Flows** (MAF)	**Surplus** (MAF)
Filling Period				
	1 June to 20 Sept.	4.94	7.93	3.00
Depletion Period				
	21 Sept. to 31 May	9.56	3.10	-6.46
	Grand Total	**14.50**	**11.03**[8]	-3.47

Flows as per Rao and Ramasheshan 1985a
Irrigation Requirements as per Rao and Ramasheshan 1985b

These figures show that the irrigation requirement in the monsoon period for Bhakra project was about 5 MAF and the flow about 8 MAF, thus, the surplus available for transfer to the winter months would be about 3 MAF.

However, this is not the actual surplus. As Rao and Ramasheshan point out[9], "Irrigation requirements given in Table 1 were assessed when the project was planned and were modified only slightly since, although the irrigation demands have changed due to the introduction of high-yielding varieties of crops which require more water."

Thus, increased water requirements in monsoon would mean that the available surplus would decline below the 3 MAF.

It is assumed (argued) that:

1. This unutilised water flows down waste to the sea, and/or
2. Since water is surplus in monsoon, it can be stored and used in the winter.

The notion that any water in the river that is not being 'used' for irrigation or industry is "waste" or "surplus" is a notion that is highly erroneous. The river, as a living ecological entity, needs to be flowing; and this means one can take out only so much and not more water. The "available surplus" is governed by this notion too. If some of the monsoon water was to

[7] Since periods for which flows and requirements are given differ slightly, we have matched them monthwise
[8] Note that the total annual flow in Table 9.2 differs from that in Table 9.1. This is because Table 9.2 gives the dependable flows and Table 9.1 gives the mean flows.
[9] Rao and Ramasheshan 1985b: Page 181

be left for flowing in the river (in modern terminology this is now called "minimum ecological flows") then we see that the "surplus" would decline further.

Moreover, we will recollect that a significant part of the monsoon flow of Sutluj was being utilised at the Sutluj Valley projects (in India and in Pakistan) and possibly also further downstream.[10] This is why it was feared that the Bhakra project would adversely affect the downstream irrigation in Pakistan (at SVP, at Sukkur). Gulhati says[11]:

> "Some of the projects like the Bhakra on the Sutluj, the construction of which has been taken up just before Independence, unless severely restricted in scope, as was the intention of the Government of undivided Punjab, would use up in India some of the waters already apportioned to then existing canals, lower down on the Sutluj, in Pakistan."

Thus, if allowance was made for this existing use, then there would have been virtually no surplus. Partition allowed this water to be released for use in India. However, even with this water being made available, the two factors described above, namely:

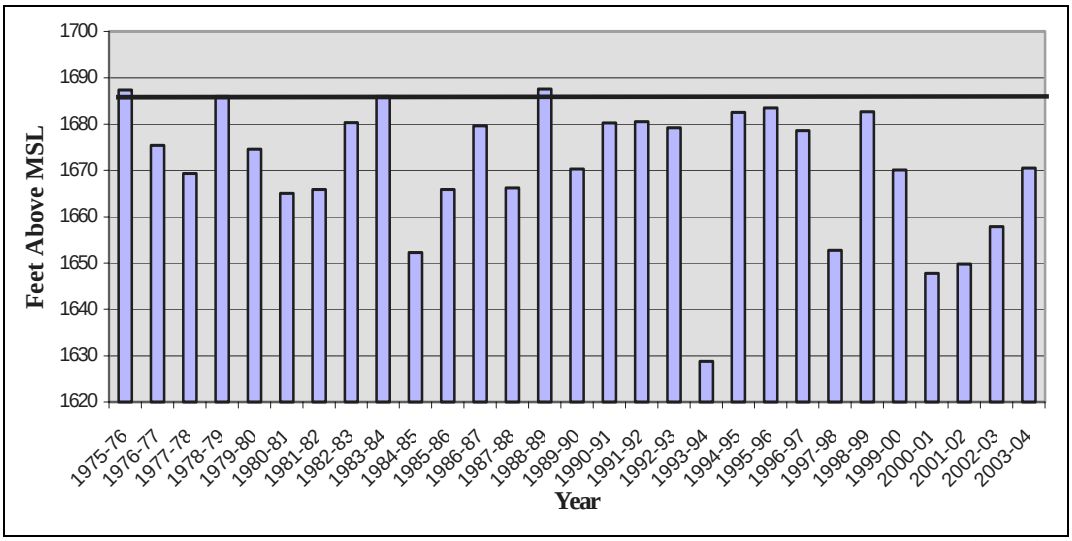
a) High irrigation requirements in monsoon leaving limited surplus
b) Need to ensure downstream flows

mean that there would have been virtually no surplus left in the monsoon months to transfer to winter.

The actual performance of the Bhakra dam validates this. The advantage claimed that the dam allowed monsoon surplus to be transferred to winter months when demand was high and flows less – has been a limited benefit.

The figures from the Bhakra Beas Management Board (Figure 9.1) show that the Bhakra dam has not filled up to the Maximum Reservoir Level in most of the years of operation.

Figure 9.1: Maximum Water Level in Bhakra Reservoir 1975-76 to 2003-04



Note - The dark black line shows Design Full Reservoir Level of 1685 feet.
Source: http://www.bhakra.nic.in/english/min_max.asp Accessed on 17.11.03

As the figures show, the maximum water level in the reservoir has exceeded the designed Maximum level of 1685 only in 4 years out of 29, and the design level of 1680 in only 10

[10] As the Sutluj combined with Beas, and later with the Chenab, it becomes impossible to say whether the waters are of Sutluj or Beas or Chenab. However, each river makes a contribution.
[11] Gulhati 1973: Page 9

years in 29. Note that these are the years since 1975 – from 1977 the waters of Beas had started augmenting the Bhakra reservoir through the BSL.

What are the implications of these figures? One, that the water inflow in the river has been below the estimates. In other words, the dam has been over-designed and the height of the dam was not justified considering Sutluj hydrology. This, we have seen was certainly the case, and the BSL was meant to correct this to some extent. Indeed, looking at the performance, it is evident that the dam height is not justified even after the Beas diversions.

The other explanation is that there was a closer match between the river flows and the requirements of irrigation, and hence the dam did not fill up. This is also indicated from the following observation of Michel, which also shows that the dam had not filled up till 1967[12]:

> "Because of the heavy irrigation and power requirements, it has not yet been possible to fill the Bhakra reservoir, nor is it anticipated that it can be achieved until after the Beas-Sutluj diversion via Pandoh tunnel…is completed…"

Another word about the carryover of monsoon storage into winter: this carryover comes with a heavy price tag. The price is not just the massive financial, social and other costs of such dams, but includes the huge impacts downstream of such storages. Such storages are altering the amount and pattern of downstream flows, changing the whole river ecology and economy and today this is recognised as leading to some of the most adverse impacts of such storages. Whatever limited surplus that Bhakra has managed to transfer from monsoon to winter has been at this cost, in addition to other impacts.

Regulation and Quality of Irrigation

Let us now look at the third aspect, namely, that of the quality of irrigation, particularly the benefit of regulation.

An important benefit attributed to the dam is the regulation that it provides, resulting in better timing of irrigation water. Canal irrigated farmers all over the country are witness to the unpredictability and unreliability of the canal systems, especially for the tail-enders. Bhakra has not been any exception. Indeed, the *warabandi* system of operating the canal network, while providing ease of management and apparent equity, has inherently meant that the matching the time of water delivery to crop requirement has gone awry. Not only did farmers tell us about the unreliability of the canal supply, but several studies also document the same.

For example, a study of the Fatehabad Circle in the Bhakra command found that[13]:

> "The problems of distribution and application in the Fatehabad branch canal are representative of similar problems on other projects in the region.
>
> - Rigid irrigation water delivery schedules with almost the same frequency throughout the growing season cannot meet crop demands.
> - The water supplied is scarce and the effects of scarcity are more severe in areas with highly saline/sodic groundwater.
> - In unlined watercourses about one third of the area toward the tail does not get any water; this leads to the unauthorized practice of sale of canal water.

[12] Michel 1967: Page 207

[13] Tyagi N.K. (undated): *Diagnostic Analysis And Some Approaches For Improving Water Delivery Performance In The Bhakra Canal Command*, downloaded from http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/003/X6626E/x6626e13.htm Accessed 21 Jan 2005

- The command areas of watercourses seem to have been fixed entirely on the basis of topography without much consideration for the soil infiltration rate."

The study also found that there was great variation in the "relative water supply" (the ratio between irrigation water supplied and demand) between the head and tail reaches. It also found that water supply is wanting in timeliness.

Another study reports that[14]:

> "The temporal distribution of an irrigation water delivery and demand ratio was used to analyze the performance of an irrigation water delivery system in the Bhakra Canal Command in India. A high degree of mismatch was found to exist between water demand and supply."

Most important, however, is the fact that in case of the Bhakra areas of Punjab and Haryana, especially Punjab, this regulation, reliability and timeliness of irrigation has been provided largely, and in a much better way by the extensive development of tubewells and groundwater based irrigation. We have already seen this in detail in the Chapter on Groundwater.

WITHOUT BHAKRA

So what *could* Punjab and Haryana have looked like if the Bhakra dam had not been built? An analysis of the facts emerging so far shows that the developments could and would have been more or less on the same lines as today.

The extra water available from the SVP could have helped augment the water supply in the existing irrigation in the Sirhind Canal areas. New canals could have been extended to bring in more land under irrigation to cover same areas as today. If the volume of water delivered to these (new) areas had been lesser than what it is currently, this is likely to have proved beneficial – since the serious waterlogging and salinisation in these areas today is partly due to excess water. One of the recommendations to control waterlogging is to actually cut down water deliveries in these areas.

Would the absence of a dam have meant that surplus monsoon flows (to whatever little extent these were surplus) could not be stored and hence winter irrigation would be less? This does not necessarily follow.

For one, the waters released in the canals in the monsoon could have been stored *in situ* on (or near) the farmers' fields and used in non-monsoon months. One study of the Sirsa district in Haryana (in the Bhakra command) points out this was a regular practise in the area[15]:

> "In the past, when farmers used to rely mainly on rainfall, it was a common practice to store and conserve as much of the rainfall as possible. However, with the development and operation of the canal irrigation system, the practice of *in situ* conservation of rain water receives less and less attention."[16]

Such *in situ* storage of waters could have been done not just with the local rainfall but also with the canals waters that could have come in.

Secondly, the waters released into the canals in the monsoon (indeed, any extra waters available in the monsoon) could have been stored as groundwater.

It may be pointed out that one of the biggest benefits claimed for the Bhakra system – that it recharged the groundwater extensively – does not actually depend on the presence of the dam,

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[14] Mishra and Tyagi 1988
[15] Dam, J.C. van, and R.S. Malik (Eds.) 2003
[16] We have not been able to study this during our field visits, but this would make a very important subject for more detailed research.

but on the canals. Thus, even if diversion canals – old and new – had come up, they would have performed the job of recharging the groundwater.

The HYV program would still have come in a big way in Punjab and Haryana. (Remember that the IADP was started in Ludhiana which had little canal irrigation). The HYV program would have demanded (as it has done today) increasing use of tubewells. Groundwater recharging due to the decades old canals systems like Sirhind, UBDC, WJC would have supported this, and the recharge from any new diversion canals added to it. A well planned, extensive program of *in situ* storage and rainwater harvesting could have increased the recharge to a great extent, and would have significantly augmented the groundwater availability. It is also possible that the tubewells irrigation would have gone on to extract more than this recharge and have developed in the same unsustainable manner!

Thus, it is not likely that the scenario in Punjab and Haryana would have been much different without Bhakra.

Of course, the financial costs, some downstream impacts, the displacement could have been avoided.

One argument is that in absence of the dam, some of the monsoon run-off in Sutluj would be lost, as it would just flow downstream. Normally, this would be considered as positive impact, since this would be critical for the downstream areas. Since much of the downstream is in Pakistan, it may be considered unpatriotic to say that we should allow at least some water to flow into the river to keep it alive!

It could also be argued that if such monsoon flow is lost to the downstream, then there would have been less water for the newly irrigated areas. In all likelihood, this would have a beneficial impact as excess water has created some of the most serious problems in the command.

It is sometimes argued that for the areas like Hissar, Sirsa, with underlain saline groundwater, canal supply is essential as these areas have meagre rainfall, and underground storage is not possible as the recharged groundwater would also become saline. We have already seen that the river flow available in monsoon could have been taken to these areas by new canals. We have also seen above that *in situ* storage was being practised in these areas, and part of this canal supply could have been stored there to be used in winter. Equally, the winter supply of Sutluj, which was committed to Sirhind areas, could have been released for these areas and *in situ* storage of monsoon waters undertaken in the Sirhind areas. There were many possibilities.

Indeed, one cannot take a static view of development. One cannot suppose that if the Bhakra project would not have come up, then nothing else would have been taken up – which is what most "without the project" scenarios implicitly assume. Our analysis shows that even without the Bhakra project, there was ample scope for development of water and agriculture, and we have outlined one possible direction that this development could have taken. Our analysis also tells us that this development could have potentially brought benefits similar to or more than what the developments with Bhakra did (and the high costs/ impacts avoided). They could also have possibly led to some unsustainable practises similar to those prevalent today.

For the sake of argument, let us assume that the waters available for the semi-arid areas of Haryana could have been smaller than today in absence of Bhakra. Possibly, the lesser quantum of water could have led to development of an agricultural cropping pattern more appropriate to the eco-climatic character of the area, avoiding or diminishing in the process the serious impacts like waterlogging that have taken place. There is also ample evidence from other parts of the country that even dry areas with very limited rainfall can use local water and soil management to develop prosperous agriculture.[17]

[17] Of course, comments on any specifics will require a detailed study of the area.

There is a larger issue here. What is the appropriate (agricultural) development strategy for this area? From the Second Irrigation Commission (1972) to the new National Water Policy, planners espouse that that development of an area should be appropriate to its eco-climatic conditions.

The new National Water Policy 2002 states (as did the earlier one in 1987):

> "Economic development and activities including agricultural, industrial and urban development, should be planned with due regard to the constraints imposed by the configuration of water availability. There should be a water zoning of the country and the economic activities should be guided and regulated in accordance with such zoning."

But the practise has been to implement the same agricultural model in all zones – growing sugarcane even in deserts[18], so to say. So long as sugarcane cultivation pays much more than say a livestock based economy (which may be more suited to such zones), there is little doubt that the people will demand water to grow sugarcane. In our undertaking, we found ample evidence of the desirability of tailoring the development strategies to the eco-climatic and local conditions. This has a crucial bearing on the country's agricultural and irrigation policies.

OPTIONS FOR THE COUNTRY

From the perspective of the country, the question "Without Bhakra" is a different one. The building of the Bhakra dam, canals etc. involved huge costs. Sustaining the production has involved further resources. Would these investments have been more productive if used somewhere else in the country? Would they have resulted in more production, or better distribution, or both? Was it worth building the dam to increase by a small amount the irrigation in some areas in Punjab and Haryana? Or would these resources have yielded better returns elsewhere?

This also brings in a related question. The contribution of Punjab and Haryana to foodgrains production in the country today appears highly unsustainable. Were there, or are there, any ways in which the country's food problem can be handled in a sustainable manner?

The assessment of this has to start with examining the realities of the claimed "foodgrains self-sufficiency" achieved by the country.

Perhaps the most serious, thought provoking and disturbing fact has been that in spite of the huge increase in the food production, millions of people go hungry even today.

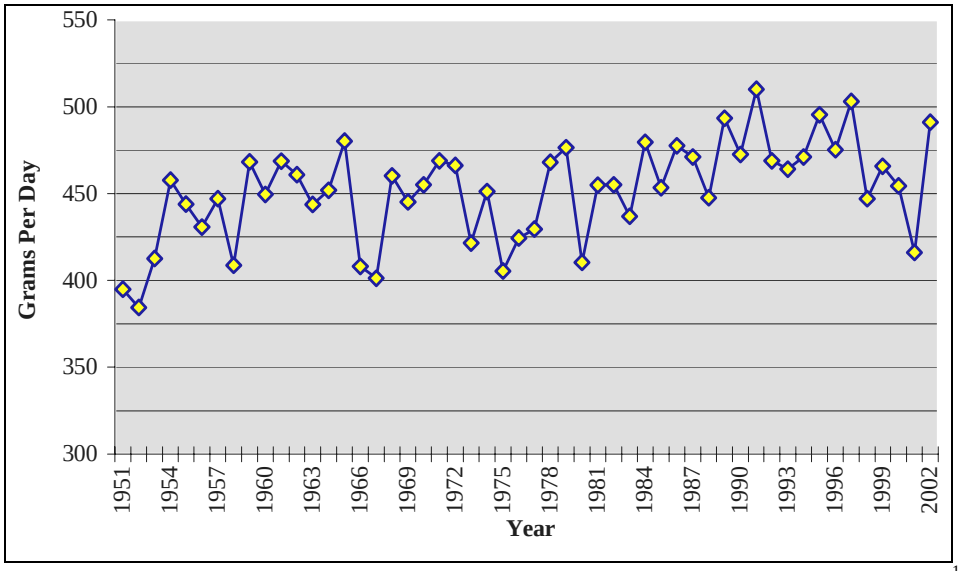
The per capita availability of foodgrains which was 480.1 grams in 1965 (just prior to the Green Revolution) reached a high of 510.1 grams in 1990 but has been declining since then and reached 416.2 grams in 2001. (See Figure 9.2)

Even this is mainly due to rice and wheat, and the per capita availability of other cereals and pulses has declined sharply (See Figure 9.3). Of particular concern are pulses, since pulses constitute a very important protein source for most Indians.

Of course, the population has increased hugely since 1960s, so the availability of foodgrains is not a mean achievement. Yet, it is clear that this has not been enough and it has not kept pace with the population. Population growth cannot be an excuse since any foodgrains policy has to take into account this growth.

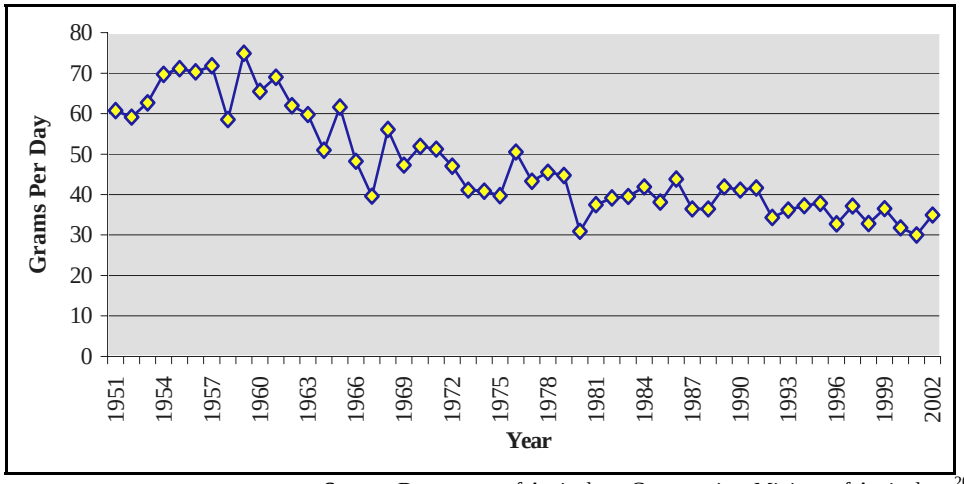
[18] For example, Kutch in Gujarat, where sugarcane is growing in the semi-arid areas, while neighbouring villages are going without even drinking water.

Figure 9.2: Per Capita Foodgrains Availability in India 1951-2001



Source: Department of Agriculture Co-operation, Ministry of Agriculture [19]

Figure 9.3: Per Capita Availability of Pulses in India 1951-2001



Source: Department of Agriculture Co-operation, Ministry of Agriculture[20]

What is more of a concern is that this availability has been accumulating in the godowns – and now even being exported, rather than reaching the people. The overflowing godowns while people go without food are the grossest perversity of the so-called "self-sufficiency".

There is little doubt that this can be traced to the policies adopted by the planners for increasing food(grains) production. The two objectives of food(grains) policy were (a) increasing food production, and (b) equitable distribution. The food(grains) policy separated the means of achieving the two. The primary emphasis was placed on the former, the argument being that we need to produce first before we can distribute. The strategy chosen for increasing food production was that of intensification and concentration – focus inputs, investments and resource in selected areas, which can give maximum returns in terms of increased outputs.

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[19] Department of Agriculture Co-operation, Ministry of Agriculture website - http://agricoop.nic.in/statistics2003/chap10.htm#chap101, Accessed on Oct 7, 2004

[20] *ibid*

The Fourth Plan Document (1969) stated[21]:

> "The Foodgrains Policy Committee (1966) postulated three objectives of food policy: to achieve self-reliance in production, to ensure equitable distribution, and to bring about price stability in the context of both production and distribution. The Committee went on to suggest that the latter two objectives could be achieved by planned management of food supplies involving such measures as procurement, control of inter-State movement of foodgrains, a system of public distribution and the building up of buffer stocks."

This separation of the means by which the two objectives – food production and equitable distribution - were to be achieved has been an important characteristic of India's food policy, and has directly resulted in the above-mentioned gross distortion. We have seen in the earlier chapters how this was partly a result of the bias of the planners towards the market deficit. A small quote from those days (1958) illustrates this thinking[22]:

> "We have 320 million acres of land under cultivation which will require a moderate dose of one maund per acre [of fertiliser]. The total quantity of fertiliser required would be about 11 million tons. Have we got this amount of resources? Supposing that the supply and distribution of manure are assured and 20 to 30 per cent increase in output is recorded, could this increased output be procured and brought to the market for urban population? …….Take for instance a 3-acre farmer who used to produce 27 mds under ordinary condition. With the present amenities, if he is able to increase production by 25%, then the total production would be 35 mds. Is it any surplus to a cereal eating family?"

This line of argument sharply represents the thinking of the planners (whether the author intended it or not).

What does this mean? If a farmer could increase his production and use this for self consumption, was this not an important national goal? To do this, he would need increased supply of inputs. But the policy makers in their wisdom felt that it was better to increase supply of inputs to areas where it could generate "procurable surplus".

Another reason given for this was that it would be better to focus inputs in areas where they would generate better returns. This was part of the logic of the "intensive" and "selective" strategy which targeted inputs to areas which could give maximum returns, and which could contribute to procurement.

As the Fourth Plan Document noted[23]:

> "7.2 The first stage of the new strategy pertained to the Intensive Agricultural District Programme. It was started in 1960-61 in three districts and was subsequently extended by stages to another thirteen. While the performance varied, it clearly demonstrated both the value of the "package" approach and *the advantage of concentrating effort in specific areas*. In 1964-65 and subsequent years, a modified version of the same approach was extended to several other parts of the country in the form of the Intensive Agricultural Area Programme." (Emphasis added)

However, even assuming that inputs to such selected areas led to higher output than our 3-arce farmer could obtain, was this really a better use of resources? For, how would the extra

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[21] Chapter 10 *Food and Nutrition;* Fourth Fie Year Plan
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/4th/4planch10.html
Accessed: Dec. 17, 2003

[22] Dasgupta 1958: '*Food Planning*'; The Economic Weekly, May 31, 1958

[23] Chapter 7 *Agriculture*; Fourth Five Year Plan : Para 7.2
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/4th/4planch7.html
Accessed: Dec. 17, 2003

production thus obtained be transferred to the 3-acre farmer so that he could satisfy his deficit? Where would he get higher purchasing power to obtain the surplus grains? The answer provided by the planners was that this would be done through procurement and public distribution- which meant further subsidies, more load on transport and so on – in short, more resources. In the process, the capacity of the 3-acre farmer would remain stagnant, while the intensification of resource inputs in a limited area would create islands of well-being, if not prosperity.

In such an arrangement, the small 3-acre farmer would be remain permanently (or at least for a long period) dependent on the Government.

On the other hand, if there could be ways in which millions of farmers all over the country could boost their production, then it would directly satisfy their needs; if this process of increasing productivity was linked to job creation, this would mean putting additional purchasing power in the hands of millions, as against a limited number in the "selective" strategy.

Such a policy would require (1) enabling access to land for the vast majority (b) increasing the productivity of lands all over the country and (c) generating employment (with much less migration) so that those who were not having access to lands could obtain the purchasing power. This meant land reforms, and linking the means of employment to the means of increasing productivity, in a decentralised manner.

This would address the needs of the millions who were either not linked to the market (subsistence farmers) or could not access the markets due to lack of purchasing power.

One of problems with focussing on "well endowed" areas of course is that this is not just a function of what nature has bestowed. Which areas become well endowed itself is a policy choice. Assured water supply and irrigation is one of the key parameters of an area's endowment and one that we are concerned with. Thus, irrigation and water policy can play a key role in creating endowments.

Irrigation planning in India has been fixated with large centralised projects. These are proposed and pushed with the argument that there is no alternative, and these create islands of better off areas, which are then chosen as a part of the strategy of selection.

In other words, a *choice* is made to create irrigation facilities in selected rather than widely spread areas; then it is said that the agricultural efforts will have to be focussed in these areas since these are the areas with better infrastructure. This is the direct result of large-scale projects that create pockets of irrigated areas. It must be noted that the decisions to proceed with such projects are a deliberate choice – rationalised by the "there is no alternative" argument. But of course, this argument does not hold. We only need to recollect the recommendations of the Ford team where a detailed case was made for widespread and dispersed efforts as against large-scale projects. Or the recommendations noted in the report of the Congress Agrarian Reforms Committee.

Writing about the Green Revolution and "the failure of the current strategy to bring about the promised agricultural growth and employment....", C.H. Hanumantha Rao also makes similar suggestions[24]:

> "A Rural Works Programme designed to strengthen the capital base of agriculture, e.g. soil conservation and minor irrigation through consolidation of holding as a part of the Plan for achieving the targeted growth of agricultural output would be non-inflationary in character and would provide the basis for sustained growth of output and employment....."

[24] C.H. Hanumantha Rao*; Socio-Political Factors and Agricultural Policies*; in Economic and Political Weekly, Special Number August 1974 Page 1285-1292

Indeed, time and again, many suggestions were made to take up wide-spread, decentralised programs of soil and water conservation that could meet both, the need of increasing production, and of generating employment.

These belie the claim that India had no options but go for building highly expensive large scale dam projects. It also disproves the oft-repeated claim that such measures as rainwater harvesting and decentralised water management options are recent suggestions and no such alternatives were proposed during that time. The fact is, there were very sound alternatives proposed then, and being proposed now; but the reasons they were rejected then remain more or less the same – that there were very strong interests pushing the large-scale projects and policies of intensification.

How does this apply to Bhakra and Punjab and Haryana?

The intensive / selective strategy for food production came clearly from a bias towards the "marketable surplus" and the urban populations depended on it; but it was also fundamental to the large-scale irrigation projects like Bhakra that came to be called by some as the "modern temples" of India. Such projects, by their very nature, can serve limited pockets of the country. Bhakra represented intensification – or centralisation – in several ways. One was the concentration of investment in a selected part of the country, second was the creation of high levels of irrigation in pockets rather than spread out all over the country, and third was the subsequent concentration of farming inputs into a small area. Equally important was the concentration of the procurement efforts through the use of the MSP and assured procurement.

Parts of Punjab where the canals did not reach but depend on groundwater too saw the intensification and concentration of inputs.

The overall result has been a remarkable expansion in foodgrains production, but without a parallel increase in the purchasing power of the millions. (For a more detailed discussion on this issue, see for e.g. Thakkar 1999). This is quite akin to the jobless "high" growth that is taking place today under the policies of globalisation, privatisation and liberalisation.

In 2002, the Government of Punjab, saddled with huge amounts of grains that were not finding a market, appointed a committee to examine how to handle this crisis. Headed by Dr. S.S. Johl, it is popularly called the Johl Committee. One of its observations is highly pertinent here[25].

> "India has accumulated huge stocks of foodgrains that are not finding market and are proving to be a heavy drain on the state exchequer and the government is obliged to purchase substantial new arrivals at higher and higher prices every season under the system of Minimum Support Prices. Although as per the nutritional requirements of the Indian population, these stocks may not be considered in excess, yet due to the lack of purchasing power with the poor, *supply exceeds demand*…." (Emphasis in original)

This is one part of the story. Just as the strategy of concentration has had an adverse impact on the consumers who are not able to buy the grains, it has had an equal backlash on the producers.

The Johl Committee report continues[26]:

> "The situation in Punjab is:……Market clearance for these foodgrains [rice and wheat] is becoming increasingly difficult both on financial account as well as on handling aspects. The rice-wheat production system in the state has, thus, become, unsustainable on economic, social and environmental grounds and even on political account…"

[25] Government of Punjab 2002: Page 104
[26] Government of Punjab 2002: Page 104

Those who argue that without the spectacular growth in foodgrains production in Punjab and Haryana, without the high yields achieved in these states – essentially based on intensification of all inputs including water – India could not have addressed the problem of food production, forget the definition of "average." An increase in the average production can be achieved either by very high growth in some parts and low growth in others, or moderate growth all over. The strategy of intensification / concentration led to the former, with all its attended problems in terms of equitable distribution. The strategy of decentralisation was condemned with the use of the TINA factor – but we have seen that the real factors were the vested interests.

If the country had chosen to plan its development Without Bhakra, or, more precisely, without the approach that Bhakra represented, then it would most likely have chosen land reforms, a decentralised, rain water harvesting, soil water conservation program, coupled with a host of other decentralised measures. All evidence indicates that this approach would have led not only to similar levels of production, but to a much better distribution of that produce, of the income generated, and much smaller adverse impacts.

It must be remembered that the strategy of intensification / concentration, the Bhakra project, the mining of groundwater and other factors that went into the high growth in Punjab and Haryana – all came with a very high cost. Significant resources – of the whole nation - were concentrated into the two states as part of the policy of intensification. No doubt, the food production went up – dramatically. But then, it cost further resources - in transaction and transportation costs - to take this food to those in other parts of the country; and even then, millions are going without. In the process, we have seen the creation of seeming islands of prosperity, of burgeoning foodgrains stocks, and yet millions without access to food, as they do not have the purchasing power.

The costs of the developments in Punjab and Haryana have been huge. There have been the financial costs of the Bharka project, the canals, the establishment to manage and run it; and then the costs of the huge groundwater irrigation infrastructure. Moreover, there have been the costs of the inputs – like fertilisers - many of which have been subsidised by the country. While this author strongly supports the need for subsidies in agriculture, the point is that it has to be recognised as a cost to the country and entails a huge opportunity cost.

Then there have been the huge impacts of the dam, the displacement, the impacts downstream and so on.

However the greatest cost that has been paid in the process is the cost paid by the land and ecology of Punjab and Haryana. And now, this cost is translating into the acute unviability of agriculture in Punjab, the increasing costs of inputs and declining returns, costly foodgrains that people cannot afford to buy, falling or stagnant yields and oppressively burdened, indebted farmers. *The whole edifice that has been seen as the climax of agricultural achievement in the country is crumbling. A dream is rapidly turning into a nightmare.* ✍

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* Sudhir Sen was the CEO of DVC from June 1948 to June 1954, and prior to that Secretary, DVC. The quoted text was written by Sen in 1974. (Sen Sudhir, '*A Richer Harvest: New Horizons for Developing Countries*', Tata McGraw-Hill Publishing Co New Delhi, 1974. - Quoted in Thakkar 2005). Thakkar, Himanshu (2005): '*Bhakra Project: Who, When, Where, Why, How? - Many questions, few answers*', draft note, Work in Progress. Used with permission.

10

A Dream Turns To Nightmare Crisis in Punjab and Haryana Agriculture

"Indo-Gangetic plains lie between the Himalayas and Peninsular India and represent a sag or depression in the earth's crust which has been filled up with alluvium brought down by the rivers. They constitute one of the most fertile tracts in the world. The alluvial soil of these plains is being cultivated from times immemorial and shows little signs of exhaustion."

First Five Year Plan Document,
Chapter on Irrigation and Power, Planning Commission, Government of India 1950

"*On the other side, continuous production of wheat and rice in annual rotation in the irrigated areas of Punjab is having a deleterious effect on soil, water, environment and social fabric of the state. Soils of Punjab have become virtually a laboratory culture that requires higher and higher doses of fertilisers, micronutrients, insecticides and pesticides to produce same level of wheat and /or rice. ….. The situation is becoming very serious day by day which can very soon proved to be economically disastrous, socially untenable and politically unsustainable, which can turn into man-made national calamity if not dealt with judiciously*."

Report of the S.S. Johl Committee,
Government of Punjab, Oct. 2002

A Dream Turns To Nightmare
Crisis in Punjab and Haryana Agriculture

IN JUST FIFTY YEARS, SOILS THAT WERE "FROM TIME IMMEMORIAL" SHOWING "little signs of exhaustion" are in a state of collapse. This is part of the price that we are paying for the "spectacular" growth in Punjab. The same is true of Haryana.

For decades, Punjab and Haryana have been idolised as the pinnacles of agricultural achievement, with Bhakra as its centrepiece.

The picture of the smiling turbaned *sikh* riding atop his tractor, waving a coloured scarf, with lush green fields all around is the quintessence of this. A tubewell with water gushing out, or the massive walls of the Bhakra dam in the background complete the image. This familiar picture has been deeply imprinted in psyche of the country, and Punjab and Haryana have become part of the Indian folklore, the Bhakra dam too shining brightly in the reflected glory.

It is said that appearances can be deceptive. One may add, "highly deceptive". The familiar picture above, alas, is an image from the past. An image that no longer represents the reality on the ground. The colours of the picture are fading. The smile on the face of the proud farmer has been replaced with a frown of worry – of many worries. The lush green fields hide the diseased soils, soils that require ever-rising chemical inputs to sustain production. The tubewell has to pump water from ever increasing depths. The tractor, in all likelihood, is on its way to one of the numerous second-hand tractor bazaars that have sprung up in the towns in Punjab, where farmers bring in tractors for distress sale, hoping that this will ease somewhat the unbearable burden of debt. This, and much more is the reality now of Punjab and Haryana.

> "Punjab is in total stagnation. Industry has shut down, agriculture is in doldrums…..Everybody thinks that Punjab is a land of plenty and the farmers are rich. Actually, 52% of our farmers are small and marginal, and they have less than two-and-half hectares. And nobody can survive on holdings that size. We have had 600 small farmers committing suicide in the last few years……"
>
> Capt. Amarinder Singh, Chief Minister of Punjab[1]

When farmers committed suicides in Andhra Pradesh, there was concern, but it could be understood. After all, these were poor farmers, in a drought prone and backward area of the country. But when suicides of farmers were reported from Punjab, the first reaction was disbelief and denial.[2] However, as the suicides continued, and more reports followed, they become impossible to ignore. The suicides by farmers are a desperate manifestation of the extreme crisis that agriculture faces in Punjab. Haryana is only a step behind.

Several observers have been warning about this emerging crisis for over a decade now[3], but this was dismissed as over-reaction or motivated. Over the last few years, articles and papers

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[1] Economic Times, Mumbai 11 June 2002

[2] See for example Swami Praveen, *Suicide Stories*, Frontline, April 24, 1998.

[3] Shiva, Vandana (1991): '*The Violence of the Green Revolution*', The Other India Press, Goa and Research Foundation for Science, Technology and Ecology, New Delhi.– to give one example.

in specialised journals, reports in the press and in the media have been trickling in, pointing to serious problems in Punjab and Haryana. Yet, these have mostly escaped the country's attention outside of the two states. For anyone who has talked to the farmers in the two states however, it is impossible to ignore what is happening on the ground. The agrarian economies of Punjab and Haryana are in a deep crisis indeed.

Both the states saw an initial burst in prosperity after the advent of the Green Revolution, but within a decade and half, the serious impacts of this began to be felt by the farmers.

In Ladwa, (Tehsil Hissar, Dist Hissar, Haryana) the *pradhan* at the Goushala, the elderly and respected Balraj *ji* told us:

> "About Bhakra, the situation is that wherever the waters reached, for the first ten years or so, there was a revolution in crops (*jabardast kranti – fasal mein*) then the downfall started, and the losses. This will happen everywhere like it happened in Bhakra. Now the water of Bhakra is having less impact in the farm. (*kheti mein kam asar kar raha hai*) 50% of the land is degrading. Where the Bhakra waters have reached, the dalhan [pulses] crop has finished."

The words of Sardar Gurmail Singh, Village Bada, District Ropar, in Punjab echo in our ears:

> "All that you can see around in Punjab [the prosperity] all that you have heard about it, please do not believe it. Things are not what they seem. Punjab is on the brink…
>
> "Things were okay till about 15 years back. All the problems have started since then."

Sardar Gurmail Singh is a medium farmer, cultivating 20 acres of land together with his brother. In an hour-long discussion, he told us all this and more on the situation of agriculture in Punjab. His was not a unique story – far from it. It was common, no matter who told it, where it was told. In village after village, from small farmer to medium farmer, from social activists, from political workers, from intellectuals, from academicians, in report after report, in Haryana and in Punjab, we heard the same stories. Stories that built a picture of an agricultural system on the verge of collapse, some parts having already succumbed.

This crisis it at once an ecological crisis, an economic crisis and a social crisis. What are the elements of this collapse?

Some of the serious problems can be stated as:

A. Land degradation, including waterlogging and salinisation[4]
B. Sharp decline in ground water levels
C. Loss of diversity in cropping pattern
D. Stagnant or falling yields
E. Increasing inputs, declining returns, the worsening economics of agriculture
F. Indebtedness of farmers

All these problems and issues are interrelated. The ecological problems are translating into the economic and social problems.

Waterlogging and salinisation is one of the most serious problems, and it is virtually impossible to have a lasting solution to the problem on lands that are underlain with saline waters. Much of the area in the Bhakra command in Haryana has bad quality groundwater. We have devoted a separate chapter to this problem, so we will not discuss this here.

ECOLOGICAL DEGRADATION AND THE SQUEEZE ON FARMERS

Some of these problems were being felt in the 80s itself, and in 1985, the Punjab Government set up a committee to look at the problem. It was headed by Dr. S.S. Johl. In 2002, the Punjab

[4] Land degradation is also taking place due to the extensive and prolonged use of fertilisers and chemicals

Government was to again set up a committee to look at the same issues – headed by the same person! In his report of 2002, Dr. Johl describes *what he had found in 1985.*[5] Among other things:

> "Yet there were strong reasons for the state to reduce overall dependence on wheat and rice on ecological considerations also. The two crops system repeating year after year for the past about one and half decade on an extensive scale had made the agro-eco-system of the State extremely fragile in the context of pests and crop diseases, soil health, human health and the overall living environment.
>
> "In short the committee realised that if the situation kept deteriorating at that rate, farmers of the State would suffer an acute economic squeeze and there would be a serious problem of market clearance in addition to over exploitation and increasing irrational use of scarce water resources and deterioration of agro-ecosystem of the State."

In Haryana, we were told about the transformation brought about by the Bhakra project. Several people told us that the areas of Hissar, Sirsa were arid/ semi arid region, but with the advent of the Bhakra project, the irrigation went up, and the agricultural productivity increased. *However, at every point, this discussion was also tempered with apprehension. A recurrent theme was that there was an initial burst of benefits, then came stagnation and the balance turned. The serious problems and losses followed. Land degradation and the adverse economics of agriculture were the major concerns voiced.*

The reader is reminded that parts of the Bhakra command in this part of Haryana were already covered by the Jamuna canals from the turn of the century or even before. When the Bhakra waters came, they replaced and/or supplemented the Jamuna waters in these areas. It is true that the quantity of the Jamuna waters was limited. In hindsight, it may have been their major plus point.

As we have seen, with the Bhakra canal, additional land could be brought under cultivation in Haryana; but the growth in food production was hardly dramatic. It is only with the Green Revolution phase that the big increases came. With it came also the HYV seeds, chemical fertilisers and pesticides. All this had an impact on the productivity – with an initial burst of increase in production, but now with very serious detrimental impacts, especially on the ecology and economics of the agriculture.

Shamsher Jat, a farmer in village Sulheda, (Tal. Narwana, Dist. Jind), Haryana said:

> "The waters have certainly benefited us. The production in our land has gone up. I have 40 acres of land. The production is more than what it was 20 years ago. The tubewells also came in about 20 years ago and that is why the irrigation has increased. 20 years ago, we were getting 20-25 *maan* of wheat per acre, now we are getting 50-60 *maan*. But now even the costs have gone up. So the net savings have gone down."

Note the reference to the additional irrigation from tubewells. This was a story repeated at many places, with farmers saying that the production has gone up, but the net benefits to the farmers have remained the same or gone down. The small farmers have been affected most severely in this.

Ramchandra Dhansingh Jat is a small farmer in the same village Sulheda. He is cultivating 5 acres of land. He said:

> "We have benefited from Bhakra. The tubewells have increased (this is the benefit of Bhakra Canal). But there is also a loss. All *tilhan, dalhan* [pulses, oilseeds] crops are gone."

[5] Government of Punjab 2002: Page 8

The tubewell irrigation was seen by him as the major benefit of the project. When asked as to how he saw the advent of Bhakra overall, he was vehement and emphatic in saying:

> "It was bad. (*bura hua*) All the other crops have been destroyed. Now we have to buy these. Our agriculture has been reduced to two crops only. For example, in case of *chana* [gram], the average yield has remained the same. Say 40 *maan*. It sells at 20 Rs. per kg. Wheat we get 50-55 *maan*, but it sells at 6 Rs. per kg. So we get more in *chana*. And input is less. But we can't grow it now. That other person (Samsher) is a big *jamidar* (landlord). What does he know? He will definitely say that this canal water was a benefit."

Thus, a clear distinction could be seen in the way the small and the big farmers perceived the benefits of Bhakra.[6]

The very unmistakable indicator of this was what the prevalent description of landless is. A number of times, we asked to speak to landless families, and in many cases we would find ourselves with families that have at least 1-2 acres of land. When we said we wanted to speak with the landless, we were told that in Haryana, if someone has 1-2-3 acres of land, he is considered landless! One would have expected that given what one has heard about the Bhakra project and its highly enhanced land productivity, even 2 acres of irrigated land would mean the farmer would be in a comfortable position, if not prosperous.

In every culture certain symbols are created through popular art. In India, Hindi films often play this role. Certain songs from films have become deep-rooted in Indian culture as symbols. There is one such song from a film made in 1974 - *Upkar*. It goes

> "*Mere Desh ki dharti, sona ugle, ugle heere moti*"
>
> (The land, the soils of my country, they produce gold, they produce diamonds)

The timing of the film, its subject and the lyrics leave little doubt that the words were inspired by the Green Revolution and the Punjab.

But the reality is that these soils, once eulogised as producing gold and diamonds, are not even able to sustain a family. Such is the situation of production and prices that small farms are not viable. This has disturbing implications for the sustainability and viability of the whole system.

Mangal is another small farmer in the village– he has 2 acres of land – and he calls himself as landless! He told us:

> "The impact (of Bhakra) has not been good. The costs have gone up so much that all [small farmers] have become unemployed, as there is no saving. This is the situation today. When Bhakra waters came, then we got good benefit. But since 10-15 years, this has changed."

For over a decade now, the farmers of Punjab and Haryana are seeing for the first time that yields from their fields are falling, or at best are stagnant. Agriculture in both these states has been reduced to virtual mono-cropping, with the wheat-rice or wheat-cotton cycle dominating overwhelmingly. In Punjab, wheat and rice together constitute over 75% of the gross cropped area.

In Punjab, average rice yields for the state reached a maximum of 3510 kgs/ha in 1989-90 and have been falling in the subsequent years[7]. The story of cotton can only be described as tragic.

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[6] One reason why the districts of Hissar, Sirsa and Fatehbad are not feeling the full brunt of the problems is possibly tied to the comparatively high land holdings in these districts.

[7] Singh Karam, Sajla Kalra, 2002: '*Rice Production in Punjab Systems, Varietal Diversity, Growth and Sustainability*', in Economic and Political Weekly, July 27, 2002. Provisional figure in the Statistical Abstracts

Both, the production and productivity of cotton in the state have plummeted. According to the Johl Committee Report[8]:

> "The State of Punjab has witnessed record production of cotton i.e. 26 lakh bales during the year 1989-90. The average yield of cotton (570 kg lint / ha) in Punjab was also the highest in the country. However, within a span of 10 years, there has been a drastic decline in both production and productivity of cotton. During 1998-99, state could harvest hardly 7 lakh bales with productivity of 206 kg lint/ ha."

In desperation, farmers are trying to saturate an already overburdened soil with more chemicals, and trying to control the uncontrollable pests with higher and higher doses of pesticides. But to little effect.

The districts of Hissar, Sirsa and Fatehbad grow about 75% of Haryana's cotton. They also have about 75% of its land area under cotton. In some areas, the excess moisture has impacted this crop. In most parts of the two states, the american bollworm has devastated the cotton crop since few years, with near total failure of the crop. Every place we visited had the same, tragic story. Farmers investing huge amounts in the input costs, spraying pesticides up to 30 sprays, and yet the whole crop getting destroyed by the bollworm. This has had in turn a serious impact on the downstream industries like ginning factories, not to talk about the farmers themselves who are getting indebted due to this.

In Hansi, Haryana we were told about how Hansi, traditionally an important cotton area had lost the position. There were 23 ginning factories there, but now most have shut shop. In Malout, Punjab we were told, there were 10 factories, now only two are left.

In Sulehda, the farmers told us about how the small landholders were the worst hit, since the cotton crop was repeatedly failing every year, and the input cost put them into greater and greater debt. The *sundi* (bollworm) was the main culprit, they said. When asked as to why don't they abandon cotton and take up some other crop – they said, what choice do we have? Now pests are affecting every crop.

What is more important than the stagnant or declining yields is that higher and higher inputs are being required to maintain these yields.

Everywhere we went, farmers told us how they have to keep putting more and more fertilisers to maintain yield; more and more pesticides to control the pests. But the soil is not responding. This is not the law of diminishing marginal returns. More inputs are required to maintain the same level of returns.

Reporting about discussions in a seminar held at the Haryana Agricultural university in Dec. 1996, Gupta and Gupta state[9]:

> "It was observed that because of declining input use efficiency, almost 50% to 100% more nutrients would be needed to obtain the same yield advantage which were obtained fifteen years back. Also that while the wheat-rice system was a very potential crop rotation for food security, there was an urgent need for maintenance of soil fertility in this rotation....
>
> "A large area in Haryana is affected by the problem of water stagnation, high water table and salt accumulation, bringing the soils under the category of sick soils. There is available evidence that the adoption of intensive monocropping and cereal based cropping and puddling in rice fields .... has resulted in deterioration of the physical

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show higher yields in the last 2 years, but whether this is a change in the clearly visible longer trends is not clear. In any case, none of the districts show the yields above 4000 kg/ha which had earlier been reached.

[8] Government of Punjab 2002: Page 34. While the production and productivity have picked in the last two years, it is still below the peak.

[9] Gupta and Gupta (2000): 81-82

> condition of the soil. Continuous use of high grade NKP fertilisers.. in the absence of organic matter recycling has resulted in deficiency of micronutrients ...”

A farmer described this in his own words.

> “In our area, it is known that if the calf of some buffalo is stillborn or dies immediately after birth, then the milk stops. It is said that the buffalo “*bhade ki ho gayee*”. Then we have to feed her much more than normal. We have to cajole her, coax her – only then the milk may start flowing. We now say that “*jammen bhade ki ho gayee hai*”. (The land too has become like this buffalo). We have to give her a lot, do a lot of fuss around her, only then will she give us something.”
>
> Sardar Trilochan Singh, Village Raipur, District Patiala, Punjab

The Johl committee report also substantiates this, as the quote from its Report at the beginning of this chapter shows. We repeat the quote here for ease of reading[10]:

> “On the other side, continuous production of wheat and rice in annual rotation in the irrigated areas of Punjab is having a deleterious effect on soil, water, environment and social fabric of the state. *Soils of Punjab have become virtually a laboratory culture that requires higher and higher doses of fertilisers, micronutrients, insecticides and pesticides to produce same level of wheat and /or rice.* This has resulted in declining total factor productivity. The situation is becoming very serious day be (sic) day which can very soon proved (sic) to be economically disastrous, socially untenable and politically unsustainable, which can turn into man-made national calamity if not dealt with judiciously.” (Emphasis added)

It is not difficult to see what has happened. The “miracle” of agriculture in these states is totally based on high inputs. The soil and the plant have been reduced to a virtual conduit for transferring and transforming these inputs into agricultural produce – that too, a very narrow selection of crops- wheat, rice and to some extent cotton. The extent to which some of the inputs have gone up can be seen from the following data.

Table 10.1: Growth of Production and Input Use in Punjab Agriculture

Indicator of Growth/Input Use	**1960-61**	**1990-91**	**Ratio of 1990-91 to 1960-61**	**Growth Rate** (Percent Per Year)
Wheat Output (Lakh Tonnes)	17.4	121.5	7.0	6.69
Rice Output (Lakh Tonnes)	2.3	65.1	28.3	11.80
Wheat Yield per acre (Kgs)	503.0	1503.0	3.0	3.71
Rice Yield Per Acre (Kgs)	408.0	1307.0	3.2	3.95
Fertiliser use per Acre (Kgs)	0.4	65.9	164.8	18.27
Number of Tubewells per 1000 acres sown area	1.6	76.9	48.1	13.73
Number of Tractors per thousand acres sown area	0.5	28.0	56.0	15.16

Source: Shergill 1998

The repeated, year after year cultivation of rice-wheat or cotton-wheat has broken the natural cycles which replenished the soils with vital nutrients. These natural cycles can be completed only if the crops grown are diverse, as different crops draw and contribute different elements to the soil. Also, for generations, people have followed the practice of leaving some portion of the land fallow, so that it can replenish itself.

[10] Government of Punjab 2002: Page (i) in Annexure I

The green revolution struck at both these practises.

A major element in the increased production was the expansion of the cultivated area and multiple cropping. As more and more area was brought under cultivation, less and less land was left fallow.

> "It was very good at first [the benefits of the increased irrigation and green revolution]. We had good crops in the beginning. Less fertiliser, good yield. But now, it is like an addict who needs more and more of the drug every day… the land is similarly addicted to fertilisers and wants more and more of it.. Otherwise it does not respond… Then again, in the early days, we used to keep some part of the fields empty so that the land could recover its strengths… now how can we keep the land fallow…. There are so many expenses…"
>
> - Santokh Singh, Village Kotli Khakhya, Dist. Nawanshahar

HIGH INPUT COSTS, DECLINING PRICES

Apart from the ecological costs – in terms of soil degradation - the economic and financial costs of these inputs have been huge – and spiralling upwards. Pesticides, fertilisers, water, energy, machines, labour - agriculture in these two states has been dependent on heavy inputs of all these. The costs of these inputs have been going up, without commensurate increases in the price of agricultural produce.

One of the important inputs whose cost – both real cost and the cost as borne by the farmer - has gone up dramatically is water. According to Pratap Singh, Village Mahas, Dist. Patiala (This village is commanded by canal):

> "The plight of the farmer is really bad today. Earlier, the groundwater level was at 5 feet (15-20 years ago), today it is not even available at 60 feet. [Needing more expenditure to pump up, higher power motors and so on.]
>
> "Fertilisers – no matter how much more we put in we are not getting the response.
>
> "In the earlier days, we farmers were happy. The cost of cultivation was minimum, or not there at all. Paddy is not a crop of Punjab at all. Earlier, our main crops were Maize, cotton, bajra, groundnut, chilly and so on. We had very little expenses, and the income was more. With the coming of Paddy, this has been reversed.
>
> "Also, earlier, one can of diesel used to cost Rs. 15/-. Now, it costs Rs. 400. The same is the case with other inputs. But the cost of our agricultural produce has not gone up in the same proportion."

Kashmir Singh, another farmer from the same village highlighted an important dimension of this.

> "While our village is served by the distributory of the Kotla canal, we still have to use the groundwater if we are to sustain agriculture. But the tubewells do not provide water properly for all. Especially the small farmer, who cannot afford to deepen his tubewell as the water level keeps going down. He is virtually without any water then."

Farmers in every part of the two states we visited repeated a story similar to this. The Johl committee report notes[11] that the groundwater level in Punjab is going down by 30 cms per year. A critical water table depth below 10 m has reached in 28% of the area of the state. Districts so affected include Ludhiana, Sangrur, Jalandhar, Patiala – all part of the Bhakra command. In Haryana, groundwater levels are falling in 48% of the state area[12]. Districts

[11] Government of Punjab 2002: 13
[12] EMCB-ENVIS Node on Water Resource Management at http://www.water-mgmt.com/en/database_haryana6.htm

affected include Mahindragarh, Riwari, Gurgaon, Kurukshetra, Kaithal, Karnal, Panipat and Ambala. Thus, several Bhakra commanded districts are in the grip of this problem.

The falling water levels are of great economic concern to the farmers. In spite of canal irrigation, we have seen that agriculture in both the states is based on huge extractions of groundwater. Paddy especially is impossible to grow without this. As water levels go deeper and deeper, farmers are being forced to re-bore and deepen their wells, every few years – at great cost. Small farmers are not able to do this. It may be noted that till 2001, farmers in Punjab were getting electricity free of charge, and now they, along with their Haryana counterparts are still paying only a small cost for it. Without commenting on the desirability or otherwise of this[13], one would like to point out here that cost of pumping is virtually not included in the farmers costs – he has to bear only the capital cost of pumping equipment, and the cost of deepening. If the cost of power is also to be borne by farmer, his costs would go up even more.

Falling groundwater is a huge threat to agriculture in the two states. In fact, since much of the agriculture depends on mining of groundwater – waters which are not being recharged – it is clear that water levels will keep going down.

> "I have three motors [to pump up water]. In 1970, the water level was 20 feet. In 1987, I had to fit a submersible pump. It had a 7.5 HP motor. Now the water level has gone to 60 feet, and I have changed to 12.5 HP and 10 HP motors. In 32 years, I have had to re-bore 4 times, and the frequency is increasing. I have had to spend a lakh of rupees every time."
>
> Sardar Meher Singh, Village Thedi, Taluka Kharad, Dist Ropar
>
> "The problem of water is becoming acute. The level of water is going down. We have had to go down by 60-65 feet. The level of water has gone down from 80 feet to 150 feet. Earlier, we could do with a normal motor. Now we have to fit a submersible motor, and that too 10-15 HP. It costs Rs. 100,000 – a lakh of rupees. And this can feed only about 5 acres. How can the farmer afford this continuous cost? And every year the water level falls, so the water delivered goes down.
>
> "At least since last 5 years, power was free for us. But now the Regulatory Commission is considering putting some charges on it. [The interview was before the Commission actually did this]. The Agricultural Price Commission that fixes the Minimum Support Price does not consider the cost of electricity.
>
> "The Government is giving electricity worth about Rs. 300 crores to farmers. But if we see the dues for the big industries, the theft, the dishonest people – it is far more. We farmers are not begging for free electricity. All we are saying is that then give us higher prices for our produce."
>
> Sardar Gurmail Singh, Village Bada, Dist. Ropar
>
> "Now the water levels have fallen so much, people here are now going in for submersible pumps. Haryana farmers have already done this, now it is our turn. But small farmers can't so easily go in for this. They can afford it only at the cost of piling up huge debts."
>
> Inderjit Singh, Village Sahauli, Dist Patiala

Even as cost of all these inputs has increased dramatically over the years, and the amount of inputs required have been going up sharply, even to maintain the same yields, the price that

[13] This author supports a significant subsidy to maintain affordable power tariffs for farmers.

the produce fetches has not gone up in the same proportion. The study on rural indebtedness in Punjab commissioned by the Punjab Government states[14]:

> "In the last about one decade (roughly since the mid-1980s) another dimension of the modernisation process of agriculture has appeared in Punjab. It is the continuing stagnation of yields of main crops, despite increasing application of modern inputs and growing expenditure on these inputs. …. it may be seen that in the last about 10 years (1985-86 to 1995-96), yield of wheat has grown at a very slow rate, yield of rice has remained stagnant and yield of cotton (American) and cotton (desi) have actually declined. Similarly yields of sugarcane, maize, and potato have remained stagnant. *The information ….. reveals clearly that net value of all crops per acre at (at constant 1980- 81 prices) has remained stagnant over this ten-year period. During the same period cash expenditure, on modern farm inputs incurred by Punjab farmers has been steadily growing and that has resulted in a continuous decline in the net surplus generated from the production* of these crops. This has resulted in Punjab farmers increasing dependence on borrowed funds to finance the purchase of their growing use of modern farm inputs. (Emphasis added)
>
> "In fact, in more recent years, the farmers have been even reporting a decline in the yield of main crops."

In the case of wheat and rice, the farmer is getting a reasonable price because almost all the produce is purchased by the Government at the Minimum Support Price (MSP). If this was not the case, the market price would be much below this, and it is doubtful whether the farmer would even recover his costs.

> "Right now, the Government is procuring the wheat, that is why the farmers are getting Rs. 600 per quintal. But if this stops, then they will not even get Rs. 300 per quintal. Then the farmers will have to give up cultivation of wheat because it will be too costly."
>
> Dr. Satbir Sura, Agriculture Development Officer, Hansi, District Hissar.

According to Shri H.S. Sidhu[15]:

> "…(G)iven the high cost structure of Punjab agriculture, Punjab does not enjoy comparative advantage in either of the two major crops. For instance the 'economic cost' of Punjab wheat to Food Corporation of India is Rs 850 per quintal if transport and storage costs are taken into account [Gulati 2000]. In contrast to this wheat is available internationally at less than $100 per tonne which works out to be Rs 475 per quintal. Even the best quality American wheat is selling in the international market at $127 per tonne which works out to roughly Rs 620 per quintal. The Government of India is not allowing free import of wheat from outside and has imposed substantial import duties on agricultural commodities. Thus, but for the government's import restrictions, it would have been extremely difficult for Punjab farmers to sell their agricultural produce. With more than $54 billion of foreign exchange reserves, India also cannot deny minimum market access in foodgrains under the WTO rules to major wheat exporters for a long time under the pretext of balance of payment problem. Once it happens the high cost Punjabi producer will be in real trouble. Already the marketing of wheat and rice is posing a serious problem both for the farmers as well as for the state-controlled buying agencies."

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[14] Shergill, H.S. 1998: '*Rural Credit and Indebtedness in Punjab*', Institute of Development and Communication, Chandigadh: Page 8. The study was commissioned by the Punjab Government.

[15] Sidhu, H.S. 2002: '*Crisis in Agrarian Economy in Punjab : Some Urgent Steps*', in Economic and Political Weekly, 27 July 2002.

Most farmers also told us that even with the MSP, agriculture is a losing proposition. Ajmer Singh Lakhowal, who heads the Bharatiya Kisan Union (Lakhowal group) told us that they had a one-point demand. Namely, the price given to the farmer should be linked to the Wholesale Price Index (WPI) with 1966-67 as the base year. His argument was that since this was the year in which MSP was introduced, it should keep up with the increase in the WPI. He said that the WPI had gone up 13 times since then, but what the farmers are getting has gone up by only 8 times.

On the other hand, even with these prices, the grains are priced out of the market – especially out of the reach of the poor who need them most.

Many farmers expressed to us grave concern about their future if the MSP is withdrawn and the farmer is left to the market forces. Several academicians, intellectuals pointed out that under the WTO, India will have to open up its market for foodgrains imports by 2005[16].

CHANGE IN CROPPING PATTERN AND ITS IMPACTS

The several suggestions to meet this crisis include the need to change the cropping pattern. This is not surprising since the loss of diversity in the cropping pattern is at the root of many problems – (1) Repetition of the same crops depletes the soil of nutrients requiring higher chemical input (2) Rice in particular needs very large quantity of water (3) When there are large areas of the same crop, pests can proliferate needing more pesticides (4) Marketing can be a problem when there are only a few crops grown by all farmers

It may be pointed out that the report of the Johl Committee is formally titled "Agricultural Production Pattern Adjustment Programme in Punjab for Productivity and Growth". In Hansi, Haryana, too we were told by the farmers that there is an emphasis for changing the cropping pattern, moving away from the current virtual mono-cropping.

Unfortunately, it is easier said than done.

It may be recollected that the Punjab Government had set up "a similar committee", under "similar situation" to recommend diversification of the cropping pattern – in 1985[17]. The setting up of another committee 17 years later testifies to the difficulties in changing the cropping pattern. There are several economic, ecological and other reasons behind it.

Let us try to understand these reasons, the change in the cropping pattern since the 1960s and the implications of the same.

The most dramatic transformation in the cropping pattern is clearly the replacement of a diverse cropping pattern with a cropping pattern dominated by just a few crops. All over Haryana, (and Punjab) the wheat-paddy cycle has come to dominate the cropping pattern. (See Annexure Pages A-29,30, and 46 for the cropping pattern of the two states over the years).

In Punjab, in 1965-66, wheat occupied 39% of the cultivated area, gram 15%, maize 10%, rice 7%. By 1990-91, wheat area was 44%, gram 1%, maize 2% and rice 27%.

Thus, area under wheat-rice went up from 46% to 71% in 1990-91. The actual area increase was much higher if we see that the total cropped area too had gone up in this period. In 2002, wheat-rice took up 78% of the total cropped area of Punjab.

In Haryana too, the case is similar, though less acute. In 1966-67, wheat occupied 18% of the total cropped area, gram 26%, *bajra* 22%, rice 5%. In 1990-91, this was 36% for wheat, 13% for gram, 12% for *bajra*, 13% for rice. In 1998-99, wheat and rice accounted for 57% of total cropped area.

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[16] Lahiry Sutapa, Distress in Punjab Agriculture under the WTO Regime: A Brief Note, FreeIndiaMedia.com
[17] Preface of the Johl Committee (2002) Report (Government of Punjab 2002)

This was also the most striking visual impression that we got during our visits. In the first visit, in Haryana[18], for miles and miles, the only crop we could see in the fields was wheat (being *rabi* season) with a sprinkling of sugarcane and *sarso*. This visual impression was corroborated by a number of farmers and others during the discussions.

We were repeatedly told that the *dalhan* (pulses), *tilhan* (oilseeds) crops were *no longer able to grow* in the area.

There are a number of reasons that seem to have contributed to the change in cropping pattern. These reasons are not in isolation of each other, but are related intrinsically to the type of agriculture introduced by large-scale irrigation and green revolution. Most important of these factors are: the availability of HYV seeds only for a few crops, namely wheat and rice, the availability of proper marketing including support price and procurement mechanism for selected crops, the returns to farmers, the impact of excessive moisture and waterlogging / soil salinity, the intensive use of chemicals in farming. It may be pointed out that while some factors force a choice on the farmer, some make it physically impossible for some of the crops like *dalhan, tilhan* to be cultivated even if the farmer wants to.

In the Shri Ladwa Goushal, Village Ladwa, Tal. Hissar, Dist. Hissar, we were told by the *Pradhan* Shri Balraj that wherever the Bhakra waters have reached, the *dalhan* crop has finished. He said that this is because the Bhakra waters come minus all nutrients, which get trapped with the silt behind the dam. He contrasted this with the Jamuna canal irrigated areas, where he said that this was not the case and so *dalhan* was not affected.[19] This may also have something to do with the fact that quantity of water from Jamuna canal was quite less. He also stated that this impact is not due to the excessive use of chemicals. He said that even where this use was not there, but irrigation from Bhakra was there, the *dalhan* was finished. He pointed out that the water levels in and around the area have reached very high levels.

In village Sulheda (Tal. Narwana, Dist. Jind, Haryana) also, we were told that while the Jamuna waters have been irrigating the village since decades, this did not have any effect on the *dalhan, tilhan* crops. But it is only with the advent of Bhakra waters when this impact started and now all the *dalhan, tilhan* crops are gone. Here however, one may also possibly see a connection with the intensive use of chemicals. We were told that in the pre-Bhakra days, there were no chemical fertilisers, pesticides. All these came with Bhakra waters. The farmers also pointed out that with this package came the new seeds, but only for crops like wheat. It appears that all these factors – excessive moisture, use of chemicals, and the options forced on to the farmers through only selected crops having support prices, and new varieties of seeds – all have played a role in the dramatic decrease of *dalhan, tilhan* crops. In Sulheda, we were told that *dal, moong, chana, til* can no longer grow here. The agriculture has been reduced to just two crops.

Waterlogging, salinity and excessive moisture is a very important reason for the change in the cropping pattern. The *dalhan* cannot grow in the high moisture of the irrigated areas. We were informed that earlier, even after the advent of canal irrigation, these were some mounds in the villages where the pulses would be grown. This was because they would not be so moist. As these mounds were leveled, the pulses crops could no longer be grown.

The rice crop was introduced in several parts initially to combat the waterlogging and salinity, but it was adopted widely as the support price made this a profitable corp.[20]

In village Lamba Khedi (Taluka Narwana, Dist. Jind, Haryana) , we were told that earlier (before irrigation from Bhakra), they used to take crops like *chana, sarso, masri, moong,* all

[18] Almost all of it in Bhakra command, part in WJC command

[19] We were to hear this from others also; since the Jamuna canal takes off from a diversion structure, it is likely that this brings in the silt with it also. The Bhakra water would not carry the silt as it would settle and be trapped behind the dam

[20] Government of Punjab: Page 12. Also interviews with villagers.

dals like udad etc., *til*, *turiya*, sugarcane, *bajra*, *juwar*, *arhar*, *makka*, *chili*, tobacco, *shan* (a jute like fiber crop). After 1970-71, these went down. Now, the only crops left are *jiri* (paddy) and wheat. They said that they cannot grow the other crops. Lamba Khedi is severely affected by waterlogging since quite some time. The Bhakra waters came to this village in about 1964.

We heard the same stories in Punjab also. From all these discussions, and other evidence, there seem to be two important reasons for the dramatic decline in pulses. One is the reason of market support and returns – these are the highest in wheat and rice; the other reason is the high level of moisture in the area with advent of large scale irrigation - even when farmers want to grow pulses, they find it difficult.

The first impact of the change in cropping pattern is the non-availability of number of crops to the people. This means that they have to purchase the same or go without them. When we suggested to some farmers that they can grow wheat and rice and purchase the other crops, the reply was that someone somewhere would have to grow these! In Sulheda, one farmer told us that this (growing only two crops and buying the others) is not possible now since the expenses in growing wheat are growing and the profit is declining.

Another impact is that the choice of the farmers has been restricted and this is likely to have big financial implications. In Sulheda, a farmer told us that even though the wheat productivity went up after the advent of Bhakra project, they are net losers. He pointed out that even though the productivity of wheat has gone up to 50-55 *maan* (11 quintals) per acre wheat sells at Rs. 6 per Kg. and this too is the support price. The yield of *chana* may be the same as the what it was earlier – about 40 *maan* (8 quintals), but it sells at 20 Rs. per kg and the input cost is very less. But the problem is that it can't grow now.

This aspect becomes very important in the context of the attempts to diversify the cropping patterns. The very factors that were responsible for the expansion of food production are responsible for these problems too.

The MSP which was offered for rice and wheat made it much more profitable to switch to these crops and thus large areas rapidly shifted to the two crops. Now, any effort to shift back to other crops needs similar kind of support in terms of prices and markets. It was repeatedly told to us by farmers that unless this support is in place, there is little possibility of diversification. The past attempts in Punjab are a testimony to this. Farmers told us about how the Government encouraged farmers to grow potatoes, and when they did this, there were no buyers and huge quantities of potatoes were thrown on the roads by the farmers.

But there is another important issue. Even if the economic support is in place, the ecological factors may not allow the change in cropping pattern.

We have seen how the excess moisture is making it very difficult to grow pulses.

Farmers also told us that once a field has been growing paddy for several years, it is very difficult to grow other crops there. We were told that the growing of paddy requires and results in compacting of the soil, and this creates problems for other crops.[21] In village Mahas, District Patiala, we met farmers who had tried to change over from the paddy crops. We saw the fields where attempts had been made to grow chilli crop, but this had failed year after year. It had been five years since the paddy crop was taken there, but still there was a problem for other corps to grow.

One of the most serious implications of this difficulty in changing the cropping pattern is that this has drastically narrowed the choices for the farmers.

As we mentioned earlier, there is an apprehension– not at all unrealistic – that soon the support prices for wheat and paddy will be withdrawn. Many farmers, intellectuals, social activists

[21] The Johl committee also notes this. (Government of Punjab 2002: Page 17)

wherever we went, told us that the only thing sustaining the wheat paddy cycle is the support prices. In case of wheat, the price is around 600 Rs. per quintal. They told us that if this is withdrawn, the market price will not even come up to 400 Rs. and wheat cultivation would become un-remunerative, as the input costs are very high. This is a distinct possibility as the WTO calls for removal of the support prices. This is likely to result in large-scale social unrest.

For the farmers, this will be aggravated by the fact that they will not have many other crops to change over to. Thus, the lack of diversity, the fact that it is not be possible to cultivate other crops in many areas has made the whole system highly vulnerable to pressures of the type that agriculture is more and more likely to face in the coming days.

As the fear of WTO, the withdrawal of MSP and opening up of the markets to wheat and rice from outside looms over the farmers, the inability to switch over assumes a grave dimension. It limits the farmers' choices and strikes at the resilience of the system.

In other words, the greatly diminished diversity has increased enormously the ecological and economic vulnerability of the system – a system that has been considerably weakened already due to increasing inputs, increasing costs, and lower returns.

IMPACT ON FARMERS

The direct impact on farmers of this increasing gap between costs and returns is increased indebtedness. When the farmer is no longer able to meet the expenses - of cultivation, of running the household – from the diminishing income, debt is the most common way out. In almost every village we went, we found large number of farmers who were in debt – and were trapped in them. Indeed, in spite of asking, we hardly found any farmers who did not have debts.

In 1998, the Punjab Government commissioned a study of the farmers' debt in the state. The findings of the study are eye-opening and reflect all that we heard on the ground. This study states:

> "This combination of growing cash expenditure on modern farm inputs and stagnant or even declining crop yields have made Punjab farmers increasingly dependent on borrowed money which many of them are finding difficult to repay out of the meagre and declining net surplus from crop production." (Shergill 1998)

While we did not see any formal studies equivalent to this for Haryana, the stories we heard from numerous farmers in various parts of the state show that Haryana is only a step behind in Punjab in this matter.

Shergill's study makes a detailed analysis of the issue drawing on comprehensive data from a stratified sample across the whole of Punjab.

The study looks at three different components of the debt:

A. Short –term debts taken for meeting the recurring seasonal expenses of cultivation

B. Long-term debt for productive use – loans taken for productive investment like tractors, tubewells, and so on

C. Loans for non-productive expenditure like marriage, social functions, consumption needs etc.

The data is also segregated as per land holding (rather, land operated).

The important findings of the study are:

- 82.9% of farmers in Punjab were found to be taking short-term loan from different credit agencies to carry out their crop production operations.
- For all farmers taken together, the average amount borrowed per operated acre come out to be Rs. 3590 (short term loan only). Amount borrowed per acre declined as farm size increased.
- The total short-term loans taken by Punjab farmers in year 1997 amounted to Rs. 3119.3 crores. Out of this, 61.31 % (1912.58 crores) were advanced by the *arthis* or commission agents, who charge exorbitant rates of interest. Only 4.71 % of the loans came from Commercial and regional banks.
- 34.43 % of farmers borrowing short-term crop loans failed to repay the entire amount borrowed after harvesting and sale of their crops. The unpaid amount totalled to 696.80 crores Rs. or 22.34% of the total borrowed amount.
- 70% of the small farmers, 40% of the semi-medium, 47% of the medium and 28.30% of the large farmers were not able to fully repay the crop loans taken by them

The study also quantifies the debt burden on farmers in terms of selected parameters. These are:

Table 10.2: Burden of Debt on Punjab Farmers

1.	Annual Interest Charges (Absolute Amount) @ 14% on debt due to formal sector agencies @ 24% on debt due to informal sector agencies	Rs. 1102.78 crores
2.	Annual Interest Charges as Percent of Net State Domestic Product Originating in Agriculture as Current Prices	10.96%
3.	Annual Interest Charges Per Operated Acre	Rs. 1073.77
4.	Principal and Interest Charges Per Operated Acre	Rs. 6621.73

Source: Shergill 1998, Page 68, Table 26

The picture that emerges is very serious indeed. Over 80% of the farmers have to take short-term loans to meet cultivation expenses, and 34% of the farmers are not able to repay the amount, which naturally accumulates. Most of these loans are taken from the *arthis*, who have come to dominate the farmers' market interaction. The *arthis* advance loans to the farmers, charging rates of interest from a “low” of 2% (per month) to a high of 5% (per month). Not only that, the farmer is then forced to sell his produce through the *arthi*, and in most likelihood has to buy the pesticides, fertilisers and in recent years even household goods from the traders specified by the *arthis*.

The interest burden works out to be an *average* of Rs. 1073.77 per operated acre, and is much higher in case of small farmers. The debt burden is not only making agriculture a losing proposition, but is virtually strangulating the farmers. Further, the whole edifice of agriculture is standing on the debts – both long-term, and short term.

The IDC study figures relate to 1997. The latest estimates are that the total debt of farmers has touched Rs. 10,000 crores, with the non-institutional (meaning from arthis) debt being about 60-80% of this, and the annual interest burden is about Rs. 3200 crores![22]

The indebtedness of the farmer, how it arises and the impact it has is dramatically illustrated by the village Harikishenpura, District Bhatinda, Punjab – the village that recently captured the attention of the media due to its *Panchayat* passing a resolution putting up the village for sale to liquidate its debts.

[22] Jaijee, Inderjeet Singh *et al* 2002: *‘Letter to President of India on “Way to Save Debt Trapped Farming Community”’*, on behalf of Movement Against State Repression, 26 May 2002, Chandigadh, unpublished.

The following conversation we had with farmers in Village Raipur[23], Tehsil and Dist. Patiala, shows a typical situation.

Q: Has any farmer incurred debt in this village?

Nachatar Singh (NS) : Every house is indebted here.

Q: But is the loan a burden or is it something that the farmer resorts to routinely?

NS: If the crop is good, then the farmer can return the loan.

Q: Has anyone here had to sell land to meet his debts?

NS: Number of people have sold off land due to debts.

Sawarna Singh (SS): (Interjecting) Say I have taken 4-5 acres of land on contract / lease for cultivation. I would have to take the money for this from the *arthi*. Then, I will also incur expenses. But the crop fails. Then I would have to sell my land. From where else will I return the money?

NS: Say I buy the tractor for the farm. But I see my neighbours house and I make a similar big *kothi* (house) which is outside my means. Then I will have to sell my tractor. Or, I spend the money for *nasha* (intoxicants)

SS: The small landholder – he is bound to lose in this system. It is better that he gives his land on contract. If he farms himself – he will lose. Look at me, I took 8 *bhigha* land (1.5 acres) on contract for Rs. 16000. But I could not sow it as there was no water. The land is lying empty. I have taken the money from the arthi. Now the interest is piling up…When I go to buy pesticide, if I have cash, it is still okay. But if it is from borrowed money from the arthi, he will not give me cash but will give me a chit – a slip of paper. I can then take the pesticide only from the shop he tells me, by giving the chit. Why talk about pesticides, now a days even the household goods like tea, sugar, all is done through such chits, at the shop that the arthi tells us.

Only if some member of the family is in service can we survive. The family that tries to live only on agriculture – their situation is bad. You can look at me and Trilochan (points to another farmer sitting next to him – that farmer has a government job) and see for yourself the difference.

Q: You are saying that you are indebted, but if one looks around the village then things seem to be quite okay.

SS: It is good only to look at. Pucca houses and so on. But inside, the real situation is bad. We know how it is. It is all based on debts now. And what we had earned in the first 10-15 years when things were good

> "Only those who have someone abroad, only those farmers can survive"
>
> Jasvinder Singh, Village Kotli Khakhya, Dist Nawanshahar.

This comment illustrates an interesting aspect of Punjab's economy. The *doaba* region (Bist *doaba*) is well known for people going abroad to work. It is said that there is at least one person abroad from every house in the *doaba*. Indeed, in our visit, all the families we met this was true.

This was the essence of what the farmers told us everywhere we went – in the command areas of Bhakra and also outside - No farmer can survive only on agriculture. The big ones can still manage, but the small farmers are really in a bad state. All the signs of prosperity are based on debts, or the earnings from the good old days in the initial 10-15 years when things were okay. This reference to the fact that things were good in the first 10-15 years and then started deteriorating has been a recurring theme in all our conversations with farmers in both the states.

[23] This is in the Bhakra command getting water via the BML. About 25% of the area is irrigated by canals and 75% by tubewells.

FARMERS SUICIDES – ACT OF DESPERATION – SYMBOL OF CRISIS

The combination of declining or stagnant yields, increasing input costs, declining prices and the huge burden of debt are strong indicators that things are seriously wrong economically and ecologically in Punjab and Haryana's agriculture. While lakhs of farmers try to come to grips with this phenomenon, number of farmers are taking the most desperate way out -- suicide.

Suicides by those considered as the most prosperous and advanced of farmers in the country are not only a pointer to the desperation of the farmers, but also raise serious questions about the whole agricultural system itself.

The first accounts of suicides by Punjab farmers were met with skepticism, denial and disbelief. But as the suicides continued and so did the reports, there is reluctant acceptance of truth. Now even the Chief Minister of Punjab has accepted this fact.

In 1998, the Institute of Development and Communication was entrusted a study on suicides of farmers and agricultural labourers in Punjab by the Government of Punjab. The purpose of the study was "to investigate the nature, extent and causes of suicides in rural Punjab". The study brings out some shocking facts[24].

> "There has been a distinct increase in the number of suicides in Punjab since 1993. In 1992-93 suicides in Punjab increased by 51.97 percent. By contrast, the all-India average registered an increase of 5.11 percent only. In the subsequent years, this trend has continued. In 1993-94, there was an increase of 14 percent, whereas in India it was 5.88 percent. In 1994- 95, the increase in the case of Punjab was 57 percent whereas in India as a whole there was a decline in suicides. In 1995-97, the increase in the suicides in Punjab was to the extent of 21 percent, whereas the decline in India to the extent (sic) of 19 percent."

The same information can be summarised as follows.

Table 10.3: Growth (Decline) in Suicide Rates – India and Punjab

Year	All-India (Per Cent)	Punjab (Per Cent)
1992-93	5.11	51.97
1993-94	5.88	14.00
1994-95	Negative	57.00
1995-97	(-)19.00	21.00

Other major finding are:

- Suicide rate among the farmers is higher as compared with that of the non-farmers. Among the farmers, again the most vulnerable sections are the small and marginal farmers and landless labourers[25].
- For example, in 1993, the suicide rate[26] of farmers was 1.98, while that of non-farmers was 0.9. In 1997, the same figures were 4.49 and 1.82.

Suicide Rate in Punjab for Farmers and Non-Farmers

	1993	1997
Farmer	1.98	4.49
Non-Farmer	0.90	1.82

[24] IDC 1998: '*Suicides in Rural Punjab*', Institute for Development and Communication, Monograph Series-V, Chandigarh.: Page 15
[25] *ibid* Page 22
[26] Suicides Per Lakh of Population

- The districts of Sangrur, Bhatinda and Mansa which have a high share of farmers' suicides also have a higher debt burden.

Many other studies and investigations, most of them done after the IDC study, some of them as late as 2002, confirm that suicides continue and that the economic crisis in agriculture and the indebtedness of the farmer are the main factors. Dr. Jagmohan Singh of Ludhiana, a Professor at the university and a human rights activist and expert on issues of globalisation and its impacts, told us that the cases of farmers suicides are on the rise. They had done an investigation on 79 cases and all were found to be due to economic reasons[27].

Dr. Gopal Iyer and Dr. Meher Singh Manick conducted a study on the farmers suicides in Punjab. They too find[28]:

> "The data clearly establishes that impoverishments and indebtedness have been the major contributory factors to the causation of suicides."

In their study, Dr. Iyer and Dr. Manick provide the figures for the costs of inputs and returns for the rice and wheat crops in the Sangrur district of Punjab. They find that "the net return per acre of paddy is Rs. 1304 and that of wheat is Rs. 590."[29] These figures are for 1997, and hence consider irrigation and electricity as free of cost. One can well understand why farmers with 1-2 acres would be known as landless!

Ashish Bose quotes a study whose report was then under preparation.[30] This study, undertaken by agricultural economist Sukhpal Singh from PAU (Ludhiana) and Suchha Singh Gill at Punjabi University Patiala investigates over 100 suicides by farmers. They find that the root cause is indebtedness.

The IDC study too identifies debt as one of the major causes of farmers' suicides in Punjab. The study points out that normally, the reasons behind suicides are multiple, and are a result of the interface between socio-economic and psychological factors. It also points out that certain factors are what can be called "predisposing factors" which create the stress and other factors are the precipitating factors, which, against the background of the stress created by the predisposing factors, precipitate the suicide. Also, a factor which may be predisposing factor in one case may be the precipitating factor in another and vice-versa.

The study also notes, "When asked about the presence of stressful liabilities it was discovered that as many as 74% suicide victims had such liabilities on them….compared with the presence of such liabilities in only 42% of the general sample. Prominent among the stressful liabilities were delay in marriage of children, inability to bear the burden of education of the children, inability to pay dowry, financial difficulties in meeting day-to-day- expense". Again the presence of financial stress is a major factor.

H.S. Sidhu[31] states:

> "There are reports of suicides by farmers because of their inability to return loans. More than one thousand farmers have committed suicide during the last five years or so. [Iyer and Manick 2000] Distress sale of farm machinery, tractors and even land are being reported daily."

Given that the agriculture in the whole state is in the grip of a crisis, the extent of farmers' suicides mentioned above may be under-estimates.

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[27] Discussion with Prof. Jagmohan Singh in Ludhiana

[28] Iyer K.G. and Meher Singh Manick 2000: '*Indebtedness, Impoverishment and Suicides in Rural Punjab*', Indian Publishers and Distributors, Delhi. Page 14

[29] *op cit* Page 34

[30] Bose, Ashish 2000: '*From Population to Pests in Punjab: American Boll Worm and Suicides in Cotton Belt*', in Economic and Political Weekly, 16 Sept. 2000

[31] Sidhu 2002

On 26 May 2002, several people representing the Movement Against State Repression (MASR)[32], including its convenor, human rights and political activist and former MLA Shri Inderjit Singh Jaijee wrote to the President of India, drawing his attention to the serious situation of the debt trap that the farming community in Punjab finds itself in. The letter, whose subject was "Way to Save Debt-Trapped Farming Community", says that:

> "Debt related suicide figures from the two blocks of Lehra and Andana in district Sangrur, from April 1, 2001 to March 31, 2002 investigated by the MASR and certified by village *panchayat* and verified by civil magistracy stand at 56…..Debt related suicides in the adjoining block of Sunam in District Sangrur and Budhlada block in Mansa District are also very high. Considering that Punjab has 138 blocks and suicides are reported from all parts of the state, the all-state figure could be as high as 4,000 a year."

The letter enclosed a list of the 56 victims along with details of landholding, debt etc.

Jaijee told us that the suicides began in the late 1980s[33]. He said:

> "I brought out the first report of farmers suicides in Punjab in 1990. This was related to the village Gulhani. But it was suppressed at that time saying that I was fanning militancy. Since I was involved in human rights issues, it was assumed that I was supporting militancy. It is only when the suicides were reported from A.P. that my contention was accepted."

Jaijee also narrated to us how his contentions kept on being met with denials[34]. He told us that he had details of 500 cases in his block itself.

Jaijee ended the discussion on suicides on an ominous note.

> "Today the first response of the desperate farmers has been suicide. But sooner or later farmers are bound to think, why should I die. Let me kill .. the *arthiyas* from whom they are taking the loans and who are seen as the most visible cause of their situation. In the last 2-3 months, there have been cases of 3 *arthiyas* being killed, by forcing spray (pesticides) down their mouths. Violence is erupting, will erupt". ✍

[32] Jaijee, Inderjeet Singh *et al* 2002: '*Letter to President of India on "Way to Save Debt Trapped Farming Community"*', on behalf of Movement Against State Repression, 26 May 2002, Chandigadh, unpublished. The letter has been signed by Inderjit Singh Jaijee, Convenor, Justice A.S. Bains, Baljit Kaur, co-convenor, Gurdarsharan Singh Grewal, former Punjab Advocate General, Lt. Gen. K.S. Gill, J.S. Toor, advocate and Dr. Gurmit Singh, advocate.

[33] Personal discussion with Shri Inderjit Singh Jaijee

[34] See also, for example, Swami Praaveen, *Suicide Stories* in, Frontline, April 24, 1998

11

Waterlogging and Salinisation

"The State of Punjab is experiencing very serious problem of water-logging in the south-western districts namely Faridkot, Ferozpur and Bhatinda, over the past few years. The water table has been continuously rising ....Vast areas of this tract have been water-logged with the result that thousands of hectares of land have gone out of cultivation, buildings have started crumbling down and roads have been badly damaged. It has been estimated that waterlogged areas ...is of the order of about 2 lakh hectares..."

Waterlogging, Soil Salinity and Alkalinity:
Report of Working Group on
Problem Identification in Irrigated Areas
with Suggested Remedial Measures,
Government of India 1991

"We pray that it should not rain, so that we can at least get some crops"

Farmers in Village Lohgad,
Dist. Sirsa, Haryana

Waterlogging and Salinisation

FOR THE FIRST TIME IN OUR LIVES, WE HEARD FARMERS PRAYING THAT IT should not rain. Even in the best-irrigated areas, rain is always eagerly awaited and much appreciated. Yet, here were farmers praying that it should not rain - not that is should not rain for a few days, but that it should not rain -at all. Their plight was understandable, though. With their lands oozing water, with ordinary farms being transformed into marshland and even ponds, the only chance of their getting some crop was if the season remained bone dry. Lohgad is just one of the many villages in the commands of Bhakra project that have been struck by the disaster of waterlogging and salinisation.

WHAT IS WATERLOGGING AND SALINISATION

In most simple terms, waterlogging – accumulation of excess water in the soil – occurs when there is an imbalance in the inflow and outflow of water in an area. Every part of land has, over centuries, developed a natural equilibrium between the water inflow – in the form of rain, underground flows etc. – and the outflow, in form of surface and subsurface flows and drainage, evaporation and so on. Massive "non-natural" inflow of external water from canal irrigation without equivalent outflow disturbs this equilibrium and results in rising water tables as the excess water percolates into the ground and accumulates. The accumulating water can come from direct seepage from the canals or from field applications of irrigation.

Another form of waterlogging is the temporary surface ponding of monsoon or flood waters. This can be due to several reasons, including disruption of natural drainage due to construction of canals, roads, blockage of drains etc. Another reason is that when waterlogging - in terms of rising water tables has already taken place, then the capacity of the ground to absorb monsoon waters diminishes and this too can lead to surface ponding.

As water accumulates, the level of ground water rises. When this reaches the crop root zone, it starts to have a serious impact on crop productivity, ultimately making the land totally unproductive and rendering the land into a wet desert.

This water dissolves the salts from the soil, and brings them to the surface, where they are deposited as the water evaporates. This results in the salinisation of the soil, again, affecting productivity adversely. Both these phenomenon normally go together. Another important mechanism of salt deposition is the irrigation water itself - whether from the canals or from groundwater. When the irrigation water evaporates, the salts that it contains are left behind. It is estimated that the canal waters bring 2 million tonnes of salt on the soil in Haryana every year.[1]

[1] Ghassemi F, A J Jakeman, H A Nix 1995: '*Salinisation of Land and Water Resources*', Centre for Resource and Environmental Studies, Australian National University, Canberra; quoting Rao et al 1990.

IMPACTS OF WATERLOGGING AND SALINITY

> "Waterlogging not only affects the agricultural land and crop productivity but also affects the growth of trees and other plants....
>
> "Waterlogging obstructs or stops the normal circulation of air in the soil root zone inhibiting activity of soil bacteria as oxygen is not drawn in the soil and carbon dioxide liberated by the plant roots cannot be dissolved and carried away. The concentration of carbon dioxide reduces the decomposition of organic matter...lacking nitrogen fixation and thereof nitrogen deficiency. The high water table and waterlogging do not permit room for growth of plant roots....In waterlogged area the agricultural operations are either impossible or difficult. The crop yield is also very poor or negligible."[2]

According to Bhamrah[3], the areas which have become waterlogged and salt infested, the crop yields have substantially decreased. He mentions a study which finds yields of paddy and wheat were 41% to 56% lower and net incomes in salt affected lands were 82% to 97% lower than unaffected lands. More generally:

> "The adverse effects of water logging and soil salinity / alkalinity render fertile soil unproductive and sometimes even barren. ...According to the Ministry of Water Resources (1991)[4], an area of 5.8 m ha was suffering from both these problems in the commands of major / medium irrigation projects in our country. This hinders the use of irrigation resources costing about 24,000 crore rupees... an annual loss of Rs. 2800 crores. The loss of foodgrains were calculated as 17 m tones which cost about Rs. 7000 crores."[5]

Waterlogging does not affect only agriculture. It also has a devastating impact on trees, on roads, buildings and infrastructure. It also leads to much higher flooding as the ground, already saturated with water, does not allow the rainfall to permeate and all of it is converted to run-off.

The phenomenon, according to Ghassemi *et al*[6] is "threatening the livelihood of one million farmers and their families, and having a significant influence on the food grain production of Haryana and in turn of India as a whole."

Not to be alarmed?

Vast areas are affected by waterlogging and salinity in Punjab and Haryana including in the command area of the Bhakra project.

Some tend to dismiss the twin problems of waterlogging and soil salinisation as a temporary phenomenon, a by-product that can be "dealt with", or something that affects a small part of the canal commands.

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[2] Tanwar, B.S. 1996: '*Water logging and Salinisation in India - Remedial Measures*', in Varma, C V J (Ed) (1996): '*Proceedings of Workshop -Waterlogging and Soil Salinity in Irrigated Agriculture, Karnal, 12-15 March 1996*', CBIP, New Delhi. & CSSRI, Karnal.

[3] Bhamrah P.J.S. 1996: '*Conjunctive Water Use Strategies to Control Waterlogging and Soil Salinity in Irrigated Commands*' in Varma, C V J (Ed) (1996): '*Proceedings of Workshop -Waterlogging and Soil Salinity in Irrigated Agriculture, Karnal, 12-15 March 1996*', CBIP, New Delhi. & CSSRI, Karnal.

[4] The report being referred to here is India, Government of (1991): *'Waterlogging, Salinity and Alkalinity - A Report of the Working Group of Identification of Extent of Affected Areas and Suggested Remedial Measures'*, Ministry of Water Resources, Government of India

[5] Bhamrah 1996

[6] Ghassemi F, A J Jakeman, H A Nix 1995: '*Salinisation of Land and Water Resources*', Centre for Resource and Environmental Studies, Australian National University, Canberra; quoting Tanwar and Kruseman 1985

According to B.G. Verghese[7]:

> "The thesis that Bhakra and the green revolution it sustains has devastated the land with waterlogging, salinity and chemical toxicity leading to soil death is patently absurd. There are certain problems of land and water management but these are being addressed. Alarms about salinity and waterlogging have been sounded in India since the development of the Ganga canals 140 years ago. Not that this should breed complacency; but there is little cause for despair."

But the figures, and official documents, tell an entirely different story.

As per Shri Vinay Kumar, Vice Chancellor, CCS Agricultural University, Hissar[8]:

> "In Central and south-western regions of Haryana ….. canal irrigation has led to the problems of water table rise, waterlogging, flooding, and secondary soil salinisation….. A current estimate of saline and waterlogged areas in the state is around 4000 km^2 [400,000 ha] and if suitable measures are not taken, the areas with such problems is likely to increase to about 20,000 km^2 within the next 2-3 decades."

As the irrigated area of Haryana is about 28 lakh hectare, this means that already about 14% area is affected and this can go upto 70%.

EXTENT OF THE PROBLEM IN BHAKRA COMMAND

Unfortunately, available data is often not categorised as per project commands; it is often only at the state level, or categorized as per districts.

Tanwar (1996) quotes the following data about Punjab and Haryana (for the whole states) for 1990-91 from Statistical Abstracts[9]:

	Waterlogged Land (ha)	**Salt Affected** (ha)
Haryana	249,000	197,000
Punjab	200,000	490,000

Haryana

Latest figures available are district wise and not project wise. The Haryana Government classifies the areas as Fully waterlogged (groundwater level between 0-1.5 m), waterlogged (1.5-3 m) and potentially waterlogged (3-10m). The waterlogged areas in Haryana for the Bhakra commanded districts in 1997 were 107,200 ha as fully waterlogged and 246,000 as waterlogged.[10] Hissar, Sirsa and Fatehbad districts account for 72,000 ha and 124,000 ha respectively out of this.

In 1986, Government of India set up working group, "Waterlogging, Soil Salinity and Alkalinity : Working Group on Problem Identification in Irrigated Areas with Suggested Remedial Measures". This Working Group submitted its report in 1991. The Working Group

[7] Verghese B.G. 1994: '*Minus Bhakra*' in Verghese B.G. 1994: '*Winning the Future: From Bhakra to Narmada, Tehri, Rajasthan Canal*', Konark Publishers Pvt Ltd, New Delhi: Page 38

[8] Dhindwal *et al*, (Ed) 2000: '*Management of Waterlogging Problem in Haryana*', Director of Extention Education, CCS Haryana Agricultural University, Hisar. July 2000

[9] It is not clear if these figures are only for canal commands, but it is certain that most of these lands will be from the canal commands.

[10] HIRMI *Sinchai Patrika* March 1999: Page 7

reports data for Haryana from June 1986 (when waterlogging is lowest as it is pre-monsoon time) for the *Bhakra Command* as follows[11]:

District	**Waterlogged Areas** (Thousand Ha)
Kurukshetra	9.218
Hissar	19.0
Sirsa	20.35
Ambala	0.600
Total	**49.168**

The same report also gives salinity-affected area as 275 thousand hectares in Haryana but no project-wise break up is given.

Punjab

For Punjab, the Working Group (GoI 1991) gives only district-wise waterlogging figures and not project wise. These are given as:

District	**Waterlogged Areas** (Thousand Ha)
Faridkot	161.975
Ferozpur	14.85
Bhatinda	21.75
Total	198.575
Say	**200.00**

Some areas in these districts[12] are in the Bhakra command. The comments of the team are very significant:

> "The State of Punjab is experiencing very serious problem of water-logging in the south-western districts namely the (sic) Faridkot, Ferozpur and Bhatinda, over the past few years. The water table has been continuously rising ....Vast areas of this tract have been water-logged with the result that thousands of hectares of land have gone out of cultivation, buildings have started crumbling down and roads have been badly damaged. It has been estimated that waterlogged areas ...is of the order of about 2 lakh hectares..."

Latest figures are not available project-wise.

According to a Punjab Agriculture University (PAU) study quoted by Dasgupta[13], the estimated waterlogged area in Muktasar and Malout districts (which earlier were part of the above three districts) in 1997 was 115,000 ha which increased to 180,000 ha in 1999.[14]

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[11] Government of India 1991: Page 48

[12] The then three districts - today some more districts have been carved out of the same region like Moga, Muktasar, Mansa

[13] Dasgupta, Kumkum (2000): '*Is the Joyride Over?*' in Down to Earth, August 15, 2000: Page 35

[14] A word of caution about the different figures. Many of the figures may not be strictly comparable with each other. This is due to three reasons. One is the timing. Waterlogging is normally measured two times – once in June, before the monsoon and second in October after the monsoon. Secondly, definitions vary across states. Some states may consider up 3 m level groundwater as waterlogged, others like Haryana may categorise this further in two ranges 0-1.5 m and 1.5 m to 3 m. Thirdly, due to the break up of districts over the years, district figures of one year may not be directly comparable.

Rajasthan

For Rajasthan, we were unable to find any figures for waterlogging and salinity problems in the Bhakra command. There figures given are mainly for IGNP command area, where the problem is very serious. The Bhakra areas in Rajasthan border the IGNP first phase areas as also the Hissar / Sirsa tracts, and we can expect the problem of waterlogging and salinity to be present here also.

The Working Group (Government of India 1991) figures for Rajasthan are only for IGNP Stage I, and it says that 179,500 ha out of the CCA of 540,000 are affected by waterlogging. This is about 33%.

According to the Director General, Indian Council of Agricultural Research, "despite certain measures taken up in developing the command of Indira Canal, serious problems of waterlogging was observed."[15]

A recent press reports presents information on how thousands of hectares of lands around Baropal in Hanumangadh district in Rajasthan have been affected by waterlogging[16].

The data from monitoring of groundwater levels in Rajasthan shows that the groundwater level has been rising every year in the Bhakra command, with the average annual rate of rise of water table ranging from 0.32 m to 0.91 m.[17]

SOME CASE STUDIES

As always, statistics conceal the individual tragedy. We visited several places in Haryana and Punjab affected by waterlogging and salinity and witnessed the great havoc that these have played with the lives of people. Some of these are outlined below.

Village Badopal, District Fatehabad, Haryana.

Badopal lies on the NH 10 between Hissar and Fatehabad. Badopal was initially a part of the Yamuna command. Around 1955, the village came under the Bhakra command. Until 1985, the canals were completely unlined. Since the canal here is the Fatehbad branch, it is always flowing.

The waterlogging problem in this village first became evident in 1978. The problem assumed very serious proportions. According to the local *patwari*, the problem was so severe that the water would stand in the field. From 1986 to 1989, it was not possible to take any crop whatsoever. Even after the lining, the problem still remains. It is not possible to take a proper crop in kharif season, and cotton was impossible to grow. The only crop here is the rabi wheat. The people in the village confirmed that since 1978, they had not been able to take the *shravani* (kharif) crop at all. Some people could not even take rabi crop. About 75% of the lands have been affected by waterlogging. As a result of this, about 25% of the people the financial position had become very bad and they were in debt.

Apart from the crop production, there have been other very severe impacts due to waterlogging. The people told us that the houses had sunk into the ground up to 2 feet The temple that was built just in 1992 has sunk in (*baith gaya hai*). The trees have also died due to waterlogging (*ped bhi jal gaye sem se*). The buildings are also being damaged – they have to be repaired every year. In all the buildings in the village, there is seepage from the sides. At one time the situation was so bad, that the cattle used to get stuck in the ground. If four people

[15] Statement by the DG at the 41st Meeting of the Environment Sun-group of the Narmada Control Authority, held on 6 January 2005 recorded in Minutes. Page 6

[16] "Water-logging leads to migration" Amarjit Thind, Tribune News Service, The Tribune, Chandigadh, May 22, 2001. Downloaded from the net from : http://www.tribuneindia.com/2001/20010522/nation.htm#13

[17] Government of Rajasthan 2002c: 365

sat on a *khat* (cot) it would sink into the ground. They could not even go for toilet outside – there was no place that was not waterloggged for several kilometres.

We visited a factory building in this village. The whole building is sinking, with differential settlement of the sides. So the owners have put in various types of supports and reinforcements – rods, lintels etc. New buildings are also developing cracks in the village within 2 years. We were also told that the national highway NH 10 had to be lifted some 6-7 feet due to problems of waterlogging – this was in a patch of 3-4 kms.

We also visited the water works of the village which was on the main road. This was supplying water to Badopal and Dharni villages. This was abandoned last year because the waterlogging had come up and destroyed the water tanks. The ground water had seeped into the water tanks. Ground water is saline here.

The village *johad* (tank) was good before, but is now destroyed because of waterlogging. Now even the cattle do not drink from the *johad*. Even the wells are similarly affected.

About 10 years ago, the Government made a monsoon surface water drain. (*sem nala*). Tubewells were installed along the canals in 1994-1995. There has been some benefit of this. Earlier, the water level near the canals was at 1 foot, now it has gone down to 6-7 feet. However, the problem has not been fully solved. The people told us that since last two years, there has been little rain, so the situation is tolerable. However, they are very apprehensive that if there is normal rainfall, then the problem will re-surface.

Village Lohgadh, District Sirsa.

Lohgadh is a village in Haryana which borders Punjab and Rajasthan. Lohgadh was also a part of the Yamuna command, until it was included in the Bhakra command in 1964.

This village has been badly affected by waterlogging.

Before going to the village, we stopped some way off outside the main village to talk to a number of people of the village and nearby. They told us that the waterlogging problem is due to the canals. The problem is so severe in places that small streams erupt from the soils. (*jameen se jharne bahane lage hai*). This has affected about 1000 ha of land. For one year the Chief Minister put a tubewell there, but there has not been any appreciable difference. Then a drain was built. But again there has been no difference. In fact, the problem is increasing. It has been very severe since last 3 years. We were also told that it is not only the lands near the canals that have been affected but also the low-lying lands. No crop now grows on these lands. Earlier, the cost of the lands was 2,70,000 Rs. per acre, now it is only 100,000 rupees and even 25,000. In some lands, while crops can be grown, the yield is very less.

The lands around the village were devastated. One patch of land had been converted into a pond! Another piece of land had turned totally slushy. We were told that some paddy crop was just harvested from this land, and the combine that had gone to harvest the same had been stuck for 4 days. Now even a tractor cannot go into the land, there is no chance of any crop being planted on this.

One of the woman showed us her land near the drain *nalla* on the way to Malout, and told us that she had only 1 acre of land. For 5 years there has been no yield on this. May be a little *dhaan* (paddy) – about 20% of the normal. We saw the land, it had much water in it - and this was on land next to the drain. On asking how they survive, she said that 2 children have been sent by her to her parents. She does wage labour work and manages. But the persons who are land owners, they cannot even do this labour work, since it is considered very much below status.

From here, we went into the main village. On the way, our guide who knows the area well pointed out to us the empty houses in the village. These people have left the village, as their

land has become unproductive due to waterlogging, he told us. When we reached there, a meeting of the village was in progress with the agricultural extension officers. We joined the meeting to discuss the various problems including waterlogging. We were told by the *sarpanch* that the problem of waterlogging has been here since about 8-10 years, but has become very severe in the last 5 years. About 1000 ha from the total of 9000 ha of the village land has become bad. Another person added that the impact is felt in the whole land area of the village, not just the 1000 ha. In some places it is severe and there is no crop at all, in others the production has drastically fallen.

Shri Sukhdayal told us that he and his brothers had about 35-40 acres land. The whole land has gone out of production. (*puri khatam ho gayi*). He went running from pillar to post all the way to the Chief Minister, but to no avail. (*sabhi door pagalon ki taraha ghoomte rahe mantri se CM tak*) Jaypal Kishorilal Sethi told us that he had 50 acres of land, all of it has gone into waterlogging. He then took some land on contract from someone else, but even on that, the crop did not grow well. He had sowed *narma (*Cotton*)*. In fact, ultimately he lost his own money in it. Kewal Krishna said that he had 8 acres of land. They are four brothers. The whole land has become waterlogged. So now his brothers have gone away to Karnal - due to the waterlogging. There is no work here. We were also told that many of the people have incurred heavy debts, and many have left the village.

In this village also, we were told that the Government has constructed a drain to solve the problem, but this has had little impact. We were told that the drain is blocked because there is no place to empty it into. The drain that we saw just outside the village (on road to Malout) was only half complete, not leading to anywhere. It was very shallow and had stagnant water.

We asked the villagers about how they were surviving if the lands were so badly affected. They told us that the agricultural people (officials of the agriculture department) tell them to start a fish farm, or sow vegetables. But, according to Sukhdayal, these were all trial and error methods. They tried sugarcane also, but it did not work out. Many people also tried to take lands of others on contract basis, but that too was not working out. Ultimately, many have just left the village or landed in debt.

On Way to Malout Town in Punjab

On the way from Lohgad to Malout, we saw the drainage *nalla* near village Fattakheda, Dist. Muktasar Punjab. The *nalla* is encrusted with salt. showing the high salinity of the water.

On the way from Mandi Dabwali to Malout (a distance of 31 km), after about 10 kms or so, the smooth, very good National Highway NH 10 suddenly became extremely bumpy. The jeep's speed had to be reduced drastically. The tar road was like a wave. This was the condition of the road almost all the way to Malout. In about 10 km patch of the road, the tar top had been removed and work was going on to raise and repair the road. All this was due to the waterlogging which had affected the road. Roads in a number of places have been badly affected due to waterlogging.

Malout Town, District Muktasar, Punjab

Malout is a town on the NH10. Malout region has been one of the worst affected areas of water logging. The entire region over 60 kms. from Malout to Faridkot and Muktasar has been affected.

In this town, we met some of the faculty members in the D.A.V. College, a school teacher who is also a union activist, a labour union activist and a journalist with the Punjabi Tribune.

Dr. Baljit Bhullar told us that the problem of waterlogging has been prevalent since last 10-12 years. Most severe impact has been for 2 years. From Malout to Faridkot, Muktasar, the whole patch of 60 kms was severely affected. The *sheesham* trees have been completely destroyed.

(*poore jal gaye*) This has resulted in the loss of hundreds of crores of rupees. Even the most ordinary tree of *sheesham* fetches about 5000-7000 rupees. When even the crops failed, the people resorted to large scale cutting of sheesham tress for fuel. Sheesham was a very important and traditionally abundant tree here. In other parts of Punjab too, we saw in large number of places, the *sheesham* trees completely defoliated, and blackened. (Details later)

Dr. Bhullar gave us an example of his relatives who did not get any crop for 8-9 years. The crop failure was such that they did not get even fodder for the cattle. Since about 4 years, the drain *nalla* has been made, and smaller drains have been put in place in the fields. So now the villages have been drained but still situation is not normal. It took two years to build the drains. Even the JCB (excavators) could not get in to the area – so much was the waterlogging. So this – work on the drain *nalla* - was the only means of livelihood for the *jamindar* (Farmer)

Dalbir Singh, journalist told us that the horticulture has been fully destroyed. Fruits like *kinno*, *amrud*, grapes, all have gone because of the waterlogging. We were also told that the cotton crop of this area has been destroyed due to too much moisture. Now, the farmers get only sugarcane, paddy, wheat. The impact of this is that earlier there were 10 cotton factories, now only 2 are left.

Shri Sudarshan Jagga told us that the situation was so bad that if a tractor was left in the field in the night, it would have sunken in by the morning. Some special machines came into the town to pull out such sunken vehicles. And they were charging huge amounts for this. Total of three cranes were operating in Malout at that time.

All this had a severe impact on the livelihoods of the people. According to Dalbir Singh, for first 15-20 years (after the canal came), the production was good and increasing. But now, after the waterlogging has come, it has started falling. The most severe problem of waterlogging started in 1995. Shri Jagga said that since the area has rich peasantry, they did not land in hunger. (*bhookhmari nahin hui*) But the labour that was coming from outside stopped coming. There were 10 cotton factories, now only 2 are left. In their school the children cannot even afford exam fees, such is the situation. He also added that the smaller farmers were worst affected and they became debt ridden. They had to mortgage their lands. Or, they took land from someone else (like those people who were in service) on contract basis. Dr. Bhullar said that some small farmers started activities like poultry, fish farming. But he didn't know how effective these things were. Others used to come every morning in the *mandi* in Malout looking for *majdoori* – for wage labour. But so much work was not available.

After the drain *nalla* had been put in place, there was some improvement. However, even now, the agriculture has not yet become fully normal. Dr. Bhullar, Shri Jagga and Com. Ramkrishna, all said, though not with much confidence, that if the drain *nalla* is completed, it will be a permanent solution to the problem. However, this was clearly more in a tone of wishful thinking, as their later statements showed. All the three said that normally the waterlogging would just go away automatically, by itself. They also said that they couldn't say that a technical solution will permanently solve the problem. Shri Jagga said that actually, even the work of the drain *nalla* is casually done (*khanapurti*). The thing is that it has not rained since last three years. If it rains normally, then the problem will come up again.

Shri Dalbir Singh expressed the same opinion. He also had a more detailed knowledge of the problem. He told us that the waterlogging had come about due to seepage from the canals. The Government had put up number of tubewells and these pump up the water in to the Sirhand Canal. But people are unhappy about it as the water is saline. A drain *nalla* was also built at great expense. However, this has not been very effective. At most, it can take care of the rainfall run-off. There is also the problem of reverse seepage from drainage *nalla* to the lower lying fields The situation is somewhat satisfactory since there has been little rainfall in the last two years. Dalbir Singh expressed the apprehension that if the rains were normal, then the problem would arise again. Almost none of the tubewells are working, mainly due to non-

payment of electricity bills. Many people have paid money and got the alignment of the drain *nalla* changed.

Later, we went to see the drain *nalla* just outside Malout. The *nalla* was completely choked up with an overgrowth of water hyacinth. We were also told that the *nalla* is used for dumping effluents and sewage. The water in the *nalla* was stagnant and not flowing.

There have been other very serious impacts of the waterlogging apart from agriculture. The whole town is like a ravaged town. When it rains, water gets into about 70% of the houses. The NH 10 had to be raised at Malout (like in Badopal and other places). Since the rainwater used to enter the city and the houses, people had also to raise the height of the houses from the ground. Even without rains, the waters have seeped up along the walls of almost all the houses. The paint on the walls has peeled off. Almost all the walls in all houses invariably have the bottom 4-5 feet damp and wet because of the rise of water from the ground. There has been differential settling as the foundations have been affected and this has led to extensive cracks and weakening of the houses and even collapse. The houses have to be repaired every now and then.

We visited the house of Dr. Bhullar. Dr. Bhullar's house is a classic example of how the buildings in the town have been affected by waterlogging. He had first got it repaired about 7-8 years ago, and then about 4 years ago, he had got several parts of it raised by few feet. Even now, he has to redo the plastering every now and then. Cracks can be seen in all the walls. About 70-80% of the houses in the town have been similarly affected. Even now, the side walls of his storeroom are damp, and though there is no bathroom on any side of the room, when it rains, water starts filling in in the room. When the GT road (NH 10 is called GT road here) level was raised, he had to raise the level of his house so that water would not come in.

Shri Jagga said that in his school there used to be water upto the level of 2 feet! Now they have raised the level of the school, but still the dampness stays.

Village Lambakhedi, Tehsil Narwana, District Jind. Haryana

Lambakhedi is 17 kms. from Narwana. The village was earlier in the Yamuna Command, but since 1964 or so, gets its waters from the Sirsa Branch of the Bhakra canal system. The problem of waterlogging started around 1978. The total agricultural land in this village is 2000 acres. Of this 1200 acres (60%) have been completely affected by waterlogging and cultivation of crops is not possible on them. While the remaining 40% is cultivable, there has been a dramatic fall in the crop yields. A pilot project for the control of waterlogging and soil salinisation has been undertaken in this village with cooperation from the Netherlands government. (The Haryana Operational Pilot Project).

Jilar Singh (Retd. SDO, Irrigation, staying at Kurukshetra) told us that the main reason of waterlogging is the canal water. Ground water here is bad. From 1952/53 till 1978 the agriculture was very good. He did not know the situation before 1952. After 1978, it started getting bad and the crops started failing. For many farmers, the failure was total. All three crops would fail.

People told us that the impact of waterlogging has been serious. Farmers try to take both, the rabi and kharif crops, but even where any crop is possible, productivity is very low – less than 50%. Many fields are lying empty. They had been sown, but nothing grew. The crops that used to grow before the Bhakra canal included Chana, Sarso, Masri, Moong, udad, all dals, til, turiya, sugarcane, bajra, juwar, arhar, cotton, makka, chili, tobacco, shan. After 1970-71, these went down. Now, only jiri (dhaan or paddy) and wheat are left. They can't take the other crops. Waterlogging was given as one of the main reasons behind this.

About 20 families have left the village in search for a regular income job due to this.

The Government built a surface drain around 1983/84 and this village was joined to the drain around 1987. While there was some relief and people had some thing to survive on, the impact was limited.

Now the Netherlands sponsored project for sub-surface drainage has come. The project involves laying a horizontal net work of perforated pipes below ground to drain the underground water. This is then collected in a sump and pumped out. Since the underground channels are being laid, the villagers hope that the problem will go away. The drained water from this will be put into the canal. However, the water is saline and there doesn't seem to be any clarity as to where it will actually be thrown, except that it should not be used for irrigation. But this is exactly what is happening.

The lands of this village show visually in a dramatic manner the impact of waterlogging and salinisation. Large patches of land are vacant of any crop; in large areas the crop is growing only in patches. Salt encrustation is also seen everywhere on a large scale.

We then visited the Haryana Operational Pilot Project (HOPP). This project is supposed to be implemented on 10,000 ha in Haryana initially. It was started first in Gohana (Dist. Sonepat) and results were reported to be encouraging. There are 12 such projects in progress in Haryana involving 10,000 ha. (See detailed discussion on HOPP later on)

The Lamba Khedi component of the project is spread over 1100 ha, divided into 22 blocks of 50 ha each. It is one year since this project has started. The cost is Rs. 15,000 per acre or 37,000 per hectare. As of now, the trench cutting and laying machines have been given by Netherlands. The running cost is in addition to this. It needs to be run for about 6-8 hours daily when necessary (8 HP engine). Running cost of diesel is to be given by villagers. Eventually, the whole set up is supposed to be run by the villagers themselves. The estimated life of the project is 30 years.

The project has had some impact as the land was so waterlogged that nothing could grow. Now some wheat and *sarso* has been planted. Some s*arso* seems to have come up well, wheat is sparse. As with the whole project, one of the main issues with this component is about how and where to dispose off the saline water collected in the sump. There is lot of uncertainty about this. As of now, the water collected is being taken by a farmer for irrigation in spite of being told not to. As per the operator, this project is an attempt, not a solution (to the problem of waterlogging).

Since it has not rained well for last few years, no one knows what the impact will be if it rains normally. People are apprehensive that if it rains normally, then the problem will relapse to as before.

OTHER IMPACTS OF WATERLOGGING

One of serious impacts of waterlogging - rather – of the increased soil moisture has been the sharp decline in the cultivation of pulses. While there have been other reasons for decline in pulses - the green revolution policy focused on rice and wheat to the exclusion of all other crops - the high moisture content has made cultivation of pulses physically impossible. Large number of farmers told us this - that it is no longer possible to grow *dalhan* and *tilhan* in these irrigated lands.

The decline in pulses not only has had a serious impact on nutritional balance of food grain production in India, it has also locked the farmers in the two states into the main crops of rice and wheat. In spite of repeated recommendations of expert committees to diversify the crops, it is difficult for farmers to go back to pulses, which can become an economically valuable crop for the farmers with the escalating inputs costs of wheat, rice and cotton. (See the discussion on cropping pattern for more details.)

Impact on Trees

In Malout we were already told about the impact of waterlogging on fruit trees like Kinnu and also on important trees like sheesham. Almost everywhere we travelled in Punjab and Haryana, we saw that the sheesham trees had blackened and died - except in areas where there was no canal irrigation!

We were told that this is due to waterlogging. Official and other reports corroborate what we have seen.

An activist in Punjab, involved in bio-diversity issues, informed us that "very upright forest officer from Haryana" had been telling her about the "emerging crisis" of sheesam and kikar trees which are dying and it is largely due to waterlogging.

In 1999, the Indian Express dated 13 December reported:

> "Sheesham trees are dying, sending forest scientists into a tizzy. The first calls reporting en masse wilting of Sheesham trees came from all over north India North Bihar, Haryana, UP and Delhi. .....
>
> "Over the last one year, the number of calls was enough to get the premier Forest Research Institute (FRI), Dehradun to get worried. Immediately teams were sent to these states that confirmed their worst fears— the Sheesham mortality rate was significantly high.....
>
> "Root samples were brought back and studied and preliminary reports given. In all the dead trees, root seemed to be infected by a fungi called fuserium, which essentially prevents the roots from absorbing the nutrients. Fuserium, though always present in the soil, was attacking the roots because of increased moisture content in the soil. The result: The trees would suddenly dry and then die.
>
> "Scientists are working on various hypotheses. .... In Haryana with canal irrigation, there has been an increase in the water table level, increasing the moisture content in the soil. And Sheesham can only thrive in sandy loam soil."

A paper by M.K. Sharma and others[18] of *Indian Council of Forestry Research & Education* on the dying of sheesham treees in North India, while stating that the reasons for the phenomenon are not fully understood, makes the following observations:

> "During recent surveys to different states i.e. Bihar, Haryana, Delhi, Punjab, Himachal Pradesh and Uttar Pradesh, sissoo mortality was observed to be prominent either in isolated trees or on the plants growing on agricultural bunds, roads and canal side.
>
> "In Haryana, an alarming 30% mortality in the major plantations i.e., Sirsa, Hissar, Rohtak and Gurgaon have been reported.
>
> "Sissoo mortality in natural forests, plantations and agroforestry systems appears to be a complex phenomenon involving a combination of many environmental stresses. The factors responsible for tree mortality are poorly understood.
>
> "In the recent past, a large-scale mortality has been reported from the northern states of India, viz. Bihar, Delhi, Haryana, Punjab, Himachal Pradesh and Utter Pradesh. Being an important timber species, it has not only disrupted the economic targets of State Forest Departments but also incurred financial losses to big and marginal farmers.

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[18] Sharma M.K., R.M. Singal and T.C. Pokhriyal 2000: '*Dalbergia Sissoo In India*'. Paper presented at Sub-Regional Seminar "Die-Back of Sissoo (Dalbergia sissoo)" Kathmandu, Nepal, 25-28 April 2000. The authors were from Indian Council of Forestry Research & Education, New Forest, Dehra Dun-248006 India

> "Sissoo mortality on road and canal sides in Bihar, Haryana and Himachal Pradesh can be correlated with prolonged water logged conditions during rainy season and seepage of canal water.
>
> In 1998, surveys were done in Haryana. In Ginnaur a pure stand of sissoo along the canal bank recorded very high mortality – 400 trees in a block were found suffering from wilt disease (pers. Obsns.). The area was water logged and the site was silty."

Clearly, waterlogging has played a critical role in the massive destruction of this valuable tree in Punjab and Haryana.

Impacts on Roads and Infrastructure

Waterlogging creates havoc as far as roads and other infrastructure is concerned. We have already described the condition of some roads witnessed by us. In Haryana, official figures state that waterlogging has cause extensive damage to the roads. About 90 kms of state roads and 150 kms of district roads will need to be raised[19]. No mention is made of national highways presumably because they are not the state's responsibility.

Buildings, houses, factories too have been extensively damaged by waterlogging. While we have described this in the reports of Malout and Badopal, unfortunately there do not seem to be any attempts by the official agencies to assess the extent of this damage.

REMEDIAL MESAURES

The obvious question in this context is– whether there are any measures that can halt, prevent and reverse this problem. And, at what costs?

Since waterlogging is a result of accumulation of excess water, the remedial measures all revolve around provision of drainage. Broadly, the drainage measures are of two types - surface drainage and sub-surface drainage.

The simplest type of drainage is to pump out the water. This is called vertical drainage - for obvious reasons. The water that is pumped out can then either be used for irrigation on field (conjunctive irrigation), or added to the canal water (augmentation), or disposed off.

Another form of sub-surface drainage is the so-called horizontal drainage - where a horizontal network of perforated pipes is buried underground, and this draws out excess water from a large area, which is then collected in a sump. This water is then pumped up, to be used for irrigation, or mixing with canal waters or disposed off. (The HOPP described in the section on village Lamba Khedi is an example of this).

Surface drainage normally consists of small field drains that collect excess waters and drain into a main drain. Surface drains are especially helpful in draining away excess or accumulated rainfall. One can give a rough analogy here of arteries and veins for the canal and drainage network - one brings in the extra water and the other removes the excess.

This, in simple terms is the fundamental armour in dealing with waterlogging. We will examine the working and efficacy a little later.

One important way to prevent salinisation of soil is to prevent waterlogging, since waterlogging is responsible for drawing out the salts from the soil. Another important way to prevent salinity is to avoid irrigation with saline ground water. However, it must be noted that all water (canal and ground) contains dissolved salts, in smaller or greater quantities, and these salts are left behind when irrigation water evaporates or is transpired by the plants. These deposited salt also add to the salinisation apart from salts brought up from the soil due to

[19] HIRMI *Sinchai Patrika*- March 1999 Issue 6 Page 11

waterlogging. The way to address this problem is to leach the salts out, either through rainwater or through canal irrigation. This requires copious amounts of water.

This in conceptual terms is how the drainage works - in practice, there are significant limitations to each of these methods, as well as significant costs.

The problem of waterlogging and salinity is easier to handle in the areas where the ground water and soils are not saline. In such cases, the water that accumulates can be pumped out and used for irrigation or for augmenting canal supplies. This is both a remedial measure as well as a preventive measure. This is what happened in eastern parts of Punjab. According to the Working Group set up by the Government of India:[20]

> "The figure of 10,57,000 ha reported as waterlogged area in Punjab reported by NCA 1976 is found to have come down as 2,00,000 ha. This is on account of conjunctive use of surface and groundwater on one hand and provision of drainage component in irrigation schemes and extensive program of shallow tubewells on the other".

The large scale development of tubewell irrigation in Punjab and Haryana after mid 60s resulted in amelioration of water logging in many parts. This, in many ways is also the reason for the optimism that is displayed that this is a problem that just needs some management and it will go away. In large parts of Punjab and Haryana we heard this optimism expressed in terms of saying that waterlogging problem "will go away on its own" or that "we just need to manage it better". This, however, is false optimism, not warranted by the situation on ground.

The problem of waterlogging and salinisation becomes extremely difficult to handle in areas that are underlain with saline water - as is the case in semi arid and arid areas. It is precisely these types of areas that constitute a significant part of the Bhakra command area, and are the areas where these twin problems have assumed alarming proportions. As the Master Plan prepared by the Government of Haryana states, "The areas experiencing the rise in water levels are primarily underlain by brackish groundwater".[21]

The most critical problem with any method of tackling waterlogging and salinity in such areas is what to do with the effluent that is generated. This severely limits the efficacy of all types of measures.

In case of vertical drainage (pumping), it is difficult to use the pumped water for direct irrigation since this will rapidly result in salinisation of the soil. There is also the problem of the salt tolerance of the crop itself.

The excess water seeping in from canal irrigation mixes with the saline groundwater and itself becomes saline. In some case, this seepage from canals which has good quality water forms a layer on the top of the saline water, and can be "skimmed off" by vertical drainage, but this has limited possibilities and can lead to what is called "upconing of saline water".

Mixing the pumped water with canal waters to dilute the salinity is practiced, but it has serious problems not only because the same canal water is used for irrigation later on, but also because the canal water is used to supply drinking water in many areas. Moreover, this process has its limits as using it again and again can lead to concentration of the salts.

Sub-surface horizontal drainage (HOPP type method) is also advocated as a solution in these areas but faces similar problems. Surface drains too beg the question on the disposal of the effluent.

Leaching out accumulated salts too is difficult since the rainfall in the arid and semi-arid areas is less and large quantities of canal waters may not be available for this purpose.

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[20] Government of India 1991: Page 133

[21] Government of Haryana (1998): '*Management of Waterlogging and Salinity Problems in Haryana, Master Plan*', Prepared by High Level Expert Committee, Government of Haryana, December 1998.

Thus, whether it is pumping out of water, skimming wells, subsurface or surface horizontal drainage - all generate water that is saline to smaller or larger extent. Disposal of this effluent is one of the most serious issues for which no proper solution has been found till date.

The only real solution is to take this out of the area. But obviously other areas are not likely to be enthusiastic for receiving these effluents. Suggested solutions are disposing the saline effluents through very deep underground bores, or in ponds built with impervious sides and bottoms. Most experts agree that the only long term permanent solution is to dispose the effluents in the sea![22]

CONTROLLING AND AMELIORATING WATERLOGGING AND STALINIZATION IN BHAKRA COMMAND & EFFICACY OF VARIOUS MEASURES

The problem of waterlogging appeared in the irrigated areas of Punjab many decades back. According to the World Bank's Irrigation Sector Review[23]:

> "...a particularly serious problem is developing in parts of Northwest India (large parts of Punjab and Haryana.....). Before irrigation development, water tables were generally at more than 25 metres depth.....the rate of rise of water table since irrigation began in the late 19th Century has in some areas been of the order of 25-30 cms/ year. This had no impact until the water table reached the root zone...The first signs of irrigation induced waterlogging and salinisation were reported in early 1920s and the problem began to become widespread in certain districts of Punjab and Haryana from 1950s."

However, since much of this area was underlain with good quality waters, the advent of large-scale tubewell irrigation in these areas brought the problem under control. We have already mentioned above how the areas waterlogged in Punjab reduced from 10 lakh ha to 2 lakh ha. Indeed, these areas now face the problem of serious depletion of ground water and rapidly falling groundwater levels.

However, the real severity of the problem is in the areas with saline or poor quality ground water. In the semi-arid and arid zones in the Bhakra command, the problem of waterlogging and salinisation is persisting since years, and ameliorative measures are having only a limited impact. The districts in Bhakra command in Haryana that have poor quality groundwater are Hissar, Sirsa, Fatehbad and Jind. In Punjab, the areas with saline groundwater are in districts Firozpur, Faridkot, Bhatinda, (including Muktsar, Moga, Mansa) – some of which fall in the Bhakra command. These are precisely the areas in both the states seriously affected by waterlogging and soil salinity, where the problem is persisting since years and is refusing to yield to any significant extent to remedial measures.

All the drainage measures (surface, sub-surface horizontal and sub-surface vertical) are normally carried out together, along with range of other measures to control salinity. We will however, examine these separately for convenience.

Vertical Drainage

Due to the salinity of ground water, it is very difficult to practice vertical drainage. This is why tubewell based irrigation is much lesser in the districts underlain with saline waters than the districts with good quality groundwater.

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[22] See for example Dhawan B.D. 1995: '*Water logging and Salinity: Phenomenon, Problem and Solution*', in Dhawan B.D. 1995: '*Groundwater Depletion and Irrigated Agriculture in India*', Commonwealth Publishers, New Delhi. Page 127

[23] World Bank 1991b

Vertical drainage in saline areas may be useful in the vicinity of the canals, where seepage water forms a layer of good quality water on the top of the saline waters. But this is limited to areas near the canal, and that too if the layer is thick enough. If not regulated properly, this can lead to saline water being drawn up.

The Haryana Government's master plan[24] proposes to install 1200 tubewells along 23 channels at a cost of Rs. 43 crores. It also states that the pumped water will be of reasonably good quality and hence will be put into the canals - and the resultant quality of mixed water will not exceed the permissible limit for drinking water.

We heard of these types of attempts in several places in Punjab and Haryana, but in most places the impact was seen to be limited. In Malout, we were told that 500 tubewells had been sunk to pump up water from the ground and this was being put into the canal. However, this was reported to control the problem only to a limited extent. Secondly, the people complained about putting the water in the canal, since this was saline water. They were saying that the saline water should be sent out to Rajasthan, since large part of the water carried by the canals was for Rajasthan. We were also informed that in any case many of the tubewells were lying idle since the bills had not been paid. This once again brings out one of the main issues in drainage - how to dispose off the saline effluents. It also shows that drainage costs - which are quite heavy - are an important factor.

Even in the poor quality groundwater areas, number of farmers continue to use it for irrigation, aggravating the problem of salinisation. In Hansi (district Hissar, Haryana), during a public meeting, we were told that the problem of waterlogging and salinisation has assumed serious proportions in the district. One interesting co-relation was pointed out here between the economic policies and land degradation. The person told us that since the support price mechanism exists only for paddy and wheat, farmers prefer to grow these crops. Since the canal water is not sufficient for the same, they use the tubewell water which is saline and this too has led to large scale salinisation. This illustrates that addressing the problem of waterlogging and salinity is not merely a technical exercise - there are many social, economic and political aspects, which sometimes can be more critical than the technical aspects[25].

Some may suggest here, therefore that the solution is to increase the supply of canal waters. However, this itself will lead to more waterlogging. In fact, the Master Plan prepared by the Government of Haryana to address waterlogging recommends a 25% cut in the canal water supply in the districts of Hissar, Sirsa and Jind (in the Bhakra command).[26] (See discussion later on).

Sub-Surface Horizontal Drainage

The Government of Haryana has also tried out sub-surface horizontal drainage to reclaim waterlogged areas. This is the Netherlands Government supported project Haryana Operational Pilot Project (HOPP).

We have already described this in the section under Lambakhedi where we saw that there was some improvement, but people were apprehensive that it may be attributable more to the lack of rains in the past two years than the HOPP itself.

The first HOPP project, at Gohana, was started in 1997 and the Kalayat (Lamba Khedi) in 2001. The official monitoring reports, while mentioning improved soil conditions, reduction in

[24]Government of Haryana 1998. Also, see details of the recommendations of the Master Plan in HIRMI *Sinchai Patrika* - March 1999 Issue 6 Page 11

[25] This example demonstrates the wide range of impacts of farmers in the two states getting virtually locked in into the wheat-rice cropping pattern.

[26] Also, see details of the recommendations in HIRMI *Sinchai Patrika* - March 1999 Issue 6 Page 11

salinity and recovery of fallow land, state the need for longer term monitoring, especially in the view of the continuous drought years.[27]

The Government of Haryana has included such drainage in its Master Plan[28] and this will be implemented on about 47,000 ha in the state. Rs. 257 crores has been budgeted for this. However, the critical problem remains - how to dispose off the effluents that will be brought out by this process. The master plan merely re-iterates that the effluent may be disposed off "into the canals/drains/reservoirs depending on the existing conditions".

The reports from HOPP itself essentially say that the problem of disposal is a three state problem and is outside the scope of HOPP. In the Gohana project, the effluent is pumped into a drain (Drain 8) which discharges into the Yamuna river, and hence no problems are envisaged. But when the subsurface drainage schemes will be taken up on a large scale this issue is bound to become a serious issue.

We did not see any signs of such schemes in Punjab. However, the HOPP website indicates that the project will be taken up at two places in Punjab.

Surface Drainage

Surface drains are also an integral part of the drainage system. However, like in most large scale canal irrigation schemes in the country, the drains have not been built along with the canal system. Even later on, only half-measures have been taken. Even where drains have been constructed, the maintenance of the drains is of very poor quality, defeating the very purpose for which they were made.

The Haryana Master Plan[29] proposes to build surface drains "to avoid recurring floods ....in southern and western parts of the state in an area of 14000 sq. km." According to the plan, "In these areas, the shallow water tables contribute immensely to [the floods] and even light storms can result in flood like situation." The total cost of the proposed structures is about 1231 crore rupees.

There are several issues here. First of all, the financial cost of these drains is very high. It must also be pointed out that these drains need land - which farmers are reluctant to part with. The land area required for surface drains may be about 15% of the land.[30] Not only does this cost money, this also means land taken out of production.

Everywhere we went, the efficacy of the surface open drains seemed limited. In number of places the drains were choked. For example, we went to see the drain *nalla* just outside Malout. The *nalla* was completely choked up with an overgrowth of water hyacinth. We were also told that the *nalla* is used for dumping effluents and sewage. The water in the *nalla* was stagnant and not flowing.

A senior journalists in Malout, who has also studied the problem of waterlogging, told us:

> "The drain *nalla* is only 5 feet deep, so it can't drain below 5 feet. Even the engineers agreed that this will not handle the problem of waterlogging. At most, this can take care of the rainfall run-off. There is reverse seepage from drainage *nalla* to the lower lying fields The situation is somewhat okay since there has been no rainfall since last two years. If the rains are normal, then the problem would arise again. ..... Many

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[27] Several Reports on HOPP website www.hopp-online.org

[28] Government of Haryana 1998. Also, see details of the recommendations in HIRMI *Sinchai Patrika* - March 1999 Issue 6 Page 11

[29] Government of Haryana 1998

[30] Datta K.K. 1996: '*Economic Feasibility of Subsurface Drainage*', in , in Varma, C V J (Ed) (1996): '*Proceedings of Workshop -Waterlogging and Soil Salinity in Irrigated Agriculture, Karnal, 12-15 March 1996*', CBIP, New Delhi. & CSSRI, Karnal.

> people have paid money and got the alignment of the drain *nalla* changed by paying money."

Reluctance by farmers to allow the drain to pass through their lands - to avoid losing land or because they are afraid of the seepage of the saline water in the *nalla* - is a major problem. In Lohgad, in Haryana, we saw drains that were incomplete as the farmers were not allowing them to pass through their lands.

As with all other measures, the major issue with surface drains too remains - what to do with the effluent. This is a serious problem. At places, we saw salt encrustations on the sides of the drain - showing the highly saline waters being carried by it. Several people pointed out to us the issue of reverse seepage of saline water from the drain. Where to put this saline water is an issue that is sure to frustrate the best plans for controlling waterlogging and salinity.

Other Measures

There have also been attempts to control waterlogging and salinity by "bio-drainage" namely, planting of trees. We saw some experiments at the farm of the CCS Agricultural University at Hissar, where eucalyptus was being grown for this purpose. We were told that this has not been found to be very effective in Haryana. However, the Master Plan proposes plantations on 200,000 ha at a cost of 385 crore rupees. It states the success of bio-drainage in the IGNP (Rajasthan Canal) area as its justification.

While these are measures on the drainage side, there are number of measures which revolve around limiting the supply of water itself to the area. The logic is - if less water is supplied, then there is less water-logging. This is why one of the recommendations of the Haryana Master plan is to reduce the canal water supply to the districts of Hissar, Sirsa (including Fatehabad) and Jind by 25%.[31]

We have seen that the canal systems in Haryana were designed to serve the greatest number of farmers possible by distributing a limited supply of water over a large area. The Bhakra canal system was designed for an irrigation intensity of 62% of the cultivable command area[32]. (i.e only 62% of the total CCA would receive irrigation in an year). Thus, it already has a limited water supply.

Even if one reduces the canal supplies to the levels that closely match the crop needs, this will not eliminate waterlogging. First of all, direct seepage from the canal will continue. Even in a lined canal system, losses still remain. For example, it is estimated in Haryana that lining the whole system -from main canal to the branches etc. - will decrease the seepage from 48% to 12%. So 12% still remains. Importantly, much of the seepage that goes to the ground is from the field application of water - about 30-35%. Hence, even if canal supplies are tailored to match crop consumption, some of the water is going to seep down from the field before the crop can take it up.

A study of the Sirsa Irrigation Circle by Bastiaanssen[33] *et al* points out:

> "In spite of leaky canals, or inefficient on-farm practices, nearly all the water that enters into the Sirsa Irrigation Circle is productively depleted by agricultural crops, as shown by the large depleted fraction of the gross inflow (82%). The low value for relative water supply is characteristic of protective irrigation, which intentionally keeps supply low relative to potential demand....
>
> "Despite a high depleted fraction, groundwater build-up at Sirsa continues as a result

[31] Government of Haryana 1998. Also, see details of the recommendations in HIRMI *Sinchai Patrika* - March 1999 Issue 6 Page 11
[32] Bastiaanssen *et al* 1999
[33] *op cit*

> of inadequate drainage. .... The addition of salts at a rate of 1.81 t/ha annually should also be of great concern."

In other words, water supply to the circle is matching the crop consumption, yet, the district faces serious problem of waterlogging and salinity.

There is another important dimension here. If canal supplies are reduced, it will be difficult to maintain the current cropping pattern - something that is already not easy. We have already seen above how farmers are even using saline groundwater to irrigate wheat and rice as canal water supplies are inadequate to maintain this cropping pattern. This practice will increase even more, aggravating the problem of salinity. Hence, reduction of canal supplies will necessarily have to be accompanied by a change in the cropping pattern. In fact, the Haryana Master Plan states that the reduction in canal supplies aims to encourage farmers to grow tolerant or semi-tolerant crops like barley, cotton, mustard, safflower, wheat, bajra, oats, sorghum, maize and guar. Missing, significantly is rice, and wheat is only one of the many crops suggested. What this implies is that the cropping pattern that is counted as a part of the "spectacular success" of Punjab and Haryana's agriculture would need to be changed. Putting it differently, continuing with the same cropping pattern will mean aggravating the waterlogging and salinity problems; in other words, the current pattern is unsustainable.

Let us take a look at the most critical problem of all which determines the efficacy of any and all measures in saline groundwater areas.

The Issue of the Effluent

We have already said above that three broad means exist for disposal of the effluent - re-use for irrigation in the same area, augmentation of canal supplies and disposal.

In case of re-use, there are several important limitations. First all of, the effluent can't be used if the salinity is not below a certain limit. Secondly, the effluent may be available when the irrigation is not required - i.e. a mismatch in timing of the effluent pumping out and the crop water requirement. In such a case, if it can't be stored, then it can't be used. Thirdly, and most important, re-use does not remove salt out of the area and hence salt accumulation continues. If it can't be leached away (which is the most likely situation due to less rainfall and limited irrigation) then this can lead to aggravation of salinity.

In case of the augmentation of canal supplies, again there are critical limitation. Mixing of the effluent with canal waters requires the salinity of the effluent to be under a limit, especially where canal waters are also used for supplying drinking and domestic use water. Secondly, this shifts the problem of salt accumulation to another part of the command - the canal water will deposit the salts in another part of the command. This solution is not so well suited to tail-enders for obvious reasons. Significant parts in the tail ends of Bhakra canal command are affected by waterlogging and salinity. Also, this may require pumping and long distance pipelines (if the canal is at a distance from the field).

Solutions for disposal include ponds with impervious layers. These will entail costs in terms of construction and land.

The reality is that no permanent and appropriate solution has been found so far to this problem of disposal of saline effluents.

To quote a report of the HOPP:[34]

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[34] Euroconsult BV & WAPCOS (1995): '*Environmental Aspects of installing Sub-Surface Drainage Systems – Mission Report*', March 1995 : Pages 17 and 9

> " .....options for the - environmental friendly - disposal of drainage effluent (mainly focussing on salinity problems) have extensively been studied and documented over last 15 years or so, but so far a clear-cut solution has not been found as yet."

And:

> "Options for the disposal of salt-containing drainage water in North West India are under study since at least the early 1980's (e.g. HSMITC- 1984: WAPCOS. 1994), but this issue, in particular the disposal in an "environmentally sound way", remains unresolved so far."

As Dr. N.K. Tyagi, then Director Central Soil and Salinity Research Institute, Karnal, points out:[35]

> "Conjunctive use however, does not permanently resolve the problem of salinity. It usually postpones the problem, may be for some decades. However, the salinity problem remains *unless and until salts are transported out of the basin from each and every unit*.....for part of the Lower Ghagghar basin in Haryana about 15% of the annual recharge would have to be thrown out of the system to maintain salinity balance at desired level." (Emphasis Added)

The only place where the waters taken out of the basin can be taken to is the sea, or the desert. This will of course entail huge costs and "financial, technical and inter-state disputes may restrict the construction of drainage carriers to the sea". (Sharma and Rao 1996)[36] Imagine the cost and complications of taking a saline water channel from Haryana through Rajasthan and Gujarat to the sea!

The reality is that irrigation of this kind, with water intensive cropping pattern in arid and semi arid areas is fundamentally unsustainable and problematic. It will inherently lead to these problems and the only way to address the same would be to radically alter the agricultural practices in these areas. It may be mentioned that the National Water Policy of Government of India, both the original in 1987 and the newly adopted one in 2002 has taken cognizance of this aspects and states[37]:

> "Economic development and activities including agricultural, industrial and urban development should be planned with due regard to the constraints imposed by the configuration of water availability. There should be water zoning of the country and the economic activities should be guided and regulated in accordance with such zoning."

The problems occurring in the western parts of Haryana and Punjab are a direct result of following practices that are in contradiction to the ecology of the area.

PARTICIPATION OF FARMERS AND PEOPLE

To be effective to even to a limited extent, the measures have to be planned and implemented in an integrated manner. They require complex monitoring and management, over a vast area in a decentralized manner- this entails extensive and effective participation of the farmers - something that the current system leaves much to desire.

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[35] Tyagi, N.K. 1996: '*Conjunctive Use of Rain Canals and Saline Ground Waters*', in Varma, C V J (Ed) (1996): '*Proceedings - Workshop on Waterlogging and Soil Salinity In Irrigated Agriculture- Karnal, March, 1996*', Central Board of Irrigation and Power, New Delhi and Central Soil Salinity Research Institute, Karnal.. Page 77

[36] Sharma D.P. and Rao KVGK 1996: 'Recycling of Drainage Effluent for Crop Production', in Varma, C V J (Ed) (1996): 'Proceedings - Workshop on Waterlogging and Soil Salinity In Irrigated Agriculture- Karnal, March, 1996', Central Board of Irrigation and Power, New Delhi and Central Soil Salinity Research Institute, Karnal. Page 145

[37] *National Water Policy 2002*, Government of India, Ministry of Water Resources; Sec. 15

The first and most important indication of this is that no attempt seems to have been made to take the farmers into confidence about the cause of waterlogging and salinisation.

In many places we went, we found it striking that even after so many years of facing the problem, many common people and farmers were not willing to relate it to the canals. One of the most common thinking we found everywhere was that the problem of waterlogging is something of a transient problem, that it is a moving phenomenon, that the waterlogging comes from "above", stays for a few years at a place, and then move "down". While we will not dismiss this off hand since we heard this at a number of places, we also heard from knowledgeable people that this was not the case. What seems to be an explanation is that as the waterlogging problem was controlled in the good quality groundwater area, people thought that it had "moved" down.

What is worrying is that if this is the level of understanding and knowledge among the common farmers who are directly affected by the phenomenon, this shows that whatever may be the official efforts, little has been done by way to involve the people in handling this issue. This does not bode well for the resolution of the problem if any.

Another aspect of the issue was revealed in Lamba Khedi, where the HOPP is in operation. People complained to us that the government is not paying attention to the surface drain. We asked the people that if this was the way the Government was functioning, why didn't they themselves take up the work on the drain and try to solve the problem. They told us that this is not only their problem. The main drain is about 15 kms from the village. It is a question of 4-5 villages. How can they alone do anything? Then also, the Government is always giving promises that things will be solved. Like, for e.g. this project (Netherlands project) is being talked about since 6 years. So no one wants to take the initiative. This attitude that the Government will come and solve everything and the people do not have to do anything was also found to be widespread.

CONCLUSION

From what we have seen, as well as from discussions in various fora and documents, the efficacy of the ameliorative and preventive measures, in the saline area, in the long term remains highly questionable. Most steps taken remain limited to technical measures, while the actual implementation in practice will depend on social, financial, economic and political factors to a great extent. People's participation is virtually absent. Most important, there is little attempt to go to the fundamental root of the problem – a cropping pattern that is in complete contradiction to the ecology. Thus, even in the most hopeful scenario, the measures will have limited impact. And while waterlogging and salinisation is extracting a heavy price, so will the measures undertaken to control these.

Even an optimistic point of view among the experts strikes a strong note of caution and we can do well to end on this note (Tanwar 1996)[38]:

> "The waterlogging problem so far tackled was prevalent in the favorable topographical land terrain and in fresh groundwater regions which did not pose the problem of disposal and the use of drainage water. The problem of waterlogging in the semi-arid to arid saline groundwater regions is highly complex which poses serious limitations for the disposal and the use of saline drainage water. This involves high and expensive technology to tackle the problem without complications of the environmental hazards, wherein farmers participation, is also inevitable."

[38] Tanwar 1996:Page 2

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Environmental Impacts

"The state has two large dams and several barrages which have affected both, the terrestrial and aquatic environment. Large reservoirs have been constructed which have led to inundation of areas rich in biodiversity leading to its loss. Further, absence of fish ladders in certain barrages have led to loss of migratory fish species. Furthermore, the dams have lead to decrease in release of water in the river systems during summer months leading to low water availability in down stream areas. As a result, the buffering and self purification capacity (due to pollution) of these rivers is reduced, adversely affecting aquatic life."

National Biodiversity Strategy and Action Plan: Punjab 2002

Environmental Impacts

LARGE DAMS HAVE ENORMOUS IMPACTS ON THE ENVIRONMENT. SO IT IS THE case with Bhakra. Like any other dam, the major impacts are due to the submergence of large areas of land and forests, the downstream impacts due to the diversion of water at the dam, and reduction in downstream silt flow, the impacts on the riverine flora and fauna – to name a few.

However, the impact of the project is not just restricted to this. The impacts of the canal system and the irrigation delivered, and the effects of the intensification of agriculture are other aspects that are equally part of the environmental impact of the dam.

Evaluating some of the environmental impacts of the Bhakra dam has been a daunting task. The many years that have passed since it was built, the lack of baseline data about the situation prior to the dam and the lack of proper monitoring of these aspects are the primary reason why we have found it difficult to precisely evaluate many of the impacts of the Bhakra dam on the ecological health of Punjab and Haryana.

Particularly frustrating has been the virtual absence of proper and in-depth studies on these issues by the official agencies.

The BBMB has brought out a note titled "Socio-Economic and Environmental Impacts of Bhakra Beas Project – An Assessment"[1]. Among the positive benefits listed by BBMB are employment at the project sites, irrigation benefits, flood control, transformation of desert areas to lush green fields, land reclamation along the sides of the river, pisciculture development and tourism enhancement. Several of these have been examined by us in other parts of this report. We were not able to examine the claimed flood control benefits. *The 6-page note of BBMB does not mention a single negative impact.* Such a cursory treatment of such a vital topic by the project agency betrays a complete neglect of and a casual approach to these issues. It also indicates the quality of the assessments that have possibly been (or not) carried out.

Due to the lack of systematic and detailed assessments[2], we have had to depend upon various other sources to try and understand the environmental impacts. This has meant that the findings are mainly indicative – but even these show that the impacts have been very serious. We can only recommend and hope for a more detailed study of these.

The most visible and serious impact of the Bhakra dam has been in the submergence area and in the downstream zone.

SUBMERGENCE AND OTHER LANDS ACQUIRED

The Bhakra dam submerged about 178.75 sq. km (17875 ha) of land area[3]. Another 1000 acres (400 ha) was acquired for the Nangal township.

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[1] Duggal S.K., J.K. Bhalla & R.S. Dogra (2001): '*Socio-Economic and Environmental Impacts of Bhakra Beas Project – An Assessment*', BBMB, Chandigadh.

[2] Except for some aspects – for e.g. Waterlogging and salinisation, or groundwater depletion

[3] BBMB 2002b: '*Status Note on Bhakra Oustees*'. This note gives the area submerged as 44153 acres – this is 178.75 sq. km. Elsewhere, in other documents, the reservoir area of Govind Sagar is given as 168.35 sq km

The most severe impact of the submergence and land acquisition for the project has been the displacement of thousands of people. This tragedy, faced by the oustees at that time in a touching demonstration of *desh-prem* (patriotism) – only to be paid back in terms of neglect and distress – is discussed in a separate chapter.

The key to understanding the impacts of such a huge project lies in what can be broadly termed as a "baseline study" – what was the environment and ecology like before the project. When baseline studies are not being carried out even in today's "enlightened" days it goes without saying that they were non-existent in those days. What was the "baseline" of the submerged area before the project? The idea that we have of the submergence zone comes from stray reports and the testimonies of the affected people. Both these point to an area that was rich in flora and fauna – both terrestrial and aquatic, heavily forested, with fertile and irrigated lands.

The plains on the banks of the river were extremely fertile. Both the kharif and the rabi crops could be cultivated. Irrigation was done with water from the Sutlej and the large number of natural streams flowing into the plains from the mountains. A variety of crops like corn, wheat and cotton grew there. Most people also owned orchards. There was a substantially large cattle economy in this region. While the people lived in the plains, the cattle sheds were situated in the mountains where there was ample fodder for the cattle to graze on.

Out of the total area submerged, 5,750 ha was forest land [4]. The impact of the submergence of the forests on the flora and fauna has not been estimated.

IMPACT ON FISHERIES

The river had number of varieties of fish, including the much sought-after *Mahseer*. As the State Biodiversity Strategy & Action Plan for Punjab[5] shows, the *Mahseer* is now lost/threatened. We quote:

> "The Fisheries department is also promoting exotic species of fish in an effort to introduce blue revolution at the cost of native species. Four exotic sps have been introduced as a result of which several native sps (especially Mahseer which was a common & delicious native fish of Punjab) have been lost/threatened. Data indicates that 32 sps of fish are near threatened, 20 sps are vulnerable, 12 sps are endangered and 2 sps are critically endangered."

Earlier, the fishing in the river was more unorganised and informal. After the creation of the reservoir, it is now being carried out on commercial basis, with fishing rights being licensed. The BBMB has stated pisciculture in the reservoir as a positive environmental benefit of the project. It is neither stated by BBMB, nor could we find any figures to show that the output of fish from the reservoir area had increased after the creation of the dam. Since the fishing prior to the damming was informal and unorganised, there may not be systematic records of the produce. It would be important to estimate the production before and after the reservoir to understand the impact in terms of quantity.

We were not able to obtain information about the status of fishing in the river downstream of the dam now and before the reservoir creation. This would also be an important aspect to study. However, since most of the river water has been diverted, it is likely that the fisheries have been drastically affected. For proper analysis of the impact of the dam on fish and fisheries, it would be necessary to look at the fisheries both in the submergence and downstream areas taken together. It is quite possible that fish output may have increased in the

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[4] Singh *et al* (2000): *'Environmental and Social Impacts of Large Dams – The Indian Experience*', Prepared for the World Commission on Dams by Indian Institute of Public Administration, New Delhi: Page 21

[5] Part of the National Biodiversity Strategy and Action Plan. Downloaded from http://www.sdnp.delhi.nic.in/nbsap/states/punjab/draftbsap.html Accessed 14 June 2002

reservoir/submergence area, but may have been offset by the loss of fisheries in the downstream.

Qualitatively, however, the impacts are clear. The species composition in the reservoir/submergence area has changed dramatically, with major portion of the yield coming from less valuable fish. We have seen the Punjab Biodiversity SAP noting that the *Mahseer* is virtually lost. The similar Strategy and Action Plan for Haryana elaborates this[6].

> "In Govindsagar of Himachal Pradesh, common carp has affected the fishery of *Cirrhinus mrigala* (mrigal) and *C. reba* (mori) due to common feeding habits. An analysis of fish catch from Dal lake (Kashmir), Kumaun lake (Uttar Pradesh), Govindsagar (Himachal Pradesh) and Pong (Punjab) reservoirs has shown that the exotic carp has dominance over the more valuable endemic mahseers and schizothoracids (Sehgal, 1989).
>
> "Between 1971-72 and 1978-79, major carps, viz., catla, rohu and mrigal contributed to the bulk of the total production from Govindsagar reservoir. Later, however, with the rise in the population of silver carp, the production of catla was lowered. The feeding and breeding vigour exhibited by silver carp led to its stabilisation at the cost of catla. Increase in silver carp population in the Gobindsagar reservoir catch has not increased the overall production of the reservoir (Natarajan, 1989*). It is just a case of substitution of two high value indigenous major carp species by an exotic carp that is poor in quality fetching lower economic returns."* (Emphasis added)

The same was told to us in Bilaspur by Sukhdev Sharma - an employee of the Fisheries Federation of Govind Sagar since 1977. He said that before the reservoir, the species caught were the much sought after *Mahseer*, *Gidd*, *Mir Carp*. After the creation of the reservoir, the *mahseer* declined sharply and it is rarely found. The earlier species were replaced by *Catla*, *Rohu* and *Singada*. But now, even that has changed and about 90% of the catch is silver carp whose returns are much smaller.

HEALTH IMPACTS IN RESERVOIR AREA

The creation of such a huge reservoir also leads to significant changes in the micro-climate, and has several impacts on the health of the people. Again, like most other impacts, these have not been documented. However, we have a note prepared by the Chief Medical Officer, Bilaspur in Himachal Pradesh in year 2000 (month and date is not given) which lists out several significant health impacts of the reservoir. This note, addressed to the Secretary, Health in Government of H.P. appears to have been prepared for submission in a Civil Suit. This note gives the following health impacts of the Govind Sagar reservoir[7]:

> "3. The reservoirs [Govind Sagar] covered all the natural water sources and are now depending (sic) on the lake water as well as the water supply scheme provided by the Govt. These water supply schemes become dry during the summer season and most of the people have to depend for water which is not all the time can be consider potable.[8]
>
> "4. In view of the situation as explained above there has been rise in Gastroentritis, entric fever and viral hepatitis incidence due to scarcity of protable (sic) water for the people residing on the both side of bank reservoirs. From the record available with

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[6] Strategy and Action Plan for Haryana under the National Biodiversity Strategy and Action Plan (NBSAP) Project; October 2001 Chapter on Conservation of Fish and Fisheries:
URL: http://www.w3.org/TR/REC-html40 Accessed 13 June 2002

[7] Note No. HFW (BLP) PH/99- H.P. Health and Family Welfare Dept. Distt. Bilaspur, prepared by Chief Medical officer in response to D.O. No. HFW-B(C)17-1/95-II dated 6 March 2000 of Secretary Health, Shimla with Subject : Impact of Reservoirs in Satluj-Beas Basin and Sundernagar Hydel Chennel on Hydroplogy, Environment and People in H.P.

[8] Verbatim, as in original, through out

> this department the incidence of these diseases has increased despite on-going health programmes.[9]
>
> "5. The reservoir provides favourable conditions for mosquito breedings and hence the incidence of malaria has also increased.
>
> "6. Whole of the reservoirs and surroundings areas is covered with fog which last upto 11 to 12 hours in a day during winter and the respiratory diseasess are also on increase.
>
> "The fog reduces the visibility leading to more incidence of accidents. Half of the normal health budget is being spent to tackle these diseases…."

Clearly, this is only a glimpse and this aspect requires much more extensive and systematic study.

DOWNSTREAM IMPACTS

As we have already seen, Bhakra dam – like many others – was built with the express purpose of 'utilisation' or 'prevention from going to the sea' of the last drop of water. Project authorities probably feel that it is just an unfortunate consequence that in preventing the last water drop from reaching the sea, it is also prevented from reaching significant riparian areas between the dam and the sea.

This had a huge impact on the areas downstream of Bhakra. As mentioned earlier, critical to understanding this impact is the baseline information. No such study exists. In the case of the Sutluj, it is even more difficult to re-construct the precise condition of the river when it was free flowing. This is because significant diversion started from the river in 1887 with the opening of the Sirhind Canal. Significant changes in the ecology downstream must have occurred then. It may be noted that it is not only complete drying up of the river that has an impact: substantial diversions can result in significant changes in the quantum and patterns of the downstream flows – both with serious consequences. It would be of considerable value but would require meticulous and painstaking research to build a picture of the free flowing Sutluj and its ecology. However, since such a task was beyond our resources, we leave it noting that when the Bharka project was being built, the Sutluj must have already been altered from its pristine state. The nature, extent and impacts of these alterations are not known.

But Bhakra was to be an order of magnitude higher transformation. With only the Sirhind Canal (and a few other inundation canals like the Grey canals) large quantities of water were still flowing in the river past Ropar, at least in the summer/monsoon. However, it was clear even as the last of the project proposals was put together that the Bhakra was going to result in virtually drying up the Sutluj below Ropar.

R.L. Anand mentions this, saying "With the completion of the Bhakra Dam the Grey canals would cease functioning as such, because there will then be no water left in the Sutlej below Rupar."[10]

We have already seen in the discussion on the command area of the project that some of the areas were included in the project command precisely because the drying up of Sutluj was to deprive them of their existing irrigation – the Zone II areas.

Talking about the increase in the proposed storage at the project after the Partition, K.N. Raj says, "it was also clear that the river would almost dry up below Rupar …"[11]

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[9] This lack of proper drinking water source for oustees of the Bhakra dam, living on the banks of a huge reservoir, is one of the most tragic aspects of the absence of rehabilitation of the oustees and is dealt with in more detail in the chapter on displacement.

[10] Anand 1956: Page 52

The water balance figures for the Sutluj river[12] show that in a mean year, out of the total of 17 MAF water flowing into the Govind Sagar (13.3 MAF of the Sutluj, and 3.82 MAF Beas waters through BSL, net of losses), about 16 MAF is diverted at Ropar and the BML. Barely 1.4 MAF is left in the river, *over the whole year* to flow down to Harike. This is just about 8% of the total inflow into the reservoir.

It is sometimes mentioned that the awareness of environmental issues was absent during the early years of dam building, and hence they were not considered. This is not really true. For example, it is simply not possible that intelligent men who design such dams would not know what would happen downstream when a river dries up. It is another matter that they may not care, or not care enough. In case of Bhakra, they knew well that the drying up of the river would render useless the Grey canals, and they made alternative provisions. But nothing seems to have been done about other aspects – the needs of the villages and towns on the Banks, the fish, the other aquatic flora and fauna, the diminishing capacity of the river to wash away pollutants and so on.

The First Plan document makes it very clear that the planners were aware of the needs to protect the downstream – in 1950!. The Chapter on Irrigation and Power states[13]:

> "12. The total quantity of water flowing in the rivers, a rough quantitative indication of which has been given in paragraph 8 above, is not wholly available or needed for irrigation.
>
> This is due mainly to the following reasons :—
>
> .....
>
> iv. Certain quantities of water must be allowed to flow in rivers for hydro-electric development, for purposes of navigation, *conservancy* and water-supply for towns and villages." (Emphasis added)

In spite of this, the project was designed in a way to wholly use up all the water.

This is sure to have had huge impacts, though as mentioned above, it has been difficult for us to evaluate the impacts of the dam in the areas between Ropar and Harike – the main stretch of the river in India – due to lack of baseline data and our resource limitations. We have already talked about the need to assess the impacts of the dam on the fishing in the river downstream of Ropar. The other downstream impacts are equally important to assess.

A significant downstream impact of the dam was the virtual end of the bountiful flood plain agriculture. When we visited Ludhiana, Prof. Jagmohan – a university professor and social activist told us that in the days before Bhakra the floods in the river would recharge the groundwater in the areas around the river and deposit silt that made the soil extremely fertile. Since the land was inundated almost annually, only one crop could be taken. But this required minimum input since both water and fertiliser were deposited by the river. When the dam was built and operational, slowly the waters stopped and the recharging ended. As the floods and waters diminished, more land became available for cultivation, and people started taking more than one crop. The construction of embankments exposed even more land. In fact, many people started cultivation even inside the embankment. However, now the farmers have had to resort to tubewell irrigation and large doses of chemical fertilisers. This has ultimately meant that the net returns to the farmer have remained the same.

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[11] Raj 1960 : Page 49
[12] Rao 1985b: Page 208
[13] Chapter 26*: Irrigation and Power*; First Five Year Plan
URL: http://planningcommission.nic.in/plans/planrel/fiveyr/1st/1planch26.html
Accessed: Nov 25, 2002

This is the other side of the benefit mentioned by BBMB of "reclamation of land". The Board put up at the Bharka dam site mentions that "Canalisation of Sutluj yielded 80,000 ha of land which was barren hither-to-fore". It is difficult to accept this claim at the face value. As with most flood-plain agriculture all over the world, the land on the floodplains is very fertile, and while flooding may restrict agriculture to a single crop a year, the production is abundant and free from costly inputs.

It appears from the description at the Bharka site that this (80,000 ha) was essentially riverbed land. If drying up the river and the cultivation of exposed land is a benefit, then one can only marvel at such a way of thinking[14]. We would state that only an in-depth examination of the extent of land use in the floodplains and the economics of the same before and after the dam would give the true picture how much of a benefit this has been.

The quantitative, or at least order of magnitude assessment of impacts of the dam on the flood-plain agriculture, as also on the fish and fisheries of the river would be an important aspect to be taken up for detailed research.

The diversion of the Beas at Pandoh, to take the waters to Govind Sagar through the BEAs Sutluj Link (BSL) has also had several serious impacts downstream of Pandoh. The Citizen's Council Mandi (CCM) has launched a campaign against the BSL demanding that 20% of the water be released from the Pandoh reservoir into the Beas so as to flow down on to Mandi. The CCM has said that the Pandoh dam stopped water in the river downstream of the dam, and the aquatic life has been destroyed after the commissioning of the project in 1977[15].

It should also be mentioned that major impacts of the Sutluj river drying up have also been felt in Pakistan. With the allocation of the three eastern rivers to India in the Indus Water Treaty, India got down to use all the waters of the Sutluj (and Beas) in the country. After leaving India, the Sutluj has a course of about 350 kms (approximately) in Pakistan before it meets the Chenab. This stretch of the river is now completely dry and sees waters only in exceptional years. While the irrigation from this stretch of the Sutluj was replaced from other sources through the Indus Water Treaty, the riverine economy, ecology and culture are heavily impacted.

The data for the River Sutlej collected at Sulaimanki (Pakistan) for the 40 years before Indus Water Treaty i.e. 1922-61, ten years after the treaty i.e. 1985-95 and recent year completed i.e. 2001-02 depicting drought conditions is as follows:

Average Annual Flow (in MAF) of Sutluj at Sulemanki[16]

1922-61	1985-95	2001-02
14	3.6	0.02

While this impact may be discounted by Indians because it is in Pakistan, it still remains a very significant impact of the dams on the Sutluj and Beas.[17]

This is not to say that Pakistan has shown any more exemplary behaviour in managing its own rivers. The construction of the Mangla dam on the Jhelum, the Tarbela and other storage dams on the Indus, and the large number of other barrages, weirs and diversions on the Indus and its tributaries in Pakistan have had a huge impact on the downstream areas, especially on the coastal areas in Sindh, including destruction of mangroves, salt water intrusion and so on.

Among the severe impacts have been those on the mangroves in the Indus delta.

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[14] In our country, with tanks and lakes in the urban and peri-urban areas being filled up rapidly to create "valuable land", this kind of thinking can well be understood.
[15] Report in the The Tribune, 6 July 2004 as quoted in *Dams, Rivers and People*, Aug-Sep. 2004.
[16] Ref: http://www.waterinfo.net.pk/pdf/riversutlej.PDF Visited on 23 Aug 2004
[17] See Additional Note 12-1 at end of chapter for details of this.

> "Mangrove forests in the Indus Delta spread over 650,000 acres and are the sixth largest in the world. The water, nutrients and silt deposited by the Indus when it discharges into the sea, sustains the mangroves. …. The forests support many species and are a source of timber, fuel-wood (18,000 tons each year), fodder, wild life (porpoises, jackals, boars, reptiles, migratory fowl birds, and 3 dolphin species), herds of camels (16,000 at certain times), and 44 fish species. The mangroves act as windbreakers and prevent storms from reaching inland. They also are a major breeding area for shrimps and crabs that earn $68 million a year in foreign exchange. ….. About 100,000 people are directly dependent upon mangroves in the delta. The number of people, including the fishermen, indirectly dependant on the mangroves may run in millions.
>
> "The mangrove forest area has reduced from 263,000 hectares in 1977, to 158,500 hectares in 1990, showing reduction of 38%. Even the remaining area is being progressively degraded. *About fifty to sixty years back, 80-105 MAF of water was discharged to the delta depositing up to 400 million tons of silt. Due to dams and water diversion upstream, the water outflow has been reduced significantly. Only about 20 MAF outflow reached the delta from barrage releases before 1991 depositing only 36 million tons of silt per year.* However, the 1991 Water Accord [an internal accord among the provinces of Pakistan] put an interim limit of 10 MAF outflow and even that limit has not been met. For nine to ten months of the year no freshwater flows out at all. The silt deposits are estimated to drop way below 30 million tons per year if the outflow remained 10 MAF or lower."[18] (Emphasis Added)

According to a recent study by International Union for Conservation of Nature (IUCN)[19], the flow in the lower Indus river decreased from 105000 MCM (85 MAF) in 1932 to 43000 MCM (34.8 MAF) in 1970 as a result of number of schemes on the Indus and tributaries; Bhakra was one of them, and contributed to this. In the 1990s, the flow has gone down to 12000 MCM (9.7 MAF). The paper documents the huge environmental impacts of this. In particular, the following comparison is interesting:

> "From an **economic** perspective the natural resources used in the Indus Delta have an estimated value of 120 million US$. This excludes the unquantifiable value of environmental aspects such as biodiversity, habitat provision and coastal protection. In comparison, releasing 25% of the Tarbela Dam water for floods, thus making it unavailable for irrigation or power generation, would cost 38 million US$. Any loss of irrigation or hydroelectric power, therefore, is likely to be more than offset by financial benefits remaining with communities in the Delta from natural-resource use."

It would be very illuminating to make a similar study for the downstream areas of the Sutluj.

SEDIMENTATION AND SILTATION IN BHAKRA RESERVOIR

"Percentage Loss of Storage Capacity

Total silt deposited in Bhakra reservoir …is 15.02% of gross storage. Silt deposited in dead storage…. is 31.30% of the dead storage capacity. Silt deposited in live storage …is 9.70% of live storage capacity" [20]

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[18] Memon, Altaf A. 2002: '*An Overview of the History and Impacts of the Water Issue in Pakistan*'; Presented at the International Conference on "Sindh, the Water Issue and the Future of Pakistan" , The World Sindhi Institute, Washington, DC, USA

[19] "*The Lower Indus River: Balancing Development And Maintenance Of Wetland Ecosystems And Dependent Livelihoods*" accessed on 2 Oct 2004 at http://www.waterandnature.org/flow/cases/Indus.pdf

[20] Paper by Duggal S.K (Member, Irrigation, Bhakra Beas Management Board), Bhalla J.K. Chief Engineer, Bhakra Dam and Bhatia N.K. presented at All India Seminar on Flood management, Chandigadh April 2002 (Duggal *et al* 2002)

When the above figures were presented at a conference, an engineer from the Ministry of Water Resources, Government of India dismissed the impact of siltation at the Bhakra reservoir saying that a 10% reduction in live capacity in 50 years is very good indeed. When we met a senior retired engineer from the Punjab irrigation department, he described the siltation in the Bhakra reservoir as "alarming".

So how does one view the sedimentation and siltation in a reservoir? One of the most heard arguments in the context of sedimentation of reservoirs (from all the players in the debate) is regarding how sedimentation affects the life of the reservoir. Dam builders throw around figures of 200-300 years for life span of most dams to dismiss concerns about the impacts of siltation. It is argued that even if siltation reduces the lifespan by 50%, we still have over a century or more.

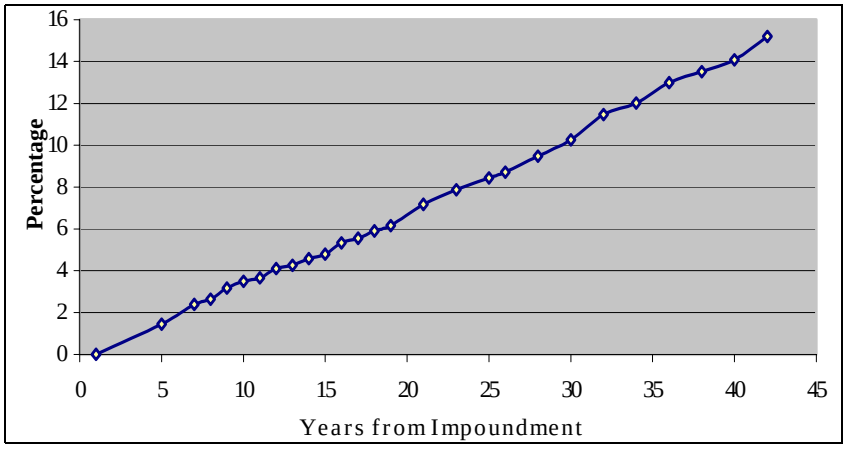
How one interprets these figures depends a lot on one's perspective. A person with a lifespan of about 60-80 years couldn't care less what happens in the 81st year, let alone in the 300th. For the succeeding generations in the river basin, the vision of a dam silted to the brim is scary and worrisome. What will happen when a dam is silted up completely? How high will the river then flow and how much will it spread? What will happen on the downstream side? These questions are increasingly being asked. The issue of siltation of dams and what is likely to happen when the life of a dam is over is one of the many in the category of questions which an ostrich-like humanity has decided to bequeath to the coming generations to ponder over. These include questions like what will happen to nuclear power plants after their lifespan is over, questions of nuclear waste disposal, of toxic landfills, of climate change and so many others.

However, the issue of sedimentation of a reservoir is an issue that goes just the life of the dam. That is and remains a serious concern; but it must be remembered that the impact *during* the life of the dam is as important, as sedimentation will influence the performance of the dam.

As pointed out at the start of this Chapter, the project has lost 9.7% of its live storage to sedimentation. A look at the chart plotting the cumulative loss of capacity against the year from impoundment shows a steady, uniform rate of loss of capacity (Figure 12.1).

Figure 12.1 Cumulative Loss of Capacity at Govind Sagar (Bhakra Dam)

(Total Capacity Lost, in Percentage)



Source: CWC 2001

What are the implications of a 10% reduction in live capacity? A loss of capacity means that the very justification for the dam is being lost. After all, the very rationale for the dam is that it can store "excess" water from one period for use in a period of scarcity - for e.g. - from the monsoon and carry it over to the winter months.

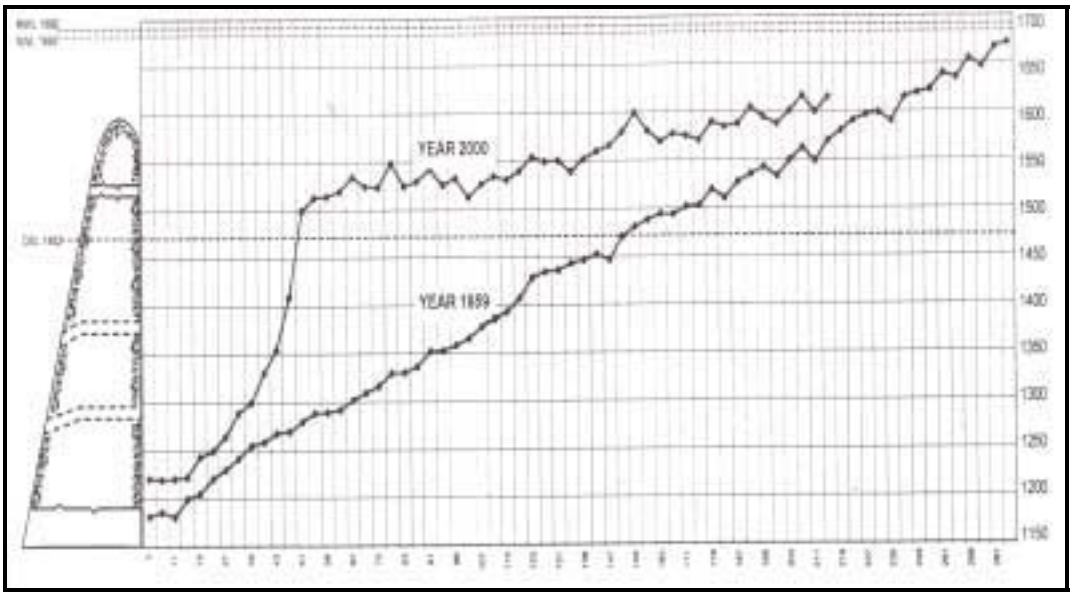
What is more critical in the case of the Bhakra reservoir is not just the amount of sedimentation itself, but the nature of the deposition that has taken place. According to Duggal[21]:

> "There is hump formation from RD 51 to RD 91 from Bhakra Dam, which is acting as a silt barrier and preventing movement of silt into the dead storage.....In this context, the operation of the reservoir needs to be reviewed judicially."

In simple words, what it means is that the silt is not going into the dead storage as planned[22], but is occupying the live storage. Not only that, but it is preventing the further movement of silt into the dead storage area, and new silt is getting deposited in the live storage. It is clearly an alarming situation. We have also been told that the silt has reached the level of the inlets.

The figure below (Figure 12.2) shows the cross section of the reservoir, the dead storage level, the maximum reservoir level, the original river bed and the silt deposition.

Figure 12.2 Longitudinal Section of Bhakra Reservoir Main Channel Showing Silt Deposit Profile



Source: Duggal *et al* 2002

What are the implications of this? According to Duggal, "The deleterious effect of hump formation is early reduction of live storage capacity"[23] and "the operation of the reservoir needs to be reviewed judicially."[24] What this means is not explained. However, if we look at some other cases, we can get an idea of what all *could* be implied.

The case of the Tarbela dam in Pakistan (on the Indus river) is very interesting. Tarbela is similar to Bhakra in many ways. It too is a "rim station" dam - built on the river just before it leaves the mountains and comes onto the plains. To manage the sedimentation, the dead level of the reservoir has been raised by 21 m in 25 years![25] While this was in the original plan of the project, it still means a huge loss in capacity.

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[21] Duggal *et al* 2002: Page 196
[22] Not a well behaved dam!
[23] Duggal *et al:* Page 200
[24] Duggal *et al*: Page 196
[25] Asianics Agro-Dev. International (Pvt) Ltd. 2000: '*Tarbela Dam and related aspects of the Indus River Basin, Pakistan*', A WCD case study prepared as an input to the World Commission on Dams, Cape Town, www.dams.org : Page 43

We are not saying that same thing will be required at Bhakra. It is just to indicate what are the types of adjustments that can possibly be required. It is important that BBMB make public the measures it is taking and the changes if any in the reservoir operations that may be required to address the issue of siltation.

What is being done to handle the problem? That the issues were recognised early on is clear. BBMB said, in 1988[26]:

> "The general loss of green cover over the vast expanses of Himalayas which form its watershed may be a potential danger for the premature loss of useful life of Bhakra reservoir if the situation is allowed to drift any longer. Fortunately, the government of India and State of Himachal Pradesh are keenly aware of this problem. ..."

A number of measures undertaken are mentioned. It appears that these measures have had little impact, since in 2002 – 14 years later, the situation has not changed much.

Duggal points out that increased developmental activities in the catchment have maintained a high average rate of siltation, and that "The average annual percentage loss of gross storage capacity comes out to be 0.36% and is practically constant...". The graph given earlier in Figure 12.1 also shows this.

BBMB had also mentioned, in 1988 that[27]:

> "But the main problem is about the silt which has already entered into the reservoir and it is extremely difficult, rather appears practically impossible, to remove or dispose of these deposits. Actually, the deposits of silt for years together have created a big hump which acts as a silt barrier within the dead storage....and the silt does not find its way through the dam openings thereby entrapping silt to the extent of 99.4% thus reducing the useful life of the reservoir."

This hump still remains a major problem, as we have seen above.

It is clear from the above that the issue of siltation in the Bhakra reservoir is very serious issue, that impacts the very benefits of the projects. It is also likely that serious measures will need to be taken to deal with the sedimentation which would have further impacts on the project benefits.

In the longer term, the sedimentation of dams means that large scale hydro / irrigation dams are not a sustainable technology. The filling up of live (and dead storages) mean alternation of the river landscape beyond recognition. No one can fully comprehend the implications of such filling up of dams. However, the issues are so grave that number of people, dam operators, government agencies are already talking about dam decommissioning.

IMPACTS ON PUBLIC HEALTH IN THE COMMAND AREA

There are some other very serious issues that are now engaging the minds of the people in Punjab and Haryana. These include the health impacts of the long-term, continuing and increasing use of chemical fertilisers and pesticides, and the resultant pollution and contamination of water resources and toxicity in agricultural and dairy products[28]. Even though these impacts raise very serious concern for public health, it is unfortunate that these have received little attention at the official level and there has been little effort at documenting and investigating these. However, several NGOs, groups and even individuals have done very important work in trying to fill this gap.

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[26] BBMB 1988: Page 273

[27] BBMB 1988: Page 276

[28] The concerns about the long-term impacts of use of chemicals in agriculture on *agriculture itself* have already seen by us in the earlier chapter.

At this point, it is important to clarify how these tie up to the Bhakra project. Some people argue that the dam is not responsible for the impacts of the chemical fertilisers and pesticides used in agriculture. This is a specious argument. If irrigation from the project is glorified by pointing to the spectacular increase in the agricultural production, then it needs to be recognised that this production was made possible due to the heavy use of chemical inputs along with the HYV seeds. It is a package that has worked together. Indeed, it is an important question whether without the kind of productivity that these chemicals brought in, the dam itself would have been financially or economically viable[29]. Hence, the effects of the extensive and intensive use of chemicals and also the erosion of bio-diversity due to the very limited variety of seeds being used are part and parcel of the total cost of doing business with such irrigation projects. To the extent that the same combination is used with other means of irrigation, these will add to the environmental costs of those particular means too.

The ongoing efforts of the groups mentioned above offer some insight into the problem. Kheti-Virasat, an organisation in Punjab, has been working since many years to highlight the problem caused by the extensive use of chemicals in Punjab agriculture and is also trying to promote sustainable organic agriculture.

Recently, Kheti Virasat was involved in a survey testing of the impacts of pesticide use on children's mental health and development. This was a survey carried out in various locations of the country by Greenpeace[30]. In Punjab, the survey looked at impacts on children in Bhatinda district, where the use of pesticides is very high. The sample was compared with a reference group in other parts of Punjab, which, "as could be expected from a state like Punjab, ..was not fully free of pesticides ...but…..the quantum of use of pesticides ...[was] starkly less.".

The survey administered several tests to test the mental ability, tactile perception, motor abilities, concentration and memory, stamina etc. These were administered to the sample and reference groups for two sets of children – age group 4-5 years, and 9-13 years. The findings of the study are serious.

> "Overall, out of the 23 tests administered to the two samples in age group of 4-5 years in Punjab, in all the tests, the less exposed children performed better, and with a statistical significance in the case of 20 of these tests.
>
> "When it comes to 9-13 years old children, 20 tests were administered, out of which the less exposed children were better in 18 tests. Out of these, 17 tests showed statistical significance. In the remaining two tests, the study group fared better but without statistical significance".

In simple words, these tests showed that pesticides have a serious deleterious impact on children's mental and physical development.

A note prepared by Kheti-Virasat as a backgrounder to a workshop "to sensitize & educate doctor, epidemiologist and Agriculture scientist on the issue of impact of agro-chemicals on human health in Punjab" and to "prepare broad base network on a bio-medical scientific platform to study the impact of agro-chemicals on general health of people in Punjab" among other things, highlights some of the impacts[31]:

> "2. OUTCOME OF THE STUDY CONDUCTED BY KHETI VIRASAT IN PUNJAB ON IMPACT OF PESTICIDES ON HUMAN HEALTH
>
> The excessive use of chemical fertilizer like urea, DPK, NPK, etc and pesticides (insecticides and weedicide) have resulted in the disorders of endocrine glands e.g.,

[29] Even *with* this productivity, the economic viability of such large dam projects is increasingly being questioned.
[30] Greenpeace 2003
[31] Kheti-Virasat 2002: '*Concept paper of Medicos' workshop to be held in Oct. 2002*'*;* Personal Communication

> thyroid, parathyroid, pituitary, kidneys and adrenals. The incidence of cancer, asthma and diseases of kidney, skin and digestive tract has increased by 20-25% in Punjab. Youngsters at the age of 25-30 are suffering from heart ailments and male infertility. Along-with suffering humanity, the soil is also sick with severe deficiency of micronutrients. Decreasing carbon content of soil has resulted in decrease in water & nutrient holding capacity. In addition organisms like bacteria, fungi and earthworms have disappeared. Furthermore, selenium levels in Punjab are very high at toxic level.
>
> The food we eat, the water and milk we drink are contaminated with one or other chemicals. So much so that traces of BHC, endosulphan, DDT & HCH the banned pesticides have been found in the most safe & sacred mother's milk in many cases in Punjab. Due to use of Endosulphan in Punjab as in Kerala, increase in birth of mentally retarded (MR) children."

The note cautions that

> "….. recently it has been postulated that long term, low exposure of these chemicals are increasingly linked to human health effects such as immuno-suppression, endocrine disruption, reproductive abnormalities and cancer."

The Strategy and Action Plan for Haryana under the National Biodiversity Strategy and Action Plan (NBSAP) Project also notes that this is a serious health hazard[32]:

> "….. the widespread use of selective herbicides had a toll on proliferation of flora because the growth varied plant species which were considered weeds were suppressed/controlled by these herbicides. The continuous use of these chemicals resulted in shift in flora, the earlier species giving way to the exotic species earlier unknown in the region. The exotic species later on acquired resistance against the herbicides and even the wheat cultivation was endangered because of the exotic weed, Phalaris minor (mandosi). New chemicals were invented to control the resistant species which toll of the biodiversity (sic).
>
> "The pesticides residue in food stuff are generally higher than the concentration considered to be safe for human/animal consumption as prescribed by the WHO. The sole reason behind the high residual concentration is indiscriminate use of chemicals. These chemicals have adversely affected the population of beneficial insects and wildlife. Recently, large population of peacock, a National Bird, was reported to have been killed due to indiscriminate use of pesticide. Therefore, emphasis is laid now a days on integrated pest management which essentially means reducing the dependence on chemicals."

While it is only now that the extent, nature and seriousness of these impacts is being acknowledged in India, it is regrettable that still scant attention is being made to most of these issues.

One ray of light in this darkness is that the Central Water Commission has desired to conduct an Environmental Impact Assessment of the Bhakra project. The earlier-referred BBMB note on the Environmental impacts of Bhakra Beas project states[33]:

> "Central Water Commission (CWC) ,Govt. of India set up a specialised EIA Directorate in 1995, when it was decided that Water Resources Development Projects constructed prior to 1978 as well as those constructed between 1978 and 1994 need to be evaluated selectively for their impacts on environment. Since 1997 five such studies have been initiated by CWC, out of which three are complete. *CWC has now*

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[32] Strategy and Action Plan for Haryana under the National Biodiversity Strategy and Action Plan (NBSAP) Project; October 2001 Section 4.4 URL: http://www.w3.org/TR/REC-html40 Last Visit 13 June 2002

[33] Duggal *et al* 2001: Page 5

> *desired to include Bhakra Dam Project for EIA studies and BBMB is proposing to give the study to CWC as a test case of EIA for big dams*." (Emphasis added)

Of course, unless the study is conducted by an independent agency with credibility, and in an open, transparent and participatory manner, there is a danger that it would end up just as a window-dressing.

Giving the study to CWC would be disastrous as a project developer and dam builder can hardly be expected to be independent in analysing the environmental (especially negative) impacts. It is the closed attitude of the dam builders that has resulted in the virtual shoving aside of these issues in the first place. We can do no better than end by a quote that eminently demonstrates the attitude of the BBMB in this matter[34].

> "As the Bhakra and Beas Projects were completed before 1978, there was no need to have the environmental clearance from the then Deptt. Of Science and Technology[35]….. However, BBMB has been adhering to all the guidelines issued from the Ministry/ Deptt. from time to time. In spite of certain provisions enacted by the Govt. of India for the polluting industries…the Multi-purpose projects managed by BBMB used to be considered environmental and eco-friendly…..Then suddenly in 1993, the Central Govt. included Power (Hydro) Generation in Schedule I …to the Water (Prevention and Control of Pollution)..Act…Consequently, once considered the most environments (*sic*) friendly source of energy become the polluting industry all at once." ✍

[34] Duggal *et al*: Page 5

[35] There was no Ministry of Environment and Forest at that time. The functions were carried out by this Department.

Additional Note 12-1

SOME IMPACTS OF THE DRYING UP OF SUTLUJ IN PAKISTAN[36]

1. Depletion of underground water resources and mounting scarcity: Sutluj river was used to re-charge the aquifer in the Cholistan desert where otherwise the ground water is very low. Since the complete stoppage of Sutluj River, the rate of ground water depletion is very alarming. The aquifer of this desert like region was immediately recharged when the area received heavy floods in 1988.

One note worthy adverse impacts of the depletion of ground water resources is the deterioration of drinking water quality. Underground water in the Bahawlpur region is contaminated with arsenic element and thus causes problems in terms of human health. Previously, fresh water supplies from Sutluj River was playing balancing act. However, the issue of water contamination with arsenic element has become very serious.

2. Livelihood Impacts: There were vast grazing lands available to local communities when the area was used to be flooded before 1970. Livestock was one of the important livelihood asset. Similarly, fishing and forest resources were commonly available to local communities. Traditional, low inputs based food crops irrigated by flood operations did also vanish.

3. Decrease in Soil Ferility: Most of the area in Bawalpur region is like desert. This region is almost tail of the Great Rajputana Desert that extends to Thar region in the Sindh province as well. The soil fertility in this region was also very very low. Flooding of Sutluj River was natural fertilizing process in the region. Since the Indus Basin Treaty and subsequent abrupt stoppage of Sutluj River, the soil fertility decreased many times and local farmers are compelled to use chemical fertilizers and pesticides to compensate this ever mounting soil fertility in the region.

4. Adverse impacts on pastoral communities of Cholistan: Cholistan desert is adjacent to the main channel of Sutluj River. Major livelihood of local communities in Cholistan was live stock rearing especially large cow herds. In case of any drought in Cholistan, local pastoral groups used to migrate to the riverine belt of the Sutluj River. Migration to the Sutluj riverine belt in the time of drought was one of the major coping strategy for these pastoral groups. However, they have now become very much vulnerable because they don't have alternative grazing lands. ✍

[36] Personal communication from friends in Pakistan based on *their* interactions with people in Bahawalpur area.

13

Displacement, Uprootment, Rehabilitation: The Forgotten People

"….the residents of villages around Bhakra, Nangal Dam, ……and numerous other developmental sites are better off than people living in the villages in whose vicinity no development project came in."

Observation in the Majority Judgement
of the Supreme Court of India
in NBA vs. Government of India & Ors. Case
WP 319/1994

"But the first dam to be built in India …at least the fundamental problem of the oustees of this dam should be resolved. We are not asking for irrigation, nothing. We only want drinking water…"

Capt. Omkar Singh Chandel,
Oustee of the Bharka Project,
in Year 2001 – 50 years after his displacement

Displacement, Uprootment, Rehabilitation
The Forgotten People

POSSIBLY THE MOST IMPORTANT THING ONE CAN SAY ABOUT THE PEOPLE displaced by the Bhakra dam is that even today, 50 years after their displacement they are still struggling to put their lives back on line.

Numbers cannot convey the immense human tragedy, the long drawn suffering and most importantly, the sense of betrayal felt by the oustees of Bhakra. But numbers are important and we will first look at them.

According to the BBMB, the Bhakra dam submerged 44153 acres (17876 ha) of land due to which 371 villages were displaced.[1] BBMB further states that 7206 families were affected comprising about 36,000 persons. But these were only the land-owning families. There is no reckoning of the landless people in these numbers. This is quite simply the practice with most of the large dams in the country. Out of the total land, 23863 acres was private land.

The town of Bilaspur, capital of the Raja of the Bilaspur State was also submerged and this affected 4000 people. The resettlement is very neatly tallied by the BBMB as follows:

Settled By H.P. Government in its own area	2395
Paid Cash Compensation and resettled according to own choice	2632
For remaining, Rehabilitation Committee established and land acquired for resettling them in the command area in Hissar	2179
TOTAL	**7206**

The BBMB Status note says "oustees had indicated their preference for lands on areas which were to be irrigated by Bhakra canals. As such, Bhakra Dam administration…acquired approximately 13200 acres of land in 30 villages of Hissar district…"

In all, the picture painted by the Status Note is of an enlightened and fair policy, well organized resettlement plan, executed by a sensitive machinery, and well settled people. Nothing could be further from the truth.

We visited two resettlement sites established in District Hissar (Haryana). In these sites we met with large number of oustees, individually and in groups. We also visited the original submergence villages, where the oustees who had "settled according to own choice" were living, on the slopes of the hills. Here again, we had meetings individually and in groups. We visited (New) Bilaspur town and talked with a number of people. We also met social and political activists, journalists and others who had / were working with the affected people. We

[1] BBMB 2002b: '*Status Note on Bhakra Oustees*', unpublished.

had access to fair number of Government notifications, papers, discussions of meetings, memoranda submitted by the oustees, news reports all from the earliest years of displacement till up to recent times. We also had the advantage of the detailed reports of an earlier fact finding visit to the Bhakra dam oustees by SANDRP[2], an organization based in Delhi. The only official document that we could get from the authorities is the above mentioned Status Note. By far the most important of all these was the voices of the people themselves.

We heard the anguished and poignant stories of people. The period of building Bhakra was the time of a newly independent nation –there was a mood of patriotism, sacrifice and nation building. We heard in people's voices the feelings of pride that their sacrifice was to contribute to the country. But the stories also told of the enormous sufferings of two generations to get back their lives on track – and not yet fully successful in this. We sensed the often unarticulated feelings of being subsequently betrayed, then simply forgotten by an ungrateful nation.

From these testimonies of the people, from the official and other papers we have, we have tried to piece together a picture of the process of displacement, uprootment and "resettlement" of the Bhakra oustees. The picture that emerges is not a pleasant picture. It is a picture that should make us hang our heads in shame. But most of all, it should stir us into action, to try and remedy, to correct and to complete a process that is 50 years over-due. And to ensure that the story of the Bhakra oustees is not repeated in other parts of the country.

SITUATION PRIOR THE CONSTRUCTION OF THE DAM

The submergence zone of the project lies nestled in a breathtakingly beautiful valley, with forested mountains rising high on the side on the river (now reservoir).

The project was being planned since the early 1900s. Right from then, the villagers never believed that a river could be dammed, that the flow of water could ever be controlled by the human race. They would say *'Dariya ko kaun rok sakta hain? Na kiseene roka hai, na rok sakega*'.[3] According to Roshanlal Chandel of the village Bhakra, the people had never seen nor heard of a dam and did not know what the damming of a river entailed.

Farming was the major occupation. The plains on the banks of the river were extremely fertile. Both the kharif and the rabi crops could be cultivated. Irrigation was done with water from the Sutlej and the large number of natural streams flowing into the plains from the mountains. A variety of crops like corn, wheat and cotton grew there. Most people also owned orchards there. The corn that was cultivated in the region was sent to Punjab and Haryana. They never used synthetic fertilisers or pesticides. They sold the fruit from their orchards. The people told us that they never had to buy foodgrains and were completely self sufficient with regards food for themselves and for their cattle. The only things that they had to buy from the market were clothes and salt.

Apart from income from agriculture, there was a substantially large cattle economy in this region. Each family owned 25-30 heads of cattle. Ghee was made and sold widely. While the people lived in the plains, the cattle sheds were situated in the mountains where there was ample fodder for the cattle to graze on.

A number of people were employed in the army. This was a source of pride for the community as well as being a source of income.

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[2] South Asian Network on Dams, Rivers and People, New Delhi www.narmada.org/sandrp and www.janmanch.org (SANDRP 2001)

[3] Who can stop the mighty river? No one ever has, no one ever can.

RESETTLEMENT POLICY

The displacement *seems* to have occurred in two stages. Initially the people upto 1280 feet level were displaced. It appears that they were not given any choice about opting for land based resettlement. They were given only cash compensation.

The people affected above 1280 feet up to 1700 feet level, were given a choice to either accept land or cash compensation.

Those getting cash compensation only were left to fend for themselves. Most of these were oustees who chose to continue to live in Himachal Pradesh itself – simply moving up the slopes of the hills on the side of the river – as they had no other place to go.

The facilities provided for those settling in Himachal Pradesh , according to BBMB, were – free fishing licenses in Govind Sagar for three years, new ferries, roads and village paths in lieu of those submerged, gainful employment on the dam.

Oustees desirous of getting land were given land in Hissar district (which is over 200 kms away from their original homes). The policy was that no oustee would be given more than 25 acres of land, but also not less than his acquired holding, *subject to his compensation amount being adequate to meet the cost.* In other words, it was not really a land-in-lieu-of-land policy. The oustees were paid cash compensation, and they were to pay for the new lands from this. It also appears that a cut was placed on the compensation given to the oustees. However, the oustees were not to be given any proprietary rights to these lands till they had "fulfilled all the conditions of resettlement" and paid all sums due from them. Among the conditions was that if any Court decision led to increase in the price of lands allotted to them, the oustees would compensate the Government for the same. [4]

Landless tenants were also declared eligible for allotment of land equal to the extent of their submerged tenancy subject to a maximum of 5 acres. The price of the land allotted to them (including 15% Compulsory Land Acquisition Charges) was recovered in 20 equal half yearly installments with a 5.25% interest.[5]

It was also decided to allot ½ acre of land free of cost to each artisan and labourer of the rural area who did not own or cultivate land *provided he shifted and settled to the Hissar district. The price of such land was recovered from the other oustees allotted lands through a 1% surcharge!*[6]

Some rudimentary facilities were also given to the oustees at the new sites in Hissar.

The town of Bilaspur was to be fully submerged. A new town was therefore built on the slopes of the adjoining mountains. The markets were situated at the foot of the mountain, while the government offices and residences were built higher up the mountain. Each family was given a plot of land. There were 3 categories of plots. House plots (10x10 sq. ft.), Commercial Plots and House cum Shop Plots (37x38 sq. ft). While the cost of plots was Rs. 4000, the families were charged Rs. 226 per plot. The families were given rehabilitation grants for the construction of their new homes.

WHAT REALLY HAPPENED

The policy was hardly fair or adequate, both, in its conception and implementation – as we shall see in detail.

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[4] From "Scheme for Allotment of Land to Bhakra Oustees" given in the Application Form to be filled in by the oustees for getting land. Interestingly, the form – at least the copy we got – was in English. We were not able to find out if the form was also available in Hindi or the local language.

[5] BBMB 2002b

[6] BBMB 2002b

What is really extraordinary is that in spite of this, the oustees themselves were remarkably understanding, cooperative and accommodating at every step even as they went through enormous hardships – an attitude that remains even today, even as the oustees are into the third generation; albeit, with a tinge of the feeling of being betrayed.

Even while pointing out some of the serious problems with the policy and implementation, the oustees repeatedly told us that this was the first dam in the country, and the Government did not have any experience in this field. So, the oustees told us, how could it be expected to have an ideal resettlement plan? The Government was learning, they said, and the oustees willingly gave it the benefit of this.

This rather touching faith in the Government was slowly to erode as the years went by and the oustees realised that it was not the "learning" that was responsible for the bad resettlement but the insensitivities.

Another important factor, as already mentioned above was the mood in the country – of nationalist sentiments, of sacrifice for the nation. The oustees too were infected with this mood.

This did not mean that the oustees just accepted what had been offered to them. They made large number of suggestions, demands, through their memoranda to the authorities; and they felt that these would be accepted in the same spirit as they were accepting their displacement.

RESETTLEMENT OF OUSTEES SHIFTED TO HISSAR DISTRICT

On 8th Nov. 1953, the "Bhakra Dam Sufferers' Association" presented a sheet outlining "Our Demands"[7]. This note clearly seems to be addressed to the then Prime Minister Jawaharlal Nehru, who apparently visited the site on this date. Among the several demands are:

> "1. The displaced persons should be rehabilitated on lands to be irrigated by the new canals and almost (sic) settled at one place...
>
> "2. Compensation of land and house property to be submerged should be settled in consultation with the Representative of the sufferers."

It ends with a hopeful plea:

> "It is prayed that your honour will order immediate instructions … and thereby save us from the uncertainty and insecurity in which we are placed at present. Let your visit give peace to our disturbed minds and remove our sufferings"

As per the demands of the oustees, a representative team of the project-affected persons was taken to Haryana (Hissar) and shown the sites proposed for rehabilitation. The team was not in approval of these sites. These sites were mainly consisting of bad quality land, overgrown with bushes and undergrowth. It was also spread out in many places.

The people instead had asked for 11000 acres of grassland that they had seen near Fatehabad in Haryana. The project affected persons had expressed a desire to be settled as a community so that they would be able to maintain their culture and methods of living. We saw this demand in the above memorandum. This demand was repeated by them at every stage. They had even written a letter to the then Prime Minister of India, Pt. Jawaharlal Nehru, demanding the same. Their demands were denied and they were forced to settle on the sites shown to them. The villagers are of the opinion that they were not settled as a community since the government was afraid that they would unite and fight the government for their rights. Finally, the people were settled in 33 villages spread over a wide area.

[7] Copy obtained by us and available in our records.

The people in the two sites visited by us - Ahlisadar and Ratta Tibba- told us that the land they were given was covered with thick overgrowth of wild vegetation. There was also thick and rampant growth of a wild form of grass, locally called *Dila*. This grass has thick nodes/knots and is difficult to uproot. It took 15-20 years of backbreaking work for the people to make the land cultivable. An entire generation spent their life just trying to make the soil arable. There were also many wild animals and snakes, making habitation on these plots very dangerous. This was not the case of just these two villages, but almost with all the resettlement sites.

A question needs to be asked at this point – why was such land chosen to be given to the oustees? The oustees had asked for lands in the Bhakra command – but certainly not for uncultivable, overgrown lands. At least, we have not come across any memorandum or letter of the oustees asking for bad and unproductive lands.

It may be also worth recalling here that Hissar was the worst off part of the command. It was placed in the Zone III. We have seen in the Chapter on the Command Area that Hissar of 1950s, comprising of today's Hissar, Bhiwani, Sira and Fathebad districts – is described as follows[8]:

> "Situated ….on the fringe of Rajasthan, it partakes of the features of a desert; dry hot weather, dust-storms, and shifting monsoon sand-dunes."

On the other hand, there were many areas in the command, especially those in Zone I "which lie near the hills and receive good rainfall during the monsoons as well as during the winter months".[9]

These included areas near and around Patiala – which means they were much closer to the original villages of the oustees. The areas where the oustees were resettled were over 200 kms away from their village. The areas in Patiala or other parts of the command like Samrala, Rajpura in Zone I were less than half the distance.

It may be further noted that land was available in these areas. We have seen that Patiala was the district in which most new land was brought under cultivation next only to Hissar. Between 1953-54 and 1958-59, 144000 ha of new land was brought under cultivation. Could part of this land not have been given to the oustees?

The reason why the oustees were given land in Hissar may be deduced from the BBMB Status which states that the Rehabilitation Committee found suitable land in Hissar district at "cheaper rates". It was obvious that unarable land, covered with thick overgrowth, in a relatively semi-arid zone would be cheaper than better lands in a better agro-climatic zone.

So we had on one side the oustees who were readily agreeable to sacrifice for the nation, placing a touching faith in the authorities; and the dam officials who did not care to even find good land for the oustees. This thinking has persisted all through these years and even today, the oustees of dams in the country are treated like second-class citizens – for whom second-rate arrangements will do – even if this is a question of their lives and livelihoods. In the spirit of cooperation and understanding the oustees did not demand lands in the Zone I areas. Yet, they did repeatedly ask for settling together as a community[10]. This too was not respected.

According to Ajmer Singh Chandel, formerly from village Bhakra, now settled in Bardana, Haryana, all families were given 16 *Marala* (1/10th acre) for house plots[11]. The value of these house plots was deducted from the amount of compensation that had been determined. Land

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[8] R.L. Anand; *Punjab Agriculture Facts and Figures*; Economic and Statistical Adviser to Government of Punjab; 1956 Page 4-5

[9] Raj 1960: Page 49

[10] For example, letter of the Bhakra Dam Suffers Association dated 14 March 1956 written to Pt. Jawaharlal Nehru. Unpublished document, copy available in our records.

[11] BBMB figures work out to 20 marala

worth the remaining money was acquired and allotted to the project affected families. An upper ceiling for land allotment was established at 25 acres. However, there was no stipulation regarding the minimum amount of land that should be allotted.[12] The result being that some received 2-3 acres of land, some far less than this – even 2-4 *marala*! Since all families received 16 *marala* for house plots, there were cases when the land received for the house plots was greater than the agricultural land received.

Ajmer Singh – who was for 15 years the president of the oustees' association – continued with the explanation for this. The amount of compensation was determined based on the value of land that each family owned in the original village. Valuation of land was done as a 5- year price average, which was extremely low compared to what it was actually worth. This is because trading in land in this region was not done regularly. There are 2 reasons for this: One, that there was never really a need to sell land, since most landowners were farmers. The other, that it was a social stigma to sell land. The average of the 5-years prices was therefore low. Another problem was that while land was acquired in 1946, according to rates prevailing at those times, land acquisition for resettlement was done only in 1956, by which time, land prices had increased.

The oustees were not to be given land-for-land, but only whatever land could be purchased with their compensation. Due to the two factors given above there was a gross difference in the quantity of land lost and the land they were able to purchase. According to Jagatsingh Chandel, an oustee of Sloa village – only 60 families out of 1700 got about 25 acres of land; most people could get only 2-3 acres.

Added to this was another serious issue. The landowners in Hissar from whom land had been acquired for resettlement of oustees were dissatisfied with the compensation given to them, and went to Court. In many cases, the Courts granted substantial increase in the prices. In these cases, the Government asked the oustees to pay the arrears! The oustees pleaded that this increase should not be passed on to them. They said that in all good faith, and in national interest, they themselves never moved the courts to get *their* compensation enhanced, even though it was so low. But their pleas fell on deaf ears, and the oustees who were stuck with bad lands now had the additional burden of paying the enhanced compensation to the former owners. [13]

In a note attached to the Agenda for the 48th Meeting of the Bhakra Rehabilitation Committee to be held on 2 May 1961, Shri K.R. Chandol, Dy. Commissioner, Bilaspur, (H.P) suggested that this matter to be included in the Agenda. He wrote:

> "As a result of the decrees of Civil Courts in reference to petitions under section 18 of the land acquisition act 1894, the prices of the land allotted to the Bilaspur oustees[14] in Hissar district have been enhanced and the allottees are being asked to pay the same. ….The Bilaspur oustees have been hard hit and request that they may be exempted from the payment of the enhanced prices….."

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[12] In fact, the minimum stipulation *was* there – of land equal to the land acquired from them – but this was subject to the oustees having adequate compensation left to meet the cost of the land. This virtually made this stipulation into a farce.

[13] We see that while BBMB claims that the lands acquired for rehabilitation were "cheaper", this was because the lands were purchased in poorer quality areas like Hissar as compared to Patiala, and because the initial compensation given to the farmers was lesser. In the end the lands were more expensive than they had thought. The brunt of this fell on the oustee who was sandwiched between less than fair compensation for his lands, while having to pay much more for the resettlement lands. It may be argued that buying lands for the oustees in Patiala would have meant that the lands would be even costlier, but this is a specious argument. In reality, the whole policy of asking the oustees to buy land with their compensation is a faulty policy. The policy should be that the Government buys for them land equal to the lands they have lost, with a minimum guaranteed economic land area.

[14] All the oustees were known by the generic name "Bilaspur oustees" or even the derogatory *bilaspurias* in the resettlement area.

What was the response of the project authorities? Pointing out that the matter had already been considered in an earlier meeting (the request of the Bilaspur Dy. Commissioner was for re-consideration), the Additional General Manager, Bhakra dam says[15]:

> "..all cases, in which price is enhanced by the civil courts are fully examined, and wherever it is legally advisable appeals are lodged in order to reduce the enhanced price. The cost of such appeals is already being borne by the Government, which is a big concession and as such, it is only fair that the enhanced price should be paid by the allotees."

Jawaharlal Nehru, in one of his speeches during a visit to Bharka has declared that the oustees are going to another land; but we will make such arrangements for them that they will forget their homeland…we will give them water, school, electricity, roads…..[16]

"But when we came here, there was nothing." Ajmer Singh told us. He continued:

> "We had asked that we all be settled together in one place. But the Government refused. So they acquired the land for us. When we came here this was all a jungle. There was overgrowth and thick bushes. The land was completely uncultivable. There was also thick and rampant growth of a wild form of grass, locally called *Dila*. This grass has thick nodes/knots and is difficult to uproot. It took us 15-20 years of back breaking work to make the land cultivable. An entire generation spent their life just trying to make the soil arable. There were also many wild animals and snakes, making habitation on these plots very dangerous.
>
> "There was no facility of even drinking water. There was no electricity. We were shifted in 1956, we got electricity in 1972.
>
> "When we came here, all that each family got was a tent each for shelter. Some places some huts were constructed. There were also many wild animals and snakes, making habitation on these plots very dangerous. Apart from these there were numerous episodes of theft; except one –two houses everybody had to face the theft. There was no one we could even complain to.
>
> "Many of the oustees had to live off the cash compensation they had got. Several families even had problems about managing a square meal".

There were also no schools, colleges, or dispensaries. The lack of post offices in the region made communication with their original homes very difficult.

Land had been allotted under the Colonisation Act, 1912. They had therefore not received title deeds for their lands. Most of the people received proprietary ownership only in 1980. Due to this, they were not able to get loans against the land, and could not invest in the land because of the uncertainty.

Irrigation – which was the reason why they had demanded and had been given land in the command – was also to prove elusive. Irrigation facilities were provided to the people only after about 15 years. Even after that there were problems as the areas were at the tail end of the system.

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[15] Notes for Agenda of 48th Meeting of Bhakra Rehabilitation Committee to be held on 2 May 1961: Item No. 13

[16] As recounted by the oustees.

A letter written by the Dy. Commissioner, Resettlement, Hissar to the Chief Engineer (South) Irrigation Works, Haryana dated 6 April 1968 is telling (Language verbatim, as in the original):

> "The difficulty of lessor *(sic)* or even not supply *(sic)* of canal water for irrigation is being faced in almost all the villages of Bharka oustees. In certain cases of a few different village the level of the land of the oustees is some what high and hence it cannot get water even at all or in little allowance. …The holdings of most of the allowtees are small and the duration prescribed for the supply of water is so short that an allottee of few bighas or even a couple of acres can get a very little advantage of irrigation in as much as the short period time for water is available just to reach their fields. Thus small land holders are not able to get water for irrigation of their whole fields and cannot meet their requirements from the small holdings."

Apart from confirming the situation of irrigation that the oustees narrated, this letter also highlights the point that many oustees had got very little land. Thus, the oustees were deprived of the two major benefits that the dam had generated – electricity and water.

Serious problems were faced even with respect to the house plots. In many cases, the house plots were forcibly occupied by the residents of the original villages. When the oustees complained against this, the locals lodged false cases against them, and the whole administrative machinery being in favour of the locals, resulted in a lot of harassment to the oustees. Even till date, there are plots that continue to be forcibly occupied, we were told.

What is worse, for many years the oustees did not get the land titles in their names and even till date, large number of cases remain outstanding. The oustees told us that 2456 oustees remain for getting proprietary rights. Clearly the issue is serious enough for the BBMB Status note of 2002 to mention that proprietary rights for the plots allotted to the oustees "have been conferred to 2212 nos. till 31.12.2001 out of 2285 nos.". The responsibility for the backlog of 73 is laid on the oustees.

Due to all these serious problems, a number of families who had opted to resettle in Hissar either did not come or went back after trying to survive in those difficult circumstances.

Economic and Social Impacts

The entire economic and social structure of this population was completely disrupted with displacement. Long arduous years were spent trying to scrape up enough for minimum sustenance. The families, when they came here initially survived on the partial cash compensation that was given and the little money that the people had brought with them. Agriculture was extremely difficult, and there were no other jobs. There are no reservations for oustee families in the case of government appointments. In Himachal at least one person in each family was employed in the Dogra regiment of the army. (This regiment recruits cadets from Jammu Kashmir and Himachal Pradesh only). They have no reservation in the army anymore. While being in the army proves as an alternate income, there is also a fierce sense of pride in being in the army. Consequently, not being able to serve in the army is not only a loss of income, but is disheartening for the community.

There have also been several other social repercussions. In Himachal, according to Shri Sansar Chand Chandel, anyone who owned less than 10 acres of land was considered poor. Now that they own 2-3 acres in Haryana, it makes the people feel they have lost their economic standing in the community. People who were thus held in high esteem in Himachal feel shame faced in Haryana.

The women mentioned that arranging marriages has become difficult. Since there has been a loss of esteem that a family enjoyed, parents are hesitant in marrying their daughters into these families. Families living in Himachal do not prefer their girls to be married into families

settled in Haryana. Girls who do marry into families settled in Haryana, have problems in settling in these villages. The climate in Haryana is very different from that in Himachal. The soil in Haryana is loose and there is a lot of dust. The heat here is high and unbearable. Relatives still living in Himachal do not visit Haryana very often because of the drastic change in the climate. Cost of travel between Haryana and Himachal is also a factor.

The women when in Himachal had more freedom of movement and could be out of the house till as late as 2.00 in the night. But in Haryana, there is the fear of being in a strange land among strange people and therefore their movements are restricted.

The people said that they were far healthier when they were in Himachal. Food intake was high and nutritious. There never went a day when they were hungry. The women said if today they could go back, they would even if they had to eat dry roti with salt. (*Yadi vahan aadhi roti ke saath namak bhi khana ho, tho who isse achha hai*).

The women of Ahlisadar told of moving circumstances, when the elders passed away not having once gone back to their homelands. Families were broken, daughters never met their parents again. The elders died having lived a life of strife, struggling to stay alive and to make the lives of their children easier. They passed away in alien lands among alien people and alien customs, always wishing they could go back just once.

So deep-rooted is this longing for their homeland that some of the women broke down when narrating all this to us.

Even 50 years after they moved to Haryana, the project-affected families still feel they are the outsiders there. They are derogatorily called *'Bilaspuria'*. (Since they are from the Bilaspur district of Himachal). They have not been able to merge with the local communities in Haryana.

The oustee families have no political representation since they are in the minority. The oustees in the Ratta Tibba resettlement site mentioned that they have not been able to elect their member to the Panchayat ever since they have settled here, making them politically weak. Their grievances are therefore neither heard nor acted upon.

They still face ostracism and severe repression at the hands of the local communities. They have not been able to build relationships here. The women say '*Hamen nahin lagta ki ye hamara gaon hai. Log alag hai hamse, sanskar alag, bhasha alag, jaati alag*'. The people feel trapped - no more being a part of their own community in Himachal, nor being accepted by the local people and not being able to adjust to the life in Haryana.

Till date the economics of their lives have not been ironed out. They still struggle to keep up with the growing expenses of agriculture in Haryana. They repeatedly emphasized the increasing cost of inputs and declining returns of agriculture. For example, they said that where good quality groundwater was available, the water levels are going down. Earlier, they could do with a 5 H.P. motor, now they need 20-25 H.P. motor.

The people told us of how the agriculture in their home villages was possible without all these inputs. They told us of how they could take two crops there and also would get fruits from the orchards. They also said that most of the oustees, many of whom already had small pieces of land, have been reduced to very small landholdings due to the division in two generations. They said that while the division would have also taken place in their original villages, there there was space to expand by bringing more land under plough. Also, there was scope for jobs in the army. The feeling that came across sharply was that while there would have been problems in their homelands too, it was much easier to address them due to more resources and the confidence and support that comes from being in one's own community.

They are also still struggling to access basic facilities. Ratta Tibba receives its drinking water from a nearby village, which let the waters out irregularly. If an argument erupts between the

two villages, the host village does not supply water to Ratta Tibba. They are presently trying to get the government to build the water works in their village also.

They have also formed an organization called the 'Purusharthi Committee' to try and address the problems of the oustees. This Committee was formed in 1990 "with a view to achieve proper rehabilitation of the Bhakra dams displaced persons."[1] It is a telling commentary on the state of affairs that even 50 years after the displacement, the oustees are fighting for proper resettlement and they still have to have an organization dedicated to this.

SITUATION OF OUSTEES SETTLING IN HIMACHAL PRADESH

As we have seen, a number of oustees were given no option, or opted to take cash compensation. Part of this was driven by the fact that those wanted to opt for land would have to go off to far off, alien lands of Hissar. There were many who opted for land, went to Hissar, and then returned due to the enormous hardships there.

The people who took cash compensation were left to fend for themselves. Most moved up along the slopes of the mountains where they are still residing. They were not to get any land. However, after much struggle, the Himachal Government did try and allot some land to the oustees staying in the state.

Those who had returned from Haryana and some others who had demanded land for land, were allotted land in the mountains under the *'Nau To*d' policy. That is, government land that was for the first time "broken" and allotted to families who had been affected by the dam. But this too were very small patches of land not more than one acre or so, according to the oustees.

The people who moved into the mountains, received cash compensation at the rate of Rs. 100-500 per acre depending upon the quality of the soil. There were no banks at the time when the compensation was given. Many of the people therefore deposited their money with the local *Sahukars* (money lenders) who the villagers claim never returned their money to them. Several families in effect were left penniless. Some people were allotted approximately 4-5 bhigas land per family in the Naina Devi Sanctuary nearby. However, according to Shri Batansingh Chandel this was not arable land and therefore the agricultural land lost was not compensated for. The landless labourers who did not receive any lands were given a token sum of Rs. 200.

The villagers were given nominal amounts for the orchards and trees that were submerged. Subsequently some people did go to the Courts to get their compensation enhanced – but it is not clear if all were able to follow up on this. One case shows the level of underestimation of compensation for trees. In 1961, one Daulat Ram went to Court and got his compensation for trees enhanced by Rs. 12385.00 – a large sum in those days[2]. The compensation for the wells was given to the government.

Since the people who settled along the mountain slopes had no lands, they faced serious economic difficulties as the major source of their income was acquired. Jobs then became the main source of survival. Some people got work at the dam site; some continued to get jobs in the army as per the tradition of the area. People told us that it is only through this that they could survive.

According to Gyansingh, outees of village Bhakra:

> "Those who were employed on the dam site were able to scrape in some money to be able to survive. With our lands gone, our only means of income was taken away. People either laboured on other people's fields (those people whose fields were not

[1] Annual Report 1999-2000 of the Bhakra Dam Oustees Pursharthi Committee, Ratta Tibba (Bhakra Dam Oustees Pursharthi Committee 2000)

[2] From the Judgement and Order of the Court. *Court of Judicial Commissioner, H.P. at Simla:Judgement in Civil Appeal No. 21 of 1962 dated 10.12.63 By Om Prakash, Judicial Commisssioner.*

> submerged) or by working on the dam. Work on the dam site however was not easy to come by. There was a general belief that the local people were inadequate when it came to working with construction material. Pathans were brought in from the North Western Frontier since they were believed to be more hardworking and as people who were skilled at working with stones and the construction of structures. There was also no policy at that time which would ensure that at least one person from each family would be employed with the BBMB, either as office help or as construction labourers. I worked on daily wage basis for 11 years and was only then regularised. In spite of the difficulties, I managed to educate all three of my children, but now there are no jobs for them."

After some time, the H.P. Government also made attempts to provide some lands to these people.

But the living conditions were abysmal. The whole infrastructure has been disintegrated due to submergence and displacement.

The biggest problem was, and *continues to be* water. It is ironic that the people displaced for such a huge reservoir, living of the banks of the same continue to suffer from such a serious water problem. For example, the following noting from the Agenda of the Rehabilitation Committee Meeting held on 2 Sept. 1966 makes the situation of water clear:

> "The oustees have been resettled in the demarcated forests/charands of Bilaspur District from time to time and besides other difficulties, the major problem which they are facing is scarcity of drinking water for their animals and human beings. This difficulty assumes serious shape when the waters in Gobind Sagar starts rising with the onset of rainy season. When the water goes down the old springs and wells come out and the oustees feel easy in drawing water. But with the rise of water the springs and wells get submerged and with no provision of water at the places of their settlements they have to tread for miles to get drinking water and in some cases they have to cross the mighty Gobind Sagar to fetch water from sources at other side. And it is very dangerous when there is wind…."

This was more than 10 years after displacement, more than 3 years after the dam had been dedicated to the nation by the Prime Minister. But the most disturbing aspect is that even today, drinking water continues to remain a major problem.

The note by the Bilaspur Chief Medical Officer quoted earlier in the Chapter on Environmental Impacts shows the situation of water today. We repeat the relevant paragraph[3]:

> "3. The reservoirs [Govind Sagar] covered all the natural water sources and are now depending (sic) on the lake water as well as the water supply scheme provided by the Govt. These water supply schemes become dry during the summer season and most of the people have to depend for water which is not all the time can be consider potable.[4]

According to "Captain" Omkar Singh Chandel of Bhakra village:

> "Our biggest problem is water. We can see the water of the Govind Sagar reservoir in the distance below us, but we do not have water. Forget about irrigation, we do not even get water properly for drinking."

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[3] Note No. HFW (BLP) PH/99- H.P. Health and Family Welfare Dept. Distt. . Bilaspur, prepared by Chief Medical officer in response to D.O. No. HFW-B(C)17-1/95-II dated 6 March 2000 of Secretary Health, Shimla with Subject : Impact of Reservoirs in Satluj-Beas Basin and Sundernagar Hydel Chennel on Hydroplogy, Environment and People in H.P.

[4] Verbatim, as in original, through out

Since the people are living on the mountain slopes it is an arduous task to go down to the river (reservoir) to get water. Even if they do it, it is a big problem since the rights to the water in the reservoir are with the Punjab and Haryana Government and according to the oustees, they do not allow the waters to be lifted by people in Himachal. Though now the authorities *tend* not to stop people from taking water for drinking, they draw the line at irrigation withdrawal.

The people had for long to depend on the mountain streams which do not necessarily flow all the year round. In 1978, the Himachal Government prepared a water supply scheme for the oustee villages, but this has not been able to cope with the requirements. And the houses which are higher up on the slopes do not even have this facility. So they have to rely on the streams, and some handpumps which are located on the roadside. But the situation becomes very difficult in the summers. We were told that during the summer, the water supply is often through tankers. The BBMB does not even allow the filling of these tankers from the reservoir.

Gyansingh of Bhakra village told us:

> "Water is serious problem here. There is now a pipeline to supply water – it came only in 1988. But it is highly unreliable – sometimes water does not come even for 4-5, even 10 days at a stretch."

Even today, drinking and domestic water remains a problem. The people used to use the Sutlej waters and those of the streams flowing into the river for drinking purposes also. Sutluj water is not accessible due to reasons given above. The streams in the hill are far and dispersed and have also reduced in number. Some of them have also dried up. We saw a small pool that had been made to collect stream waters. This dries up in a couple of months after the monsoons, since the quantity of water which accumulates in it is negligible. The people have to now climb down steep slopes to reach a water source sometimes having to go as far as a kilometer or two to fetch drinking water. The government has installed taps at several points mainly along the main road, but the water received is inadequate. In the summer months the village receives no water at all.

In spite of giving up their lands and livelihood for a project to generate electricity, the oustees themselves did not get the benefit of this for years. There is a legendary story about Shri K.L. Rao in this connection. The oustees at Bharka narrated the story to us. Shri K.L.Rao, then central Irrigation Minister visited the Bhakra site. A person from the village, Hawaldar Dhunichanji went to him in the day with a lit lantern and told him '*Deep tale andhera*', (darkness under the lamp) meaning that while the dam site was heavily lit in the night, the village in which the dam was built did not receive electricity that was being generated there. The reason given by the BBMB for Bhakra village not having electricity was that the village had no roads and therefore the electricity poles could not be installed. BBMB also indicated that this (supply of electricity) was an unfair burden on the project. Shri Rao immediately proclaimed that the village would definitely receive electricity and that there would be no charge for it. The village received electricity finally in 1970; they had to pay for it.[5]

K.L. Rao himself narrates this incident in his memoirs[6].

> "…… It was many years later, during one of my visits to the dam site, that I found that the new village of Bhakra had neither drinking water nor electricity, though surrounded by blazing brilliant lights. This was indeed unfair and I asked the Bhakra Management Board to supply both power and water to the village. Even then, there

[5] Other villages got electricity even later according to the oustees.

[6] Rao, K.L. 1978. *Cusecs Candidate : Memoirs of an Engineer*, New Delhi: Metropolitan Book Co., quoted in Rangachari, R., N. Sengupta, R.R. Iyer, P. Banerji and S. Singh (2000): '*Large Dams: India's Experience*', a WCD case study prepared as an input to the World Commission on Dams, Cape Town, www.dams.org

> were objections. The Management Board thought that this was not a proper charge on the Project. This indeed was an absurd approach which I overruled."

Another major problem for the people living on the mountain slopes is that of landslides. People believe that a major factor to have precipitated this is the massive blasting activities that have been undertaken in the region. Whatever may be the reasons, there has been a big increase in the incidents of land slides that have occurred. The people refer to this phenomena as 'Sliding and Crushing'. Sliding is when the land beneath or below the house slides; crushing is when land above slides and crushes the house. There has been wide spread damage to property and life due to this. Several homes have sunk in upto 10 feet. Many others have been crushed by these landslides. Part of Shri Omkar Singh Chandel's house was once swept away in one such episode. While the authorities were willing to pay some families whose houses had been grossly damaged a sum of Rs. 5000-10000, this is a paltry sum compared to the cost of building. In 1988, the villagers wrote to the government demanding that they be resettled in safer zones. The government has received in all 1500 applications. In December 2001, 2 of these 1500 people received notices from the government mentioning that they would be given land in another area. While one of these 2 people has passed away, the villagers are not able to recognise the identity of the other person.

Several lands near the reservoir also became difficult to access and dangerous to live on since they were surrounded by water on three sides. These patches of land, slide lower into the reservoir every year. They have approached the government, asking them to take over their lands and consider them to be part of the oustee group and therefore being entitled for rehabilitation. The response of the government was extremely discouraging. They were told that they would be bound to accept the amount of compensation that the BBMB would decide upon and that they would have no say in the issue. Also, they would not be allowed to retrieve the material from their old houses. Considering their past experiences with the BBMB, the people did not trust that they would be compensated in a just manner and therefore have resigned themselves to a fate of living in danger and in being completely submerged at any point of time.

Another serious problem was that many of the local roads, paths, ferries were cut off due to the reservoir. The authorities had promised that other paths would replace these. But this was not done for a long time, and even today, the people have to travel much longer distances in many cases.

Apart from the dislocation, the oustees are also paying the price for living in a place of "national importance". There is restriction in the access to the villages. If an outsider wants to enter the Bhakra and neighbouring villages, permission has to be sought from the BBMB office in Nangal. Entry after nightfall is also restricted. There have been occasions when a marriage procession was detained in Nangal, since they arrived after nightfall. Till some years ago, this rule was applicable even for people who live in the village. A person living in Bhakra village had to apply for a permit to enter his/her own village! The people opposed this and expressed their discontent through a *dharna* at the dam site, only after which was this rule relaxed for those who lived in Bhakra village.[7]

FISHERIES

We were not able to meet any of the fisherpeople themselves. The information that we have obtained is from the other oustees and from a senior employee of the Fisheries Federation.

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[7] Of course, this will be justified by the dam authorities under the name of security measures. They should then also be aware that there are stories rife about how, if one does not have a pass, a few crisp notes are an equally acceptable substitute. The standard request from the guards is "*Mundenu kuch*…." and an appropriate response allows unencumbered entry.

Fishing was essentially carried out in an informal and unorganised manner before the dam. Hence, there is little record of the amount of catch. After the construction of the reservoir, the activity was transformed into a commercial activity with no one being allowed to fish without a license.

However, the government did not allow fishing activity in the reservoir during the first 2-3 years after the construction of the dam. This proved detrimental to the fishing communities in the region (the Daud's and the Rana's). Finally in 1972 (as per what oustees told us), licenses were given to fisher families at the rate of Rs. 50 per license. The BBMB Status note states that free licenses were granted to the oustees for a period of three years but does not mention the year. This though did not prove as a solution to these communities, since method of fishing in a reservoir is different from that in a river. They had to be trained in this new technique of fishing, for which fisherpeople from Bengal had come. These Bengali fisherpeople settled here. New apparatus had to be obtained and new methods learnt; several families could not go back to fishing. Some of them now ferry boats across the reservoir, while others till the little land that they have received as compensation.

In 1972, the families who owned licenses were organised into societies. There are in all 5 societies in the Gobind Sagar Reservoir area -3 of these in Bilaspur district and the other 2 in Una district. The members of these societies shared the profits earned. In 1976, a federation of the 5 societies was formed. Though the fisherpeople could sell only to the Federation, the Federation itself contracted the marketing to private contractors for a long time. Initially only fishing communities were given fishing licenses. Later on people from non-fishing communities were also granted fishing rights. It is said that many people, who had been employed in the fisheries department of the BBMB, quit their jobs, took licenses and started fishing in the reservoir. Now, in the past 2-3 years, only oustee families from the fisher community have been given licenses. Today there are a total of 2000 members in 13 societies. The boundaries in which each society can conduct fishing are clearly demarcated. Even the size of the net that a fisherperson can use is defined. The management of the federation is elected by its members, the societies, which also comprise people with non-fishing backgrounds. The fisheries department of the BBMB also conducts fishing in the reservoir.

There have been several hurdles in this entire process. With the entry of non-fishing communities in the fishing activity, it soon became just another business, which was conducted for profit making - very often sidelining the well being of the fishing communities.

The turnover of the Federation has gone up in the last 10 years or so, after the Federation took over the marketing from private contractors. Since figures before the dam are not available, we are not able to compare the increase in output if any. However, the composition of the species of fish has undergone a dramatic change. The earlier much sought after delicious native varieties like *Mahseer* are now almost gone and an overwhelming part of the catch has been replaced by the exotic silver carp, a low value fish. (See Chapter on Other Environmental Impacts.)

These two communities of Rana and Daud apart from fishing also ran water-run wheat flour mills along the banks of the river. There are 700 such project affected families. With the damming of the river, the wheat mills had to shut down. They were not allowed to conduct fishing in the reservoir for the first 10-12 years. These communities therefore lost their means of income in their entirety. These communities were given some lands for their homes and some agricultural land. These lands were however reported to be not arable.

We have not been able to estimate how much of a role fisheries played in making a livelihood available to the oustees, and how many oustees benefited. This will need a longer and more in-depth study. However, given that the (1) the old method and accouterments of the fisherpeople were no longer useful in the reservoir (2) that the fisherpeople from outside came in many years after the reservoir was created (3) fishing was closed in the initial years - it appears that

the fishing could not have played a substantial role as an economic support activity for the fisherpeople in the initial 15-20 years.[8]

BILASPUR TOWN

The town was the capital of the Bilaspur princely state ruled by Raja Anantchand, at the time of construction of the dam. This state was also one of the last states to be merged in the year 1954. The town has several ancient temples and palaces. The entire old Bilaspur town was submerged in the reservoir.

The present (New) Bilaspur town was resettled in 1954. The town was to be resettled in a completely different region – in areas that are now in Pakistan. However, the people insisted that they be resettled in the same area. The new town was therefore built on the slopes of the adjoining mountains. The markets were situated at the foot of the mountain, while the government offices and residences were built higher up the mountain. Each family was given a plot of land. There were 3 categories of plots. House plots (10x10 sq. ft.), Commercial Plots and House cum Shop Plots (37x38 sq. ft). The families were given rehabilitation grants for the construction of their new homes.

According to Shabbir Qureshi, a journalist in Bilaspur, this grant was too small, and so was the compensation given to the oustees for the properties submerged. So it was very difficult for people to construct houses in the new town. So the Government gave loans – which the people were not able to return for several decades. Ultimately, part of these loans was forgiven by the Government.

As in the villages, there was the joint family system operational here. Hence, the same phenomena of non-inclusion of adult sons in the list of project affected families is seen here. With families growing with every generation, the people feel the need either for larger homes or for more homes to be constructed. In the report on Bhakra oustees written by Vimal Bhai for SANDRP, the people say, *'Hamare vishal gahron mein se in machis ke dibbi mein le aye'*.[9] At the time of displacement, the population of the town was 3500. The new town was planned to accommodate a population of 4000. Today the population exceeds 10000! Before submergence there was space in the adjoining areas for the town to expand. But now there is the reservoir on one side and the hills on the other, thus congesting the town.

Besides this, several families from the villages are now demanding rehabilitation in the town since living in the villages has become unsafe and agriculture is no more economical. According to the SANDRP report, the government's Rehabilitation Committee had declared complete the rehabilitation process in 1983, 20 years after the completion of the dam and 27 years after actual displacement! In 1999, the Rehabilitation Committee was again called upon to look into the 3000 applications that had been submitted by the Bhakra oustees. On scrutinising these applications, 787 were considered valid by the Committee. (The parameters for scrutiny are not clear). Of these 787, 153 families have been promised land for land lost.

While the town was planned, with schools and other amenities provided for, Shri Shabbir Qureshi was of the opinion that the new town lacked the infrastructure that the old town had. A college had been built in 1954 just before submergence and was reconstructed only in 1964, 10 years after the development of the new town. The new town also received electricity only in 1960. But there was no electricity in the old Bilaspur and they saw electricity in the new town only.

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[8] We were also told that there was a long gap of 10-12 years (over and above the first 2-3 years when fishing was not allowed) when there was no fishing activity in the reservoir, but we have not been able to confirm this.

[9] "From our huge houses we were brought to these match boxes."

The old town had natural sources of water. There was a live spring (*Kharsi ka pani*) in the region as also a spring and fresh water lake (*Naun talaab*). The old town received its water supply from these 2 live springs. Incidentally, these springs were not submerged and the town still receives water from one of them. The town is currently facing severe water problems, especially in the summer when the water in the spring and the lake reduces. Tankers have to be brought in, to supply water.

With the presence of the reservoir, distances have also changed. A villager who lives 40 kms away before impoundment has to now travel a total of 120 kms to reach the town. Boats were used to cross the river before impoundment. Now, with the high silt deposits, the area has become marshy and dangerous for people and animals to traverse. In the summer season, students, government employees find it extremely difficult to cross over to the town. The government was to build bridges at 3 different places to enable free travel across the reservoir. While only one is built, the other 2, after 50 years of the existence of the reservoir, are yet to be constructed!

As in the rehabilitation sites and the villages, the economics of this town has been affected. However, this might have been tempered since there were some alternate opportunities of income. Also, many people had job opportunities in the army which continued. Today the economy is dependent on the shops and the commercial outfits that have sprung up in the town. A large number of people are employed in the government and the army. Some of those who were economically well off earlier, lost their old wealth and have slid down the economic ladder. While some families moved into the new town immediately after it was built, some families had waited until the waters actually started filling up. The families who had moved in to the town later, took far more time to settle in and to establish themselves financially.

CONCLUSION ?

The 50 years long story of the suffering and anguish of the Bhakra oustees is not yet over. What is significant is that even today, the oustees have not been fully settled and continue to battle it out in their own way. The Government too has been making some intermittent and sporadic efforts. It is too little, too late, but in such matters, it is better late than never. What is required is for these efforts to be stepped up dramatically and a comprehensive plan needs to be prepared –with an initial status survey and then identification of the measures necessary. A time bound program then needs to be made, and the funds for this unquestionably have to come from the project.

Bhakra project was implemented under unique circumstances. Circumstances due to which it got not just the cooperation of the oustees but also their blind faith to the extent that no other project in India got. This was accompanied by a condition which is impossible for any other project in India to get - that at least the resettlement part of the project was completely free from any corruption. Almost each and every oustee made it a point to tell us about the absence of corruption in the Government rehabilitation machinery in those days. Such were the unique circumstances that the Bharka project authorities had.

Unfortunately, these were squandered off. There was a unique opportunity to carry out the rehabilitation in a manner that would have got the authorities the enduring trust of the oustees. Unfortunately, this was not to be – this is one of the greatest tragedies of Bhakra – the breaking of the trust the people had in a newly born nation.

As a whole generation of oustees battled against severe odds to even ensure survival, the sense of betrayal grew in the minds of the oustees. On one hand, the oustees told us of the early days when the dam officials would tell them that the dam needs to be built to provide food for our country, and “we also thought, if this so, it is okay… the whole mood was like that”. The same oustees are now asking very different questions.

One oustee told us, "The freedom fighters who sacrificed for the country are getting pensions[10]. We also made huge sacrifices. But we only got hunger."

Another oustees told us "Regarding the irrigation benefits, we get the same amount of irrigation as the original residents of this area get. So there is nothing extra for our sacrifice….."

A pained Omkar Singh Chandel says:

> "We are not asking for irrigation, or any such benefits. *Par Hindustan ka pahala bandh jo bana hai, unki mulbhoot samasyaoka to hal ho. Hum to sinchai bhi nahi maang rahe, kuch nahi, aur kuch nahi…sirf peene ka pani chahiye..*"[11]

The words of Shri Roshanlal, another oustee reflect the sqandering away of the enormous goodwill by the project authorities.

> "*Jo bhi dam se ujadte hain, unhe nuksan hi hota hain. Koi phaiyda nahin hota. Jin logon ne qurbaniyan di, unka kya hua*?"[12]

We can never forget the following exchange between two of the oustees that took place in our presence.

Shri Batansingh, an oustee, said that they had asked the BBMB to at least adopt the village from which the dam gets its name – Bhakra , but BBMB was unwilling to do so. He also says *'Dam se phayda hua, anaaj mila, industries lagin, par visthapith ko kuch nahin mila*'. (The dam produced benefits, foodgrains, industries, but the oustees did not get anything).

The response of Captain Omkar Chandel is remarkable – it exhibits not a just a biting sarcasm, but also the intense sense of humour that seems to have helped them endure the sufferings of the last 5 decades. He replies

> "*Hamen to vo ek hi cheez mili- jiske liye saari duniya tadapti hai- naam. Bhakra naam sabhi jaante hain."*
>
> (We have got that one thing which the whole world craves – name – recognition. Today, everyone knows the name Bhakra) ✍

[10] The Government of India had declared a life long pension and free railway travel for all those who had fought in India's freedom struggle and had gone to jail.

[11] "But the first dam to be built in India …at least the fundamental problem of the oustees of this dam should be resolved. We are not asking for irrigation, nothing. We only want drinking water…."

[12] "Those who are ousted by a dam, always end up suffering – they are always the losers. They get no benefit. What happened to those who made this sacrifice?"

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14

In Conclusion: Behind Bhakra, Beyond Bhakra

"More … that is what we need. All the problems can be solved if we have more water."

Comment by a participant in a public meeting in Narwana, Haryana

"The proposed plan will not fully satisfy either side. No plan could do that; there is not enough water to fill all demands."

Eugene Black, President of the World Bank, writing to Prime Ministers of India and Pakistan in 1954, urging them to accept the plan proposed by the Bank to resolved the Indus Water Dispute.

In Conclusion
Behind Bhakra, Beyond Bhakra

BEHIND BHAKRA

DEDICATING THE BHAKRA PROJECT TO THE NATION ON 22ND OCTOBER 1963, Pandit Jawaharlal Nehru was moved to say[1]:

> "Bhakra Nangal is something tremendous, something stupendous, something which shakes you up when you see it. ……"

It does. I still remember my first view of the dam – breathtaking, even overwhelming.

Yet, for all this, our study found the Bhakra dam and project to be a most ordinary project, an ordinary dam much like any other large dam – with all its flaws and blemishes.

We saw that the design of the dam was driven by the need to strengthen negotiating positions in the interstate disputes - first between Sind and Punjab, and later India and Pakistan – than the need to address the dry areas. This is a phenomenon that is seen in many other projects. We saw that while the justification being given was to take waters to the dry areas of Hissar tracts the priority was given to augment the SVP. The areas proposed to be irrigated by the project had also been highly exaggerated – a familiar phenomenon in large dam projects.

Most dam projects, by the very fact that they store water that otherwise would have flowed on further down, work to transfer water from the downstream areas to the upstream. In the case of Bhakra, this was taken to the extreme, and the areas benefited by the project are actually a transfer of irrigation from downstream (SVP areas) to the upstream.

We found that the anticipated foodgrains production from the project – a crucial part of its very *raison d'etre* - had not been properly worked out but only some general estimates made.

In these and in many other ways the Bhakra project was just another dam. Nor was it much different as far as performance went. Indeed, its performance has been at gross variance with its larger-than-life public image.

We started with the widespread public perception that Punjab and Haryana are the granaries of the nation and that this is due to Bhakra. The "Punjab=Bhakra" (and to a lesser extent "Haryana=Bhakra") is an equation entrenched in popular mind in India. We soon found that this was far from the truth. Irrigation in the Punjab and Haryana had began many decades before Bhakra. This was from diversion schemes including the Western Jamuna Canal, the Upper Bari Doab system, the Sirhind canals, to name only the major systems.

As far as Bhakra is concerned, 20% of the total cultivable area of Punjab is commanded by Bhakra. For Haryana, the same figure is 31% . *Punjab and Haryana are much more than Bhakra.*

[1] BBMB 2002a: Page 9

One of the issues that this brings up is whether there is any difference between the irrigation from the diversion systems and storage systems. The advantage claimed for a storage structure is that it can provide better regulation, and especially help augment irrigation in winter, when river flows are smaller, by transferring excess monsoon water to winter months. But this is at the manifold costs including displacement, downstream deprivation and so on. A diversion structure, by its very nature, causes less disruption in the flow of the river. This is especially true of the monsoon or the high flow season. The weir or barrage will cause much less submergence and displacement as compared to a storage dam that creates a reservoir.[2] Thus, the major impacts in terms of displacement, submergence of forests, and severe downstream effects are avoided. There will be some impacts downstream – to the extent of the diversions taking place; but overall, the impacts are much smaller. The financial cost is also normally much less than a storage dam.

The irrigation developed in the Indus basin through these diversion schemes had much smaller social and environmental impacts. Much of the irrigation in the two states comes from such systems.

Even if we assume the contribution of an irrigation system to the production in the two states is in proportion to the area covered by it, Bhakra would not be responsible for more than 31% of Haryana's production and 20% of Punjab's. This is a far cry indeed from the public perception of Bhakra's role.

However, we found that this would be a gross misrepresentation. Between the two states, Punjab's production of foodgrains is twice as much as Haryana. And in Punjab, Bhakra has made little dent. An analysis of the command area reveals that much of the Bhakra command in Punjab was already irrigated, or was in well endowed areas. And the irrigation from Bhakra canals played a limited role in these areas. In Punjab, irrigation development after the mid-1960s really took off with the explosive growth in the groundwater irrigation through tubewells. We may recollect here that the Bhakra project was designed to irrigate, at best, a maximum of 62% of the culturable command area annually. In Punjab, even this was not achieved.

In Punjab, even in the Bhakra command areas, tubewell irrigation has been the overwhelming major source. *If there is one thing our study has exposed – it is that "Punjab=Bhakra" equation is a big myth.*

The growth of tubewell based irrigation was mirrored in Haryana.

We saw that the real jump in foodgrain production came after the advent of the Green Revolution, with the coming of HYV seeds. While Bhakra is strongly associated with the Green Revolution in public mind, we need to note that neither the Green Revolution nor irrigation came to Punjab/Haryana with the Bhakra project. Irrigation was there over a hundred years before Bhakra, and the Green Revolution came in only 12 years after the irrigation from the project had begun. The Green revolution is quite distinct from Bhakra.

There is little doubt, as our study clearly shows, that the driving force behind the Green Revolution was the tubewell based irrigation. This was true of Haryana, and certainly of Punjab. The high rates of growth in the foodgrains production, and the cropping pattern that includes large area of rice could be achieved only by massive extraction of groundwater – far beyond the normal recharge.

So rapid has been the growth in the groundwater extraction that a huge part of Punjab and Haryana's production today comes from the areas dependent on unsustainable extraction of groundwater – 43% for Punjab, and 34% for Haryana. This is based on water which is not being recharged, which had accumulated through decades or even centuries. *The miracle of*

[2] Dam builders sometimes say that the weir or barrage will cause no submergence, but this not strictly true as it can affect areas through higher backwater during times of flood.

Punjab and Haryana is in reality highly unsustainable, and now is in the process of a collapse.

Our calculations show that the contribution of Bhakra project – including the benefit of the groundwater recharge due to the canals – is 11% in Punjab and 24% in Haryana. Compare this with the above mentioned figures of production dependent on unsustainable mining of groundwater.

Our study has found that the impact of the Bhakra project was mainly in Haryana, that too in the drier districts of the Hissar tracts. The contribution of these areas - the areas served by Bhakra, has been limited. This limited contribution has come with huge costs. The costs of the dam – financial, social, ecological, the land degradation in the command areas, large scale waterlogging and salinisation of the soil which seems very difficult, if not impossible to manage, the deprivation of the areas downstream, the displacement of thousands of people, the impact of the prolonged and extensive use of chemicals and so on. These costs have been enormous, long-term and in all probability irreversible.

What is perhaps equally important is that these costs are translating into serious economic problems for the agriculture of the two states, threatening its very viability. Yields are stagnating, and more important, more and more inputs are being required to get the same output. *Margins of farmers are being squeezed; grains are too expensive for the people of the country to buy*. As the Johl committee Report points out[3]:

> "India has accumulated huge stocks of foodgrains that are not finding market …..Although as per the nutritional requirements of the Indian population, these stocks may not be considered in excess, yet due to the lack of purchasing power with the poor, supply exceeds demand….On the other side, the farmers, especially the farmers in the surplus producing areas, are experiencing an economic squeeze due to the decreasing margins between their costs of production and the prices they receive. Punjab in particular is in catch twenty two.…"

These declining margins have created massive indebtedness among the farmers, leading many to be caught in a debt trap. In several cases this has even led the farmers to the extreme step of committing suicide.

Neither the farmer is happy, nor does the consumer gain. Was this the desired goal of the project?

Some may be quick to argue as to what has this got to do with the project. Was the project responsible for all these problems? We would pose a counter question – how is it that the project did not prevent this? That such a situation has arisen in spite of the project?

Also, if irrigation from the project is glorified by pointing to the spectacular increase in the agricultural production, then it needs to be recognised that this production was made possible, among other things, by the heavy use of chemical inputs along with the HYV seeds, a policy of Minimum Support Price and large scale assured procurement. It is a package that has worked together. Indeed, it is an important question whether without the kind of productivity that these chemicals brought in, the dam itself would have been financially or economically viable[4]. Hence, the effects of the extensive and intensive use of chemicals and also the erosion of bio-diversity due to the very limited variety of seeds being used are part and parcel of the total cost of doing business with such irrigation projects. [5]

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[3] Government of Punjab 2002: Page 104

[4] Even with this productivity, the economic viability of such large dam projects is increasingly being questioned.

[5] To the extent that the same combination is used with other means of irrigation, these will add to the costs of those particular means too.

After all, no one is interested in the dam for its own sake.[6] The dam is a means to using the water resources for development –ensuring at the minimum adequate and affordable access to food for people and a reasonable livelihood for the farmers. If the long-term impacts result in these very goals being negated, then this necessitates some rethinking.

Large storage dams with extensive canal networks are among the most expensive of irrigation systems. To justify such an expensive interventions, the returns should be as much or more. With the current paradigm, such high returns (in terms of food or agricultural production) are possible only with the massive use of chemical and other inputs. This has led to the problems of soil degradation, threatening the long term well-being of the system. It is quite possible that cheaper means of irrigation (or, more generally, of increasing crop productivity) will not require such high returns to make themselves viable, and can thus manage with lesser inputs, leading to lesser economic and ecological problems. Since they would also be decentralised, they would address in a better way the problem of equitable distribution.

Will such systems meet the problem of food production? We will address this issue in the next section in detail; but it may well bear repeating that the issue to be addressed is not just of food production – but also of food security and access to food. In terms of all three, we have no doubt that other means are more effective than large storage dams.

It is clear that the early dam projects – taken up immediately prior to or just after independence – hardly looked at this issue of the economic viability. The First Five Year Plan notes[7]:

> "A number of projects – some multipurpose and others only for irrigation – were sanctioned soon after the end of World War II. On some of these, works were started before the completion of detailed investigations and of economic studies necessary to obtain a correct appraisal of the technical and financial aspects of the projects...."

K.N. Raj is even stronger[8]:

> "There had been no appraisals, of this scope[9], attempted in India either for the Bhakra Nangal or for any of the other proposed investment schemes. The project reports, on the basis of which the investment decisions are taken, give certain standard technical details and some estimates in very general term of the probable effects on production; these are supplemented by surveys and reports in regard to particular aspects of the projects, but the information given is usually fragmentary and analysis of the data does not add to anything like economic appraisal."

So what does this mean – that such projects are never viable? That we should never build a (large) dam? This is a huge debate that is of enormous contemporary relevance and significance, but it is not our intention to go into it here.[10] We will touch this debate in one

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[6] Except possibly the contractors.

[7] Chapter 26 *Irrigation and Power*, First Five Year Plan

[8] Raj 1960: Page 3

[9] What the words "*of this scope*" imply is noted in the paragraph previous to the one quoted and we reproduce the same here: "In the case of Bhakra Nangal project, several aspects of it would strike one, even at a first glance, as raising issues of considerable importance of economic point of view……The implications of all these clearly deserve to be pursued, and judged alongside the merits of the scheme, in a comprehensive economic appraisal. Once this is done with reference to explicitly stated criteria, and the project ranked in order of preference with other competing projects of a comparable kind, non-economic considerations, as also the economic imponderables, can be introduced and seen in better perspective."

[10] We would like to point out that a very important process, involving eminent experts representing all sides of the large dams debate, in the form of the **World Commission on Dams** has addressed very comprehensively, very convincingly this question. The WCD with 12 members representing dam builders, engineering companies, NGOs, affected peoples movements etc. was set up in 1998 to assess the development effectiveness of large dams worldwide and come out with a set of criteria and guidelines (only) under which large dams should be built. The unanimous report of the WCD was published in Nov. 2000 and provides a set of core values, strategic priorities, policy principles and guidelines under which new dams should be built. See www.unep-dams.org

respect though – and that is, the use of the Bhakra dam project as a model to justify large dam building programs elsewhere in the country. Proponents of large dams point to the spectacular success of the agriculture in Punjab (and to an extent in Haryana) and attribute it to the Bhakra project. This is then used as an argument to advocate, justify or otherwise push for other large dam projects. It is an argument that is brought into play to counter (wish away?) the adverse impacts of large dam projects. The Bhakra project, used as a proxy for the agricultural "success" of Punjab is used as an argument to end all arguments against large dams. So entrenched is the perception of Agricultural Success=Punjab=Bhakra that this argument often succeeds.

Our study has shown that this argument is widely off the mark. The agricultural success of Punjab and Haryana has been a short burst of prosperity that is not only stagnating but is plunging into economic, ecological and social crisis. And even this short burst has had little to do with Bhakra. Hence, the use of Bhakra as an argument to justify other large dams is a highly specious argument.

At this point we may also mention that apart from this basic flaw, the use of Bhakra to justify other large dams is problematic also because it is often not recognised that Bhakra was built under circumstances very different from what obtain now in other parts of the country. Let us recollect some of the more important circumstances that were unique to Bhakra.

First of all, it should be noted that the Bhakra project did not create any new irrigated areas; it simply transferred the areas being irrigated by the SVP in Pakistan to India. Bhakra could provide irrigation to Hissar tracts only by drying up the whole of Sutluj below Ropar.

Secondly, Bhakra was built in the days of the newly-independent-nation euphoria. This euphoria, and the accompanying outpouring of patriotic sentiment was to push aside many problems with the project. We have already seen the attitude and approach of the oustees who were ready to put up with many serious shortcomings in the resettlement program.

The lack of corruption, certainly in the resettlement process (reflecting in all probability the lack of corruption overall) –at least in the early days – was another rather unique condition – never again to be seen in India. These two sets of circumstances made building the Bhakra much easier as it helped push aside major issues and problems.

Thus, using Bhakra as an argument to justify more large dams is a seriously flawed argument. Yet, Bhakra has been thus used countless number of times without understanding the facts behind it. *Raag Durbari*, the hilarious and hard-hitting satire has captured this very well[11]:

> **"……** *इस देश के निवासी परम्परा के कवि हैं। चीज़ को समझने के पहले वे उस पर मुग्ध होकर कविता कहते हैं। भाखड़ा–नंगल बाँध को देखकर वे कह सकते हैं, ''अहा! अपना चमत्कार दिखाने के लिए, देखो, प्रभु ने फिर से भारत–भूमि को ही चुना।'* **"**[12]

BEYOND BHAKRA

The Bhakra project represents, in a way, the climax of irrigation development in the Indus basin. The fascinating course of irrigation development in the Indus basin began with the advent of the Harappan age, starting with the *sailaba* agriculture, then the earliest inundation canals that needed to re-built every year, the evolution of these canals to long channels with an

[11] Shukla, Shrilal 1968: '*Raag Darbari'*, Rajkamal Paperbacks, New Delhi :Page 16

[12] Can be translated as: "The denizens of this country are by tradition poets. They get captivated by a thing before even understanding it and compose poetry to it. Looking at the Bhakra Nangal dam they can say "Aah! God has once again chosen the land of Bharat (India) to display his miracles" "

elaborate network of distributaries, to the construction of permanent headworks to enable perennial irrigation.

With the headworks the system changed from being an inundation system to a diversion system, with better control on the diversions from the river. Each of these phases was marked by increasing abstractions from the rivers. Yet, for long, these were small enough not to cause any significant change in the river flows.

With the advent of the British era, developments took place at a rapid pace, and as more and more diversion schemes came up, an interesting phenomenon that was not in the picture so far made its appearance. For the first time, the abstractions from the rivers started reaching such a point that the areas lower down started feeling the reduction in flows. This typically manifested itself in disputes between separate political entities when the two areas fell in distinct political divisions – the Sind-Punjab dispute is an example of this. Words like 'upstream' and 'downstream' started to take on a different meaning. Areas downstream began to feel concerned that "their" flows were being taken away.

Still, the concern so far was limited to the "lean season" flow, as the existing weirs and barrages could divert only limited quantities of the monsoon flows. Much of the floods would pass over the weirs or barrages and flow on downstream. Of course, as the number of points where the river was "tapped" increased, a larger portion of even the monsoon flows began to be diverted.

Around this time, the idea of storing the monsoon flows began to be floated. It was an enticing idea – to those who saw the waters running "away" past them. Little thought was given, of course, to the fact that this water that was flowing past them, was flowing on to someone else. As technology made it possible to translate this idea into reality, the era of large storage dams began. Bhakra was the first of the storage dams in the Indus Basin, soon to be followed by other like the Pong on the Beas, the Mangla on Jhelum and Tarbela on the Indus. The storage dams brought with them a quantitative change in the abstraction of waters from the rivers.

At some point along this evolution, the abstraction turned into exploitation. *At some point, to use a modern term, the system became unsustainable.* At what point do the withdrawals from nature start becoming destructive and detrimental? This is one of the most heatedly debated, most contentious issues of today. This is the issue that lies at the core of our study.

The progression of increasing withdrawals from the rivers in the Indus basin was paralleled by similar developments in other areas.

The use of the bucket and rope and the *shaduf* to draw waters from the wells gave way to the Persian wheel. More water could now be drawn from the ground. The advent of diesel and electric motor pumps and tubewells led to a huge jump in the capacity to extract groundwater. For the first time in human history, human beings had at their disposal the means to bring out water faster than nature was recharging it.

Storage dams put for the first time the capacity in human hands to dry up rivers.

Settled agriculture was a step ahead in "taking" from the soil as compared to mere hunting-gathering. Double cropping, multiple cropping increased this. With the HYV seeds came hugely increased capacity to take up from the soils – to the extent that the nutrients contained in the soils were not enough to feed the "hunger" of these seeds. Heavy inputs of chemical fertilisers were necessary to make possible the high productivity of these seeds.

The progressively increasing withdrawals in all these systems are at the heart of the dramatic growth of agriculture in Punjab and Haryana. *All these systems have passed the point of sustainability.*

Every element in the "success" of the agriculture in Punjab and Haryana is based on over-extraction. The states are pumping more groundwater than is being recharged. The seeds are

drawing more from the soils than there is; and the dams are diverting away more water from the rivers than they should – all of it at huge social, ecological and economic costs. Clearly, if we want that a vast nation be fed from a limited area – then we will have to extract far more from this small part. If we want to develop agriculture that is going against the grain of the geo-climatic make up of an area, we will have to provide the inputs externally.

When and why does the level of extraction become unsustainable? Clearly, there will not be one answer. No one person can set a limit and say that this level is okay and not beyond this. But there are some broad parameters that can be our guide in this.

Nature is designed with cyclic processes. Various elements go through a cycle, getting transformed, transported in the process, but coming back to the original state. The water cycle is well known, as is the carbon cycle. These cyclic processes are highly interlinked and are in a state of dynamic equilibrium. [13]In contrast, most human designed processes are linear in nature – on one side are the inputs, which transform into outputs, and there are by-products. The outputs and by-products ultimately become "wastes" often creating serious problems of disposal. In nature, there are no wastes – because outputs or "by products" of one process are inputs for the next stage of the cycle.

Human interventions in the nature often tend to disrupt the natural cycles. *We would say that the extent to which human interventions lead to deviations from these cycles and disturb the equilibrium is a good measure of unsustainability.* To ensure sustainability on the other hand, we need to be as close to the natural cycles as possible.

If we look at the irrigation and agriculture development in Haryana and Punjab through this perspective, we can understand what is happening. The river that was earlier flowing into the sea is now being diverted somewhere else. In parts this water is now accumulating in the soil causing waterlogging. The groundwater that had been recharged since centuries is being taken out, with no replacement. The nutrients that are taken from the soil do not get back to it. Instead, we are pouring in chemicals, themselves extracted by disrupting other cycles.

All these have consequences that even now we are not fully grasped of. But those we *can* see are serious enough.

Some say that these are merely problems of management. Better management, better technology and more money can set these problems right. This approach is often called the 'technological fix' approach.

We see more fundamental issues at the heart of the problem[14] – the essential unsustainability of these unlimited extractions. We believe that solutions will need a shift in the way of working. The need is to address the root cause of the problem – namely, the shift away from and the disruption of the natural cycles. *In fact, this approach is not to be limited only to Punjab and Haryana, but should be the guiding norm all over the country.*

In case of irrigation, this approach would mean starting with soil water conservation measures and local rainwater harvesting, as this is what would cause minimum disruption. Groundwater use would have to be limited to the amount being recharged – though the amount being recharged can be increased through several measures. In case of agriculture, this approach would mean organic agriculture, with minimum of chemical inputs. It would also mean diversity of crops, it would also mean agriculture that is in consonance with the geo-climatic set up of the area.

Would these imply only moderate increase in yields of foodgrains? Even if it did, it not would be of concern if this meant moderate increase over large areas. Of course the increase may not necessarily be moderate. People working on such lines have achieved yields that are

[13] At least, were in dynamic equilibrium till large scale human interventions disrupted them.
[14] Sometimes we are ridiculed as being "doomsday-ers".

remarkable. During our visit to Haryana, we visited Sukho Majri, a place that is now famous nationally and internationally for its rainwater harvesting and soil water conservation efforts. Sukho Majri was in complete contrast to what we had seen in rest of Haryana. We saw large variety of crops. We saw great use of organic manure. The yields here were comparable with what is achieved elsewhere in the state – in fact, the farmers claimed that the yields were higher. Few farmers in the village were in debt. Here we saw farmers who were not complaining of higher input costs. And Sukho Majri is nowhere near a fully organic based agriculture.

Certainly, Sukho Majri has a different climate than say Sirsa. But the same *principles* can be applied anywhere.

It is often argued that if we are to feed the millions in the country then we need to step up our yields even higher. There is little doubt about this. But it is often forgotten that the average yield can be increased either by (a) very high yields at one point and low yields elsewhere, or (b) a moderate increase all over.

We have seen the problems with the former – the need to increase inputs vastly in small areas, (and hence extract them excessively, or transfer them from long distances and transfer the output back again), leading to increased costs, and other ecological problems that ultimately impact on the extractions themselves. On the other hand, the latter strategy has the advantage of requiring moderate increases in inputs, meaning not only moderate disruptions in natural cycles – but also decreasing substantially the cash burden on farmers. The output too would be relatively more equitably distributed.

A question can be raised – should be raised – will this be effective in meeting our food and other needs?

Before we look at this, we would like to emphasise one thing. Whether the approach above can meet our needs or not, one thing is certain – the current approach, as exemplified by Punjab and Haryana certainly cannot. It is ecologically, economically, financially – and hence socially and politically - unsustainable.

Coming to the alternative approach – there is little doubt that a moderate increase in yields and productivity spread out over large areas can meet our food requirements.

A look at the overall figures will be instructive. In 1997-98, the all-India area under foodgrains was 123.85 m ha, and output was 192.26 m tons. (Rice and wheat accounted for 56% of this). This is equivalent to an average yield of 1552 kg/ha. If we can achieve an increase of 100 kg/ha in this, we will get an additional output of 12 m tons. The area in Punjab under foodgrains in the same year was 5.951 m ha (93% of it under wheat and rice). To get an increase of 12 m tons output, yields would have to increase by 2050 kg/ha. Reasonable increases in yields can be obtained by a variety of measures that will also need only reasonable inputs, with moderate impacts. Extreme increase in yields will need excessive increase in inputs, with large impacts. Of course, this calculation is only indicative of the broad principle, and actual planning would have to take into consideration the differences in land quality, crops other than wheat and rice and so on. But there is little doubt that a decentralised approach can work, and meet our requirements with only moderate impacts.

Indeed, *only such an approach* can meet our needs. And meet it at lesser costs – both capital and recurring, and lesser ecological costs.

More….– How Much is Possible and How Much is Enough

Of course, such a system may not create islands of prosperity and opulence in midst of poverty. It may not lead to “showcase” agricultural systems of “spectacular” (though unsustainable) performance. It will certainly not help grow sugarcane or rice in deserts.

Take rice – rice is a crop that can and is grown without irrigation in Kerala or Chattisgadh. Yet, in Punjab it cannot grow without huge extractions of groundwater. If we insist on growing rice here (for reasons of higher returns or other reasons), there is no other way but to keep extracting more, and more – till may be one day there is nothing left. At that point, the catastrophic collapse of the systems would play havoc.

Yet, this is precisely the approach we are following. At a public meeting in Haryana, held to help us interact with the people on these issues, the problems facing Haryana's agriculture, including groundwater depletion were presented. One person got up and said "All our problems are because we do not have enough water. We need more. More water and all our problems will be solved." This, when Punjab is consuming 35 MAF of water and Haryana 27 MAF every year in agriculture.

It is not just an individual, we saw that this belief was widely prevalent. The groundwater levels are falling – so bring in more water – problem solved. Simple. Deceptively simple. Deceptive because it does not answer the question – bring from where? And even if there is an answer today – what when *that* source reaches its limits? Deceptive because it looks at only the supply side – no thought is given as to why the groundwater levels are falling; and whether the cause for that (rice in Punjab to continue our example) is justified. Deceptive because it hides the fact that unless you put a limit to the cause behind falling groundwater, no matter how much you bring in from outside, it won't be enough…ever.

In other words, unless we also pay attention to how (and how much and for what) the water is being used – we will always need more and more water – which means higher and higher extractions, which will be then justifications for large dams, over-extractions of groundwater and so on - unsustainability.

No system can be sustainable – ecologically, economically, socially – unless it pays attention to this "other side" – namely, use or consumption – and thinks about the limits and ranges for this.

One dimension of this is the justification of the end use, and whether this end use is the optimal use of resources. For example, growing rice – on the large scale as is being done today in Punjab – is this justified? Is this the optimal use of water resources? *Only if this end-use is justified can the extractions be justified*. In general, trying to grow crops unsuited to the agro-climatic conditions would be unjustified – or at least, a sub-optimal and high cost strategy.

The other dimension of this is that any system, whether the end-uses justify it or not, will have its natural limits[15]. This means that we have to live with a recognition that our consumption would eventually have to have some limits. What these limits are, how these will be defined, and what are the implications of this for our production processes are some of the most critical issues that humankind needs to address.

Some people would say that this is an anti-development view, and will quickly pounce on this statement saying – Ah! So you want India to live in the dark ages. You don't want development. But this would be a distortion of what we are saying. We are not against development – or consumption. But we want to emphasise that this will have limits – must have limits. (And that development is not just about increasing consumption). That we will have to make a distinction between needs that are basic and needs that are – for the want of a better word – luxury. We believe that the former can be comfortably met – that sustainable prosperity is possible. But it will be difficult to meet the needs of luxury without crossing the limits of sustainability. Without paying huge costs.

We agree that "More" is a legitimate element of the goals of any development process. But we would say that development is not simply "more and more". And that there are types and types

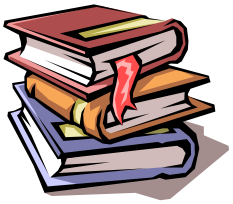
[15] These limits may not be sharply defined points but rather fuzzy boundaries which would be a function of the costs – financial, ecological, economic, social.

of "more." After all, Oliver Twist also asked for "More". And in recent years, *"Yeh Dil Mange More"* is sought to be projected as the aspiration of the nation[16]. But these two refer to two very different types of needs. This distinction should be recognised as also the fact that there will be limits to the needs that can be met. And that there will be costs in meeting these needs, costs that will escalate sharply as we reach the limits imposed by nature.

The irrigation/agricultural systems in Punjab and Haryana show what can happen as we reach these limits, and the kind of costs - financial, economic, ecological, social – that we have to pay to push these limits. They raise fundamental issues in terms of how much, how and for what to extract from nature. The developments in Punjab and Haryana show the close interdependence between ecological, economic and social sustainability. In this, they exemplify the biggest developmental challenges to India – and also show the possible directions for the country to meet its developmental objectives.

We believe that this is the most important message offered by our study. ✍

[16] For those not familiar – this has been for long the slogan of a Pepsi ad campaign in India. It translates to "The heart asks for more".



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Annexures

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SALIENT FEATURES OF THE BHAKRA-NANGAL PROJECT

BHAKRA-NANGAL PROJECT Total Cost : Rs. 245.28 crores	
Bhakra Dam	
Type of Dam	Concrete straight gravity
Height above the deepest foundation	225.55 metres (740 feet)
Height above river bed	167.64 metres (550 feet)
Length at top	518.16 metres (1700 feet)
Width at top	9.14 metres (30 feet)
Length at bottom	99 metres (325 feet)
Width at base	190.5 metres (625 feet)
Elevation at top of dam above M.S.L.	El. 518.16 metres (1700 feet)
Reservoir	
Catchment Area	56980 sq. kms.
Normal reservoir level	El. 512.06 metres (El. 1680 feet)
Dead storage level	El. 445.62 metres (El. 1462 feet)
Area of reservoir	162.48 sq. kms.
Length of reservoir	96.56 kms.
Live storage capacity at EL 1680 ft	6911 m cum (5.60 MAF)
at EL 1685 ft	7191 m cum (5.83 MAF)
Gross storage capacity at EL 1680 ft	9340 m cum (7.57 MAF)
at EL 1685 ft	9621 m cum (7.80 MAF)
Dead Storage capacity	2430 m cum (1.97 MAF)
Bhakra Power Plants	
Number of Power Houses	2
Installed capacity of Left Bank Power Plant	540 – 5 units of 108 MW each
Installed capacity of Right Bank Power Plant	660 MW – 5 units of 132 MW each
Nangal Dam	
Height	29 metres (95 feet)
Length	304.8 metres (1000 feet)
Power Houses on Nangal Hydel Channel	
Number of Power Houses	2 (Ganguwal & Kotla)
Total installed capacity of each Power House	77.65 MW each (2 units of 24.20 MW and one of 29.25 MW each)

Source: BBMB 2002a

BEAS PROJECT UNIT I Total Cost : Rs. 449.17 crore	
Pandoh Dam	
Type of dam	Earth-cum-rockfill
Height above river bed	61 metres (200 feet)
Height above deepest foundation	76.2 metres (250 feet)
Elevation at top of dam	El. 899.16 (El. 2950 feet)
Length at top	255 metres (835 feet)
Width at base	268.22 metres (880 feet)
Width at top	12.19 metres (40 feet)
Reservoir	
Maximum reservoir level	El. 896.42 metres (El. 2941 feet)
Normal reservoir level	El. 883.92 metres (El. 2900 feet)
Minimum reservoir level	El. 883.92 metres (El. 2900 feet)
Gross storage capacity	4100 ha metres (33240 acre feet)
Live storage capacity at El. 2941 ft.	1855.98 ha metres (15039 acre feet)
Pandoh Baggi Tunnel	
Capacity	254.85 cumecs (9000 cusecs)
Sundernagar Balancing Reservoir	
Capacity	370 ha metres (3000 acre feet)
Maximum width of reservoir	449.88 metres (1476 feet)
Capacity of Syphon Escape	328.48 cumecs (11600 cusecs)
Dehar Power Plant	
No. of units	6
Installed Capacity	165 MW x 6 = 990 MW

Source: BBMB 2002a

BENEFITS OF THE PROJECT

New areas irrigated	28.8 lakh ha
Area where irrigation was improved	9 lakh ha
Energy	6500 MU/year

Source: Board at the dam site.

Annual Increase in Agricultural Production

As Claimed by BBMB

Project	**Annual Increase**			
	Foodgrains	Cotton	Pulses, Vegetables, Oil, seeds, fodder etc.	Sugarcane
Bhakra Nangal	1.57 m tons	0.185 m tons	0.44 m tons	0.365 m tons
BSL (Beas Unit-I)	0.224 m tons	0.051 m tons	0.965 m tons	0.031 m tons

Source: BBMB 2002a Page 50

SOME IMPORTANT DATES AND EVENTS

Date/Year	Event
3000 BC – Early 19th Century	Number of inundation channels and diversion channels from various Indus basin rivers constructed with increasingly extensive canal systems. Development of well irrigation.
1355	Canal constructed taking off from the Jamuna river with a aim to provide water to the hunting estate of the Emperor Feroz Shah Tughlak in Hissar. This is the precursor of today's Western Jamuna Canal. Canal fell into disuse later.
1568	Emperor Akbar restores the Jamuna canal. Small areas of land irrigated from it.
1605-1623	Emperor Jehangir builds a 80 km long canal off-taking from the river Ravi to take water to his fortress and hunting ground near Sheikhpura.
1633	Ali Mardan Khan, celebrated engineer of Shah Jehan, builds another canal known as Hansli, off-taking from the left bank of Ravi. This irrigates a part of the Bari Doab area. This is the precursor of the Bari Doab Canal irrigating large areas today in Punjab.
Upto Early 19th Century	Several other canals built on the Indus basin rivers irrigating large areas.
1809	British enter Indus basin with Government of India accepting the allegiance of the Sikh rulers, extending the British rule to the tract between Jamuna and Sutluj.
1817	First phase of the British interventions in irrigation in the Indus basin begins with restoration of the Western Jamuna Canal. This is followed by restoration, improvement in several other important canals.
1843	British annex Sindh and it is attached to the Bombay province.
1849	The portion north and west of Sutluj (Maharaja Ranjit Singh's empire) annexed by the British. Full Indus basin comes under the British.
1869	Second Phase of British intervention in irrigation in Indus basin – construction of new canal systems – begins with construction of the Sirhind Canal system with headworks at Ropar. This system even today irrigates a large part of Punjab. Large number of systems were constructed following this.
1901-1903	First Irrigation Commission set up and completes its work.
1908	First Bhakra scheme mooted. Sir Louis Dane moots the idea of a storage dam near Bhakra after coming from a trip from the area.
1910	Detailed report on the Bhakra site prepared. Costs found prohibitive and hence proposal dropped.
1915	Bhakra proposal revived, with a note concluding that the revenue earning possibilities had been greatly underestimated. Project Division opened in October 1915.
1919	The first detailed and comprehensive project report for a high dam at Bhakra prepared. Height of the dam 120.40 m (395 ft) Gross Storage 2.58 MAF (3182.38 MCM). Scheme not taken up. Investigations continue.
1914-1919	First World War

Date/Year	Event
1921	Sutluj Valley Project consisting of fours headworks and number of canal systems on the Sutluj sanctioned. Built over next few years.
1923	Sukkur barrage on the Indus river sanctioned. This was the most important project in Sindh.
1927	Committee recommends revised (increased) height of 152.4 m (500 ft) for the dam at Bhakra. Storage was to be 4.75 MAF
1932	Investigations for 500 high dam at Bhakra carried out.
1935	Anderson Committee on "Distribution of Waters of the Indus" appointed by Government of India. To recommend an allocation that is "acceptable and equitable to all parties", the main parties being Sindh and Punjab provinces.
1935	Government of India Act passed. Becomes effective in 1937. Water becomes a provincial subject.
1937	Sindh constituted as a separate Province (splitting it off from Bombay)
1939	Detailed Project Report for the 500 ft high Bhakra dam taken up by Dr. A.N. Khosla. Maximum Reservoir Level (MRL) was to be 1600 ft
1939-1944	Second World War
1941	Indus Commission (Rau Commission after its Chair Jst. Rau) – a quasi-judicial commission – constituted to look into the water dispute between Sindh and Punjab provinces.
1942	Rau Commission gives its report.
1943	Bengal Famine
1944	D.L. Savage, Chief Engineer of US Bureau of Reclamation requested to examine the site and report on feasibility of construction of a dam with Maximum Reservoir Level 1600 ft. Positive recommendation with suggestions for further explorations of foundations etc. Carried out 1945-47.
1945	Draft Bilaspur Agreement between Punjab Government and Raja of Bilaspur restricts Bhakra dam MRL to 1580 ft.
1945	Specification Design of the Bhakra Project with MRL 1580 ft drawn up. Height of dam was 146.3 m (480 feet) above bed rock.
1946	Work on the Nangal project begins
1947	Partition of India and Pakistan
1 April 1948	Standstill agreement ends; India shuts off irrigation channels to Pakistan from Headworks controlled by India –to the Dipalpur canal from Ferozpur on Sutluj and to the UBDC from Madhopur on Ravi.
1948	Work starts on Harike barrage at the confluence of Sutluj and Beas. Completed in 1952.
1948	Post partition redesign of the Bhakra project to a Full Reservoir Level of 1680 ft, later increased to 1685 ft. with the Bilaspur state no longer considered an impediment.
1948	Prime Minister Pandit Jawaharlal Nehru calls for food self sufficiency by 1951
26 Jan. 1950	East Punjab (Indian Punjab) formally renamed as Punjab
1951/53	Final Project Report of Bhakra dam and project
1951	First Five Year Plan begins
1952	Harike Barrage completed

Date/Year	Event
1956	End of First Five Year Plan. Virtually all restrictions and control on food dismantled.
8 Nov. 1953	The "Bhakra Dam Sufferers' Association" present a sheet outlining "Our Demands". They petition Prime Minister Jawaharlal Nehru for settling them together at one place.
8 July 1954	Nangal Hydel Channel and network of Bhakra canals declared open. First irrigation deliveries begin from Nangal project.
1956	India begins food grain imports under PL480. (PL 480 passed by the US Congress in 1954.)
Nov. 1956	Merger of PEPSU into Punjab
14 March 1956	Letter of the Bhakra Dam Suffers Association written to Pt. Jawaharlal Nehru reiterates their demand for settling people together.
1955-56	Irrigation from Bhakra- Nangal reaches one million acres mark.
1956-61	Second Five Year Plan
31 March 1958	Construction of Rajasthan Canal formally inaugurated by G.B. Pant, Home Minister, Union of India.
July 1958	First impoundment at Bhakra dam. Storage at Govind Sagar begins.
1 July 1958	Sirhind Feeder opened.
1959	Bhakra Nangal Agreement between the states of Rajasthan and Punjab on the sharing of the water and power from the project and Sutluj river.
1959	Ford Foundation Team (Agricultural Team) comes to India and presents its report on tackling the Food Crisis.
1960	Indus Waters Treaty signed between India and Pakistan
1961-65	Third Five Year Plan
1961	The Intensive Agricultural Districts Program (IADP) begins on the recommendations of the Ford team in 13 districts in the country. Ludhiana is the district in Punjab.
11 Oct. 1961	First water released in Rajasthan Canal
1962	Publication of "Silent Spring" by Rachel Carson, highlighting for the first time the huge impacts and danger of pesticides used in agriculture.
22 Oct 1963	Bhakra dam completed and dedicated to the nation by then Prime Minister Jawaharlal Nehru.
1966	India's food imports reach its peak of 10 million tons of cereals
1 Nov. 1966	Punjab divided into Punjab and Haryana with some districts going to Himachal Pradesh
1966	Mexican varieties of High Yielding Seeds introduced in India. The beginning of the Green Revolution.
1966-69	Plan Holiday (Three annual plans)
1969-74	Fourth Five Year Plan
December 1971	Indo-Pak war and liberation of Bangladesh
1971	Foodgrains imports reach negligible levels; food "exported" to Bangladesh.
1975	Foodgrains imports touch another high at around 8 million tons
25 June 1975	Internal Emergency declared in the country.
7 July 1977	Diversions from river Beas into Bhakra reservoir begin through the Beas Sutluj Link (Beas Unit I)

Date/Year	Event
1977-78	Number of tubewells in Punjab touch half a million mark
1984	Operation Blue Star
1985	Punjab Government sets up the first committee to recommend measures to diversify its cropping pattern. (Johl Committee)
1990	One of the earliest reports of suicides by farmers in Punjab brought out.
1998	IDC, Chandigadh publishes its study on "Suicides in Rural Punjab" entrusted to it by Punjab Government. It confirms the large number of debt-driven suicides of farmers in Punjab.
2000	Another study on Suicides of farmers in Punjab published by Dr. Gopal Iyer and Dr. Meher Singh Manick. This also confirms farmers' debt and adverse economics of agriculture as the major causes of farmers suicides.
2002	Punjab Government again sets up a committee to advise it on diversification of the cropping pattern, headed by the same person as in 1985. (Johl Committee)
12 July 2004	Punjab Assembly passes the Punjab Termination of Agreement Act 2004 annulling water agreements entered by Punjab with other states including the 1981 Agreement.

GLOSSARY*

Foodgrains	Total cereals and total pulses. Oil seeds are not included in the calculations of foodgrains
Reh	Local word used in Punjab and Haryana for 'Soil Salinity'
Sem	Local word used in Haryana for waterlogged area
Arthiya	Commission Agent who acts as a broker for the farmers in selling their grains at the *mandi*. He also acts as a local moneylender and is the most important source of short-term credit that farmers need for cultivation expenses. The rates of interest charged by the *arthi* range from 2% per month (24% per year) to 5% (60 % per annum).
Partition	The partition of British ruled India into India and Pakistan in 1947.
Pre-Partition Punjab	The Punjab province as before 1947. This includes today's Indian states of Punjab and Haryana and the Pakistani province of Punjab. Some parts of today's Punjab and Haryana were princely states prior to 1947 and hence were not in the British Province of Punjab.
Undivided Punjab	The Indian state of Punjab from 1947 to 1966. During this Punjab consisted of what are today the states of Punjab and Haryana. On 1 Nov. 1966, the undivided Punjab was divided into the states of Punjab and Haryana, with some areas going to Himachal Pradesh. PEPSU had merged with the undivided Punjab in 1956.
PEPSU	Patitala and East Punjab States' Union – A union consisting of the princely states of Patiala, Jind, Kapurthala, Nabha, Maler Kotla etc. PEPSU merged with Punjab in 1956.
Weir	An ungated structure built at right angles to the flow of a river to help divert the flow into a canal or channel. The weir is not a storage structure and generally the water level remains within the riverbank levels. Flood or high discharge flows on downstream over the weir.
Barrage	Same as a weir but with gates.
Dam	The dam is also built across the flow of the river and is typically a storage structure and will create a reservoir.
Gross or Geographical Command Area (GCA)	The whole or geographical area that a canal network reaches. This will include also roads, uncultivable area, built up area etc.
Culturable or Cultivable Command Area (CCA)	The part of the Gross Command Area that is cultivable.
Annual Irrigation	The area actually irrigated annually in an irrigation command.
Intensity of Irrigation	Ratio of the area actually irrigated annually to the Cultivable Command area.
Net Area Irrigated	Area irrigated, without double counting. If part of the area is irrigated for two crops in a year, it is counted only once.
Gross Area Irrigated	The total area irrigated annually, with multiple counting of areas irrigated for more than one crop a year.

* Not in alphabetical order so as to keep related terms together.

Net Sown Area	Area sown in a year, without double counting. If part of an area is sown more than once in a year, it will be counted only once.
Gross Sown Area	The total area sown in a year, with multiple counting of areas sown for more that one crop a year.
Kanak	Wheat (Literally, gold)
Jiri	Paddy
Rim Station	The point at which the river leaves the mountains to descend on the plains.
Kharif	Monsoon (summer) crop or crop season
Rabi	Winter crop or crop season

ABBREVIATIONS

A.I.C.C.	All India Congress Committee
B.B.M.B.	Bhakra Beas Management Board
B.M.B.	Bhakra Main Branch
B.M.L.	Bhakra Main Line
B.S.L.	Beas Sutluj Link
C.A.G.	Comptroller and Auditor General
C.C.A.	Culturable Command Area
C.W.C.	Central Water Commission
D.P.R.	Detailed Project Report
E.I.A.	Environmental Impact Assessment
F.R.L.	Full Reservoir Level
G.A.I.	Gross Area Irrigated
G.C.A.	Gross Command Area
G.M.F.	Grow More Food
G.S.A.	Gross Sown Area
H.O.P.P.	Haryana Operational Pilot Project
H.P.	Horse Power
H.P.	Himachal Pradesh
H.Y.V.	High Yielding Variety
I.A.A.P.	Intensive Agricultural Areas Program
I.A.D.P.	Intensive Agricultural Districts Program
I.G.N.B.	Indira Gandhi Nahar Board
I.G.N.P.	Indira Gandhi Nahar Pariyojana
M.A.F.	Million Acre Feet
M.C.M.	Million Cubic Metres
M.R.L.	Maximum Reservoir Level
M.S.P.	Minimum Support Price
M.U.	Million Units
M.W.	Mega Watts
N.A.I.	Net Area Irrigated
N.B.A.	Narmada Bachao Andolan
N.H.	National Highway
N.H.C.	Nangal Hydel Channel
N.S.A.	Net Sown Area
N.W.F.P.	North Western Frontier Province (Pakistan)
P.A.U.	Punjab Agricultural University
P.E.P.S.U.	Patiala and East Punjab States Union
S.V.P.	Sutluj Valley Project
S.Y.L.	Sutluj Yamuna Link
SANDRP	South Asia Network on Dams, Rivers and People
T.I.N.A.	There Is No Alternative
T.V.A.	Tennessee Valley Authority
U.B.D.C.	Upper Bari Doab Canal
W.C.D.	World Commission on Dams
W.J.C.	Western Jamuna Canal
W.T.O.	World Trade Organisation

UNITS

Killa	One Acre
Kanal	$1/8^{th}$ Acre (8 Kanal = 1 Acre)
Marala	$1/20^{th}$ of a Kanal (hence = $1/160^{th}$ of an acre). The standardised marala of the revenue dept was 25 sq. yards.
Murrabba	25 acres
Maan	20 kilos
MAF	Million Acre Feet (= 1234 Million Cubic Meters)
Ha-m	Hectare-Meter
MCM	Million Cubic Meters
Ha	Hectare (= 2.47 acres)
Cusecs	Cubic Feet per Second
Cumecs	Cubic Meters per Second

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Dr. Karam Singh, Ludhiana
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Google.com - The Search Engine
Gurbaksha Singh Maggo, Nabha
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Gyan Singh, Bhakra
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Himanshu Upadhyaya, Surat
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Irrigation Department Punjab & Staff, Chandigadh
Jagdeep Singh
Jagdish Chandra, Mundhal
Jagjit Singh Chandel, Bilaspur
Jagman Singh, Chandigadh
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Shantidevi, Village Simla
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Smitha Badrinarayan
Subir Gokarn & Arnaud Lunel,
Sudarshan Jagga, Malout
Sukhdev Sharma, Bilaspur
Sukhdev, Nangal
Supratik Chakravarthy, Mumbai
Surendra Singh, Kheti Virasaat, Nabha
Sushil Joshi, Hoshangabad
T.N.Srinivasan, Yale
Teen Murti Library, New Delhi
Teluram Gautam, Dabetta
Trilochan Singh, Village Raipur
Tultul, Bhopal
Umendra Dutt, Delhi
Venkatesh Iyer, University of Delaware
Venu Govindu, Vishakhapatnam
Vijaykumar Singh Puroiya, Ahlisadar
Vimalbhai, New Delhi
Vinay and Charul, Ahemdabad
Yograj Chandel, Bhakra
Zubeida Birwani, Karachi

MAJOR PROJECTS ON INDUS BASIN RIVERS

	Across Ravi	Across Beas	Across Sutlej	Across Chenab	Across Jhelum	Across Indus
In India	Thein	Pandoh (BSL)	Bhakra			
	Madhopur HW	Pong	Nangal			
			Ropar H/W			
			Harike H/W			
			Ferozepur H/W (Obselete)			
In Pakistan	Balkoi		Sulemanki	Marala	Mangala	Tarbela
	Sidhnai		Islam	Khanki	Rasul	Kalabaugh
			Panjnad	Qadrabad		Chashma
				Trimmu		Taunsa
						Guddu
						Sukkur
						Kotri (Hydrabad)

See Also Map 2

DISTRIBUTION OF RIVER WATERS AMONG PUNJAB, HARYANA AND RAJASTHAN

The figures for the water available in the rivers of Punjab and Haryana and its distribution have often been at the centre of controversy. Different sources sometimes give differing figures, and some figures have been changing over time – not only due to reasons of improving measurements, but due to reasons of water disputes. We will ignore these factors and look at the broad figures of the water availability in the rivers of the three states and their sharing. Given our mandate, we will focus on Sutluj.

Indus and Tributaries – Division Between India and Pakistan

We have already seen the figures for Indus and its tributaries in Chapter 1. The table is repeated here for convenience.

Catchment and Runoff of the Indus Rivers at Rim Stations[1]

River	Gauging Station	Catchment Area (Sq. Km)	Average Annual Run-off 1922-61 (Million Acre Feet)
Sutluj	Ropar	48044	14
Beas	Mandi Plain	16834	13
Ravi	Madhopur	8028	7
Chenab	Marala	29525	26
Jhelum	Mangala	33410	23
Kabul	Warsak	67339	17.4
Indus	Attock	264178	93

It appears that the figures for Kabul are included in the Indus figures.

Same figures as given by Gulhati are:

Mean Volumes of Flow
(Million Acre Feet)

River	April-June	Jul- Sept.	Oct. -Dec	Jan.-March	Annual
Sutluj	3.2	8.4	1.2	0.8	13.6
Beas	1.9	8.5	1.3	1.0	12.7
Ravi	1.9	3.3	0.5	0.7	6.4
Chenab	6.7	13.1	1.7	2.0	23.5
Jhelum	9.9	8.2	1.8	2.7	22.6
Indus	27.9	48.7	7.1	5.8	89.5
	51.5	90.2	13.6	13.0	168.3

Note: *Flows as at rim stations, mean for 25 years (1921-22 to 1945-46)*
Source Gulhati 1973: Page 452

As we can see there are small differences, but more or less the figures tally.

Annual mean flows of Sutluj range are of the order of 13-14 MAF.

The Indus Waters Treaty of 1960 divided this between India and Pakistan with India getting the complete right over waters of the three eastern rivers namely Sutluj, Beas and Ravi.

[1] Michel 1967: Page 33

Ravi Beas Waters - Inter State Agreement of 1955 and Others

On 29 January, 1955, an inter-state conference held at New Delhi allocated the Ravi and Beas waters – surplus to the pre-partition uses –to various states. The allocations were as follows[2]:

Mean annual Ravi-Beas Flows as per 1921-45 series: 19.28 MAF

Pre-partition uses:

Punjab	1.98 MAF
Rajasthan	1.11 MAF
J&K	0.04 MAF
Total	**3.13 MAF**
Losses	0.30 MAF

Net Available for Distribution: 15.85 MAF

Allocation

Punjab (including share of Delhi of 0.2 MAF)	5.9 MAF
PEPSU	1.30 MAF
Rajasthan	8.00 MAF
J & K	0.65 MAF
TOTAL	**15.85 MAF**

Any variations in the flows were to be divided on a pro-rata basis, subject to J&K share remaining fixed at 0.65 MAF.

In 1956, with PEPSU merging in Punjab, the total share of Punjab went to 7.2 MAF.

When Punjab was divided in 1966 into Haryana and Punjab, a dispute arose between the two on sharing of this 7.2 MAF. Ultimately, the Government of India, through its Notification dated 24.3.76 allocated 0.2 MAF to Delhi and the remaining was divided equally between Punjab and Haryana – 3.5 MAF each.

The dispute however continued and in 1981, an agreement was effected between the concerned states. The new allocations were:

State	**MAF** (Million Acre Feet)
Punjab	4.22
Haryana	3.50
Rajasthan	8.60
Delhi Water Supply	0.20
Jammu & Kashmir	0.65
Total	**17.17**

It may be seen that the net surplus available in Ravi-Beas had gone up from the earlier 15.85 MAF and this has helped increase the share of Punjab. This "device" was to be used later on also. The 1981 agreement also ran into problems, and the dispute persists even till date. This agreement has been in the news recently due to the Act passed by the Punjab Assembly nullifying all its interstate water agreements.

[2] Dhillon 1983: Pages 22-23

Bhakra Nangal Agreement 1959

It may be noticed that the Sutluj waters did not figure in this. This is because Sutluj waters were already allocated as a part of the Bhakra project. Though the formal Bhakra Nangal Agreement between Punjab and Rajasthan was signed in 1959, "Important decisions regarding details of areas to be irrigated, irrigation canal systems, share in power generation .... were taken in a special meeting of Bhakra Control Board held on 27th and 28th August 1951."[3]

According to clause 9(2) of the Bhakra Nangal Agreement of 13.1.1959, the shares of the parties in the stored water supplies are under[4]:

Punjab(including Haryana)	84.78%
Rajasthan	15.22 %

On bifurcation of Punjab into Punjab and Haryana, the share was divided between them. The final figures however do not exactly match the earlier figures. The final figures as follows[5]:

Distribution of Sutluj Waters

Punjab	57.88%
Haryana	32.31%
Rajasthan	9.81%

Distribution of Power From Bhakra Complex

Punjab	46.21%
Haryana	33.49%
Rajasthan	15.22%
H.P.	2.12%
Chandigadh	2.97%

Some sources maintain that the share of Rajasthan in Sutluj waters remains 15.22% but that the actual share works out to be 11% as consideration has to be given to pre-Bhakra supplies of Sirhind[6].

For our purpose, the broad figures will suffice. Thus, if take the average flow of Sutluj to be 13 MAF, the state-wise shares come to be:

Distribution of Sutluj Waters

Punjab	7.52 MAF
Haryana	4.23 MAF
Rajasthan	1.27 MAF

[3] Government of Rajasthan 2002c: Page 119
[4] http://www.rajirrigation.gov.in/4bhakhra.htm#waters downloaded on 11 October 2004
[5] http://wrmin.nic.in/cooperation/rvbstribunal.htm Downloaded on 23 Jan 2002
[6] Government of Rajasthan 2002c: Page 96

All India

AREA, PRODUCTION AND YIELD OF WHEAT AND RICE

Year	Wheat			Rice		
	Area (M ha)	**Production** (M Tons)	**Yield** (Kh/Ha)	**Area** (M ha)	**Production** (M Tons)	**Yield** (Kh/Ha)
1950-51	9.75	6.46	663	30.81	20.58	668
1951-52	9.47	6.18	653	29.83	21.30	714
1952-53	9.83	7.50	763	29.97	22.90	764
1953-54	10.68	8.02	750	31.29	28.21	902
1954-55	11.26	9.04	803	30.77	25.22	820
1955-56	12.37	8.76	708	31.52	27.56	874
1956-57	13.52	9.40	695	32.28	29.04	900
1957-58	11.73	7.99	682	32.30	25.53	790
1958-59	12.62	9.96	789	33.17	30.85	930
1959-60	13.38	10.32	772	33.82	31.68	937
1960-61	12.93	11.00	851	34.13	34.58	1013
1961-62	13.57	12.07	890	34.69	35.66	1028
1962-63	13.59	10.78	793	35.69	33.21	931
1963-64	13.50	9.85	730	35.81	37.00	1033
1964-65	13.42	12.26	913	36.46	39.31	1078
1965-66	12.57	10.40	827	35.47	30.59	862
1966-67	12.84	11.39	887	35.25	30.44	863
1967-68	14.99	16.54	1103	36.44	37.61	1032
1968-69	15.96	18.65	1169	36.97	39.76	1076
1969-70	16.63	20.09	1208	37.68	40.43	1073
1970-71	18.24	23.83	1307	37.59	42.22	1123
1971-72	19.14	26.41	1380	37.76	43.07	1141
1972-73	19.46	24.74	1271	36.69	39.24	1070
1973-74	18.58	21.78	1172	38.29	44.05	1151
1974-75	18.01	24.10	1338	37.89	39.58	1045
1975-76	20.45	28.84	1410	39.48	48.74	1235
1976-77	20.92	29.01	1387	38.51	41.92	1089
1977-78	21.46	31.75	1480	40.28	52.67	1308
1978-79	22.64	35.51	1568	40.48	53.77	1328
1979-80	22.17	31.83	1436	39.42	42.33	1074
1980-81	22.28	36.31	1630	40.15	53.63	1336
1981-82	22.14	37.45	1691	40.71	53.25	1308
1982-83	23.57	42.79	1816	38.26	47.12	1231
1983-84	24.67	45.48	1843	41.24	60.10	1457
1984-85	23.56	44.07	1870	41.16	58.34	1417
1985-86	23.00	47.05	2046	41.14	63.83	1552
1986-87	23.13	44.32	1916	41.17	60.56	1471
1987-88	23.06	46.17	2002	38.81	56.86	1465
1988-89	24.11	54.11	2244	41.73	70.49	1689
1989-90	23.50	49.85	2121	42.17	73.57	1745
1990-91	24.17	55.14	2281	42.69	74.29	1740
1991-92	23.26	55.69	2394	42.65	74.68	1751
1992-93	24.59	57.21	2327	41.78	72.86	1744
1993-94	25.15	59.84	2380	42.54	80.30	1888
1994-95	25.70	65.77	2559	42.81	81.81	1911
1995-96	25.01	62.10	2483	42.84	76.98	1797
1996-97	25.89	69.35	2679	43.43	81.74	1882
1997-98	26.70	66.35	2485	43.45	82.53	1900
1998-99	27.52	71.29	2590	44.80	86.08	1921
1999-2000	27.49	76.37	2778	45.16	89.68	1986
2000-01	25.73	69.68	2708	44.71	84.98	1901
2001-02	25.92	71.81	2770	44.62	93.08	2086

Source – Department of Agriculture Co-operation, Ministry of Agriculture website - http://agricoop.nic.in/statistics2003/chap4a.htm#chap45a, Accessed on Oct.7, 2004

All-India

AREA, PRODUCTION AND YIELD OF FOODGRAINS

Along with Percentage Coverage Under Irrigation

Year	**Area** Million Hectares	**Production** Million Tons	**Yield** Kg./Ha	% Coverage Under **Irrigation**
1950-51	97.32	50.82	522	18.1
1951-52	96.96	51.99	536	18.4
1952-53	102.09	59.20	580	18.1
1953-54	109.07	69.82	640	18.1
1954-55	107.86	68.03	631	18.4
1955-56	**110.56**	**66.85**	**605**	**18.5**
1956-57	111.14	69.86	629	18.2
1957-58	109.48	64.31	587	19.3
1958-59	114.76	77.14	672	18.7
1959-60	115.82	76.67	662	18.8
1960-61	**115.58**	**82.02**	**710**	**19.1**
1961-62	117.23	82.71	706	19.1
1962-63	117.84	80.15	680	19.8
1963-64	117.42	80.64	687	19.8
1964-65	118.11	89.36	757	20.2
1965-66	**115.10**	**72.35**	**629**	**20.9**
1966-67	115.30	74.23	644	22.2
1967-68	121.42	95.05	783	21.6
1968-69	120.43	94.01	781	23.6
1969-70	123.57	99.50	805	23.7
1970-71	**124.32**	**108.42**	**872**	**24.1**
1971-72	122.62	105.17	858	24.5
1972-73	119.28	97.03	813	25.4
1973-74	126.54	104.67	827	24.5
1974-75	121.08	99.83	824	26.5
1975-76	**128.18**	**121.03**	**944**	**26.5**
1976-77	124.36	111.17	894	27.4
1977-78	127.52	126.41	991	27.7
1978-79	129.01	131.90	1022	28.8
1979-80	125.21	109.70	876	30.3
1980-81	**126.67**	**129.59**	**1023**	**29.7**
1981-82	129.14	133.30	1032	29.6
1982-83	125.10	129.52	1035	30.8
1983-84	131.16	152.37	1162	30.9
1984-85	126.67	145.54	1149	31.9
1985-86	**128.02**	**150.44**	**1175**	**31.4**
1986-87	127.20	143.42	1128	32.6
1987-88	119.69	140.35	1173	33.5
1988-89	127.67	169.92	1331	34.4
1989-90	126.77	171.04	1349	35.0
1990-91	**127.84**	**176.39**	**1380**	**35.1**
1991-92	121.87	168.38	1382	37.4
1992-93	123.15	179.48	1457	37.4
1993-94	122.75	184.26	1501	38.7
1994-95	123.86	191.50	1546	39.6
1995-96	**121.01**	**180.42**	**1491**	**40.1**
1996-97	123.58	199.44	1614	40.0
1997-98	123.85	192.26	1552	40.8
1998-99	125.17	203.61	1627	42.4
1999-2000	123.10	209.80	1704	43.9
2000-01	**121.05**	**196.81**	**1626**	**NA**
2001-02	121.91	212.03	1739	NA

Source – Department of Agriculture Co-operation Department, Ministry of Agriculture website – http://agricoop.nic.in/statistics2003/chap4a.htm#chap45a,, Accessed on Oct.7, 2004

All-India

NET AVAILABILITY OF FOODGRAINS

(Gms/Capita/Day)

Year	Rice	Wheat	Other Cereals	Total Cereals	Gram	Total Pulses	Total Foodgrains
1951	158.9	65.7	109.6	334.2	22.5	60.7	394.9
1952	158.5	57.6	109.3	325.4	19.8	59.1	384.5
1953	165.9	62.5	121.5	349.9	24.2	62.7	412.6
1954	194.1	58.0	136.0	388.1	27.3	69.7	457.8
1955	179.7	58.3	134.9	372.9	31.0	71.1	444.0
1956	**187.7**	**61.5**	**111.2**	**360.4**	**29.0**	**70.3**	**430.7**
1957	192.7	71.6	111.0	375.3	32.8	71.8	447.1
1958	164.8	66.5	119.0	350.3	25.3	58.5	408.8
1959	191.0	78.5	123.9	393.4	35.5	74.9	468.3
1960	187.8	78.3	118.0	384.1	27.7	65.5	449.6
1961	**201.1**	**79.1**	**119.5**	**399.7**	**30.2**	**69.0**	**468.7**
1962	203.2	84.2	111.5	398.9	27.3	62.0	460.9
1963	186.9	79.2	117.9	384.0	24.7	59.8	443.8
1964	201.4	90.1	109.5	401.0	20.3	51.0	452.0
1965	210.2	93.6	114.7	418.5	25.5	61.6	480.1
1966	**161.9**	**95.4**	**102.6**	**359.9**	**18.3**	**48.2**	**408.1**
1967	154.0	90.5	117.3	361.8	15.3	39.6	401.4
1968	183.7	95.8	124.6	404.1	24.6	56.1	460.2
1969	190.5	100.5	106.8	397.8	17.4	47.3	445.1
1970	190.2	102.3	110.6	403.1	21.9	51.9	455.0
1971	**192.6**	**103.6**	**121.4**	**417.6**	**20.0**	**51.2**	**468.8**
1972	197.8	126.0	95.3	419.1	19.0	47.0	466.1
1973	172.0	118.1	90.4	380.5	16.7	41.1	421.6
1974	190.4	108.8	111.2	410.4	14.8	40.8	451.2
1975	158.9	112.1	94.8	365.8	14.2	39.7	405.5
1976	**187.2**	**79.5**	**107.1**	**373.8**	**20.2**	**50.5**	**424.3**
1977	168.8	114.5	103.0	386.3	18.4	43.3	429.6
1978	196.2	126.3	100.0	422.5	17.8	45.5	468.0
1979	200.3	132.3	99.2	431.8	18.6	44.7	476.5
1980	166.1	126.8	86.6	379.5	10.7	30.9	410.4
1981	**197.8**	**129.6**	**89.9**	**417.3**	**13.4**	**37.5**	**454.8**
1982	193.2	127.9	94.8	415.9	14.0	39.2	455.1
1983	169.8	144.4	83.3	397.5	15.6	39.5	437.0
1984	197.8	140.8	98.9	437.6	13.7	41.9	479.5
1985	188.8	138.6	87.9	415.3	12.9	38.1	453.4
1986	**212.0**	**151.0**	**70.7**	**433.7**	**16.2**	**43.8**	**477.5**
1987	206.0	157.8	71.0	434.8	12.3	36.4	471.2
1988	188.2	154.2	68.8	411.2	9.6	36.4	447.6
1989	215.0	156.2	80.3	451.5	13.4	41.9	493.4
1990	212.1	132.6	86.8	431.5	10.7	41.1	472.6
1991	**221.7**	**166.8**	**80.0**	**468.5**	**13.4**	**41.6**	**510.1**
1992	217.0	158.6	58.9	434.5	10.1	34.3	468.8
1993	201.1	140.2	86.6	427.9	10.7	36.2	464.1
1994	207.4	159.5	67.1	434.0	11.8	37.2	471.2
1995	220.0	172.7	64.9	457.6	14.9	37.8	495.5
1996	**204.4**	**176.0**	**62.0**	**442.5**	**11.3**	**32.7**	**475.2**
1997	214.0	179.1	72.9	466.0	12.4	37.1	503.1
1998	200.3	151.5	62.4	414.2	13.4	32.8	447.0
1999	203.4	162.3	63.4	429.2	14.6	36.5	465.7
2000	203.7	160.0	59.0	422.7	10.8	31.8	454.4
2001	**190.5**	**135.8**	**56.2**	**386.2**	**8.0**	**30.0**	**416.2**

Source – Department of Agriculture Co-operation, Ministry of Agriculture website – http://agricoop.nic.in/statistics2003/chap10.htm#chap101, Accessed on Oct 7, 2004

All-India

CONSUMPTION OF FERTILISERS

(In Terms of Nutrients N, P & K)

Year	N ('000 Tons)	P ('000 Tons)	K ('000 Tons)	TOTAL ('000 Tons)
1951-52	**58.7**	**6.9**	**-**	**65.6**
1952-53	57.8	4.6	3.3	65.7
1953-54	89.3	8.3	7.5	105.1
1954-55	94.8	15	11.1	120.9
1955-56	**107.5**	**13**	**10.3**	**130.8**
1956-57	123.1	15.9	14.8	153.8
1957-58	149	21.9	12.8	183.7
1958-59	172	29.5	22.4	223.9
1959-60	229.3	53.9	21.3	304.5
1960-61	**210**	**53.1**	**29**	**292.1**
1961-62	249.8	60.5	28	338.3
1962-63	333	82.8	36.4	452.2
1963-64	376.1	116.5	50.6	543.2
1964-65	555.2	148.7	69.3	773.2
1965-66	**574.8**	**132.5**	**77.3**	**784.6**
1966-67	737.8	248.6	114.2	1100.60
1967-68	1034.6	334.8	169.6	1539.00
1968-69	1208.6	382.1	170	1760.70
1969-70	1356	416	210	1982.00
1970-71	**1487**	**462**	**228**	**2177.00**
1971-72	1798	558.2	300.6	2656.80
1972-73	1839	581.3	347.6	2767.90
1973-74	1829	649.7	359.8	2838.50
1974-75	1765.7	471.5	336.1	2573.30
1975-76	**2148.6**	**466.8**	**278.3**	**2893.70**
1976-77	2456.9	634.9	319.2	3411.00
1977-78	2913	866.6	506.2	4285.80
1978-79	3419.5	1105.9	591.5	5116.90
1979-80	3498.1	1150.9	606.4	5255.40
1980-81	**3678.1**	**1213.6**	**623.9**	**5515.60**
1981-82	4068.6	1322.3	673.2	6064.10
1982-83	4224.3	1437	727	6388.30
1983-84	5204.4	1730.3	775.4	7710.10
1984-85	5486.1	1886.4	838.5	8211.00
1985-86	**5660.8**	**2005.2**	**808.1**	**8474.10**
1986-87	5716	2078.9	850	8644.90
1987-88	5716.8	2187	880.5	8784.30
1988-89	7251	2720.7	1068.3	11040.00
1989-90	7386	3014.2	1168	11568.20
1990-91	**7997.2**	**3221**	**1328**	**12546.20**
1991-92	8046.3	3321.2	1360.5	12728.00
1992-93	8426.8	2843.8	883.9	12154.50
1993-94	8788.3	2669.3	908.4	12366.00
1994-95	9507.1	2931.7	1124.7	13563.50
1995-96	**9822.8**	**2897.5**	**1155.8**	**13876.10**
1996-97	10301.8	2976.8	1029.6	14308.10
1997-98	10901.8	3913.6	1372.5	16187.90
1998-99	11353.8	4112.2	1331.5	16797.50
1999-2000	11592.7	4798.3	1678.7	18069.70
2000-01	**10920.2**	**4214.6**	**1567.5**	**16702.30**
2001-02	11310.2	4382.4	1667.1	17359.70

Source- Department of Agriculture Co-operation, Ministry of Agriculture website - http://agricoop.nic.in/statistics2003/chap15.htm#chap151, Accessed on Oct 7, 2004

PUNJAB AT A GLANCE

General	
Geographical Area (000 Ha)	5036.2
Divisions	4
Districts	17
Tehsils	72
Cities	14
Towns	143
Villages	12780
Inhabited Villages	12413
Population	
Population	24,289,296
Males	12963362
Females	11325934
Sex Ratio	874 F/1000 Males
Sex Ratio (0 – 6 Years)	793 F/1000 Males
Rural Population	16043730
Percentage to Total	66.05%
Urban Population	8245566
Percentage to Total	33.95
Density	482
Literate And Educated Persons	14853810
Literacy Rate	69.95
Scheduled Castes (1991)	5742528
Percentage (1991)	28.31 %
Climate	
Average Rainfall	462.8
Agriculture	
Total Cultivable Area	4311
Net Area Sown (000 Ha)	4268
Gross Area Sown (000 Ha)	7941
Cropping Intensity [(GSA/NSA)x100)]	186.05 %
Production of Crops (000 MT)	
Total cereals	24,867
Total pulses	31
Total foodgrains	24,898
Cotton	221.85
Total Oilseeds	84
Irrigation	
Net area irrigated by (000 Ha)	
Govt. Canals	987
Wells/Tube wells	3068
Others	2
Total (Net Irrigation)	4057
Net Area Irrigated as % to Net Area Sown	95.05 %
Net Area Irrigated as % to Total Cultivable Area	94.11 %
Gross area irrigated (000 Ha)	7607
No. of Tube wells and Pumping sets (Lakhs)	9.25
Forest	
Area under forests (000 Ha)	305.5
Electricity	
Consumption of electric power (Million KWH)	19,441
Unit sold per capita (KWH)	821
Roads	
Metalled Roads Per 100 SqKM	91.2
Villages connected with pucca roads	
Gross Domestic Product (Crore Rupees)	46,444

Punjab

NET AREA SOWN AND GROSS AREA SOWN (M HA.)

Year	Cultivable Area	Net Sown Area	Gross Sown Area	NS as % to Total Cultivable	Cropping Intensity
1950-51	4.814	3.544	4.170	73.62	117.66
1951-52	4.769	3.574	4.182	74.95	116.99
1952-53	4.730	3.575	4.473	75.59	125.12
1953-54	4.708	3.721	4.479	79.04	120.38
1954-55	4.703	3.754	4.724	79.81	125.84
1955-56	**4.701**	**3.615**	**4.567**	**76.90**	**126.33**
1956-57	4.657	3.885	5.049	83.43	129.95
1957-58	4.682	3.909	4.977	83.49	127.33
1958-59	4.638	4.041	5.153	87.13	127.51
1959-60	4.508	3.987	5.061	88.45	126.94
1960-61	**4.341**	**3.750**	**4.737**	**86.39**	**126.32**
1961-62	4.344	3.836	4.800	88.31	125.13
1962-63	4.321	3.833	4.981	88.71	129.95
1963-64	4.310	3.855	4.884	89.44	126.69
1964-65	4.318	3.895	5.125	90.20	131.58
1965-66	**4.317**	**3.803**	**4.889**	**88.09**	**128.56**
1966-67	4.319	3.870	5.171	89.60	133.62
1967-68	4.325	3.992	5.441	92.30	136.30
1968-69	4.287	3.941	5.288	91.93	134.18
1969-70	4.283	4.027	5.499	94.02	136.55
1970-71	**4.291**	**4.053**	**5.678**	**94.45**	**140.09**
1971-72	4.297	4.076	5.724	94.86	140.43
1972-73	4.297	4.086	5.931	95.09	145.15
1973-74	4.297	4.113	6.037	95.72	146.78
1974-75	4.296	4.092	5.904	95.25	144.28
1975-76	**4.298**	**4.158**	**6.255**	**96.74**	**150.43**
1976-77	4.296	4.167	6.285	97.00	150.83
1977-78	4.295	4.171	6.390	97.11	153.20
1978-79	4.292	4.177	6.630	97.32	158.73
1979-80	4.290	4.182	6.535	97.48	156.26
1980-81	**4.287**	**4.191**	**6.763**	**97.76**	**161.37**
1981-82	4.294	4.210	6.929	98.04	164.58
1982-83	4.289	4.202	6.915	97.97	164.56
1983-84	4.290	4.212	6.977	98.18	165.65
1984-85	4.296	4.189	7.013	97.51	167.41
1985-86	**4.298**	**4.197**	**7.158**	**97.65**	**170.55**
1986-87	4.297	4.202	7.217	97.79	171.75
1987-88	4.287	4.157	7.326	96.97	176.23
1988-89	4.306	4.205	7.387	97.65	175.67
1989-90	4.309	4.193	7.393	97.31	176.32
1990-91	**4.385**	**4.218**	**7.501**	**96.19**	**177.83**
1991-92	4.372	4.215	7.518	96.41	178.36
1992-93	4.300	4.134	7.550	96.14	182.63
1993-94	4.300	4.223	7.627	98.20	180.62
1994-95	4.258	4.210	7.693	98.87	182.73
1995-96	**4.247**	**4.136**	**7.712**	**97.39**	**186.46**
1996-97	4.368	4.223	7.808	96.68	184.89
1997-98	4.370	4.266	7.871	97.62	184.51
1998-99	4.288	4.173	7.740	97.32	185.48
1999-00	4.281	4.211	7.847	98.36	186.35
2000-01	**4.321**	**4.264**	**7.935**	**98.68**	**186.09**
2001-02	4.308	4.268	7.941	99.07	186.06
2002-03	4.302	4.224	7.826	98.19	185.27

Source: Various Statistical Abstracts of Punjab, Statistical Handbook of 1995.

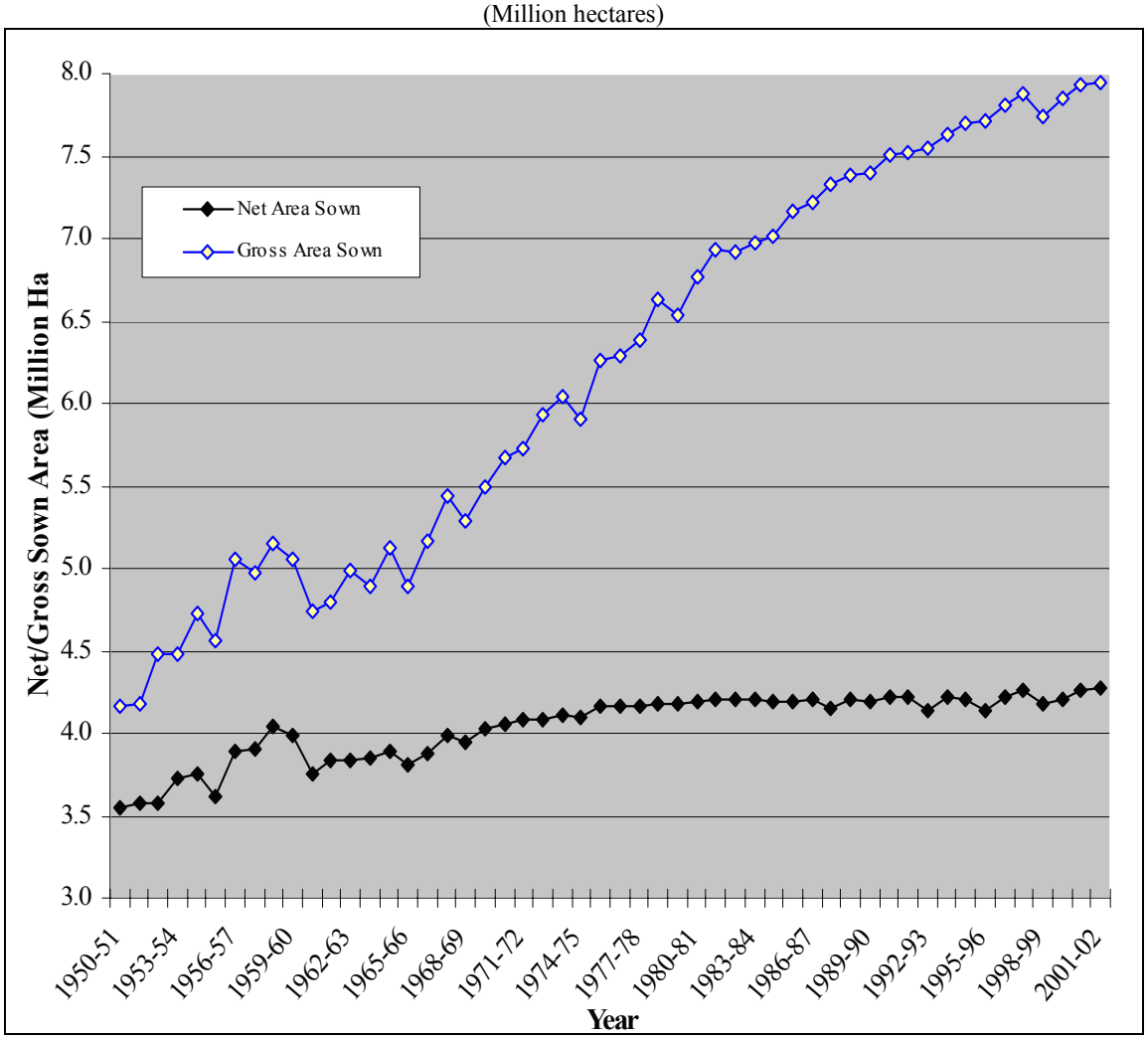
Comment: **1.** Total Geological Area - 5.04 M Ha.

2. Data between 1950-51 to 1954-55 and 1956-57 to 1959-60 are not comparable with data for rest of the years.

Punjab

NET AREA SOWN AND GROSS AREA SOWN

(Million hectares)



Punjab

NET AREA IRRIGATED AND GROSS AREA IRRIGATED

Year	Net Area Irrigated by Source			Gross Area Irrigated (M Ha)	NAI as % to Net Area Sown	GAI as % to Gross Area Sown
	Canal	Well/TW (M Ha)	Total (M Ha)			
1950-51				2.28		54.67
1951-52				2.35		56.22
1952-53				2.37		52.99
1953-54	1.40	0.83	2.24	2.47	60.15	55.03
1954-55	1.48	0.92	2.42	2.60	64.42	54.94
1955-56	**1.43**	**0.88**	**2.32**	**2.60**	**64.06**	**56.90**
1956-57	1.28	0.79	2.08	2.66	53.57	52.72
1957-58	1.26	0.74	2.01	2.63	51.44	52.89
1958-59	1.18	0.74	1.93	2.73	47.73	52.95
1959-60	1.16	0.73	1.93	2.69	48.49	53.13
1960-61	**1.18**	**0.82**	**2.02**	**2.65**	**53.84**	**55.88**
1961-62	1.24	0.74	2.00	2.70	52.06	56.15
1962-63	1.24	0.85	2.11	2.83	55.00	56.84
1963-64	1.22	0.83	2.13	2.87	55.36	58.78
1964-65	1.22	0.84	2.11	3.04	54.07	59.26
1965-66	**1.30**	**0.89**	**2.26**	**3.14**	**59.51**	**64.12**
1966-67	1.27	0.98	2.28	3.37	58.81	65.09
1967-68	1.29	0.99	2.29	3.46	57.34	63.66
1968-69	1.29	1.35	2.65	3.82	67.29	72.30
1969-70	1.31	1.52	2.84	4.08	70.40	74.20
1970-71	**1.29**	**1.59**	**2.89**	**4.24**	**71.26**	**74.72**
1971-72	1.37	1.55	2.96	4.38	72.50	76.47
1972-73	1.28	1.65	2.94	4.57	71.95	77.01
1973-74	1.29	1.68	2.98	4.62	72.36	76.51
1974-75	1.41	1.77	3.18	4.77	77.79	80.80
1975-76	**1.37**	**1.74**	**3.12**	**4.93**	**75.01**	**78.83**
1976-77	1.39	1.80	3.19	5.08	76.65	80.83
1977-78	1.39	1.86	3.29	5.19	78.78	81.29
1978-79	1.39	1.84	3.26	5.51	78.09	83.04
1979-80	1.52	2.00	3.52	5.71	84.24	87.34
1980-81	**1.43**	**1.94**	**3.38**	**5.78**	**80.70**	**85.48**
1981-82	1.32	2.07	3.41	5.97	80.95	86.10
1982-83	1.46	2.08	3.55	6.15	84.48	88.92
1983-84	1.48	2.12	3.61	6.27	85.68	89.92
1984-85	1.40	2.21	3.62	6.35	86.44	90.51
1985-86	**1.41**	**2.27**	**3.69**	**6.51**	**87.92**	**91.01**
1986-87	1.44	2.27	3.72	6.59	88.46	91.31
1987-88	1.42	2.31	3.72	6.73	89.58	91.89
1988-89	1.46	2.31	3.78	6.84	89.80	92.55
1989-90	1.47	2.44	3.92	6.92	93.47	93.58
1990-91	**1.58**	**2.23**	**3.82**	**7.05**	**90.47**	**94.05**
1991-92	1.52	2.42	3.94	7.11	93.48	94.59
1992-93	1.45	2.39	3.84	7.15	92.94	94.70
1993-94	1.54	2.39	3.93	7.24	93.00	94.90
1994-95	1.54	2.40	3.95	7.29	93.80	94.81
1995-96	**1.56**	**2.28**	**3.84**	**7.34**	**92.94**	**95.13**
1996-97	1.62	2.41	4.04	7.45	95.55	95.45
1997-98	1.55	2.47	4.02	7.56	94.26	96.06

Year	Net Area Irrigated by Source			Gross Area Irrigated (M Ha)	NAI as % to Net Area Sown	GAI as % to Gross Area Sown
	Canal	Well/TW (M Ha)	Total (M Ha)			
1998-99	1.05	2.91	4.02	7.44	96.31	96.15
1999-00	1.09	2.86	3.97	7.54	94.18	96.14
2000-01(P)	**1.00**	**3.02**	**4.02**	**7.65**	**94.30**	**96.38**
2001-02(P)	0.99	3.07	4.06	7.67	95.06	96.59

Source

- Various Statistical Abstracts of Punjab, Statistical Handbook of 1995.
- Government of Punjab website - http://www.punjab.gov.in/webii/General/Abstract/PDF/157-223.pdf and http://www.punjab.gov.in/webii/General/Abstract/PDF/239-251.pdf Downloaded on Oct.7, 2004

Comment

- "Other" source not listed but included in total Net Irrigated Area.
- Data between 1950-51 to 1954-55 and 1956-57 to 1959-60 are not comparable with data for rest of years

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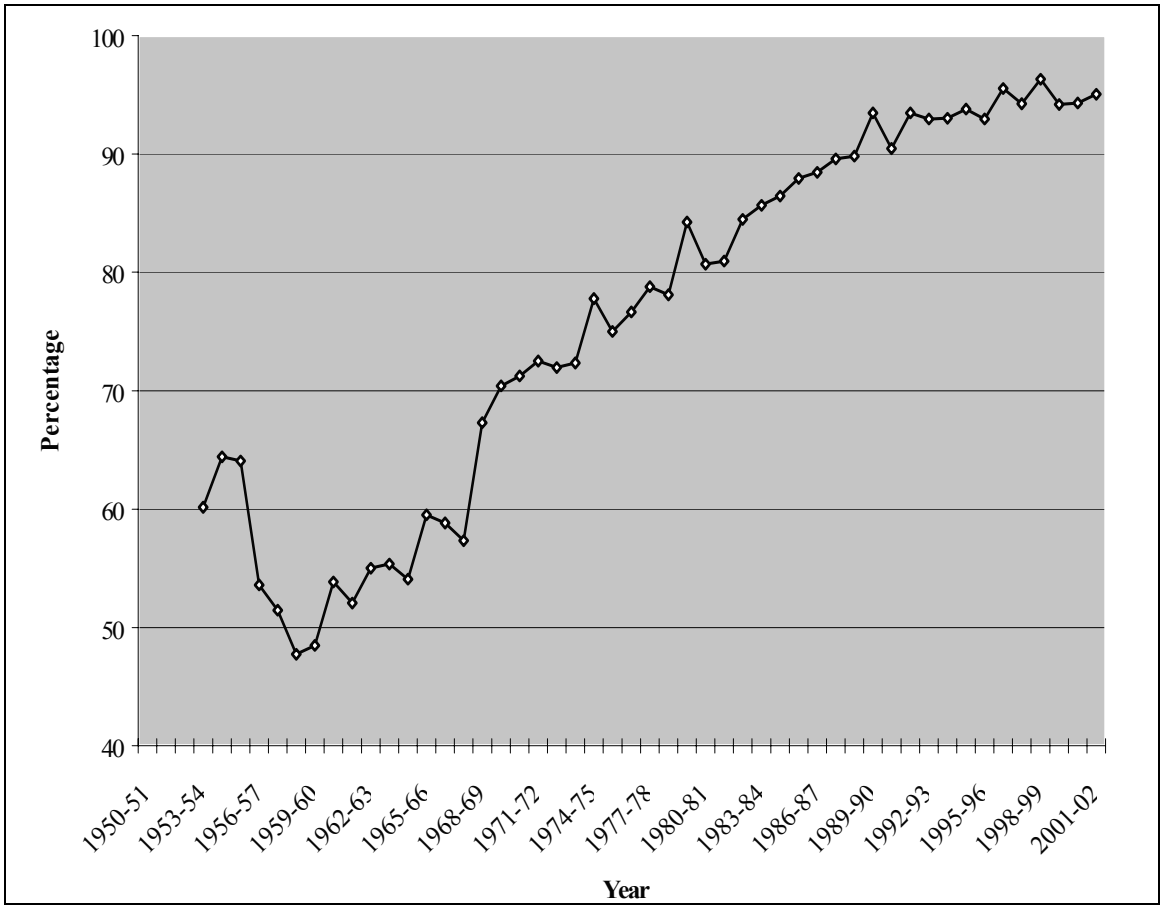
Punjab

NET AREA IRRIGATED AS % OF NET SOWN AREA



Punjab

SHIFT IN CROPPING PATTERN (1950-51 TO 2000-01)

(Area Sown in '000 Ha)

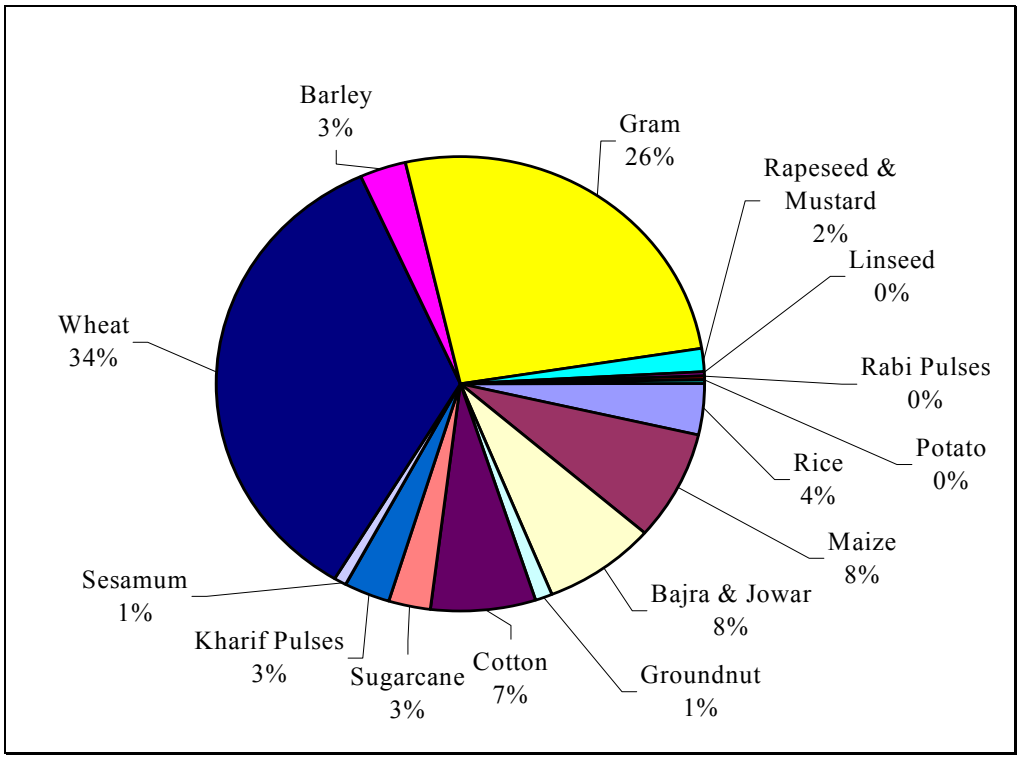
Crop	1950-51	1955-56	I960-61	1965-66	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01
Rice	120	149	227	292	390	565	1183	1714	2015	2184	2612
Maize	252	260	327	389	555	577	382	260	188	171	164
Bajra & Jowar	247	141	140	160	212	187	70	33	12	8	6
Groundnut	38	53	67	135	174	168	83	45	11	8	4
Cotton	225	430	446	459	397	580	648	559	701	742	473
Sugarcane	91	96	133	169	128	114	71	78	101	136	121
Kharif Pulses	97	80	32	20	38.5	40	61	102	72	68	42
Sesamum	24	21	8	10	15	23	17	14	18	24	19
Wheat	1137	1292	1400	1550	2299	2449	2812	3112	3273	3221	3408
Barley	100	98	66	67	57	120	65	50	37	44	32
Gram	851	1002	838	602	358	381	258	108	60	20	8
Rapeseed & Mustard	62	39	106	84	103	122	146	150	69	102	55
Linseed	4	4	4	4	3	2	2	1	1	1	0
Rabi Pulses	13	13	33	22	17	26	22	15	14	5	5
Potato	6	7	9	14	17	26	40	43	23	39	64
Other Vegetable	NA	NA	23	NA	23	NA	24	32	31	38	46
Fruits	NA	NA	42	NA	50	NA	29	47	69	84	34
Fodder & Other Crops	NA	NA	859	NA	866	NA	959	716	827	864	657

Source - Johl Committee Report, Page No. - 21

Punjab

CROPPING PATTERN - 1950 - 51

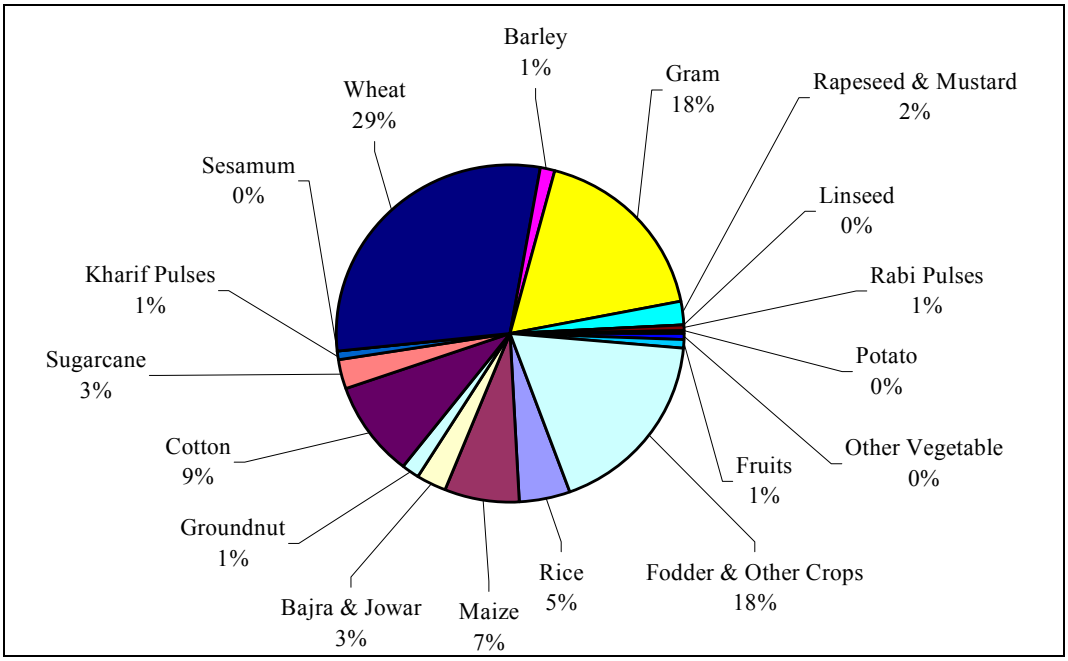
(Area Sown in '000 Ha)



Punjab

CROPPING PATTERN - 1960 - 61

(Area Sown in '000 Ha)

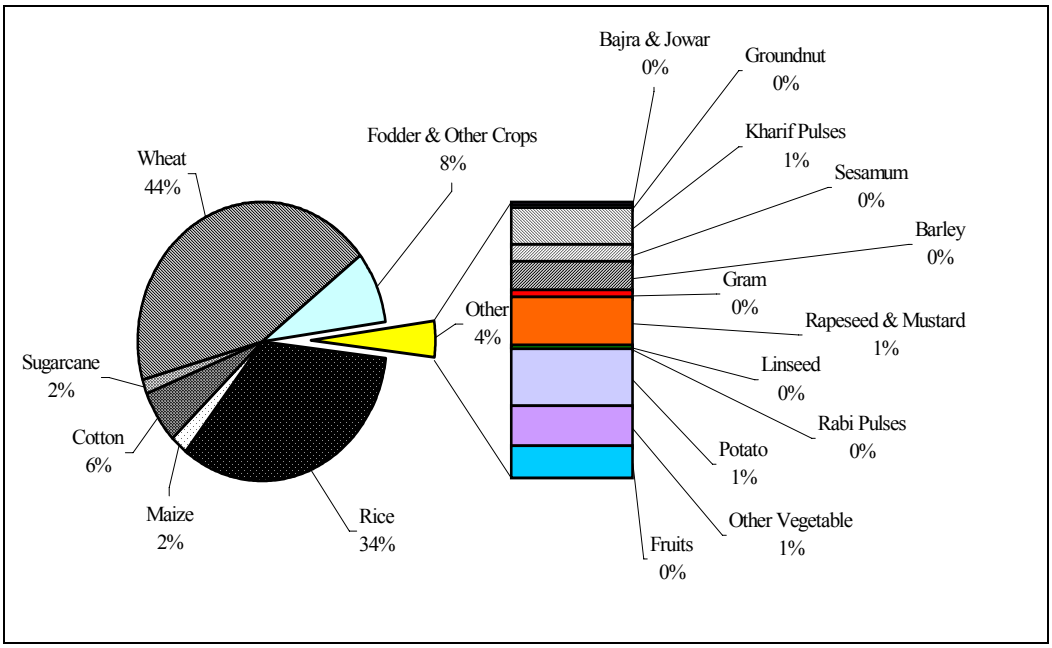


Punjab

CROPPING PATTERN - 2000 - 01

Area Sown in '000 Ha

(Less than 1% is shown as **'other'**)



Punjab

AREA PRODUCTION AND YIELD OF WHEAT & RICE

Year	Wheat			Rice		
	Area (M Hec)	Production (M Met. Tons)	Yield (kg/Hec)	Area (M Hec)	Production (M Met. Tons)	Yield (kg/Hec)
1950-51	1.137	1.024	901	0.120	0.107	892
1951-52	1.172	1.209	1032	0.120	0.151	1263
1952-53	1.121	1.228	1095	0.131	0.207	1580
1953-54	1.163	1.240	1066	0.136	0.200	1471
1954-55	1.236	1.337	1082	0.144	0.203	1414
1955-56	**1.292**	**1.136**	**879**	**0.149**	**0.107**	**718**
1956-57	1.344	1.354	1008	0.155	0.243	1562
1957-58	1.329	1.327	999	0.174	0.252	1444
1958-59	1.479	1.589	1075	0.200	0.295	1470
1959-60	1.431	1.499	1047	0.218	0.365	1671
1960-61	**1.400**	**1.742**	**1244**	**0.227**	**0.229**	**1009**
1961-62	1.436	1.766	1230	0.228	0.230	1009
1962-63	1.516	1.761	1162	0.247	0.261	1057
1963-64	1.511	1.895	1254	0.257	0.275	1070
1964-65	1.579	2.367	1499	0.287	0.351	1223
1965-66	**1.550**	**1.916**	**1236**	**0.292**	**0.292**	**1000**
1966-67	1.608	2.451	1524	0.285	0.338	1185
1967-68	1.790	3.335	1863	0.314	0.415	1322
1968-69	2.063	4.491	2177	0.345	0.470	1364
1969-70	2.166	4.865	2245	0.359	0.535	1490
1970-71	**2.299**	**5.145**	**2238**	**0.390**	**0.688**	**1765**
1971-72	2.336	5.618	2406	0.450	0.920	2045
1972-73	2.404	5.368	2233	0.476	0.955	2007
1973-74	2.338	5.181	2216	0.499	1.140	2287
1974-75	2.207	5.286	2395	0.569	1.179	2071
1975-76	**2.439**	**5.788**	**2373**	**0.567**	**1.447**	**2553**
1976-77	2.630	6.392	2432	0.680	1.776	2611
1977-78	2.617	6.642	2538	0.858	2.497	2910
1978-79	2.739	7.439	2716	1.052	3.090	2937
1979-80	2.813	7.868	2797	1.172	3.052	2604
1980-81	**2.812**	**7.677**	**2730**	**1.183**	**3.233**	**2733**
1981-82	2.914	8.544	2932	1.269	3.750	2955
1982-83	3.052	9.168	3004	1.322	4.156	3144
1983-84	3.124	9.422	3015	1.481	4.536	3063
1984-85	3.094	10.176	3289	1.644	5.052	3073
1985-86	**3.112**	**10.988**	**3531**	**1.714**	**5.485**	**3200**
1986-87	3.185	9.447	2966	1.786	5.949	3331
1987-88	3.131	11.084	3540	1.720	5.442	3164
1988-89	3.158	11.580	3667	1.778	4.925	2770
1989-90	3.247	11.666	3593	1.908	6.697	3510
1990-91	**3.273**	**12.159**	**3715**	**2.016**	**6.510**	**3229**
1991-92	3.237	12.309	3803	2.071	6.745	3257
1992-93	3.283	12.397	3776	2.072	7.028	3392
1993-94	3.335	13.377	4011	2.179	7.642	3507
1994-95	3.311	13.539	4089	2.265	7.658	3381
1995-96	**3.223**	**12.518**	**3884**	**2.161**	**6.768**	**3132**
1996-97	3.230	13.679	4235	2.160	7.338	3397
1997-98	3.301	12.751	3853	2.278	7.893	3465
1998-99	3.337	14.456	4332	2.519	7.940	3152
1999-00	3.388	15.910	4696	2.604	8.716	3347
2000-01	**3.408**	**15.551**	**4563**	**2.612**	**9.157**	**3506**
2001-02	3.422	15.509	4532	2.489	8.824	3545

Source: Various Statistical Abstracts of Punjab, Government of Punjab Website
http://punjabgovt.nic.in/agriculture/AGRICULT.HTM, Accessed on Sep 13, 2003,
http://punjabgovt.nic.in/agriculture/agricult.htm, Accessed on Jan 10, 2004.
http://www.punjabgov.net/about_agri2.asp, Accessed on Jan 10, 2004.
http://www.punjab.gov.in/webii/General/Abstract/PDF/157-223.pdf, Accessed on Oct 7, 2004.

Note: Data between 1951-52 to 54-55 and 1956-57 to 59-60 are not comparable

Punjab

AREA PRODUCTION AND YIELD OF FOODGRAINS

	Total Cereals			Total Pulses			Total Foodgrains		
Year	Area (M Ha)	Production (M M Tons)	Yield (kg/Ha)	Area (M Ha)	Production (M M Tons)	Yield (kg/Ha)	Area (M Ha)	Production (M M Tons)	Yield (kg/Ha)
1950-51	1.834	1.423	776	0.940	0.546	581	2.774	1.969	710
1951-52	1.914	1.773	926	0.798	0.535	671	2.712	2.308	851
1952-53	1.877	1.991	1061	0.863	0.589	683	2.740	2.581	942
1953-54	1.963	2.061	1050	1.001	0.832	831	2.964	2.894	976
1954-55	1.962	1.998	1019	1.112	0.827	743	3.074	2.825	919
1955-56	**1.930**	**1.558**	**807**	**1.072**	**0.687**	**641**	**3.002**	**2.245**	**748**
1956-57	2.085	2.204	1057	1.154	0.833	722	3.239	3.037	938
1957-58	2.073	2.139	1032	1.040	0.710	682	3.113	2.848	915
1958-59	2.290	2.354	1028	1.159	1.036	894	3.448	3.390	983
1959-60	2.216	2.420	1092	1.168	0.828	709	3.384	3.248	960
1960-61	**2.149**	**2.452**	**1141**	**0.893**	**0.707**	**791**	**3.042**	**3.159**	**1038**
1961-62	2.205	2.587	1174	0.904	0.725	802	3.109	3.313	1066
1962-63	2.327	2.450	1053	0.873	0.608	697	3.200	3.058	956
1963-64	2.281	2.757	1208	0.814	0.472	580	3.095	3.229	1043
1964-65	2.471	3.340	1352	0.791	0.687	868	3.262	4.027	1234
1965-66	**2.454**	**3.000**	**1222**	**0.643**	**0.389**	**605**	**3.097**	**3.389**	**1094**
1966-67	2.631	3.643	1385	0.682	0.528	774	3.313	4.171	1259
1967-68	2.944	4.883	1659	0.587	0.479	815	3.531	5.362	1519
1968-69	3.184	5.949	1869	0.400	0.257	643	3.583	6.206	1732
1969-70	3.347	6.505	1943	0.423	0.412	975	3.770	6.917	1835
1970-71	**3.513**	**6.997**	**1992**	**0.414**	**0.308**	**759**	**3.927**	**7.305**	**1860**
1971-72	3.530	7.623	2159	0.375	0.301	803	3.905	7.924	2029
1972-73	3.633	7.399	2037	0.372	0.291	781	4.005	7.690	1920
1973-74	3.666	7.326	1998	0.419	0.347	827	4.085	7.673	1878
1974-75	3.626	7.703	2124	0.321	0.241	749	3.947	7.944	2012
1975-76	**3.890**	**8.425**	**2166**	**0.427**	**0.396**	**928**	**4.317**	**8.821**	**2043**
1976-77	4.065	9.005	2215	0.386	0.330	855	4.450	9.335	2097
1977-78	4.074	10.004	2456	0.390	0.340	870	4.464	10.344	2317
1978-79	4.344	11.363	2616	0.396	0.308	777	4.740	11.671	2462
1979-80	4.473	11.717	2620	0.267	0.174	650	4.740	11.890	2509
1980-81	**4.513**	**11.717**	**2597**	**0.341**	**0.204**	**597**	**4.854**	**11.921**	**2456**
1981-82	4.673	13.157	2816	0.320	0.159	496	4.992	13.316	2667
1982-83	4.807	14.050	2923	0.202	0.120	595	5.009	14.170	2829
1983-84	5.006	14.649	2926	0.192	0.131	682	5.199	14.780	2843
1984-85	5.151	15.948	3096	0.198	0.146	740	5.348	16.094	3009
1985-86	**5.169**	**17.023**	**3293**	**0.219**	**0.198**	**905**	**5.388**	**17.221**	**3196**
1986-87	5.295	16.032	3028	0.222	0.176	794	5.517	16.209	2938
1987-88	5.137	16.994	3308	0.152	0.093	610	5.289	17.087	3231
1988-89	5.250	16.937	3226	0.164	0.180	1093	5.414	17.117	3161
1989-90	5.413	18.867	3486	0.133	0.095	710	5.546	18.961	3419
1990-91	**5.524**	**19.112**	**3460**	**0.149**	**0.110**	**739**	**5.673**	**19.222**	**3388**
1991-92	5.540	19.548	3528	0.103	0.080	782	5.643	19.628	3478
1992-93	5.597	19.982	3570	0.104	0.076	729	5.701	20.058	3518
1993-94	5.759	21.495	3732	0.102	0.081	795	5.861	21.576	3681
1994-95	5.802	21.667	3735	0.100	0.087	873	5.901	21.754	3686
1995-96	**5.604**	**19.722**	**3520**	**0.103**	**0.084**	**818**	**5.706**	**19.806**	**3471**
1996-97	5.593	21.481	3841	0.098	0.081	824	5.691	21.562	3789
1997-98	5.789	21.105	3646	0.162	0.107	660	5.951	21.212	3565
1998-99	6.046	22.853	3780	0.074	0.047	635	6.120	22.900	3741
1999-00	6.191	25.166	4065	0.061	0.041	665	6.252	25.197	4029
2000-01	**6.222**	**25.279**	**4063**	**0.055**	**0.039**	**709**	**6.277**	**25.318**	**4033**
2001-02	6.106	24.867	4073	0.049	0.031	633	6.155	24.898	4045

Source Various Statistical Abstracts of Punjab and Government of Punjab Websites
http://punjabgovt.nic.in/agriculture/agricult.htm, Accessed on Sep 13, 2003,
http://punjabgovt.nic.in/agriculture/agricult.htm, Accessed on Jan 10, 2004.
http://www.punjabgov.net/about_agri2.asp, Accessed on Jan 10, 2004.
http://www.punjab.gov.in/webii/General/Abstract/PDF/157-223.pdf, Accessed on Oct 7, 2004.

Note Data between 1951-52 to 54-55 and 1956-57 to 59-60 are not comparable.

Punjab

AREA, PRODUCTION AND YIELD OF COTTON

Year	American			Desi			Total		
	Area (000 Ha)	Production (000 MT)	Yield (Kg/Ha)	Area (000 Ha)	Production (000 MT)	Yield (Kg/Ha)	Area (000 Ha)	Production (000 MT)	Yield (Kg/Ha)
1950-51	79.00	19.74	250.00	146.00	25.96	178.00	225.00	45.70	203.11
1951-52	79.76	19.56	245.22	199.19	41.61	208.87	278.95	61.16	219.26
1952-53	102.02	27.56	270.12	176.52	40.01	226.63	278.54	67.56	242.56
1953-54	168.02	50.50	300.54	136.84	33.25	242.97	304.86	83.74	274.70
1954-55	280.57	64.36	229.41	118.62	23.11	194.85	399.19	87.48	219.14
1955-56	**287.00**	**58.85**	**205.00**	**143.00**	**19.02**	**133.00**	**430.00**	**77.87**	**181.09**
1956-57	327.94	78.23	238.56	132.79	23.65	178.08	460.73	101.88	221.13
1957-58	304.05	76.28	250.87	183.00	41.43	226.38	487.04	117.70	241.67
1958-59	270.04	61.52	227.81	221.05	44.63	201.89	491.09	106.15	216.14
1959-60	263.97	67.92	257.30	183.81	46.41	252.47	447.77	114.33	255.32
1960-61	**245.00**	**65.79**	**269.00**	**202.00**	**54.51**	**270.00**	**447.00**	**120.30**	**269.13**
1961-62	212.00	63.57	300.00	270.00	77.28	286.00	482.00	140.85	292.22
1962-63	211.00	61.04	289.00	260.00	72.87	280.00	471.00	133.91	284.31
1963-64	258.00	84.43	327.00	254.00	69.01	272.00	512.00	153.44	299.69
1964-65	254.00	81.89	322.00	235.00	64.55	275.00	489.00	146.44	299.47
1965-66	**222.00**	**68.97**	**311.00**	**237.00**	**62.65**	**264.00**	**459.00**	**131.62**	**286.75**
1966-67	199.00	66.86	335.00	236.00	65.33	277.00	435.00	132.19	303.89
1967-68	227.00	84.15	371.00	192.00	55.90	291.00	419.00	140.05	334.25
1968-69	229.00	84.05	369.00	163.00	51.41	316.00	392.00	135.46	345.56
1969-70	220.00	83.74	381.00	188.00	60.26	321.00	408.00	144.00	352.94
1970-71	**212.00**	**84.78**	**399.00**	**185.00**	**62.53**	**338.00**	**397.00**	**147.31**	**371.06**
1971-72	246.00	98.84	407.00	229.00	73.90	326.00	475.00	172.74	363.66
1972-73	235.00	94.36	407.00	271.00	86.16	322.00	506.00	180.52	356.76
1973-74	301.00	129.36	430.00	222.00	67.36	303.00	523.00	196.72	376.14
1974-75	342.00	142.20	416.00	205.00	61.56	301.00	547.00	203.76	372.50
1975-76	**363.00**	**146.92**	**404.00**	**217.00**	**63.19**	**292.00**	**580.00**	**210.11**	**362.26**
1976-77	375.00	142.21	379.00	180.00	50.83	282.00	555.00	193.04	347.82
1977-78	440.00	164.27	374.00	169.00	44.88	263.00	609.00	209.15	343.43
1978-79	470.00	181.87	387.00	161.00	42.33	264.00	631.00	224.20	355.31
1979-80	460.00	163.99	357.00	170.00	40.88	241.00	630.00	204.87	325.19
1980-81	**502.00**	**164.73**	**329.00**	**147.00**	**35.53**	**241.00**	**649.00**	**200.26**	**308.57**
1981-82	546.00	182.40	334.00	140.00	34.34	246.00	686.00	216.74	315.95
1982-83	582.00	181.90	313.00	142.00	25.16	177.00	724.00	207.06	285.99
1983-84	556.00	107.44	193.00	94.00	12.75	136.00	650.00	120.19	184.91
1984-85	409.00	193.12	471.00	63.00	17.89	287.00	472.00	211.01	447.06
1985-86	**471.00**	**213.85**	**452.00**	**88.00**	**25.46**	**288.00**	**559.00**	**239.31**	**428.10**
1986-87	496.00	264.37	533.00	71.00	23.15	326.00	567.00	287.52	507.09
1987-88	565.00	300.05	531.00	56.00	16.66	298.00	621.00	316.71	510.00
1988-89	701.00	345.31	492.00	57.00	15.13	266.00	758.00	360.44	475.51
1989-90	669.00	394.87	591.00	64.00	22.26	354.00	733.00	417.13	569.07
1990-91	**637.00**	**306.40**	**481.00**	**64.00**	**18.24**	**285.00**	**701.00**	**324.64**	**463.11**
1991-92	615.00	391.14	636.00	104.00	34.74	334.00	719.00	425.88	592.32
1992-93	635.00	375.06	591.00	66.00	24.08	369.00	701.00	399.14	569.39
1993-94	536.00	246.50	460.00	41.00	10.88	267.00	577.00	257.38	446.00
1994-95	538.00	281.93	521.00	60.00	19.50	325.00	598.00	300.22	502.00
1995-96	**649.00**	**300.49**	**463.00**	**93.00**	**27.16**	**292.00**	**750.00**	**331.50**	**442.00**
1996-97	626.00	291.27	467.00	90.00	26.17	300.00	742.00	327.25	441.00
1997-98	626.00	133.52	213.00	98.00	25.61	264.00	724.00	159.13	219.79
1998-99	456.00	81.62	179.00	106.00	19.61	185.00	562.00	101.23	180.12
1999-00	381.00	128.16	337.00	96.00	33.79	352.00	477.00	161.95	339.52
2000-01 (P)	**358.00**	**156.68**	**437.00**	**115.00**	**46.83**	**408.00**	**473.00**	**203.51**	**430.25**
2001-02 (P)	507.00	193.70	382.00	100.00	28.55	285.00	607.00	222.25	366.14

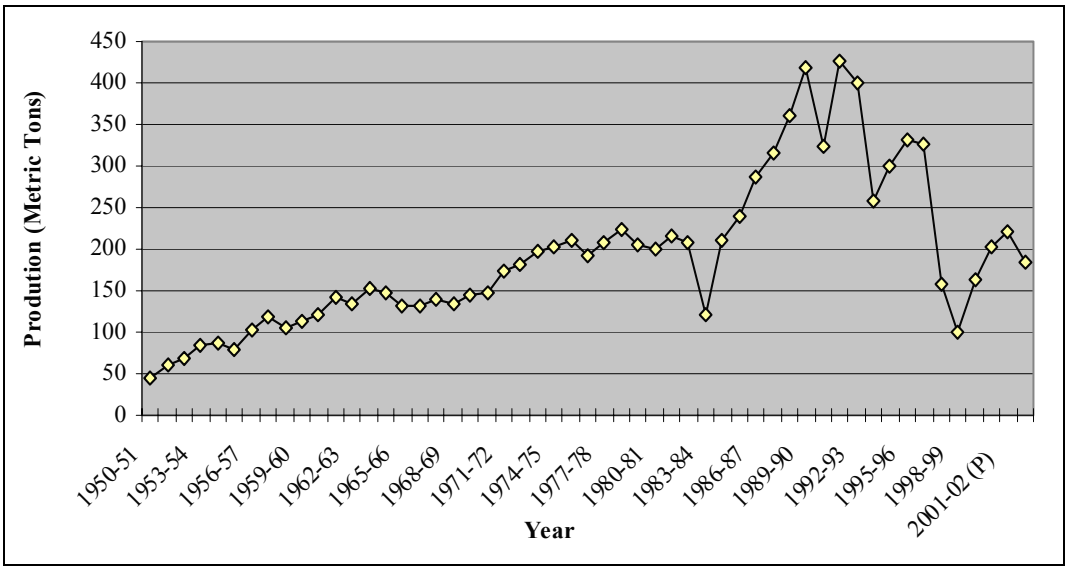
Source Various Statistical Abstracts of Punjab, Government of Punjab websites
http://punjabgovt.nic.in/agriculture/agricult.htm, Accessed on 13 Sep 2003s
http://www.punjab.gov.in/webii/General/Abstract/PDF/157-223.pdf., Accessed on Oct. 7, 2004

Comment Production and Yield are in terms of cleaned cotton.
Data between 1950-51 to 1954-55 and 1956-57 to 1959-60 are not comparable with data for rest of the years.

Punjab

PRODUCTION OF TOTAL COTTON

(Metric Tons)



Punjab

CONSUMPTION OF FERTILIZERS

(000 Tons)

Year	N	P	K	Total
1960-61	5		0	5
1965-66	**43**	**3**	**0**	**46**
1966-67	46	4	1	51
1967-68	83	12	4	99
1968-69	135	27	10	172
1969-70	147	21	6	174
1970-71	**175**	**31**	**7**	**213**
1971-72	225	53	12	290
1972-73	240	66	19	325
1973-74	218	68	21	307
1974-75	189	42	13	244
1975-76	**232**	**53**	**10**	**295**
1976-77	259	93	21	373
1977-78	331	105	29	465
1978-79	419	155	29	603
1979-80	477	179	30	686
1980-81	**526**	**207**	**29**	**762**
1981-82	562	217	34	813
1982-83	626	230	36	892
1983-84	706	253	32	991
1984-85	759	267	22	1048
1985-86	**787**	**287**	**24**	**1098**
1986-87	803	290	23	1116
1987-88	791	297	24	1112
1988-89	796	301	20	1117
1989-90	818	315	12	1145
1990-91	**877**	**330**	**15**	**1221**
1991-92	930	314	18	1262
1992-93	934	254	11	1199
1993-94				
1994-95				
1995-96				
1996-97				
1997-98				
1998-99	1081	275	19	1375
99-2000	1086	335	26	1447
2000-01	**1008**	**282**	**23**	**1313**
2001-02	1070	307	30	1407
2002-03	1111	299	31	1441

Source Various Statistical Abstracts of Punjab

Punjab

ANNUAL RAINFALL BY DISTRICTS (MM)

Districts	1970	1980	1990	1997	1998	1999	2000	Average for 5 years (1998-2002)
Gurdaspur	926.3	1155.0	1214.9	1038.3	662.6	810.6	830.1	793.0
Amritsar	594.6	869.8	650.8	813.2	554.8	327.1	207.9	316.1
Kapurthala	554.9	683.0	780.5	973.5	492.0	464.5	542.0	457.3
Jalandhar	171.4	873.9	1195.7	596.7	469.6	315.7	364.2	369.0
Nawan Shehar	@@	@@	@@	1932.6	936.7	705.1	699.4	742.7
Hoshiarpur	999.3	906.1	1075.6	916.3	1004.6	641.0	658.0	649.6
Rupnagar	983.4	759.0	1092.4	967.0	641.8	675.2	793.4	709.3
Ludhiana	756.7	38.0	523.9	607.8	589.3	504.4	437.2	582.6
Firozpur	232.3	956.2	421.6	405.3	127.9	95.6	130.3	100.3
Faridkot	*	511.4	567.8	350.4	151.0	262.7	256.5	243.8
Muktsar	@@	@@	@@	883.1	520.1	508.5	358.0	421.0
Moga	@@	@@	@@	551.6	259.0	234.5	175.0	229.6
Bathinda	499.2	355.9	342.1	274.9	173.6	42.5	136.1	160.0
Mansa	**	**	**	146.3	132.9	72.2	77.1	151.7
Sangrur	521.9	521.4	527.2	540.7	377.2	228.8	202.0	233.5
Patiala	555.6	835.7	662.7	819.8	779.0	470.1	641.2	647.7
Fatehgarh Sahib	**	**	**	253.2	244.9	285.0	155.0	319.0
Punjab	**672.3**	**739.1**	**754.6**	**710.0**	**477.5**	**390.8**	**391.9**	**419.2**
Comment	*Data included in Firozpur and Bathinda districts							
	** District Mansa and Fatehgarh Sahib were created in April 1992, hence data of these districts is included in Bathinda and Patiala respectively.							
	@@ Districts Muktsar, Moga and Nawanshehar were created in 1996, Data of Muktsar & Moga included in Faridkot and that of Nawanshehar in districts Jalandhar							
Source	Various Statistical Abstracts of Punjab 2004							

HARYANA AT A GLANCE

General	
Geographical Area (000 Ha)	4421
Divisions	4
Districts	17
Tehsils	61
Cities	
Towns (1991)	94
Villages	6955
Inhabited Villages	6781
Population	
Population	21,082,989
Males	11,327,658
Females	9,755,331
Sex Ratio	861 F/1000 M
Sex Ratio (0 – 6 Years)	820 F/1000 M
Rural Population (1991)	12409000
Percentage to Total (1991)	75.37 %
Urban Population (1991)	4055000
Percentage to Total (1991)	24.62 %
Density	477
Literate And Educated Persons	12225036
Literacy Rate	86.59 %
Scheduled Castes (1991)	3251000
Percentage (1991)	19.75 %
Climate	
Average Rainfall	564.5
Agriculture	
Total Cultivable Area	3865
Net Area Sown (000 Ha)	3700
Net Area Sown as % to Total Geo. Area	83.69 %
Gross Area Sown (000 Ha)	6450
Cropping Intensity [(GSA/NSA)x100)]	174.32
Production of Crops (000 MT)	
Total cereals	12252
Total pulses	84
Total foodgrains	12336
Total Cotton	176.46
Total oilseeds	709
Irrigation	
Net area irrigated by (000 Ha)	
Govt. Canals	1433
Wells/Tube wells	1395
Others	14
Total (Net Irrigation)	2842
Net Area Irrigated as % to Net Area Sown	76.81 %
Gross area irrigated (000 Ha)	5041
No. of Tube wells and Pumping sets (Lakhs)	6.04
Forest	
Area under forests (000 Ha) (1994-95)	159
Electricity	
Consumption of Electric Power (Million KWH) (1994-95)	7824.3
Unit sold per capita (KWH) (1994-95)	446
Roads	
Metalled Roads Per 100 SqKM	54.8
Villages Connected with Pucca Roads (1994-95)	6677
Gross Domestic Product (Crore Rupees)	34,800.4

Haryana

AREA, PRODUCTION AND YIELD OF WHEAT AND RICE

	Wheat			Rice		
Year	Area (M Ha)	Production (M MT)	Yield (Kg/Ha)	Area (M Ha)	Production (M MT)	Yield (Kg/Ha)
1950-51	0.362	0.294	812	0.075	0.043	573
1951-52	0.382	0.321	840	0.063	0.066	1046
1952-53	0.361	0.468	1297	0.067	0.093	1391
1953-54	0.378	0.451	1193	0.077	0.121	1572
1954-55	0.443	0.545	1228	0.072	0.111	1537
1955-56	**0.543**	**0.619**	**1140**	**0.078**	**0.060**	**769**
1956-57	0.547	0.649	1188	0.098	0.125	1270
1957-58	0.538	0.602	1121	0.101	0.163	1606
1958-59	0.573	0.662	1156	0.116	0.189	1632
1959-60	0.589	0.611	1037	0.130	0.225	1722
1960-61	**0.628**	**0.814**	**1296**	**0.155**	**0.175**	**1129**
1961-62	0.648	0.870	1343	0.163	0.203	1245
1962-63	0.670	0.804	1200	0.165	0.154	933
1963-64	0.689	0.834	1210	0.158	0.220	1392
1964-65	0.723	0.922	1275	0.185	0.266	1438
1665-66	**0.678**	**0.869**	**1282**	**0.192**	**0.205**	**1063**
1966-67	0.743	1.059	1425	0.192	0.223	1161
1967-68	0.841	1.438	1710	0.217	0.287	1323
1968-69	0.898	1.529	1703	0.229	0.272	1188
1969-70	1.017	2.147	2110	0.241	0.372	1545
1970-71	**1.129**	**2.342**	**2074**	**0.269**	**0.460**	**1709**
1971-72	1.177	2.402	2041	0.291	0.536	1842
1972-73	1.271	2.231	1756	0.291	0.462	1585
1973-74	1.177	1.811	1539	0.292	0.540	1851
1974-75	1.117	1.954	1749	0.275	0.393	1427
1975-76	**1.226**	**2.428**	**1980**	**0.304**	**0.625**	**2059**
1976-77	1.349	2.735	2027	0.330	0.815	2473
1977-78	1.360	2.845	2092	0.371	0.965	2601
1978-79	1.482	3.398	2294	0.459	1.228	2678
1979-80	1.477	3.295	2231	0.509	0.941	1848
1980-81	**1.479**	**3.490**	**2360**	**0.484**	**1.259**	**2602**
1981-82	1.562	3.686	2357	0.505	1.252	2481
1982-83	1.723	4.347	2524	0.490	1.276	2607
1983-84	1.793	4.458	2499	0.561	1.332	2485
1984-85	1.705	4.421	2593	0.557	1.363	2447
1985-86	**1.701**	**5.260**	**3094**	**0.584**	**1.633**	**2797**
1986-87	1.782	5.057	2836	0.628	1.543	2457
1987-88	1.731	4.861	2808	0.464	1.077	2321
1988-89	1.827	6.225	3407	0.602	1.443	2397
1989-90	1.857	5.907	3181	0.642	1.750	2730
1990-91	**1.850**	**6.436**	**3479**	**0.661**	**1.834**	**2775**
1991-92	1.806	6.496	3597	0.637	1.803	2831
1992-93	1.963	7.108	3621	0.707	1.880	2659
1993-94	1.994	7.217	3619	0.755	2.061	2730
1994-95	1.985	7.297	3676	0.796	2.230	2802
1995-96	**1.972**	**7.291**	**3697**	**0.830**	**1.847**	**2225**
1996-97	2.017	7.826	3880	0.831	2.463	2964
1997-98	2.057	7.528	3660	0.914	2.556	2800
1998-99	2.188	8.568	3916	1.086	2.432	2239
1999-00	2.317	9.650	4165	1.083	2.583	2385
2000-01	**2.355**	**9.669**	**4106**	**1.054**	**2.695**	**2557**
2001-02	2.300	9.437	4103	1.028	2.726	2652

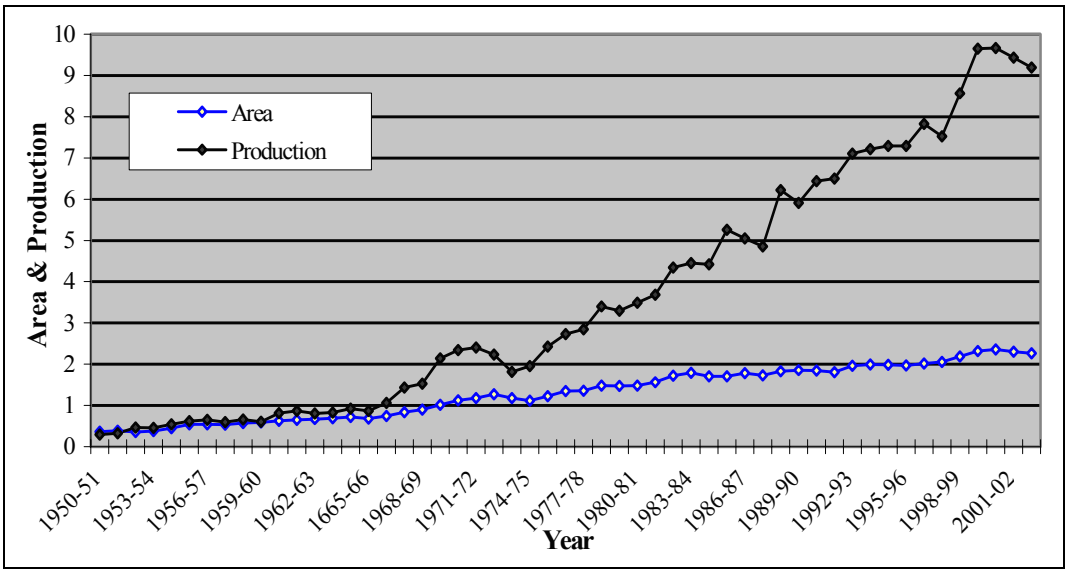
Source: Various Statistical Abstracts of Haryana and Government of Haryana website http://agriharyana.nic.in/cropwisearea_area.htm, http://agriharyana.nic.in/cropwisearea_production.htm and http://agriharyana.nic.in/cropwisearea_yield.htm. D/L on Jan 9, 2004

Comment : Data between 1950-51 to 1954-55 and 1956-57 to 1959-60 are not comparable with data for rest of the years.

Haryana

WHEAT : AREA SOWN & PRODUCTION

(Million Hectares, Million Metric Tons)



Haryana

AREA, PRODUCTION AND YIELD OF FOODGRAINS

	Total Cereals			Total Pulses			Total Foodgrains		
Year	Area (M Ha)	Production (M MT)	Yield (Kg/Ha)	Area (M Ha)	Production (M MT)	Yield (Kg/Ha)	Area (M Ha)	Production (M MT)	Yield (Kg/Ha)
1950-51	1.807	0.827	458	0.945	0.420	444.4	2.752	1.247	453
1951-52	1.740	0.599	345	0.427	0.182	425.4	2.167	0.781	361
1952-53	1.834	1.172	639	0.666	0.502	753.4	2.500	1.675	670
1953-54	1.896	1.235	652	0.765	0.650	849.7	2.660	1.885	709
1954-55	1.723	1.058	614	1.406	0.912	648.4	3.129	1.969	629
1955-56	**1.987**	**1.219**	**613**	**1.565**	**1.045**	**667.7**	**3.552**	**2.264**	**637**
1956-57	1.866	1.208	647	1.446	1.136	785.5	3.312	2.344	708
1957-58	1.916	1.291	674	1.459	1.056	723.5	3.376	2.347	695
1958-59	1.966	1.274	648	1.588	1.458	918.0	3.554	2.732	769
1959-60	1.936	1.339	692	1.488	0.893	600.3	3.425	2.232	652
1960-61	**2.115**	**1.450**	**686**	**1.606**	**1.303**	**811.3**	**3.721**	**2.755**	**740**
1961-62	2.086	1.562	749	1.460	1.018	697.3	3.546	2.580	728
1962-63	2.081	1.418	681	1.512	0.938	620.4	3.480	2.356	677
1963-64	2.018	1.542	764	1.462	0.691	472.6	3.564	2.233	627
1964-65	2.184	1.720	788	1.380	0.995	721.0	3.480	2.715	780
1665-66	**2.108**	**1.576**	**748**	**0.915**	**0.408**	**445.9**	**3.023**	**1.985**	**657**
1966-67	2.370	2.029	856	1.150	0.563	489.6	3.520	2.592	736
1967-68	2.655	2.690	1013	1.296	1.316	1015	3.951	3.970	1005
1968-69	2.463	2.315	940	0.655	0.449	685	3.118	2.764	886
1969-70	2.678	3.411	1274	1.189	1.215	1022	3.867	4.626	1196
1970-71	**2.709**	**3.939**	**1454**	**1.159**	**0.832**	**717.9**	**3.868**	**4.771**	**1234**
1971-72	2.750	3.861	1404	1.205	0.682	565.9	3.955	4.543	1149
1972-73	2.911	3.488	1198	1.056	0.585	553.8	3.968	4.073	1027
1973-74	2.884	3.353	1163	1.082	0.483	446.3	3.966	3.836	967
1974-75	2.824	2.965	1050	0.781	0.374	478.9	3.605	3.339	926
1975-76	**3.017**	**4.088**	**1355**	**1.194**	**0.952**	**797.4**	**4.211**	**5.040**	**1197**
1976-77	3.040	4.384	1442	1.108	0.876	790.3	4.148	5.260	1268
1977-78	2.988	4.335	1451	1.217	1.005	825.9	4.205	5.340	1270
1978-79	3.140	5.245	1671	1.134	1.084	956.4	4.273	6.333	1482
1979-80	3.097	4.696	1517	0.601	0.348	578.5	3.697	5.037	1362
1980-81	**3.168**	**5.533**	**1747**	**0.795**	**0.503**	**632.2**	**3.963**	**6.036**	**1523**
1981-82	3.232	5.692	1761	1.116	0.347	310.9	4.348	6.039	1389
1982-83	3.251	6.334	1949	0.561	0.315	560.7	3.812	6.649	1744
1983-84	3.475	6.526	1878	0.720	0.363	503.6	4.195	6.889	1642
1984-85	3.296	6.481	1966	0.692	0.367	530.1	3.989	6.848	1717
1985-86	**3.197**	**7.460**	**2333**	**0.846**	**0.687**	**811.3**	**4.043**	**8.147**	**2015**
1986-87	3.461	7.161	2069	0.679	0.467	687.7	4.140	7.628	1843
1987-88	2.920	6.199	2123	0.265	0.112	423.7	3.186	6.311	1981
1988-89	3.483	8.836	2537	0.728	0.674	924.8	4.212	9.510	2258
1989-90	3.335	8.279	2482	0.604	0.430	711.0	3.939	8.709	2211
1990-91	**3.337**	**9.017**	**2702**	**0.742**	**0.542**	**730.1**	**4.079**	**9.559**	**2343**
1991-92	3.188	8.805	2762	0.389	0.273	701.9	3.577	9.078	2538
1992-93	3.510	9.955	2836	0.462	0.326	706.6	3.972	10.281	2589
1993-94	3.416	9.774	2862	0.478	0.469	981.0	3.893	10.243	2631
1994-95	3.537	10.456	2956	0.475	0.516	1086.3	4.012	10.972	2735
1995-96	**3.571**	**9.721**	**2722**	**0.450**	**0.451**	**1002.0**	**4.021**	**10.172**	**2530**
1996-97	3.609	11.102	3076	0.417	0.345	827.3	4.026	11.447	2843
1997-98	3.755	10.956	2918	0.433	0.376	869.4	4.187	11.332	2706
1998-99	4.073	11.782	2893	0.409	0.323	789.7	4.482	12.105	2701
1999-00	4.154	12.987	3126	0.136	0.078	573.5	4.290	13.065	3045
2000-01	**4.185**	**13.195**	**3153**	**0.155**	**0.099**	**638.7**	**4.340**	**13.294**	**3063**
2001-02	4.065	13.150	3235	0.189	0.149	788.4	4.254	13.299	3126
2002-03	3.848	12.252	3184	0.128	0.084	656.3	3.976	12.336	3103

Source: Various Statistical Abstracts of Haryana and Government of Haryana website http://agriharyana.nic.in/cropwisearea_area.htm, http://agriharyana.nic.in/cropwisearea_production.htm and http://agriharyana.nic.in/cropwisearea_yield.htm. D/L on Jan 9, 2004

Comment: Data between 1950-51 to 1954-55 and 1956-57 to 1959-60 are not comparable with data for rest of the years.

Haryana

NET AREA SOWN AND GROSS AREA SOWN

(Million Hectares)

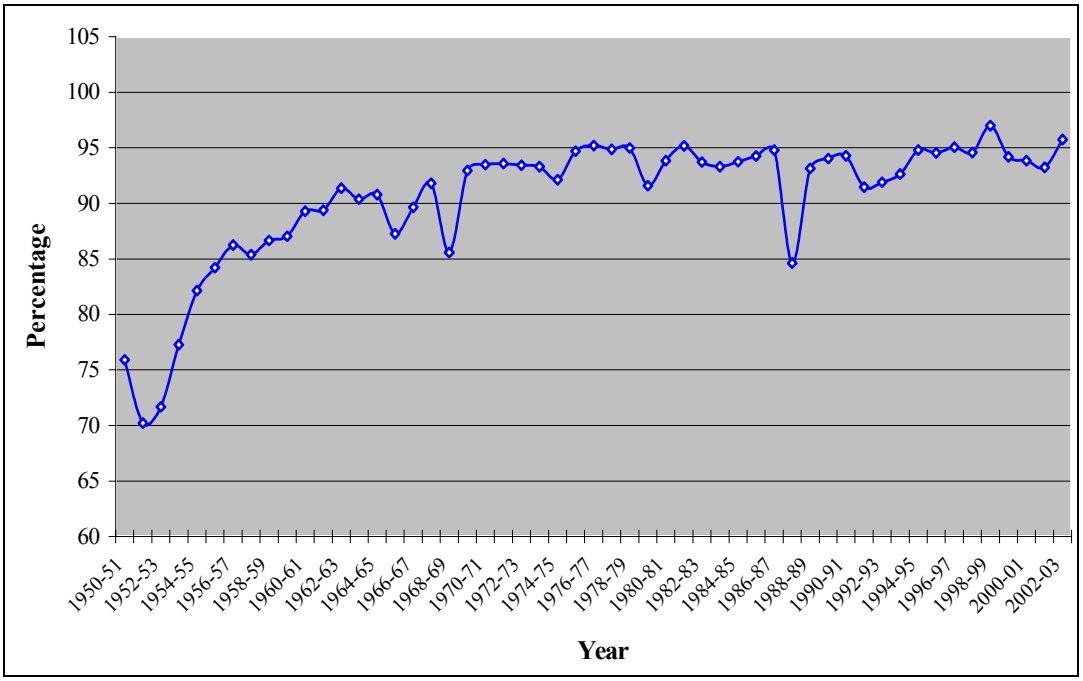
Year	Cultivable	Net Sown	Gross Sown	NS as % to Total Cultivable	Cropping Intensity
1950-51	3.930	2.983	3.334	75.9	111.8
1951-52	3.779	2.653	2.979	70.2	112.3
1952-53	3.802	2.725	3.129	71.7	114.8
1953-54	3.780	2.921	3.369	77.3	115.4
1954-55	3.775	3.100	3.923	82.1	126.6
1955-56	**3.919**	**3.300**	**4.504**	**84.2**	136.5
1956-57	3.765	3.247	4.258	86.2	131.2
1957-58	3.758	3.209	4.271	85.4	133.1
1958-59	3.750	3.249	4.461	86.7	137.3
1959-60	3.781	3.291	4.311	87.0	131.0
1960-61	**3.809**	**3.401**	**4.584**	**89.3**	134.8
1961-62	3.829	3.422	4.500	89.4	131.5
1962-63	3.799	3.471	4.614	91.4	132.9
1963-64	3.842	3.472	4.471	90.4	128.8
1964-65	3.835	3.481	4.577	90.8	131.5
1965-66	**3.824**	**3.337**	**4.070**	**87.3**	122.0
1966-67	3.819	3.423	4.599	89.6	134.4
1967-68	3.828	3.514	5.150	91.8	146.6
1968-69	3.825	3.273	4.053	85.6	123.8
1969-70	3.817	3.548	4.941	93.0	139.3
1970-71	**3.813**	**3.565**	**4.957**	**93.5**	139.0
1971-72	3.812	3.567	5.048	93.6	141.5
1972-73	3.805	3.555	5.188	93.4	145.9
1973-74	3.822	3.566	5.150	93.3	144.4
1974-75	3.820	3.519	4.842	92.1	137.6
1975-76	**3.827**	**3.624**	**5.451**	**94.7**	150.4
1976-77	3.829	3.646	5.282	95.2	144.9
1977-78	3.843	3.645	5.435	94.8	149.1
1978-79	3.843	3.650	5.522	95.0	151.3
1979-80	3.884	3.557	4.862	91.6	136.7
1980-81	**3.839**	**3.602**	**5.462**	**93.8**	151.6
1981-82	3.846	3.660	5.826	95.2	159.2
1982-83	3.842	3.600	5.306	93.7	147.4
1983-84	3.859	3.600	5.688	93.3	158.0
1984-85	3.857	3.616	5.512	93.8	152.4
1985-86	**3.833**	**3.613**	**5.601**	**94.3**	155.0
1986-87	3.821	3.622	5.662	94.8	156.3
1987-88	3.821	3.233	4.686	84.6	144.9
1988-89	3.827	3.564	6.012	93.1	168.7
1989-90	3.821	3.593	5.661	94.0	157.6
1990-91	**3.792**	**3.575**	**5.919**	**94.3**	165.6
1991-92	3.836	3.508	5.570	91.4	158.8
1992-93	3.800	3.492	5.853	91.9	167.6
1993-94	3.793	3.513	5.815	92.6	165.5
1994-95	3.753	3.558	5.985	94.8	168.2
1995-96	**3.793**	**3.586**	**5.974**	**94.5**	166.6
1996-97	3.803	3.615	6.075	95.1	168.0
1997-98	3.886	3.675	6.143	94.6	167.2
1998-99	3.807	3.692	6.214	97.0	168.3
1999-00	3.771	3.552	6.029	94.2	169.7
2000-01	**3.758**	**3.526**	**6.115**	**93.8**	173.4
2001-02	3.825	3.566	6.318	93.2	177.2
2002-03	3.865	3.700	6.450	95.7	174.3

Source: Various Statistical Abstracts of Haryana and GoH website
http://agriharyana.nic.in/agricultureatglance.htm, Accessed on Aug, 22, 2004.

Comment Data Between 1950-51 and 1959-60 are not comparable with rest of the years.

Haryana

NET AREA SOWN AS % OF CULTIVABLE AREA



Haryana

NET AREA IRRIGATED AND GROSS AREA IRRIGATED

(Million Hectares)

Year	Net Area Irrigated by Source			Gross Area Irrigated	NAI as % to Net Area Sown	GAI as % to Gross Area sown
	Canal	Well/TW	Total (Net Irri)			
1950-51				0.66		30.0
1951-52				0.79		33.6
1952-53				0.80		32.0
1953-54	0.526	0.208	0.744	0.82	25.5	29.7
1954-55	0.604	0.211	0.825	0.96	26.6	25.5
1955-56	**0.689**	**0.203**	**0.903**	**0.99**	**27.4**	**22.2**
1956-57	0.677	0.208	0.894	0.97	27.5	23.5
1957-58	0.702	0.200	0.911	1.00	28.4	23.4
1958-59	0.797	0.201	0.890	1.05	27.4	22.4
1959-60	0.779	0.217	1.019	1.10		23.2
1960-61	**0.823**	**0.166**	**1.007**	**1.21**	**29.6**	**26.3**
1961-62	0.933	0.109	1.046	1.26	30.6	28.0
1962-63	0.932	0.170	1.109	1.36	32.0	29.5
1963-64	0.983	0.218	1.208	1.43	34.8	32.0
1964-65	1.009	0.211	1.225	1.43	35.2	31.1
1965-66	**0.959**	**0.224**	**1.225**	**1.49**	**36.7**	**36.6**
1966-67	0.991	0.289	1.293	1.74	37.8	37.7
1967-68	0.889	0.227	1.132	1.78	32.2	34.6
1968-69	0.907	0.385	1.312	1.86	40.1	46.0
1969-70	0.950	0.437	1.408	2.16	39.7	43.7
1970-71	**0.952**	**0.574**	**1.532**	**2.23**	**43.0**	**45.0**
1971-72	0.965	0.594	1.565	2.33	43.9	46.1
1972-73	0.953	0.672	1.632	2.48	45.9	47.7
1973-74	1.012	0.719	1.736	2.58	48.7	50.2
1974-75	1.031	0.743	1.779	2.60	50.6	53.6
1975-76	**1.036**	**0.713**	**1.754**	**2.73**	**48.4**	**50.1**
1976-77	1.057	0.734	1.798	2.70	49.3	51.1
1977-78	1.096	0.771	1.873	2.78	51.4	51.1
1978-79	1.117	0.795	1.917	2.98	52.5	53.9
1979-80	1.200	0.969	2.174	3.13	61.1	64.4
1980-81	**1.161**	**0.967**	**2.134**	**3.31**	**59.2**	**60.6**
1981-82	1.183	1.055	2.248	3.46	61.4	59.3
1982-83	1.262	1.090	2.356	3.56	65.4	67.1
1983-84	1.186	1.000	2.190	3.60	60.8	63.2
1984-85	1.203	0.981	2.189	3.50	60.5	63.6
1985-86	**1.192**	**1.052**	**2.248**	**3.68**	**62.2**	**65.7**
1986-87	1.204	1.140	2.348	3.91	64.8	69.1
1987-88	1.220	1.355	2.579	3.88	79.8	82.9
1988-89	1.239	1.286	2.532	4.07	71.0	67.8
1989-90	1.359	1.294	2.657	4.25	73.9	75.1
1990-91	**1.338**	**1.262**	**2.600**	**4.24**	**72.7**	**71.6**
1991-92	1.381	1.256	2.666	4.34	76.0	77.9
1992-93	1.359	1.238	2.628	4.47	75.3	76.4
1993-94	1.353	1.283	2.663	4.52	75.8	77.6
1994-95	1.383	1.304	2.719	4.60	76.4	76.8
1995-96	**1.375**	**1.352**	**2.760**	**4.67**	**77.0**	**78.2**
1996-97	1.372	1.353	2.766	4.79	76.5	78.8
1997-98	1.397	1.363	2.792	4.83	76.0	78.6
1998-99	1.433	1.395	2.842	5.04	77.0	81.1
1999-00			2.888		81.3	
2000-01			**2.958**		**83.9**	
2001-02			2.938		82.4	

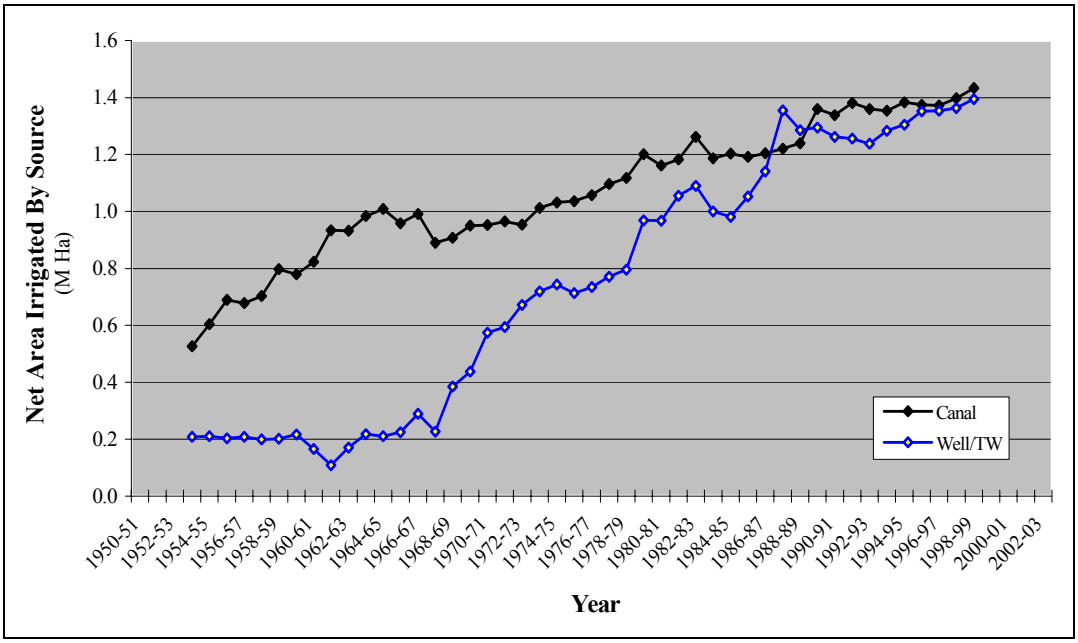
Source: Various Statistical Abstracts of Haryana Government of Haryana website http://agriharyana.nic.in/agricultureatglance.htm, Accessed on Dec. 30, 2003

Comment: Data Between 1950-51 and 1959-60 are not comparable with rest of the years. "Other" source not listed but included in total Net Irrigated Area.

Haryana

NET AREA IRRIGATED BY SOURCE

(Million Hectares)



Haryana

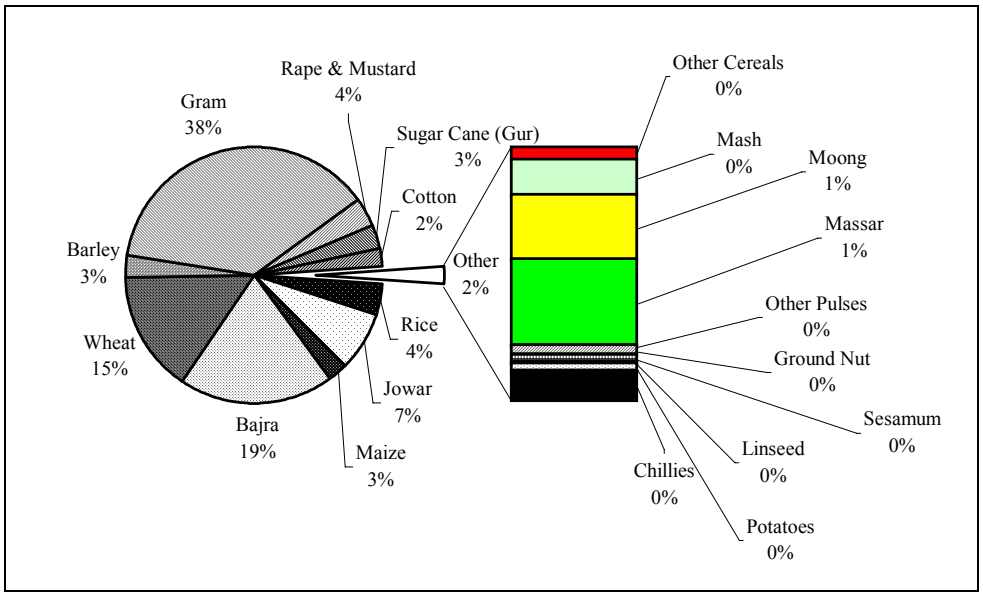
DECADAL CROPPING PATTERN

(Area Sown 000 Ha)

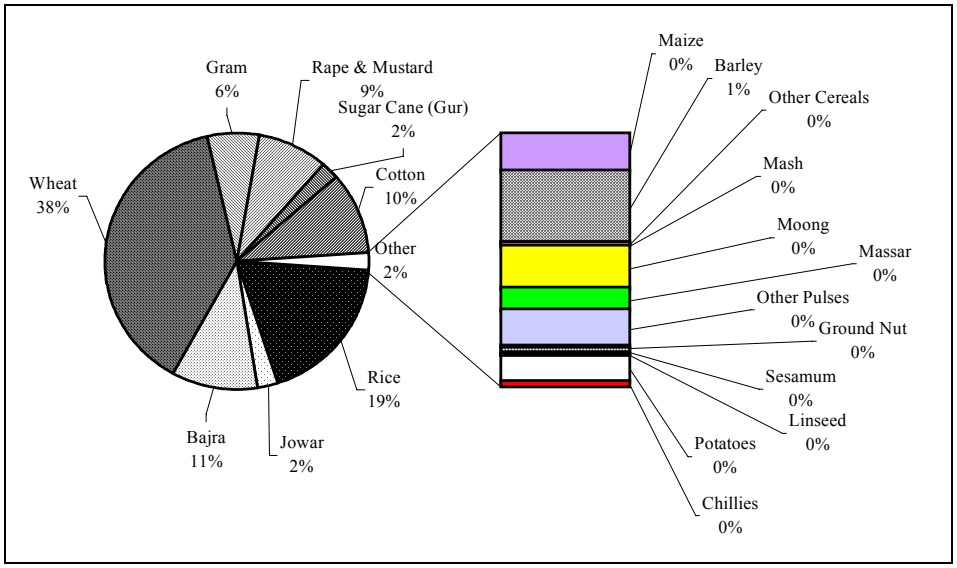
	Rice	Jowar	Maize	Bajra	Wheat	Barley	Gram	Rape & Mustard	Sugar Cane (Gur)	Cotton	Other Cereals	Mash	Moong	Massar	Other Pulses	Ground Nut	Sesamum	Linseed	Potatoes	Chillies
50-51	75	286	33	927	362	111	886	108	56	54	13	17.4	22.9	19.0	0.00	1.60	2.40	0.60	1.22	0.00
60-61	**155**	**308**	**106**	**801**	**628**	**112**	**1543**	**152**	**130**	**93**	**5**	**12**	**21.8**	**29.3**	**0.00**	**3.10**	**2.40**	**0.80**	**2.27**	**9.60**
66-67	192	270	87	893	743	182	1062	198	150	183	3	7.9	13.6	35.1	31.00	11.10	1.70	0.60	3.70	6.22
67-68	**217**	**293**	**115**	**885**	**841**	**302**	**1160**	**246**	**121**	**241**	**2**	**11.5**	**38.3**	**41.3**	**45.00**	**14.50**	**1.70**	**0.60**	**3.30**	**13.95**
70-71	269	207	114	880	1129	109	1063	130	156	193	0.9	8.9	22.5	26.8	37.50	10.40	1.80	0.50	4.60	9.59
80-81	**484**	**136**	**71**	**871**	**1479**	**125**	**723**	**300**	**113**	**316**	**1.8**	**12.5**	**4.1**	**27.4**	**28.90**	**6.20**	**3.70**	**0.40**	**11.40**	**10.60**
90-91	661	130	35	609	1850	51	649	474	148	490	2.7	3.4	10.7	18.3	60.30	2.60	6.10	0.10	10.50	5.00
98-99	**1086**	**130**	**20**	**613**	**2188**	**36**	**357**	**498**	**128**	**583**	**0**	**2**	**21**	**11.0**	**18.00**	**1.00**	**3.00**	**0.00**	**14.00**	**2.00**
00-01	1054	109	15	608	2355	44	125		143	555										
2002-03	**906**	**113**	**16**	**515**	**2268**	**30**	**55**		**190**	**519**										

Source: Various Statistical Abstracts of Haryana.
Government of Haryana website - http://agriharyana.nic.in/cropwisearea_area.htm, Accessed on Jan 9, 2004

Haryana
CROPPING PATTERN 1960-61
(Less than 1% is shown as **'other'**)



Haryana
CROPPING PATTERN 1998-99
(Less than 1% is shown as **'other'**)



Haryana

AREA PRODUCTION AND YIELD OF COTTON

Year	American			Desi			Total		
	Area (000 Ha)	Production (000 MT)	Yield (Kg/Ha)	Area (000 Ha)	Production (000 MT)	Yield (Kg/Ha)	Area (000 Ha)	Production (000 MT)	Yield (Kg/Ha)
1950-51	2.00	0.36	180	52.00	9.50	183	54.00	9.86	183
1951-52	13.36	2.84	213	39.27	6.93	177	52.63	9.78	186
1952-53	21.86	5.87	268	25.91	3.91	151	47.77	9.78	205
1953-54	30.36	8.00	263	27.53	6.22	226	57.89	14.22	246
1954-55	55.47	15.11	272	29.15	6.40	220	84.62	21.51	254
1955-56	**62.00**	**12.15**	**196**	**32.00**	**4.68**	**146**	**94.00**	**16.83**	**179**
1956-57	91.09	23.65	260	28.34	5.87	207	119.43	29.51	247
1957-58	99.19	20.45	206	37.25	6.93	186	136.44	27.38	201
1958-59	80.57	16.00	199	36.03	6.40	178	116.60	22.40	192
1959-60	60.73	16.36	269	29.15	6.22	213	89.88	22.58	251
1960-61	**54.00**	**13.80**	**257**	**39.00**	**8.85**	**227**	**93.00**	**22.65**	**244**
1961-62	50.00	13.52	270	58.00	11.96	206	108.00	25.48	236
1962-63	56.00	14.11	252	62.00	18.04	291	118.00	32.15	272
1963-64	100.00	31.87	318	77.00	21.68	282	177.00	53.55	303
1964-65	101.00	31.54	312	74.00	20.00	270	175.00	51.54	295
1965-66	**113.00**	**30.59**	**271**	**83.00**	**21.88**	**264**	**196.00**	**52.47**	**268**
1966-67	81.00	24.18	300	102.00	27.59	289	183.00	51.77	283
1967-68	138.00	39.15	283	103.00	28.15	274	241.00	67.30	279
1968-69	125.00	38.74	310	87.00	21.96	253	212.00	60.70	286
1969-70	91.20	30.96	343	103.20	30.17	290	194.40	61.13	314
1970-71	**88.60**	**32.04**	**359**	**104.80**	**31.50**	**299**	**193.40**	**63.54**	**329**
1971-72	112.30	39.96	354	129.40	39.06	303	241.70	79.02	327
1972-73	116.10	36.90	321	141.60	39.24	276	257.70	76.14	295
1973-74	108.10	46.80	433	143.30	32.58	227	251.40	79.38	316
1974-75	130.00	43.18	332	116.70	33.49	286	246.70	76.67	311
1975-76	**108.30**	**36.38**	**340**	**146.70**	**42.67**	**290**	**255.00**	**79.05**	**310**
1976-77	115.40	42.16	366	128.20	39.10	305	243.60	81.26	334
1977-78	155.60	50.32	327	110.00	28.39	258	265.60	78.71	296
1978-79	176.80	76.50	435	108.30	25.67	233	285.10	102.17	358
1979-80	196.00	70.04	357	117.40	29.75	250	313.40	99.79	318
1980-81	**211.60**	**81.60**	**387**	**104.60**	**27.71**	**264**	**316.20**	**109.31**	**346**
1981-82	230.20	88.57	387	99.30	27.88	278	329.50	116.45	353
1982-83	276.50	107.78	391	120.90	35.02	289	397.40	142.80	359
1983-84	284.20	73.27	259	121.10	23.12	191	405.30	96.39	238
1984-85	220.20	85.00	388	74.40	18.36	247	294.60	103.36	351
1985-86	**262.30**	**105.74**	**402**	**81.80**	**20.91**	**255**	**344.10**	**126.65**	**368**
1986-87	303.50	131.75	433	77.20	21.76	286	380.70	153.51	403
1987-88	349.40	102.00	293	67.00	15.30	221	416.40	117.30	282
1988-89	361.50	126.99	351	71.60	16.83	237	433.10	143.82	332
1989-90	404.80	184.11	456	66.80	18.36	277	471.60	202.47	429
1990-91	**421.60**	**177.14**	**421**	**69.00**	**19.21**	**278**	**490.60**	**196.35**	**400**
1991-92	439.40	203.49	464	66.40	24.48	371	505.80	227.97	451
1992-93	469.90	217.77	463	62.80	22.10	352	532.70	239.87	450
1993-94	488.00	169.83	348	74.90	21.25	283	562.90	191.08	339
1994-95							556.00	233.07	419
1995-96	**490.30**	**167.62**	**342**	**161.50**	**50.66**	**313**	**651.80**	**218.28**	**335**
1996-97							653.00	256.19	392
1997-98	455.70	141.61	310	176.00	46.58	265	631.70	188.19	298
1998-99	387.00	109.82	284	196.00	38.76	198	583.00	148.58	255
1999-00							544.00	221.68	408
2000-01							555.00	235.11	424
2001-02							630.00	122.74	195
2002-03							519.00	176.46	340

Source: Various Statistical Abstracts of Haryana and Government of Haryana website http://agriharyana.nic.in/cropwisearea_area.htm, http://agriharyana.nic.in/cropwisearea_production.htm and http://agriharyana.nic.in/cropwisearea_yield.htm. D/L on Jan 9, 2004

Comment: Production and Yield are in terms of cleaned cotton.
Data between 1951-52 to 54-55 and 1956-57 to 59-60 are not comparable with rest of the years.

Haryana

CONSUMPTION OF FERTILIZERS

(Thousand Tons)

Year	N	P	K	Total
1963-64	7.8	0.3	0.0	8.2
1964-65	13.8	0.5	0.0	14.3
1965-66	**13.2**	**0.4**	**0.0**	**13.6**
1966-67	12.6	0.6	0.1	13.3
1967-68	30.2	1.7	0.5	32.5
1968-69	40.3	5.5	1.2	47.0
1969-70	47.0	5.1	1.8	53.9
1970-71	**61.0**	**6.9**	**2.2**	**70.1**
1971-72	73.4	6.3	2.4	82.1
1972-73	83.1	8.2	2.6	93.9
1973-74	94.1	16.5	4.5	115.0
1974-75	66.1	7.1	2.3	75.5
1975-76	**86.3**	**8.3**	**2.3**	**96.9**
1976-77	115.5	15.7	6.0	137.1
1977-78	150.2	28.7	9.3	188.1
1978-79	161.9	31.8	10.3	204.1
1979-80	174.5	30.2	10.7	215.4
1980-81	**187.4**	**31.3**	**12.1**	**230.8**
1981-82	208.7	32.0	10.8	251.6
1982-83	216.2	37.3	9.7	263.2
1983-84	259.5	53.0	13.7	326.3
1984-85	272.7	56.2	7.6	336.6
1985-86	**296.4**	**69.6**	**6.2**	**372.2**
1986-87	327.0	82.0	5.8	414.8
1987-88	300.7	88.3	4.9	393.9
1988-89	383.6	119.6	5.9	509.2
1989-90	402.6	129.1	3.8	535.5
1990-91	**443.2**	**138.0**	**5.0**	**586.3**
1991-92	470.4	161.6	5.1	637.2
1992-93	464.7	141.4	2.5	608.6
1993-94	522.9	148.4	0.4	671.7
1994-95	559.1	150.5	2.6	712.3
1995-96	**587.0**	**133.6**	**3.2**	**723.8**
1996-97	619.2	139.2	3.1	761.5
1997-98	649.9	181.8	3.8	835.5
1998-99	662.7	171.8	4.0	838.4
1999-00	670.4	226.2	5.2	901.8

Source: Various Statistical Abstracts of Haryana

Haryana

DETAILS OF DARK, GREY AND WHITE BLOCKS

(On the basis of Ground Water Assessment As on April 1st, 1997)

Sr. No.	District	Number of blocks		
		Dark (Dev. > 85%)	**Grey** (Dev. 65-85%)	**White** (Dev. < 65%)
1	Ambala	2	1	-
2	Bhiwani	3	1	4
3	Faridabad	1	2	2
4	Gurgaon	5	1	3
5	Fatehabad	2		3
6	Hisar	-	2	5
7	Jind	2	-	5
8	Kurushetra	4	-	-
9	Kaithal	2	-	3
10	Karnal	6	-	-
11	Mahendragarh	5	-	-
12	Panchkula	1	1	2
13	Panipat	3	1	
14	Rewari	5		
15	Rohtak	-	-	5
16	Jhajjar	2	2	1
17	Sirsa	1	1	5
18	Sonepat	1	3	3
19	Yamuna Nagar	2	2	1
	Total	**47**	**17**	**42**

Source: Government of Haryana website: http://agriharyana.nic.in/gwc_dark.htm
Accessed on Jan 9, 2004

Haryana

DISTRICTWISE WATERLOGGED AREAS (JUNE 2002)

District	Geographical Area (000 Ha)	Hilly area (000 Ha)	Area in Sq. KM under various depth range (mtrs.) June' 02			
			Fully Waterlogged (0 - 1.5)	Waterlogged (1.5 - 3)	Potential Waterlogged (3 - 10)	Safe area (>10)
Ambala	1596	3	22	210	1153	208
Bhiwani	4871	47	14	317	1562	2931
Faridabad	2105	88	-	45	1401	571
Fatehabad	2491	-	3	127	873	1488
Gurgaon	2750	177	12	101	1011	1449
Hisar	3860	-	68	243	2694	855
Jind	2736	-	4	134	1698	900
Jhajjar	1868	-	53	227	1493	95
Kurukshetra	1682	-	-	-	7	1675
Kaithal	2284	-	-	18	995	1271
Karnal	2471	-	-	-	1340	1131
Mahendragarh	1939	46	-	-	29	1864
Panchkula	789	353	-	-	215	221
Panipat	1250	-	-	-	741	509
Rewari	1559	23	-	-	335	1201
Rohtak	1668	-	21	311	1317	19
Sonepat	2261	-	23	187	1557	494
Sirsa	4276	-	17	165	1984	2110
Yamunanagar	1756	153	-	22	1128	453
Total	**44212**	**890**	**237**	**2107**	**21933**	**19445**

Source Government of Haryana website - http://agriharyana.nic.in/gwc_loggedarea.htm
Accessed on Jan. 9, 2004.

Note: This is the pre monsoon period when area under waterlogging is at its lowest.

Haryana

DISTRICTWISE AVERAGE DEPTH OF WATER

During June 1974 and June 2002 (Mtrs)

District	Jun-74	Jun-02	Historical Fluctuation June 74 June, 02	Seasonal Fluctuation June 2002 Oct 2002
Ambala	5.79	7.23	-1.44	0.75
Bhiwani	21.24	16.5	4.74	-0.48
Faridabad	5.79	8.24	-2.45	0.46
Fatehabad	10.48	10.04	0.44	0.06
Gurgaon	6.04	13.18	-7.14	0.07
Hisar	15.47	7.14	8.33	-0.14
Jind	11.97	7.96	4.01	-0.37
Jhajjar	6.32	5.79	0.53	0.28
Kurukshetra	10.21	19.35	-9.14	-1.28
Kaithal	6.28	10.45	-4.17	-1.43
Karnal	5.72	9.52	-4.2	0.05
Mahendragarh	16.11	25.73	-9.62	-7.36
Panchkula	7.58	13.04	-5.46	0.78
Panipat	4.56	11.27	-6.71	-0.41
Rewari	11.75	16.28	-4.53	-0.19
Rohtak	6.64	4.84	1.8	-0.02
Sonepat	4.68	6.87	-2.19	0.29
Sirsa	17.88	10.33	7.55	-0.28
Yamunanagar	6.26	8.75	-2.49	1.11
Total	**9.51**	**11.21**	**-1.7**	**-0.42**

Source: Government of Haryana website http://agriharyana.nic.in/gwc_fluctuations.htm
Accessed on Jan 9, 2004

Haryana

ANNUAL RAINFALL BY DISTRICTS

(in cms)

District	1980	1985	1990	1995	1997	1998
Ambala	96.7	109.9	156.1	165.9	93	152.2
Panchkula	-	-	-	-	135	149.6
Yamunanagar	-	-	145.6	148	116.3	147.3
Kurukshetra	60	52.9	55.9	102.4	80.4	137.6
Kaithal	-	-	90.8	77.7	67.5	70.6
Karnal	83.5	44.2	88.5	74.3	59.3	74.5
Panipat	_	_	53.7	87.4	76.5	65.1
Sonipat	101.4	60.1	69.4	91.5	68.3	60.2
Rohtak	46.9	59.3	55.1	84.9	54.9	59.2
Jhajjar	-	-	-	-	19.3	52.8
Faridabad	52.8	59.3	63.9	59.9	59.8	62.9
Gurgaon	54.1	78.3	56.6	73.2	63	63.5
Rewari	-	-	54.1	95.3	66.3	64.9
Mahendragarh	54.6	39.3	55.6	86	67.1	40.7
Bhiwani	30.1	36.6	49.7	66	48.3	38.6
Jind	31.8	56.2	47.9	99.6	72.5	83.5
Hisar	29.3	35.2	41.7	47.3	49	37.4
Fatehabad	-	-	-	-	46.4	68.6
Sirsa	21.3	62.8	46.2	37.1	44.9	31
Haryana	**662.5**	**694.1**	**1130.8**	**1396.5**	**1287.8**	**1460.2**

Source Envis Node For Water Resource Management website
http://www.water-mgmt.com/en/database_haryana3.htm, Accessed on Feb 2nd, 2004

Ganga Nagar & Hanumangarh Districts (Rajasthan)

CROPPING PATTERN (2001-02)

Area Sown (Hectares)

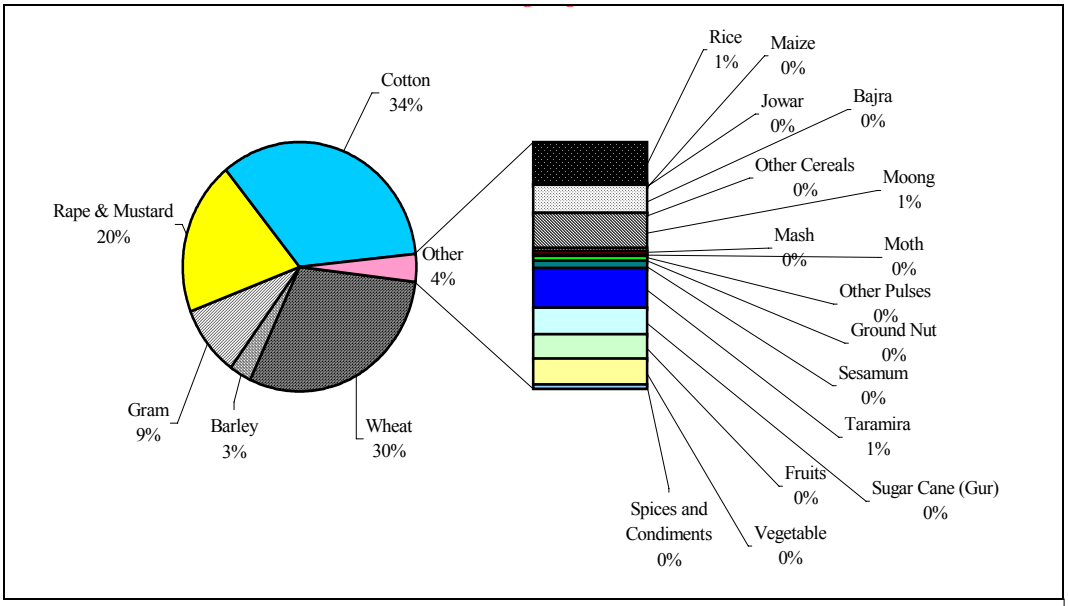
	Rice	Jowar	Maize	Bajra	Wheat	Barley	Other Cereals	Gram	Moong	Mash	Moth	Other Pulses	Rape & Mustard	Ground Nut	Sesamum	Taramira	Cotton	Sugar Cane (Gur)	Fruits	Vegetable	Spices and Condiments
G'nagar	4588	196	71	2965	218401	21765	0	65766	3765	346	279	226	145463	527	728	4254	247275	2843	2582	2766	221
H'garh	33537	9	2	51854	202958	15801	0	77358	1529	155	17576	103	45286	79	2668	1550	165145	64	255	876	97

Source SA of Rajasthan 2001-02

Ganga Nagar

CROPPING PATTERN 2000-01

(Less than 1% is shown as 'other')

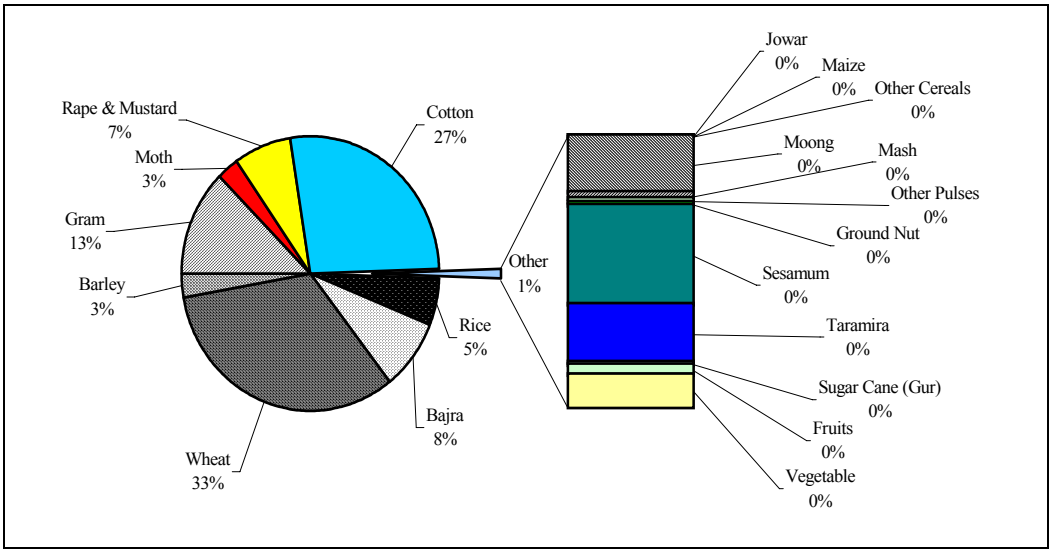


Source : SA of Rajasthan 2001-02

Hanumangarh

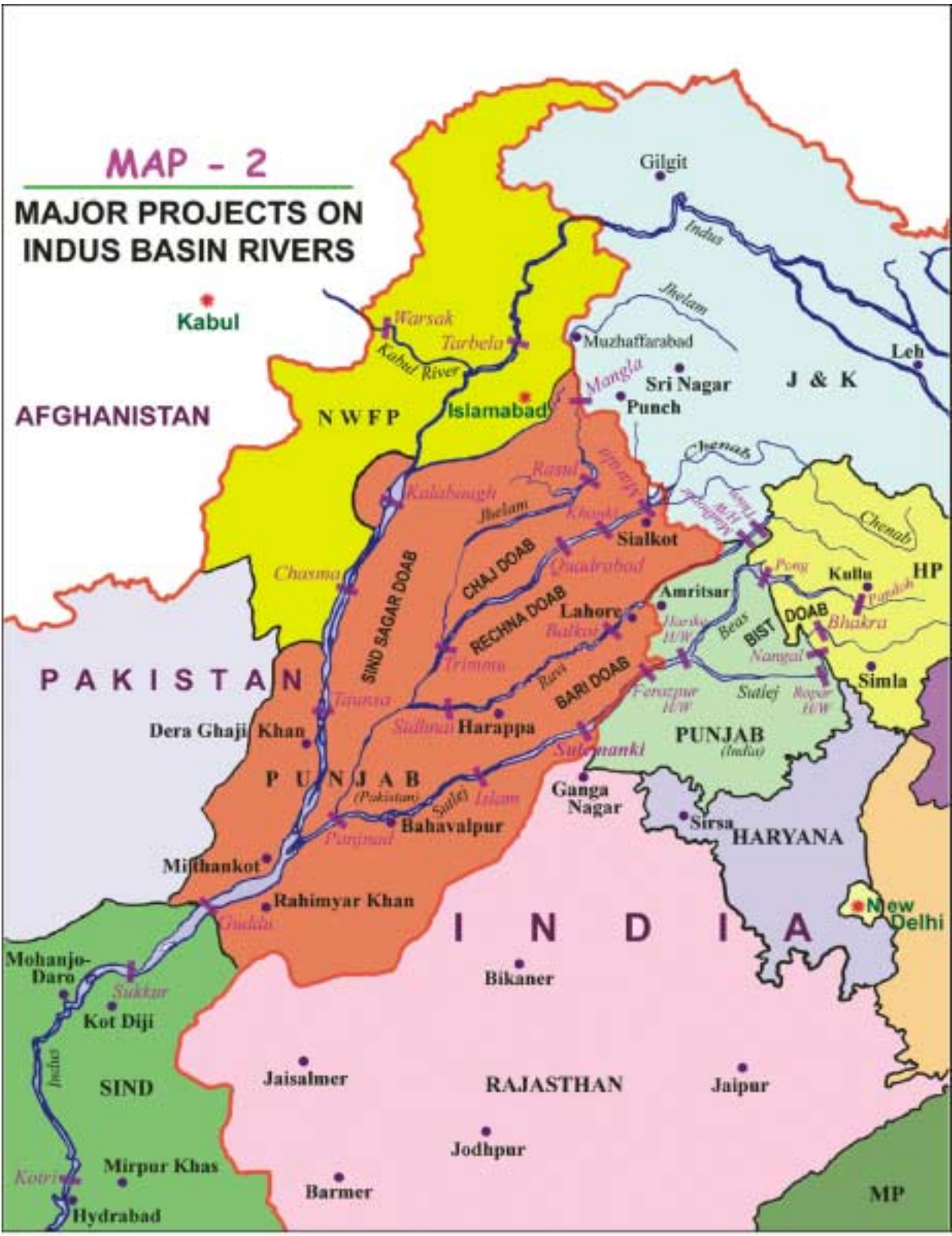
CROPPING PATTERN 2000-01

(Less than 1% is shown as 'other')



Source : SA of Rajasthan 2001-02

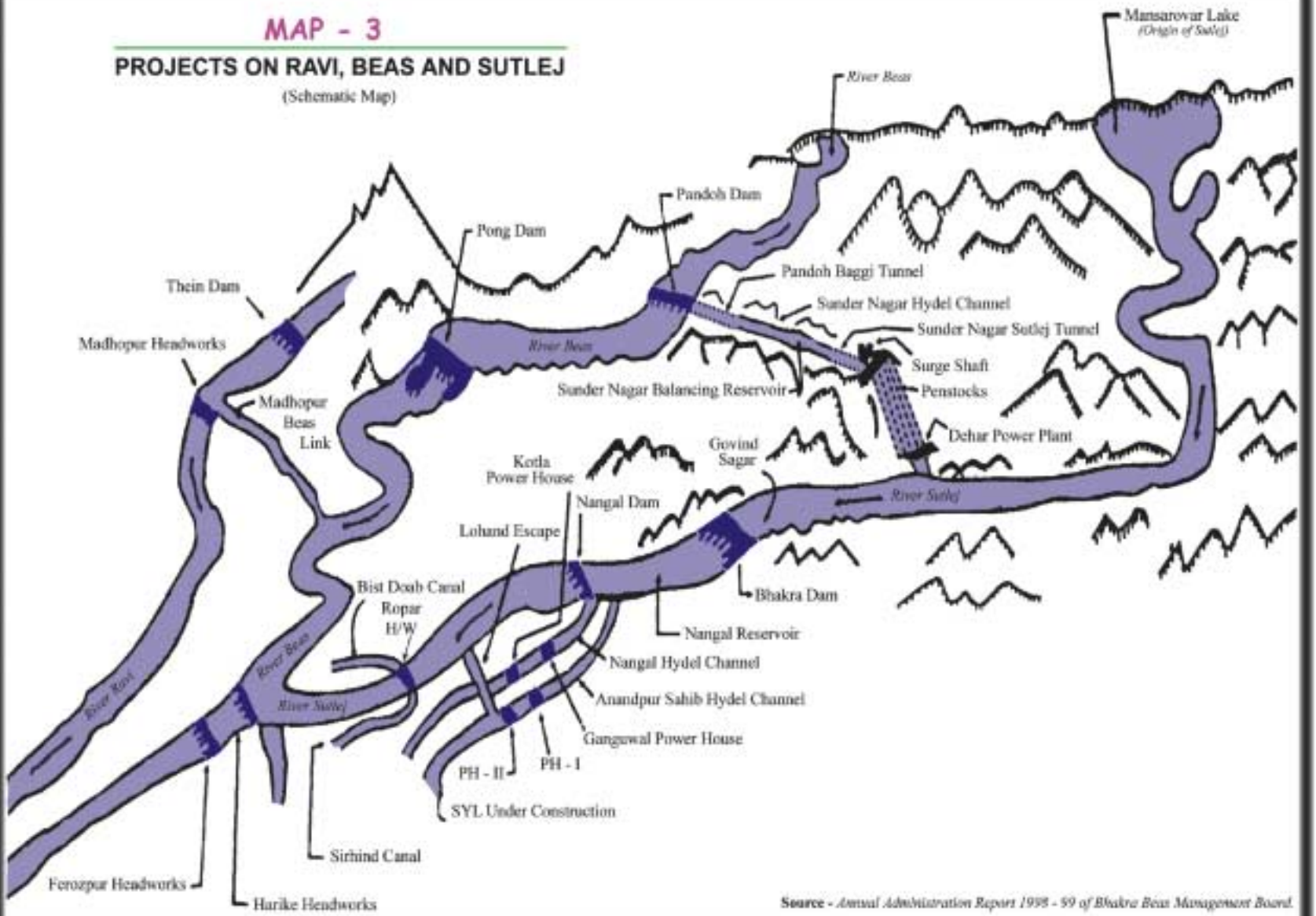

MAP - 1
INDUS BASIN RIVERS
CHINA
Gilgit
Indus
Jhelum
Kabul
Kabul River
Muzaffarabad
Sri Nagar
Punch
Leh
J & K
AFGHANISTAN
NWFP
Islamabad
Jhelum
Chenab
Sialkot
SIND SAGAR DOAB
CHAJ DOAB
RECHNA DOAB
Lahore
Amritsar
BIST DOAB
Kullu
HP
TIBET
Indus
Sutlej
Manasarovar Lake
PAKISTAN
Ravi
BARI DOAB
Sutlej
Simla
Dera Ghazi Khan
Harappa
PUNJAB
(India)
Chamoli
Dehradun
UTTARANCHAL
P U N J A B
(Pakistan)
Sutlej
Ganga Nagar
Sirsa
HARYANA
NEPAL
Bahawalpur
Mithankot
Rahimyar Khan
New Delhi
Mohanjo-Daro
Bikaner
Kot Diji
I N D I A
Indus
SIND
Jaisalmer
RAJASTHAN
Jaipur
UTTAR PRADESH
Jodhpur
Mirpur Khas
Barmer
Hydrabad
Mirpur Batoro
Lakhpat
Dhola Veera
Bhuj
Mahesana
MADHYA PRADESH
ARABIAN SEA
GUJARAT
Bhopal
LEGEND
International Boundary
State Boundary
Rivers
Maps are meant to be indicative only.


MAP - 2
MAJOR PROJECTS ON INDUS BASIN RIVERS
Kabul
AFGHANISTAN
Gilgit
Indus
Jhelam
Leh
Warsak
Tarbela
Kabul River
Muzhaffarabad
Mangla
Sri Nagar
J & K
Punch
NWFP
Islamabad
Chenab
Rasul
Kalabagh
Jhelam
Khanki
Sialkot
Chashma
SIND SAGAR DOAB
CHAJ DOAB
Quadirabad
Chenab
Pong
Kullu
HP
Amritsar
Lahore
RECHNA DOAB
Balloki
Beas
BIST DOAB
Bhakra
Nangal
Simla
PAKISTAN
Trimmu
Ravi
BARI DOAB
Ferozpur H/W
Sutlej
Ropar H/W
Taunsa
Sidhnai
Harappa
Dera Ghaji Khan
Sulemanki
PUNJAB (India)
PUNJAB (Pakistan)
Ganga Nagar
Sutlej
Islam
Bahavalpur
Panjnad
Sirsa
HARYANA
Mithankot
Rahimyar Khan
Sudlu
New Delhi
INDIA
Mohanjo-Daro
Sukkur
Kot Diji
Bikaner
Indus
SIND
Jaisalmer
RAJASTHAN
Jaipur
Jodhpur
Mirpur Khas
Kotri
Barmer
MP
Hydrabad

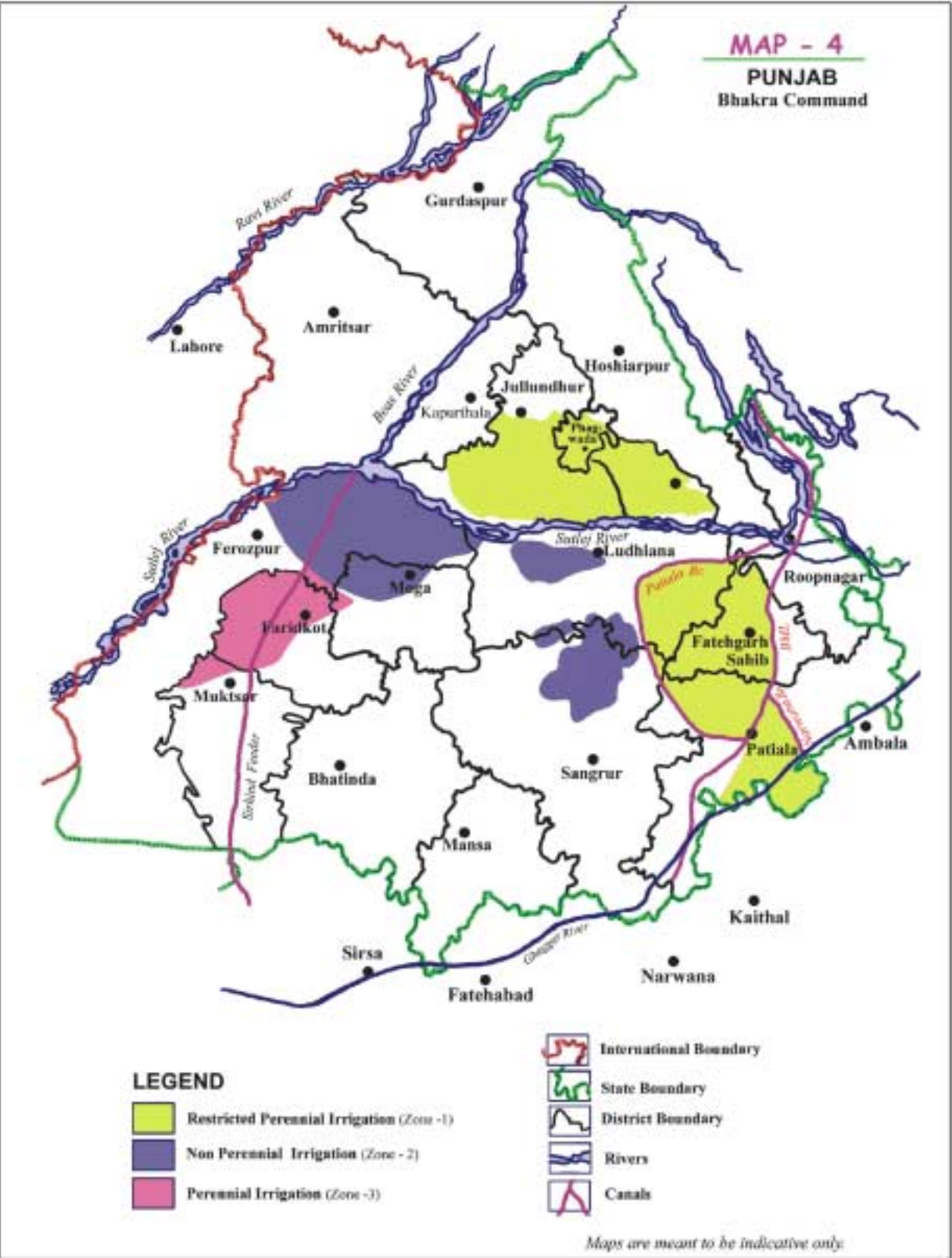
MAP - 3

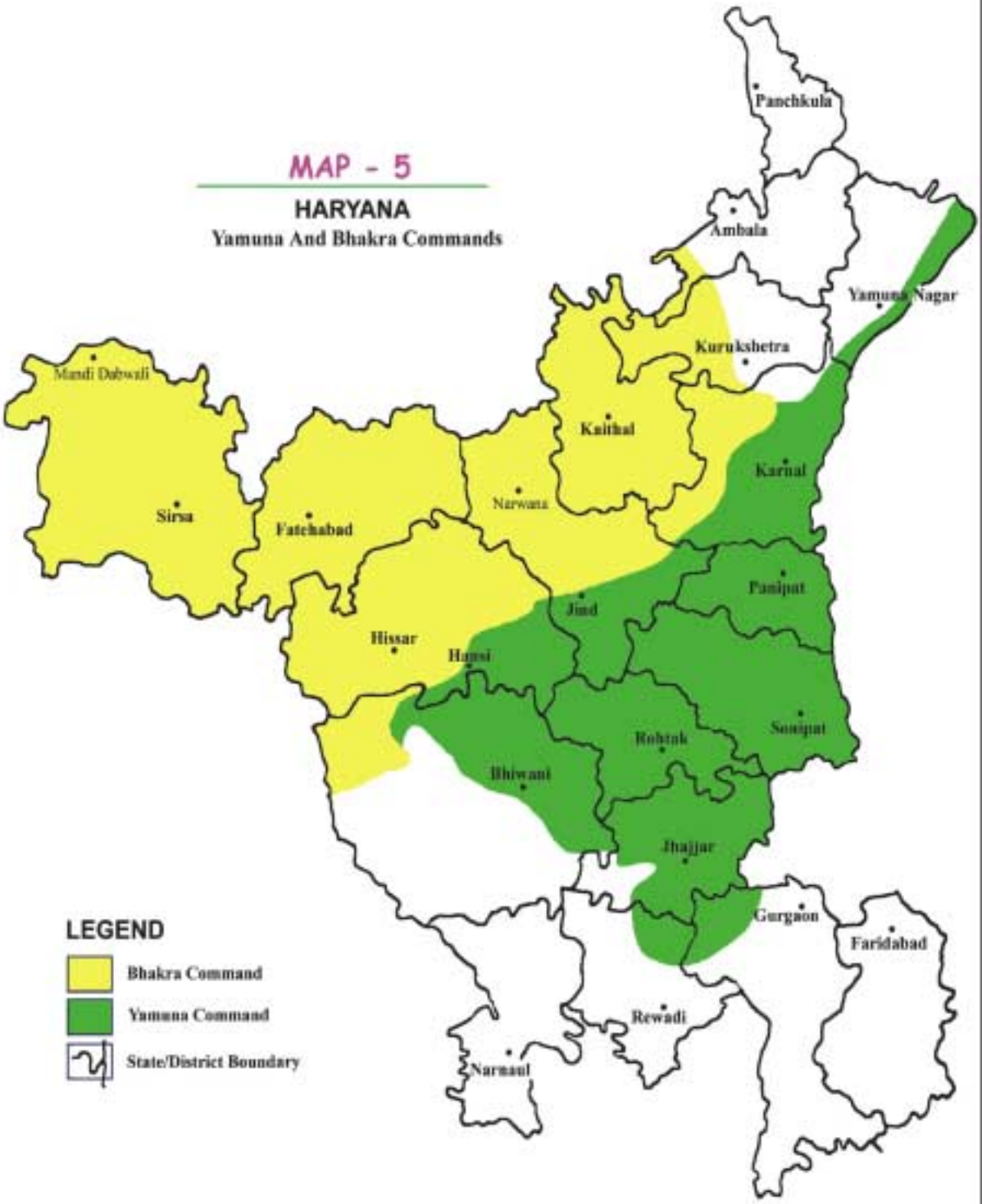
PROJECTS ON RAVI, BEAS AND SUTLEJ

(Schematic Map)



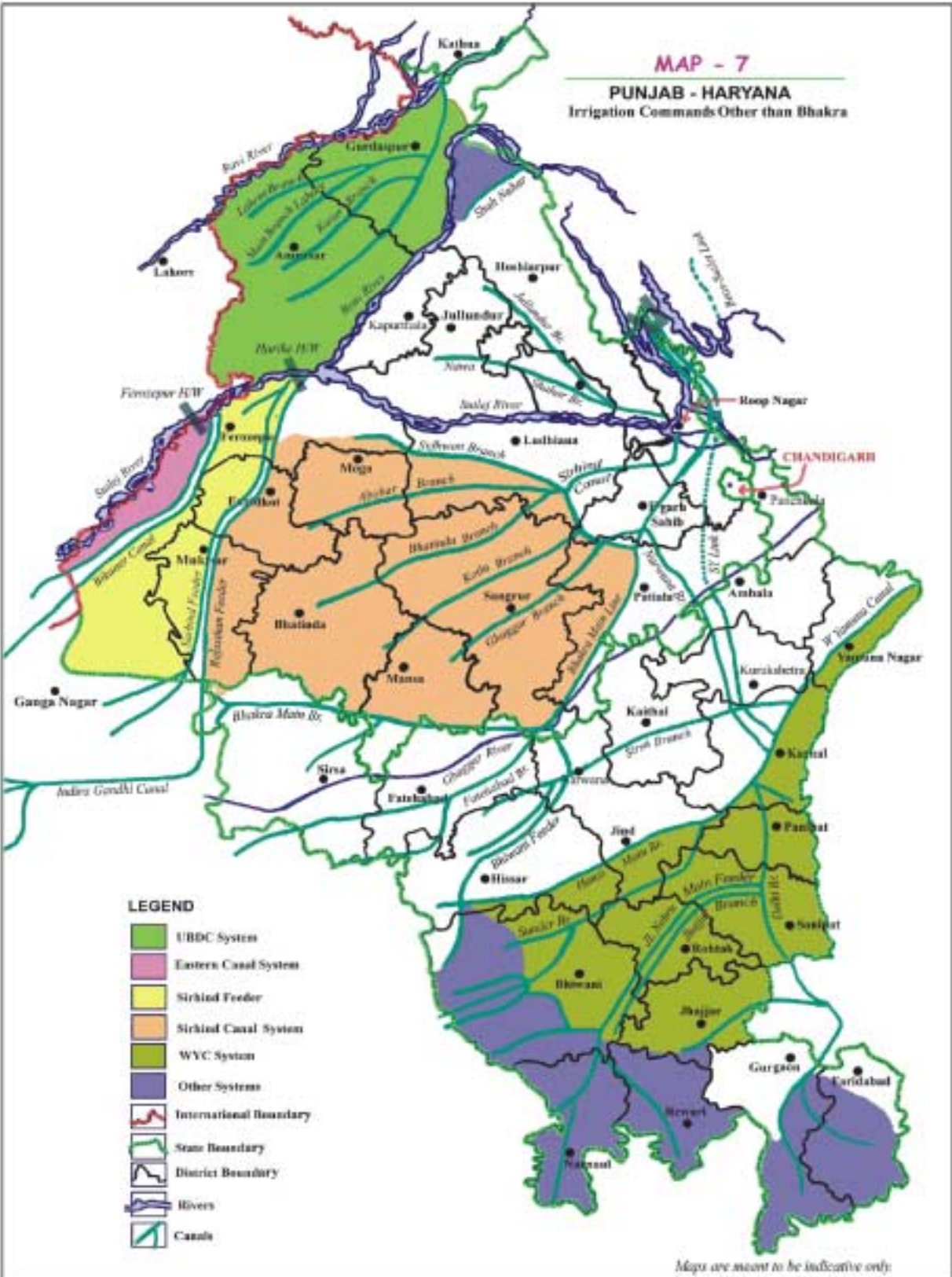
Source - *Annual Administration Report 1998 - 99 of Bhakra Beas Management Board.*


MAP - 4
PUNJAB
Bhakra Command
Ravi River
Gurdaspur
Amritsar
Lahore
Hoshiarpur
Jullundhur
Beas River
Kapurthala
Phagwara
Sutlej River
Ferozpur
Sutlej River
Ludhiana
Mogha
Roopnagar
Faridkot
Fatehgarh Sahib
Muktsar
Patiala
Ambala
Bhatinda
Sangrur
Mansa
Kaithal
Sirsa
Ganga River
Narwana
Fatehabad
LEGEND
Restricted Perennial Irrigation (Zone -1)
Non Perennial Irrigation (Zone - 2)
Perennial Irrigation (Zone -3)
International Boundary
State Boundary
District Boundary
Rivers
Canals
Maps are meant to be indicative only.



Maps are meant to be indicative only.


MAP - 6
RAJASTHAN
Bhakra Command
PAKISTAN
HARYANA
UTTAR PRADESH
MADHYA PRADESH
GUJARAT
Bikaner Canal
Ganga Nagar
Indira Gandhi Canal
Hanumangarh
Churu
Jhunjhunun
Bikaner
Alwar
Sikar
Bharatpur
Dhaulpur
Karauli
Jaisalmer
Nagaur
Jaipur
Jodhpur
Sawai Madhopur
Ajmer
Tonk
Barmer
Pali
Bhilwara
Bundi
Baran
Kota
Jalor
Rajsamand
Chittaurgarh
Jhalawar
Sirohi
Udaipur
Dungarpur
Banswara
LEGEND
Bhakra Command
Canals
International Boundary
District/State Boundary
Maps are meant to be indicative only.


MAP - 7
PUNJAB - HARYANA
Irrigation Commands Other than Bhakra
Kalka
Gurdaspur
Ravi River
Lahore Branch
Main Branch Lahore
Amritsar
Lahore
Shah Nahar
Hoshiarpur
Beas-Sutlej Link
Beas River
Jullundur
Kapurthala
Jullundur Br.
Harike HW
Nawa
Shahar Br.
Sutlej River
Roop Nagar
Ferozepur HW
Ferozepur
Ludhiana
Sirhind Branch
Sirhind Canal
CHANDIGARH
Mogha
Abohar Branch
Faridkot
Fatehgarh Sahib
Panchkula
Bhatinda Branch
Kotla Branch
Makhar
Bikaner Canal
Ghaggar Feeder
Rajasthan Feeder
Sangrur
Patiala
Ambala
Bhatinda
Ghaggar Branch
Bhakra Main Line
Yamuna Nagar
W. Jamuna Canal
Kurukshetra
Mansa
Ganga Nagar
Bhakra Main Br.
Kaithal
Sirsa
Ghaggar River
Sirsa Branch
Karnal
Indira Gandhi Canal
Fatehabad
Faridabad Br.
Tohana
Jind
Panipat
Bhiwani Feeder
Hisar
Hansi
Main Br.
Main Feeder
Delhi Br.
Sonipat
Sunder Br.
Jl. Nahar
Rohtak
Bhiwani
Jhajjar
Gurgaon
Faridabad
Mewat
Narnaul
LEGEND
UBDC System
Eastern Canal System
Sirhind Feeder
Sirhind Canal System
WYC System
Other Systems
International Boundary
State Boundary
District Boundary
Rivers
Canals
Maps are meant to be indicative only

MAP - 8

PUNJAB AND HARYANA POLITICAL

Source - Maps of India

Land affected by waterlogging and salinisation near village Lamba Khedi, Taluka Narwana, District Jind, Haryana. The damage to the crop can be seen as only part of the sown crop has come up. Salt encrustation can be seen in the background.

Land affected by waterlogging at village Lohgad, Dist. Sirsa, Haryana.

Land with heavy salt encrustation on the top. At Directorate Farm, attached to Hissar Agricultural University, Hissar, Haryana.

Failed crop on waterlogged land near Lohgad, Dist. Sirsa, Haryana

A drain *nallah* to control waterlogging, just outside Malout town, district Muktasar, Punjab. The *nallah* is choked with overgrowth of hyacinth. In places, the *nallah* is also used for disposal of sewage, effluents etc.

Seesam trees which have blackened and died due to the waterlogging problem.

Dampness along the wall at a house in Malout town, District Muktsar, Punjab leading to peeling off of the paint and plaster. Waterlogging has impacted about 70% of the houses in this town, and houses require repair at regular intervals.

A stretch of the National Highway No. 10 between Mandi Dabwali, Haryana and Malout, Dist Muktasar, Punjab. The road is being raised and repaired as it has suffered extensive damage due to waterlogging.

Chilli crop on land that previously used to grow paddy. In Punjab, attempts to diversify crops is becoming very difficult as other crops are difficult to raise on lands where paddy is grown.

Study Team

This Report has been authored by ***Shripad Dharmadhikary***, who has also been the lead researcher and coordinator of the study. The research team consisted of ***Swathi Sheshadri*** and ***Rehmat*** (both for part of duration of the study).

Swathi Sheshadri completed her Master of Arts in Social Work (MSW) in May 1999 from the Tata Institute of Social Sciences (TISS), Mumbai with specialisation in Medical and Psychiatric Social Work. She has also completed her Master of Commerce (M.Com) from Sydenham College of Commerce and Economics, Mumbai in August 1997. Before joining Manthan she worked with various organisations in the field of finance and community and mental health. She was with Manthan from its inception in October 2001 till June 2003. In Manthan, apart from the Bhakra study, she was also involved in monitoring water privatisation issues, especially the General Agreement on Trade in Services (GATS). She is currently with the National Youth Foundation in Bangalore.

Rehmat is from a small village Chikhalda, District Dhar, Madhya Pradesh, on the banks of the Narmada. His village, home and land are affected by submergence due the Sardar Sarovar project. He is a graduate (B.Sc.) and worked as a full time activist with the Narmada Bachao Andolan for 12 years. Subsequently trained in planning, designing and constructing water harvesting projects, he worked on such projects in a number of places before joining Manthan. He was with Manthan from July 2003 till Dec. 2003, and has joined again from Jan. 2005. He has been involved with the Bhakra study both, formally, when he has been a part of Manthan, and informally when he has not been a part of the Manthan team. Apart from the Bhakra study, he is involved with the issues of water privatisation and continues to work on implementation of rural water harvesting projects.

Shripad Dharmadhikary completed his graduation in 1985 with a Bachelor of Technology (B.Tech) degree from the Indian Institute of Technology (IIT) Bombay. He worked for a couple of years with industry, and then for a year with a research institute studying development policy issues. He was a full time activist of the Narmada Bachao Andolan for 12 years, before setting up the Manthan Adhyayan Kendra in 2001. Manthan is a centre set up to research, monitor and analyse water and energy issues. He is the coordinator of the centre.

Nilesh Sanotia and **Manish Vyas**, both with Manthan, helped with inputting, managing and cross checking the data. **Himanshu Upadhaya,** on a month's deputation from SANDRP, contributed with some important research input. **Mukesh Jat**, who was with Manthan also assisted with parts of the study.

UNRAVELLING

BHAKRA

is the report of a study of the Bhakra Nangal project carried out by Manthan Adhyayan Kendra. This study was carried out over three years from December 2001 to December 2004.

The Bhakra Nangal project has become a legend in India. It is accorded overwhelming, at times the sole credit for rescuing India from hunger and famine, for making India self-sufficient in foodgrains production, for making Punjab and Haryana highly prosperous and surplus states.

Forty years after it was completed, the project continues to be used as one of the main arguments in justifying new large dam projects in the country. Indeed, "What would be the situation without the Bhakra project?" is a question that it used less as a question than as an answer, as an argument, as a justification.

However, there have been few studies of the precise role played by the project. This study examines the reality behind these perceptions related to the Bhakra project. The study attempts to look at the broad developmental impacts of the project, in particular its impact and contribution to food security in the country.