Report No. 198

Evaluation Study of Sarda Sahayak Pariyojana

Programme Evaluation Organisation
Planning Commission
Government of India
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Preface

At the instance of Planning Commission, Programme Evaluation Organisation (PEO) outsourced the Sarda Sahayak Pariyojana (SSP) to Centre for Advanced Research and Development (CARD) for assessing the impact of the project on farmers' agricultural productivity.

The presentation on the findings of the study was made by study team of CARD under the chairmanship of Deputy Chairman at Planning Commission in January, 2007. The draft report was revised by CARD by addressing the issues that emerged during the presentation. The main findings of the report are:

- The gap between the water requirement for agricultural activities and the availability of assured irrigation to the targeted districts of Uttar Pradesh through SSP is reported to be as high as 50 per cent.

- The impact assessment of the project suggests that mere construction of irrigation canals without judicious mix of land development and adoption of complementary inputs may not necessarily improve the economic well-being of the farmers.

The study received continuous support and encouragement from Deputy Chairman, Member (Evaluation) and Member-Secretary, Planning Commission. The study was designed and conducted under the direction of Dr. Vivek Sharma, Chief Functionary, CARD, Bhopal. Dr. Milindo Chakrabarti with the technical assistance of Shri Anjan Chakrabarti gave a final shape to the present report. The technical inputs and suggestions provided through consultative processes established with CARD by Shri Ashish Kumar, Director, Regional Evaluation Office(PEO) including his team at REO, Lucknow and Shri Servesh Kumar the then Director at PEO, Headquarters under the guidance of Dr. S.P. Pal the then Adviser (Evaluation) deserve special mention. We are thankful to Shri S.K. Sharma, Tech. Officer and Shri Shri S.V. Wankhede, Artist of Charts & Maps Units, Planning Commission for designing the coverpage of the report. The efforts put in by the staff of PEO, Headquarters especially Shri Amar Singh, Director, Shyamoli Sen, Consultant and Shri Dharmender Singh Sajwan, Tabulation Clerk for improving the presentation of the report are gratefully acknowledged.

(V.K. Bhatia)
Adviser (Evaluation)

Dated: March, 2007
Place: New Delhi

Acknowledgement

The Centre for Advanced Research and Development, Bhopal expresses its deep gratitude to the Programme Evaluation Organization, Planning Commission, Yojana Bhavan, Government of India, New Delhi for sanctioning the “Impact Assessment Study of *Sarda Sahayak* Canal Project of Uttar Pradesh”. The study envisaged an in-depth analysis of the impact of the Sarda Sahayak and identifies the impacts of the project at household and village level based on some of the selected socio-economic and environmental parameters.

I am indebted to Irrigation Department, Sarda Sahayak Pariyojana, Ganga Sinchai Bhavan, Lucknow, UP and the respective engineers of the selected districts for extending their kind support and necessary guidance which enabled the investigating team in accomplishment of their objectives of data collection. Mr. S.C.Sharma, Chief Engineer in the irrigation department, who coordinated the liaison work, also deserves gratitude.

I owe my sincere thanks to Mr. Ashish Kumar, Director, Regional Evaluation Office and his team at REO, Lucknow, Uttar Pradesh, for making it possible to carry out the survey in the state. I would also like to thank Dr.S.P.Pal, the then Advisor and Mr.Servesh Kumar Director, Planning Commission, along with their team, who were always ready to help and provide regular guidance during the course of study. Mr V.K.Bhatia, Advisor, PEO deserves a special mention for bringing the study to a conclusive end.

I would also like to acknowledge the members of the investigating team who deserve to be lauded for providing the base of the report through extensive survey, interviews and focus group discussions and adding substantial input by making useful observations which enabled the report to gain a clear insight into the actual situation. The study was conducted by the team comprising Dr. Sunil Dutt Sharma, Amit Sharma, Vishal Nayak, Sachin Sakalle, Gauri Shankar, Manish Gangwar, Atul Afle, Shailender Solanki, Ajit Mishra, Varun Khatri, Vijay Chaudhry, Vivek Rohit, Pitamber Mohanta, Alok Bose, Sandeep Dikhit, Bhagwan Das and Raju Patil. Dr Pradeep Bose, Senior Consultant provided overall supervision and guidance to the survey team and also helped in finalising the draft report. Mr. D.B. Rawat, who provided valuable input in editing the report and Ms. Deepti Nayak and Ms. Bhavana Shrivastava, provided the back up support are also acknowledged.

The active participation of all the stake holders of SSP, i.e. the officials of line departments, the Panchayat representatives and the beneficiaries and non-beneficiaries deserve a share in the success of this venture, as their meaningful participation was the basis of success of all the efforts.

I am also grateful to Dr. Pradeep Bose, Dr. Archana Singh, Er. VP Singh, Er.AM Mathur, Dr. Rajvir Singh, Mr Videh Upadhyay, Ms Madhura Rawat, Mr Aishwarya, Mr.Avinav Kumar and Mr Sameer Kumar for providing technical inputs to the study. Dr.Milindo Chakrabarti, who has finalised the draft report and Mr. Anjan Chakrabarti who provided research support to Dr Milindo, deserve my special thanks.

Dr. Vivek Sharma
Chief Functionary
CARD, Bhopal

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Acronyms

A.En.	Assistant Engineer
CADA	Command Area Development Authority
CARD	Centre for Advanced Research & Development
CCA	Culturable Command Area
Crore	Ten million
Cumecs	Cubic meters per second
Cusecs	Cubic feet per second
CWC	Central Water Commission
Ex.En.	Executive Engineer
FSL	Full Supply Level
Hec.	Hectares
J.E.	Junior Engineer
Lac	Hundred thousand
NGO	Non-Government Organization
PIM	Participatory Irrigation Management
SSP	Sarda Sahayak Pariyojana
S.E.	Superintendent Engineer
UP	Uttar Pradesh
UPWSRP	Uttar Pradesh Water Sector Restructuring Project
WALMI	Water And Land Management Institute
WUA	Water User's Association

Executive Summary

The vibrancy or failure of Indian agriculture is largely dependent on monsoon. The rains that are received during this season are not only erratic in supply but also unpredictable causing devastation like droughts, floods, etc. Realising the peculiar characteristics of monsoon that has far reaching effect on Indian agriculture, the Govt.'s intervention in providing assured irrigation to Indian farmers through surface irrigation assumed paramount importance following the success of green revolution in the early sixties. Sarda Sahayak Pariyojana (SSP) was also one such Govt.'s intervention in 1968 by providing canal irrigation to the unserved areas falling under the command area of Sarda Canal Project (SCP) commissioned in 1926. The 260 km long feeder channel of SSP that emerged from the banks of the Sarda River located in Sharda Nagar village of Lakhimpur Khiri district provides canal irrigation to 16 districts of central and eastern Uttar Pradesh. The SSP aims at irrigating culturable command area (CCA) of 16.77 lakh hectare with 70 per cent irrigation intensity. The project was completed in 2000 with an estimated cost of Rs. 1300 crore.

2. At the instance of Planning Commission, Programme Evaluation Organisation (PEO) outsourced the Sarda Sahayak Pariyojana (SSP) to Centre for Advanced Research and Development (CARD) for assessing the impact of the project on farmers' agricultural productivity with the following objectives of the study:

I. to assess the impacts of the project on households and villages in terms of some selected socio-economic and environmental parameters;

II. understand the systemic impact of SSP on changing the efficiency of the agricultural sector in its command area;

III. investigate the causes behind the time overrun and

IV. suggest necessary remedial actions for improving the effectiveness of the implementation of the project.

3. Sampling Design

Five distributaries and all the 15 districts of the command area are covered under the sample study. The spread of the selected villages was designed to cover all the three irrigation categories of head reach, middle reach and tail reach. The selection was made in such a way that all the districts (at least one tehsil from each district) were covered under one or the other category. Further, from each selected district/tehsil, 4 villages were selected; two villages from the intensively irrigated areas and one village from the moderately irrigated

and one from the least irrigated areas. The sample size used for the study is as follows:

Sample Size for Evaluation of Sarda Sahayak Pariyojana (SSP)

S. No.	Respondent Category	Proposed	Actual Sample
	(A) Command Area Villages		
1	Beneficiary Farmers households under command area	15 per village	971
2	Non beneficiary farmers Households	2/3 per village	138
3	Landless Agricultural Labour	2/3 per village	148
	Sub-total	**1257**	
	(B) Control Villages		
1	Farmers	8 per control village	123
2	Landless Agricultural Labour	2 per control village	31
	Sub-total		**154**
TOTAL			**1411**

4. Investigation Tools & Methods

A comprehensive club of investigative tools was used for collection of primary and secondary Data. The data was collected from sources like *anganwadi* workers, Panchayat offices, *patwaris,* block and district offices, irrigation department and other government offices. The investigation tools included canvassing of (1) Semi-structured Schedules at the levels of villages, households and individuals, (2) Participatory Resource Appraisal Method, (3) holding Focussed Group Discussions and (4) Observations by field investigators.

5. Differential Impacts in Command and Non-Command Areas

Of the total 1411 households surveyed, data for 1232 households have been analysed to assess the impact of the intervention on their income, ownership of assets, etc.

5.1 Impact on Income

If we examine the socio-economic indicators vis-à-vis the farmers falling within the command area of SSP and those remaining outside, we find that *Sarda Sahayak Pariyojana* does not appear to have made considerable impact on the household income, ownership of assets and investment profiles of the people. It is revealed that those residing within the command area enjoy around 6 per cent

advantage in gross income over their counterparts located outside the command area.

5.2 Ownership of Assets

Assets may be distinguished under two categories. While the first category of assets is used in agricultural activities, the other category of assets is used mainly for non-agricultural purposes. There has been a perceptible rise in the agricultural asset base of those residing within the command area of SSP. The only agricultural asset to have lost favour is the dug well. An identical trend is observed in respect of non-agricultural household assets, the exceptions being motorcycles and bullock carts. Incidentally, the residents of the non-command area exhibit a better performance in enhancing their asset profile—both agricultural and non-agricultural — during the period under review. Their performance appears to be much significant as their initial asset base was quite insignificant compared to the residents of the command area of SSP.

5.3 Investment Profile

A comparative assessment of the investment portfolio of the residents of SSP command area and those off it also does not paint a very rosy picture about the impact of the project. The SSP residents have made an average investment of Rs. 38324.58 compared to Rs. 34168.43 by the other group.

5.4 State of Outstanding Borrowing

Investments and procurement of assets are simultaneously accompanied by indebtedness of the residents across the region. The residents irrespective of their location of residences are indebted to the extent of a little over 12 per cent of their gross average annual income. However, the difference is significant in respect of credit requirements for farming, with the command area residents going with a higher level of outstanding credit.

5.5 Irrigation Profile of the Households

An irrigation project is designed to facilitate agricultural practices in its command area. Accordingly, the operational holding per household is higher in the command area, even though a tendency towards further fragmentation of holding is observed in terms of the decline in the size of average operational holding between 1979-80 and 2003-04. Interestingly, the average size of holding has increased significantly in the non-command area— a characteristic feature worth further probing. Irrigation intensity (measured as the ratio of gross irrigated land to operational holding expressed in per centage term) is 83.77 per cent in the command area compared to 88.71 in the non-command area. This difference should be weighed against the fact that in 1979-80, the irrigation intensity in the

command area was 75.99 and that in the other region was 0.00. Another feature worth enumerating is the fact that water from SSP canals irrigates 47.82 per cent of the irrigated lands in the command area, with tube wells chipping in with a share of another 35.85 per cent, a marginal decline from the pre-project situation. While wells catered to 41.98 per cent of the irrigation requirements in 1979-80, their share is becoming insignificant now. In non-SSP regions, tube wells provide 91.34 per cent of the irrigation requirements. It is also observed that around 3.4 per cent of the operational holding is waterlogged in 2003-04 in the command area compared to about 2.5 per cent in the non-command area.

6. Differential Impacts with Command Areas

The changes in agricultural practices in the SSP command area due to implementation of the canal irrigation system have been examined. It is observed that SSP has not only changed the agrarian practices in terms of changing the package of practices adopted for growing crops, portfolio of agricultural crops and their proportional distribution across SSP's command area, but it has also altered the yield rates of these crops significantly.

6.1 State of Indebtedness

The beneficiaries are indebted to the extent of a little over 13 per cent of their gross average annual income, while the non-beneficiaries are indebted to the extent of almost 16 per cent of their gross average annual income. However, the difference is significant in respect of credit requirements for farming, with the beneficiaries going for a higher level of outstanding credit. The beneficiaries are also looking for credit to facilitate their children's education, a feature missing among the non-beneficiaries.

6.2 Impact on Yield

Sample study across sixteen command districts of SSP revealed that the average yield per hectare for four major crops was higher for the beneficiary farmers of SSP command as compared to those of non-beneficiaries.

7. Inter-Temporal Variations among Beneficiaries

The gross agricultural incomes of beneficiaries rose marginally between 1980 and 2004 at constant 2003-04 prices (0.68%). The share of income from animal husbandry sector —around 15 per cent of the total annual income in 1979-80 — dropped to mere 5 per cent of the total in 2003-2004. The species of livestock that dwindled drastically was that of the cows – both bullocks and *desi* cows. However, the quantity of milk sold by the command beneficiaries has marginally increased, due to the rise in number of buffaloes and exotic breeds of cows.

8. Changes in Agricultural Practices

There has been a visible spurt in the use of chemical fertilizers and pesticides while the use of farmyard manure (FYM) dropped drastically by 60 per cent level FYM still remained the essential input for enhancing the land fertility, along with the use of chemical fertilizers. Eight per cent farmers used only the farmyard manure even during the post SSP phase.

Seed Treatment and Sowing Methods have changed considerably. Use of fungicides and culture has become very common which did not happen in the pre SSP phase at all. The pre-dominant use of broadcasting method of sowing still exists, but use of seed drills and row sowing has become quite popular in the latter phase. The use of hormones and weedicides has been rising gradually.

Harvesting practices have not changed much between the year 1979-80 and 2003-04. Manual harvesting is still popular as it was in the late 1970s. However, the post-harvesting practices have changed dramatically during this hiatus of 24 years. Wholesale mechanization of post-harvesting operations has taken place.

9. Impact of SSP on Settlements

Eighty-one villages were studied in detail. There were 391 settlements in these villages. Each village, on an average, had 4.83 hamlets. Only 196 of these hamlets or *purvas*, accounting for 50 per cent hamlets only, received irrigation from SSP. In other words, if SSP claims to have provided irrigation to a village, it actually means SSP was able to provide irrigation to only two of its four hamlets.

The basic services of public health and education cover almost the entire population. The status of veterinary services was relatively poor, as there was only one veterinary hospital located in the entire area. The telephone network and postal services are fairly accessible in the area. Almost 70 per cent of the surveyed villages are electrified. There are 6 branches of different banks servicing the area. The connectivity from the main road to many of the villages is still an issue to the resolved. Land ownership is concentrated in few hands and the proportion of marginal farmers to small and large farmers continues to remain high. A few families were owning the maximum land holdings in the villages of Fatua, Fatehpur and Sahabpur in Allahabad district, where the proportion of cultivators to all other workers ranged between 10 per cent and 13 per cent. There were also villages like Akbalpur in Azamgarh district and Mohanpur Girant in Ambedkar Nagar district where the proportion of agricultural labourers was also abysmally low.

10. Impact of Women

With the introduction of canal irrigation which provided assured irrigation to agriculture, the women's involvement in farming activities has increased. Though the women empowerment in terms of health and family welfare, decision in income spending has not improved, their nutritional status has improved due to increase in farm income.

11. Impact on Employment Scenario

Landless labourers (88%) were able to get sufficient work after the commissioning of SSP. In the pre-SSP phase, only 77 per cent landless labourers were able to find enough work for themselves within the command villages. A shift from the earlier practice of payment of wages in kind to that in cash is visible in the villages in command area. Requirement of captive labour increased simultaneously in the command villages.

12. Impact on Efficiency of Agricultural Sector in Command Area

Under the present trend of globalisation and competitive attitude towards the agricultural sector, it is worth noting whether and how SSP contributed towards increasing the efficiency of agricultural production in its command area. We propose to consider efficiency of the agricultural system in terms of the efficiency of the changes in the land use pattern observed in the command area of SSP between 1979-80 and 2003-04. A look at the data gathered during the survey reveals a considerable decline in the quantum of land under cultivation between 1979-80 and 2003-04. The decline has been caused by several factors like conversion of agricultural land for non-agricultural uses, increased salinity of soil, fragmentation of holdings on inheritance etc. However, the decline in cultivated land was not evenly distributed across the eight major crops grown in the command area. While area under paddy, mustard and sugar increased, that under wheat, millet, maize, gram and *arhar* declined. It is imperative that we investigate if such changes in cropping pattern added to the efficiency of the agricultural system as well the availability of the crops in question in the command area of SSP.

An increase in Total Factor Productivity (TFP) over time signifies an increased efficiency in the sense that same level of output can be produced with lesser amount of inputs (land in the context of the present study) or a higher level of outputs can be generated using the same basket of inputs. While the former approach leads to as an input oriented measure of efficiency, the latter yields output oriented measure of efficiency. In this section we have developed input oriented measure of TFP changes to accommodate the observed decline in the area of land available to grow the major crops in SSP command area.

We constructed the Malmquist Index using Data Envelopment Analysis (DEA) to estimate the extent of changes in total factor productivity (TFP) across the distributaries as well as across the main eight crops that are grown in the command area of SSP. Construction of Malmquist index not only gives a quantitative idea about the change in TFP, but also helps identify the factors contributing to the change.

To facilitate estimation of the Malmquist Indices for each crop across each distributary, we used a simple one output-one input model. Land under a particular crop has been considered the only input in the model, with production, in physical terms, being taken as the output. Thus the impact of the irrigation system on improving the yield of a crop per unit of land between the two points of time under consideration is reflected in the change in TFP. One must add that use of other inputs, like, tractors, fertilisers, credit etc. also contributed to the change in yield of land. We may safely assume that availability of assured and cheap irrigation facilities through SSP preceded the decision to apply increased doses of these inputs in production.

Efficiency analysis using Data Envelopment Analysis (DEA) techniques identify the following features in respect of the change in the cropping patterns in the command area between 1979-80 and 2003-04.

– The total factor productivity (TFP) change in land has been recorded to be the highest for maize, improving by about 111.6 per cent between the periods under review, followed by wheat — around 102.4 per cent.

– On the other hand, there has been around 3 per cent decline in the TFP of gram.

– The improvements in TFP for *Arhar* and Mustard are quite insignificant, while the rest recorded moderate improvements.

– To facilitate comparison, we estimated the corresponding figures for India with data disaggregated at the state level for the comparable period. The results indicate a higher TFP growth for the country as a whole for all crops other than Maize and Wheat. The variations in respect of paddy and millet are not that significant though. This comparison is meaningful keeping in mind the fact that compared to an irrigation intensity of about 43.4 per cent for the country as a whole SSP command area enjoys a figure of 83.17 per cent. SSP canals irrigate about 47.82 per cent of the gross cropped area in the command area!

To look into the contributions of change in efficiency (EFF), change in technology (TECH), change in the efficiency of the decision-making farmers (PEFF) and change in scale efficiency (SEFF) towards the change in TFP, it is observed that:

- All of them contributed positively towards the growth of TFP in paddy, maize, sugarcane and millet, even though the contributions of SEFF —efficiency in identifying an optimal area for cultivation that helps derive maximum return from the land under the particular crop— are the least for all crops.

- Wheat registered a healthy growth in TFP even at the cost of reduction in SEFF, while mustard recorded a decline in all factors excepting in TECH. Apparently, availability of irrigation and the concomitant technological advances contributed to the meagre growth of TFP in mustard.

- Increase in TECH and PEFF helped an insignificant improvement in arhar, while in spite of some improvement in TECH, TFP growth for gram has been negative.

- On comparison with the national scenario, TECH recorded higher values in SSP in respect of paddy, maize, wheat and arhar. Those for sugarcane and millet are considerably lower in SSP, indicating the possibility that either irrigation alone cannot help achieve the desired growth in TFP or the irrigation intensity in the land under sugarcane is much higher than those within SSP command area. Focussed investigations into this issue are imperative to an informed and suitable policy decision.

To develop an overall understanding of the impact of SSP on the efficiency of the agricultural system of the command area, we estimated a weighted composite index of change in TFP with the share of the respective crop in total land under cultivation as the weights. All the distributaries have been ranked in respect of the change in composite index of change in TFP. The rankings indicate a relatively better performance in villages located at the head ends of the distributaries. It is, however, difficult to comment on the relative performance of villages located at the middle ends compared to those located at the tail ends from the data available at hand.

13. Techno-Economic Findings

Like many canal irrigation projects, the gap between the irrigation potential created by SSP and the irrigation potential utilized by it subsequently was big. SSP claims to have the total coverage of 16.74 lac hectares' worth culturable command area (CCA), but it has actually not been able to cover not more than 11.5 lac hectares (68.7% of the designed capacity).

During the course of the study, it was observed that most canals were being run at much below their potential. At numerous locations, belonging to districts of Rae Bareli, Sultanpur, Pratapgarh, Faizabad and Mau, it was seen that when the level of water flow in the distributaries and minors fell below thefull supply level (FSL), the farmers construct artificial temporary bunds to block the water and breach the canal banks or outlets for carrying water to the fields.

Moreover, the actual SSP irrigated area fell below the desired levels. For example, the Sultanpur Branch Canal, which was supposed to irrigate 4002 hectares per year, between the years of 1999-2000 to 2003-04, actually irrigated 2130 hectares (or 53.2%). Similarly, Faizabad *prakhand*, which was supposed to irrigate 76,142 hectares per year, between the years of 1999-2000 to 2003-04, actually irrigated 31869 hectares (or 41.85%).

Researchers found that about 150 minors in Jaunpur, Rae Bareli district, along the course of Hydergarh's flow; were going to be handed over to the water users' association (WUA) in near future. Hence SSP was vigorously engaged in creating WUA related bodies. But the actual implementation model and its action processes, with WUAs at the helm of affairs, were not made clear to the WUA members. The procedures and formalities of making WUAs seemed more important to the SSP and the World Bank aided UP's Water Sector Restructuring Project than the promotion and development of a situation specific participatory Irrigation management based model for the SSP command; for which no worth while action research project was undertaken.

Segregation of SSP's activities from those of Command Area Development Agency and latter agency's inability to garner community support and absence of water users' effective body–led to formation of least participatory irrigation management system in the command area of SSP. Lack of respect and say for the most important stake holders of SSP, the farmer beneficiaries, jeopardized the formation of any rational water delivery scheduling system from the very start. Further, the irrational water rates helped the community to turn around and put the department on the dock. Whereas the department of irrigation that owns and runs the SSP, hardly recovers 33 to 40 per cent of the total annual operational cost of the project.

It was also understood by the team that the Feeder channel passed through some sodic or *usar* patches. The channel banks on *usar* soil patches get

easily eroded owing to their lightness. Moreover, a considerable chunk of usar soil gets dissolved in water. Thus berm formation process along the banks is not accomplished, leading to collapse of banks on the usar patches, causing flooding of many miles within the command area of SSP. However, the area under saline land in SSP command is decreasing. Because flushing saline lands with irrigation causes leaching of salts.

Field based discussions suggested that the water charges should be based on volume of water consumed per farmer per interval and not on the area irrigated and the crops taken.

A detailed study of 36th Irrigation Division of SSP was undertaken. It showed that between four years (1997-98 to 2001-02) total loss in irrigated land area was about 39000 hectares, in this division alone.

Sitapur, Ambedkar Nagar, Mau, Jaunpur and Varanasi districts have already exploited their ground water potential beyond 55 per cent. Hence these districts are left with very limited surplus ground water left to tap.

One of the major reasons for lesser availability of water, increase in maintenance costs and loss of revenue is theft of water from breaches in the distributaries and minors. This can be overcome to an extent by handing over more and more of the minors to the WUAs and at the same time by an increased level of vigilance and patrolling.

14. Critiquing Financial Aspects of SSP

Regarding Institutional Policy and legal analysis of Sarda Sahayak Pariyojana, it might be construed through developing a close understanding of structural and non-structural initiatives undertaken under this Pariyojana. The structural initiatives include SSP command area development project established in 1973-74, full utilization of the intended irrigation potential leading to creation of field channels, lining of channels and creation of water control structures under On Farm Development Programme (OFP). Performance of SSP in terms of undertaking such structural initiatives could be termed adequate. Whereas, the performance of SSP in terms of undertaking non-structural initiatives constituting development of Osrabandi, Wara bandi scheme, the creation of farmer's association for allotment of irrigation water or water user association, the identification of beneficiaries as per their landholding, the role of *Panchayati Raj* Institutions and in particular *Jal Prabandhan Samitis* at the village level has particularly been lacking and need further tightening up. Over eleven cost iterations were made for SSP, resulting in escalations in its estimates. The projections and estimates of SSP at the initial stage in 1966-67 were for Rs. 99.61 Crores, which ultimately rose to actual investment of Rs. 1299.12 Crores by March 2001.

One very significant aspect of SSP that needs reiteration here is that large parts of Feeder Channel, as well as the main canals were not lined because of

the cost escalation factor. However, non-lining of the canal has made the Sarda Canal System a high water conveyance loss system. Only 56 per cent of the total volume of water that it carries actually reaches the users.

There might be many genuine reasons for cost escalation of SSP over its eight estimates. However, one can't gainsay the fact that due to a large amount of maintenance and operating costs that accrued between 1968 and 2001 have been added over the years and capitalized. Hence the fixed cost of SSP seems inflated by a margin of about 16 per cent. Of the several causes attributing to the cost escalation and price rise - over-shooting the planned timeframe and inadequate provision in the previously developed proposals - were the two most substantive causes. These two causes together accounted for the cost rise to the tune of 87.18 per cent. Price rise was most significant because it alone contributed to about 52 per cent of cost escalation. Inadequate provision of costs in the earlier proposals contributed for rise in costs by 35.18 per cent. Similarly, the reasons for cost escalation explained in building the link channel of 28.4 Km also seem difficult to digest. We find that three line items of cross drainage, earthwork and maintenance together accounted for 71.35 per cent of the total escalated amount. And it seems illogical to believe that the earlier designers could not visualize the needs for cross drainage, earthwork and maintenance rationally. In any case, the link channel had to make provisions for cross-drainage of Soti and Suheli rivers; but building those huge siphons as the best and effective cross-drainage pattern–one could do without and go for cheaper alternate solutions. Another factor that led to an extra ordinary rate in cost-swell was the lining of feeder- channel in a very late phase of the project implementation, costing additional amount of Rs. 156 crores. Yet, only a very small fraction of the feeder channel was lined, that hardly reduced the conveyance losses, in any significant way. Finally, the escalation of costs owing to the changed estimates in construction of five main canals from the feeder channel too needs critiquing. Building a 258.5 Km. long Feeder channel and carrying 23,000 cusecs of water without lining of its bed taught the irrigation department a very important lesson that it will have to undertake lining of its largest canal's bed, as well. Hence the Daryabad canal had to be lined. It led to cost escalation to the tune of about Rs. 30 crores. But no satisfactory reason was given for unprecedented rise in earthwork of canals from about eight crores to 92 crores, more than 11 times the initial budget. Three reasons furnished do not answer the question, fully. Well, owing to delays, cost escalation of 24 crores has been budgeted. How could there be three times the escalation of the original cost? Two other reasons cited for cost escalation are: change in scope and inadequate provisions in the previous proposal. If one were to look at it critically, one finds that it was rather the political expediency than in the expansion of scope, which caused unduly expansion in the cost of earthwork, bridges and regulators. The long stretches of Dariabad and Hydergarh branches have actually eaten into the coffers of state government and left the farmers high and dry (in remote areas of Azamgarh, Mau, Gazipur and Ballia).

The Sarda Sahayak Project, with its full development and utilization of irrigation capacity, has resulted in additional food production of 9.73 million tones annually and also it has added significantly to the production of some non-food items also. The expected increase in revenue owing to SSP was expected to be worth Rs.2278.15 crores per annum. But it achieved about 40 per cent of the expected revenues per annum. While the capital investment on SSP works out at Rs.6629.44 per hectares. Thus return on capital is 3.25 per cent and the benefit cost ratio works out to 7.08.

15. Conclusions and Suggestions

If we were to deduce the gross cropped area of SSP's command area we shall have to look at the ratio of kharif and rabi crops in the post-canal scenario. Actually the area under *rabi* crop is about 25 per cent more than the Kharif crop area. Hence, if we count double the cropped area in these districts and add 20 per cent of *jayad* crops in the command area, the total figure will come between 12.5 to 13 lacs ha of the total canal irrigated area in the SSP command.

With the commissioning of SSP the command districts have been able to irrigate 90 per cent of their arable area. In reply to the queries regarding the adequacy, timeliness and silt-free nature of water provided by SSP, 57.22 per cent farmers said that they were satisfied with the water resource, for its adequacy, timeliness and de-silting efforts. Non- availability of enough water in time - was the major problem of most of the dissatisfied farmers. Silting and clogging of canals was articulated as the second biggest problem of the farmers. The upstream farmers sometimes caused the problem to the farmers at the tail end due to their deliberate cutting and bunding of canals. Thus they stopped water to reach the downstream farmers, at the tails. But, SSP's technical failure to reach the tail ends could not be condoned, which occurred due to a bevy of problems, including- water logging, high conveyance losses, faulty designs and cutting at the up streams.

One very interesting conclusion becomes apparent that even though all the hype created by SSP was that it would bring adequate water to Purvanchal region of Uttar Pradesh or the districts of Ballia, Gazipur, Jaunpur, Mau and Azamgarh; it actually delivered only 50 per cent of what it was set out to achieve. Many farmers in Ballia, Gazipur, Azamgarh and Mau still await the promised water to reach their fields. Rather, the lands of these farmers have become the ready flooding grounds for the swollen waters of rainy season. Now, with the basin approach being mooted, probably, the policy makers and engineers will focus on the Sarju-Ghaghra sub-basin of Ganga basin also and try to reach its saturation level, as early as possible. However, the gap between water required and water available is quite big to fulfill unless 8,000 Cusecs of water is earmarked for these four eastern UP districts.

It was a mistake made by our engineers to site the diversion of Ghaghra channel at Katarnia Ghat. If diversion were made eight kilometres up stream, while Ghaghra was still traversing the rocky surface and not the alluvium plains, it would have contained as little silt as did the Sarda Canal. Another engineering related mistake observed by the researchers was that in eight of 55 villages visited the bed level of canal minors was lower than the level of fields at multiple sites, which made the flow irrigation redundant unless one embanked the channel's flow through land-filled abutments and water spilled over the canal banks, causing damage to banks of canal.

There does not seem to be any reasonable justification for not undertaking conjunctive irrigation methods in the initial phases of SSP implementation. It could have contained a lot of sodicity related problems that ruined thousands of hectares worth good land in the districts of Rae Bareli, Pratapgarh, Sultanpur, Barabanki, Faizabad and Allahabad in late 1970s and early 1980s. Nevertheless, it needs to be pursued more vigorously, now. Similarly, SSP top management's inability to develop and package an indigenous participatory irrigation management (PIM) based model in its early phase of implementation – was another major oversight; which needs to be corrected soon.

Policy makers will have to make hard decisions soon to help turn around the management of SSP, both operational and strategic. There have though been instances of irrigation department seeking over all consultancies from IIM, Lucknow and TCS; but these seem to be thematically and operationally very limited and narrow, despite not seemingly sounding so. Because these were minor palliative measures and not long-term perspective based overhauling mechanisms. Moreover, it might not be possible anymore for Uttar Pradesh Government to keep subsidizing enormous quantities of water to a section of the society indefinitely. Besides, it is time now to introduce PIM in the SSP command area, with open door policies, whereby, the SSP Management invites NGOs to help develop and implement PIM modules in various irrigation sections of the *pariyojana*. Rediscovering issues related to *osrabandi* and *warabandi* and redefining the role of CADA in the newer set up are also very germane to the PIM agenda. Then comes the issue of identifying cost and responsibility centers of SSP and redesigning of entire organizational structure around these seems to be the need of the hour. Further, any overhaul without retraining and re-inducting schedules of the staff is not going to work. Hence it is a tall but necessary order.

The experiences from the impact of SSP also suggest that mere construction of irrigation canals, without taking adequate care of ensuring efficient utilization of land and other complementary inputs, may not necessarily improve the livelihood status of the farmers, compared to those not being accorded the benefits of a canal irrigation system. Simultaneous institutional support are necessary to guarantee that the efficiency of the agricultural system is improved to its optimal level.

Chapter 1

Introduction

1.1: Introduction - Plan of the Report

Indian agriculture is often identified as inefficient due to its greater dependence on monsoon. The onset of green revolution and the attendant shift to modern technology requiring use of high yielding variety of seeds, chemical fertilisers, pesticides and to top it all, assured and larger supply of water played a major role in increasing the importance of irrigation in Indian agriculture. As per the figures available, around 41.24 percent of the country's gross cropped area was irrigated in 2002-2003. A source-wise break-up reveals a further smaller share of surface water in India's irrigation potential (28.2% by canals—both government and private, and another 3.61% by tanks). About 63.31 percent of irrigation demand was met out of ground water reserve in 2002-03. The corresponding figure for 1970-71, at the dawn of green revolution, was 35.49 percent. In view of the growing concern about the rapid depletion of the ground water reserve, the necessity of developing irrigation systems dependent on surface run-off water cannot be overemphasized.

However, there exists a strong debate about the way to utilise the surface water. A mainstream argument runs in terms of constructing huge reservoirs on a river and store the water for controlled use as and when necessary. Even though such efforts have multi-purpose utility like hydro-power generation and flood-control, 95 percent of India's large dam-based water management systems are primarily constructed for providing irrigation services to the nation[1]. The opponents of this view argue that a large dam based irrigation system not only inflicts considerable environmental damage on the region, it is 1also not cost-effective[2] (McCully, 2001, Singh, 2002).

Sarda Sahayak Pariyojana (SSP) was initiated in 1968 with the objective to irrigate a culturable command area (CCA) of 16.77 lac hectares with 70 percent irrigation intensity, effective irrigated area thus being 11.69 lac hectares. The initial cost estimates were Rs. 64.84 crores. The project was ultimately completed in June 2000 with an estimated cumulative cost of around Rs. 1300 crores. However, in the process the project underwent considerable changes in

[1] Dams: by Esther Duflo & Rohini Pande: NBAER Working Paper 11711, October 2005 Page 6.
[2] Silenced Rivers: The Ecology and Politics of Large Dams: by P. McCully: Zed Books: London: 2001; Taming the Waters: The Political Economy of Large Dams in India: by S. Singh: Oxford University Press: New Delhi: 2002.

terms of its design and the revised estimate of the size of the CCA has been worked out to be 19.25 lac hectares. These figures suggest the unit cost of irrigation per hectare to be Rs. 6753. Such a unit cost compares well with those of some of the big irrigation projects being carried out right now. For example, cost of creating irrigation potential for 1 hectare of cultivated land under the Sardar Sarovar Project in Gujarat is estimated at Rs. 172000. The corresponding figure for Indira Sagar Project in Madhya Pradesh stands at Rs. 123740.

Sarda Canal Project (SCP) emerges from Upper Sarda Barrage located at Banbasa village of Nainital district in Uttranchal state. It was commissioned in 1926 for providing protective irrigation to fifteen districts of central and eastern Uttar Pradesh (UP). Besides, it provided basic irrigation support to ten north central districts of UP. After four decades of SCP's installation, in late 1960s, there was a dramatic spurt in demand for irrigation owing to the onset of green revolution in India, in general and in the command area of Sarda Canal, in particular. In a study, conducted by irrigation department of UP in 1967, it was found that SCP was able to provide irrigation to only 19 percent of its command area. Hence a new project, called *Sarda Sahayak Pariyojana*, was conceived and formulated in 1968 for providing canal irrigation to those un-served areas of SCP's command.

Being one of the premier river diversion based irrigation projects of India, SSP provides canal irrigation to sixteen districts of central and eastern UP. The 260 Km. long Feeder Channel of SSP emerges from the banks of Sarda River, located in Sharda Nagar village of Lakhimpur Khiri district. Five major canals, viz. Dariyabad, Barabanki, Pratapgarh, Allahabad and Hydergarh arise from the Feeder Channel that provide irrigation to lakhs of farmers in 150 development blocks of 16 districts in UP. The total length of SSP based canals, including minors and distributaries, comes to approximately 15,000 Km. A lion's share of the feeder channel's water is drawn from Ghaghra River through a link canal of 28.7 kms that has the discharge capacity of 480 cumecs. The link canal emerges from Girija Barrage, in Bahraich district and falls in the Sarda River at Sharda Nagar.

This project was installed with the discharge capacity of 23,000 Cusecs and culturable command area (CCA) of about sixteen lac hectares to augment and extend irrigation in the lower reaches of Sarda Canal System. The project envisaged diversion of supplies from rivers Ghaghra and Sarda by constructing barrages across and linking the two. SSP provides very exhaustive irrigation to six districts of Allahabad, Rae Bareli, Sultanpur, Barabanki, Jaunpur and Pratapgarh but provides below 20 percent of the districts' total demand for irrigation services in the (five) districts of Ambedkarnagar, Faizabad, Mau, Sitapur and Varanasi. However, the districts of Ballia, Gazipur and Lucknow get barely 20 percent of the total irrigation through the SSP.

The objectives of the present evaluation study are to

– Identify the impacts of the project at the levels of (i) household and (ii) village in terms of some selected socio-economic and environmental parameters;

– Understand the systemic impact of SSP in changing the efficiency of the agricultural sector in its command area;

– Investigate the causes behind the time overrun and

– Suggest necessary remedial actions to ensure the objectives for which the project was designed and commissioned are meaningfully achieved.

The present report is divided into 5 chapters. The first chapter introduces the project and describes the sampling design and methodology taken up for the study. Socio-economic impact of SSP has to be understood from three perspectives. Firstly, the differential impacts on villagers situated within the command area of SSP and those residents off it are to be considered. Secondly, it is necessary to understand the differences in impact, if any, of the project on those who have access to canal waters compared to those who do not enjoy such privilege, both residing within the command area. Chapter 2 not only takes up these issues spread over three separate sections, but also looks deeper into the impact of SSP on the vulnerable sections of the society, namely, women and the landless workers. Chapter3 involves an exercise to understand the systemic impact of SSP in changing the efficiency of the agricultural sector in its command area. Chapter 4 is devoted to techno-economic findings and investigates the causes behind the time overrun. Chapter 5 concludes by suggesting necessary remedial measures to meaningfully achieve the objectives of SSP.

1.2: Sampling Design and Methodology

1.2.1 Methodology

A multistage stratified random sampling procedure was followed to identify the respondents for the socio-economic survey. At first, out of the total 9000 villages covered by the SSP a smaller set of 300 villages, 20 villages in each district, were identified for further sampling purposes based on the following criteria:

– Situation of Villages on main canal and distributaries

– Situation of Villages in the canal network-on head, middle, and tail end

– Size of village

– Roadside villages/interior villages

Of the 300 villages identified as above, five villages from each district were selected. Of the five villages per district (along the routes of two distributaries per district) four villages were command area villages and one was a control village. Further, of the four command area villages, two were located on the head of the canal, one located at the middle and another at the tail end of the canal.

From each of the sixty command area villages, twenty respondents were selected for recording the impact assessment data. Out of these 20 respondents, 15 were beneficiary farmers, and 5 were non-beneficiary farmers and landless agricultural labourers together. Similarly, from each of the 15 control villages, the selected sample included 8 farmers and 2 landless agricultural labourers. The overall selection of beneficiaries was based on the following criteria:

– The size of irrigated landholding of the respondent household.

– Literacy level.

– Caste classification.

– Status regarding poverty line.

Therefore, a total of 1411 respondents were identified, as under.

Table: 1.2.1 Sample of Respondent Households

	Respondent Category	Proposed	Actual Sample
(A)	**Command Area Villages**		
1.	Beneficiary Farmers households under command area	15 per village	971
2.	Non beneficiary farmers Households	2/3 per village	138
3.	Landless Agricultural Labour	2/3 per village	148
	Sub-total		**1257**
(B)	**Control Villages**		
1	Farmers	8 per control village	123
2	Landless Agricultural Labour	2 per control village	31
	Sub-total		**154**
	TOTAL		**1411**

1.2.2 Investigation Tools and Methods

A comprehensive club of investigative tools was used for collection of primary and secondary Data. The secondary data was collected from sources like *anganwadi* workers, Panchayat offices, *patwaris,* block and district offices, irrigation department and other government offices.

a) Semi-structured Schedule

Separate schedules were prepared for eliciting information from each respondent group like beneficiary farmers, non-beneficiary farmers and landless labourers. One set of schedule was to study the household level changes on various aspects like income-expenditure pattern, changes in asset holding, basic amenities and living conditions along with the profile of the respondents. Another schedule was prepared to collect information on overall impact of canal project on gender issues at the village and household level and facilitating equity, if any, in gender relations. Yet another schedule was prepared for landless (agricultural labourers) respondents to map the changes in occupational profile, employment conditions and their relationship with the farming community. A separate schedule was developed to appraise the changes in agriculture pattern, animal husbandry practices, technology shifts, and post-production practices. In a few selected villages, where the WUAs were in place, a separate schedule was designed to understand the performance and functionality of WUAs. The details of the schedules prepared are;

Village Level Schedule

The schedule has two parts. The first part deals with the available infrastructure level and the second part canvasses the post project changes in the land use, land holding, occupation patterns, changes in irrigation levels and sources, and changes in the production of various crops. The impact is also measured through assets creation, environmental changes and irrigation levels.

Household Schedule

Household schedule is the main instrument of data collection over two periods of pre and post project. The first part of the schedule has demographic information and land holding details. One part deals with farm-based production, yield and market price etc of agriculture, horticulture, livestock, fisheries etc. One section records the items of household income and expenditure from primary and other sources of occupation while the other part records all the household and farm assets. The impact of project is also assessed through the changes in housing condition, savings and investments and the level of indebtedness.

Individual Schedule

The individual schedules were canvassed for three category of respondents namely; farmer household, landless labourer and women to asses the direct and indirect impact of the programme on these categories. The impact on landless labourer was assessed through changes in work responsibility, mode, duration and level of payments, wage rate, etc. The gender issue was assessed through the changes in the role of women in occupation, mobility and in decision-making. The impact on farmers' households was assessed through changes in the agriculture production, cropping pattern, assets and incomes, etc. Changes in the irrigation and agricultural practices were also studied. All these household level and individual schedules were canvassed to both the beneficiaries and non-beneficiaries.

b) PRA Techniques

Participatory Resource Appraisal (PRA), helped investigators in rapport building with local communities, understand them and make the respondents comfortable in participation of the data collection exercise. It acted as an ice-breaking exercise. PRA processes were used to generate different kinds of data, identifying groups and evoking their participation. Village level demographic details were collected from secondary sources while data on irrigation, farmer's response, asset allocation, irrigation and agricultural impact etc. as collected through PRA exercises like social mapping, resource mapping, and timeline exercise.

c) Focused Group Discussion (FGDs)

Focused group discussions provided access to forms of data that were not obtained easily with either of the other two methods. With the help of FGD, small and homogenous group were brought together as representatives of a much larger community; for example the farmers group or the women heads of the farming community or the landless labour etc. The purpose was to create an informal situation in which the members of the group could discuss the topic of concern among themselves with the help of a facilitator and in the presence of one or more observers. A free and fare atmosphere was deliberately created so that the group participants could feel that they can express what is truly in their minds and hearts. FGDs were conducted with the senior and experienced farmers for generating qualitative information on changes appearing in agricultural pattern and husbandry practices over the decades since the initial period of the project. A framework of questions was prepared to keep the discussion on track and to help the investigators at the time of focused group discussions.

d) Observations

In the current study, simple non-participant observation has been followed. The investigators observed various aspects related with the study and an observation guide was prepared for the purpose. Observation diary was maintained by each investigator to preserve the data being captured by them during field visit, which were later used for triangulation and giving a complete perspective of the situation.

Tool Preparation & Pre-testing

After the indicators for recording the impact were identified, suitable tools were designed for collecting data on each aspect, keeping in mind the different respondent groups. The tools were pre-tested in the command area of medium sized canal irrigation project (Barna dam) in Hoshangabad district of Madhya Pradesh. The investigation team members were made aware of the technical aspects of the irrigation projects. The team members were able to test the instruments of investigation, which were later modified on the basis of field findings. They could also gain confidence by understanding all the technical terminologies of canal irrigation systems.

1.2.3 Field Investigation

The primary data were collected with the help of personal interviews, conducting focused group discussions, observation and exercising PRA techniques with the groups and individuals. The team of investigators consisted of multi-disciplinary researchers of varied experience. The primary data collection was carried out from May 2004 to August 2004. The secondary data collection, however, continued till November 04. The purpose of the study was disclosed to the respondents before the group meetings so that their expectations, if any, were normalized.

Along with the socio-economic study, three subject-specialists studied three other important aspects respectively. These aspects were environment and legal consequences of the irrigation intervention, technical aspects related to irrigation efficiency and financial features of the canal system.

Chapter 2

Differential Impacts

2.1: Differential Impacts in Command and Non-Command Areas

Household level impact of SSP can be evaluated from three perspectives. Firstly, a spatial comparison between the impacts on the farmers located in the command area and off it can identify the differentials. Such differences can be highlighted in this section. Secondly, it is necessary to identify the differences in impact on the beneficiaries of the canal system and those who were not to receive any direct benefits directly from the canals as per the technical design of the canal system—both the groups residing within the command area. The following section goes into such details. Finally, an inter-temporal comparison between the status of the beneficiaries before the onset of the project and that obtained after inception also helps identify the impact. Section 5 concentrates on the inter-temporal variations in impact on the project beneficiaries.

2.1.1 General Household Profile

Table 2.1.1 gives a brief profile of the villagers surveyed. Although a total of 1411 households were surveyed during field visits, data for 1232 households have been utilised for generating the tables below. A little over 21 percent of these households are below poverty line, with the incidence of poverty being a shade higher in the command area. As “elite capture”–control and capture of the facilities available in the public domain–is often cited as a reason behind failure of public sector intervention in development, it will be interesting to note that lesser proportion of representation in the local level institutions by the sample households is observed in the command area. It is worth noting that a larger proportion of sample households are members of water users’ associations in the non-command area - a feature, probably of far reaching implications for the success or otherwise of the SSP irrigation system in achieving the objectives identified for it.

Table 2.1.1: General Household Profile

	Command Area	Non-Command Area
Number of households	**1113**	**119**
Number of households below poverty line	**237** (21.29)	**22** (18.49)
Membership in *Panchayati Raj* Institutions	**61** (5.48)	**10** (8.40)
Membership in Water Users' Association	**19** (1.71)	**5** (4.20)
Membership in Village Committees	**24** (2.16)	**6** (5.04)

2.1.2 Impact on Income

If we examine the socio-economic indicators vis-à-vis the farmers falling within the command area of SSP and those remaining outside we find that *Sarda Sahayak Pariyojana* does not appear to have made considerable impact on the household income, ownership of assets and investment profiles of the people. Table 2.1.2 provides a comparative insight into the differences in average gross and net income between the villagers located within the command area and those off it. It is revealed that those residing within the command area enjoy around 6 percent advantage in gross income over their counterparts located outside the command area. However, once we concentrate into the net income, a more realistic parameter for comparison in livelihood profiles, those off the command area appear to be in a little advantageous position, enjoying around 6.6 percent higher income.

Table 2.1.2: Gross and Net Incomes of the Villagers

	Command Area		Non-Command Area	
	Pre-project	Post-project	Pre-project	Post-project
Average Gross Income in Rs. (current prices)	**8733.96**	**73844.97**	**N.A**	**69729.53**
Average Gross Income in Rs. (constant 2003-04 prices)	**49154.09**	**73844.97**	**N.A.**	**69729.53**
Average Net Income in Rs. (current prices)	**N.A.**	**16644.56**	**N.A**	**17742.54**
Average Net Income in Rs. (constant 2003-04 prices)	**N.A.**	**16644.56**	**N.A**	**17742.54**

2.1.3 Ownership of Assets

Assets may be distinguished under two categories. While the first category of assets is used in agricultural activities, the other category of

assets is used mainly for non-agricultural purposes. Table 2.1.3 suggests that there has been a perceptible rise in the agricultural asset base of those residing within the command area of SSP. The only agricultural asset to have lost favour is the dug well. An identical trend is observed in respect of non-agricultural household assets, the exceptions being motorcycles and bullock carts. Incidentally, the residents of the non-command area exhibit a better performance in enhancing their asset profile—both agricultural and non-agricultural—during the period under review. Their performance appears to be much significant as their initial asset base was quite insignificant compared to the residents of the command area of SSP. One interesting point worth noting is the fact that only one in 100 households of those staying of the SSP command area owned a house in 1979-80, now an average household own more than 1 house. The residents of the villages enjoying the irrigation facilities of SSP are yet to achieve this distinction. The average number of owned houses per household is still less than 1.

2.1.4 Investment Profile

A comparative assessment of the investment portfolio of the residents of SSP command area and those off it also does not paint a very rosy picture about the impact of the project (Table 2.1.4). The SSP residents have made an average investment of Rs. 38324.58 compared to Rs. 34168.43 for the other group —an advantage of a little over 12 percent. Again, in view of the fact that they began with a zero investment portfolio in 1979-80, their achievements are quite creditable, putting an question mark on the effectiveness of SSP. A look into the investment profile at a disaggregated level provides further interesting insights. Residents of non-command area pay, on an average, a higher insurance premium compared to those from the command area. The former invest nothing on land development, though they have been investing quite heavily in capital goods. Command area residents are paying more on loan repayment and real estate assets. The craze for gold and silver does not appear to differ considerably between the two groups.

2.1.5 State of Indebtedness

Investments and procurement of assets are simultaneously accompanied by indebtedness of the residents across the region (Table 2.1.5). The residents irrespective of their location of residences are indebted to the extent of a little over 12 percent of their gross average annual income. However, the difference is significant in respect of credit requirements for farming, with the command area residents going with a higher level of outstanding credit.

Table 2.1.3: Asset Profiles of the Villagers

Assets per household (number)	Command Area		Non-Command Area	
	Pre-project	Post-project	Pre-project	Post-project
Agricultural Assets				
Tractors	**0.01**	**0.10**	**0.00**	**0.03**
Threshers	**0.05**	**0.19**	**0.00**	**0.15**
Chaffcutters	**0.45**	**2.97**	**0.01**	**0.78**
Pumpsets	**0.06**	**0.18**	**0.00**	**0.24**
Improved tools	**0.04**	**0.14**	**0.00**	**0.22**
Wells	**0.19**	**0.15**	**0.00**	**0.15**
Tube wells	**0.11**	**0.34**	**0.00**	**0.42**
Harvesters	**0.00**	**0.00**	**0.01**	**0.00**
Non-agricultural Assets				
Own house	**0.87**	**0.98**	**0.01**	**1.08**
Televisions	**0.01**	**0.29**	**0.01**	**0.39**
Refrigerators	**0.00**	**0.01**	**0.00**	**0.03**
Washing Machines	**0.00**	**0.00**	**0.00**	**0.00**
Air coolers	**0.00**	**0.04**	**0.00**	**0.03**
Motor cycles	**0.02**	**0.01**	**0.19**	**0.18**
Four wheelers	**0.00**	**0.01**	**0.00**	**0.04**
Telephones	**0.00**	**0.04**	**0.01**	**0.03**
Bullock Carts	**0.11**	**0.02**	**0.00**	**0.03**

Table 2.1.4: Investment Profiles of the Villagers

Investment per household (Rs.)	Command Area		Non-command Area	
	Pre-project	Post-project	Pre-project	Post-project
Purchase of land	65.67	5678.67	0.00	2025.21
Gold and silver	1454.57	6185.07	0.00	6613.45
Govt. securities	102.11	4317.16	0.00	5372.27
Life insurance	202.62	5067.55	0.00	8084.82
Capital investment	78.96	3426.47	0.00	10084.03
Lending	8.78	408.52	0.00	84.03
Loan repayment	87.88	1236.13	0.00	723.11
Real estate	18.61	9800.70	0.00	1151.26
Investment on land development	157.16	1424.50	0.00	0.00
Other	4.39	779.81	0.00	30.25
Total	**2180.75**	**38324.58**	**0.00**	**34168.43**

Table 2.1.5: Debt Profiles of the Villagers

Indebtedness per household (Rs.)	Command Area		Non-Command Area	
	Pre-project	Post-project	Pre-project	Post-project
Household expenditure	90.58	1284.16	0.00	1210.08
Farming	343.22	4585.98	0.00	3722.69
Marriage	185.98	2277.27	25.21	2336.13
Other celebration	1.08	16.17	0.00	132.77
Health expenditure	21.29	765.23	0.00	1052.94
Children's education	0.00	52.38	0.00	58.82
Total	**642.15**	**8981.19**	**25.21**	**8513.43**

2.1.6 Irrigation Profile of the Households

An irrigation project is ostensibly designed to facilitate agricultural practices in its command area. SSP is no exception. Expectedly, the operational holding per household is higher in the command area, even though a tendency towards further fragmentation of holding is observed in terms of the decline in the size of average operational holding between 1979-80 and 2003-04. Interestingly, the average size of holding has increased significantly in the non-command area — a characteristic feature worth further probing. Table 2.1.6 gives some idea about the nature of difference existing between the command and non-command areas in terms of their irrigation profiles. Irrigation intensity (measured as the ratio of gross irrigated land to operational holding expressed in percentage term) is 83.77 percent in the command area compared to 88.71 in the non-command area. This difference should be weighed against the fact that in 1979-80 the irrigation intensity in the command area was 75.99 and that in the other region was 0.00. Another feature worth enumerating is the fact that water from SSP canals irrigates 47.82 percent of the irrigated lands in the command area, with tube wells chipping in with a share of another 35.85 percent, a marginal decline from the pre-project situation. While wells catered to 41.98 percent of the irrigation requirements in 1979-80, its role has been rendered insignificant today. In non-SSP regions, tube wells provide 91.34 percent of the irrigation requirements.

A canal based irrigation system also contributes to increased salinity due to water logging of a section of cultivable land situated near the canals. Proper lining of the canals is considered very important to keep the possibilities of such land degradation to its minimum. It is observed that around 3.4 percent of the operational holding is waterlogged in 2003-04 in the command area, compared to about 2.5 percent in the non-command area.

Table 2.1.6: Irrigation Profiles of the Villagers

	Command Area		Non-command Area	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Operational Holding (in ha.)	1664.63	1374.19	1	130.00
Arable land (in ha.)	1581.56	1206.62	0	122.54
% Share of arable land in operational holding	95.01	87.81	0	94.26
Operational holding per household (in ha.)	1.50	1.23	0.01	1.09
Arable land per household (in ha.)	1.42	1.08	0.00	1.03
Non-arable land (in ha.)	63.94	33.05	0.00	4.25
Non-arable land per household	0.06	0.03	0.00	0.04
Fallow/Water-logged land(in ha.)	53.83	67.27	0.00	3.26
Fallow/Water-logged land per household (in ha.)	0.05	0.06	0.00	0.03
%Share of Fallow/Water-logged land in operational holding	3.23	3.38	0.00	2.51
Land under irrigation (in ha.)	1264.91	1526.77	0.00	115.32
Land under irrigation per household (in ha.)	1.14	1.37	0.00	0.97
%Share of irrigated land in operational holding	75.94	83.77	0.00	88.71
Area irrigated by canals (in ha.)	121.21	730.03	0.00	0.50
Area irrigated by well (in ha.)	530.99	12.33	0.00	1.98
Area irrigated by tube well (in ha.)	494.93	547.37	0.00	105.34
Area irrigated by other sources (in ha.)	368.85	10.90	0.00	1.13
% Share of canals as source of irrigation	9.58	47.82	0.00	0.43
% Share of wells as source of irrigation	41.98	0.81	0.00	1.71
% Share of tube wells as source of irrigation	39.13	35.85	0.00	91.34
% Share of other sources as source of irrigation	29.16	0.00	0.71	0.98

2.2: Differential Impact within Command Area

This section gives an insight on the changes in agricultural practices in the SSP command area as a possible result of the implementation of the canal irrigation system. It is observed that SSP has not only changed the agrarian practices in terms of changing the package of practices adopted for growing crops, portfolio of agricultural crops and their proportional distribution across SSP's command area but it has also altered the yield rates of these crops significantly.

2.2.1 General Household Profile

Table 2.2.1 gives a brief profile of the villagers surveyed. Although a total of 113 households were surveyed in the command area during field

visits, data for 1109 households have been utilised for generating the tables below. A little over 20 percent of the beneficiary households are below poverty line, with the incidence of poverty being considerably higher among the non-beneficiaries. As “elite capture”—control and capture of the facilities available in the public domain— is often cited as a reason behind failure of public sector intervention in development, it will be interesting to note that lesser proportion of representation in the local level institutions by the beneficiary households is observed among the beneficiaries. It is worth noting that a larger proportion of non-beneficiary households are members of water uses’ associations in the command area—a feature, probably of far reaching implications for the success or otherwise of the SSP irrigation system in achieving the objectives identified for it. Proportionate representation in the village committees is, however, higher for the beneficiaries.

Table 2.2.1: General Household Profile in the Command Area

	Beneficiaries	Non-Beneficiaries
Number of households	971	138
Number of households below poverty line	200 (20.60)	36 (26.09)
Membership in *Panchayati Raj* Institutions	45 (4.63)	8 (5.80)
Membership in Water Users’ Association	8 (0.84)	2 (1.45)
Membership in Village Committees	15 (1.54)	1 (0.70)

2.2.2 Impact on Income

We now compare the socio-economic indicators of the beneficiary farmers and those not considered officially as beneficiaries. Table 2.2.2 provides a comparative insight into the differences in average gross and net income between the beneficiary households and the non-beneficiary ones. It is revealed that the beneficiary households enjoy around 12.83 percent advantage in gross income over their non-beneficiary counterparts post-project. It should be noted that pre-project, the non-beneficiaries were enjoying a positive gross income differential (20.51%). However, once we concentrate into the net income, a more realistic parameter for comparison in livelihood profiles, the differential comes down to 13.87 percent. One may, thus safely argue that the SSP has played an instrumental role in improving the livelihood status of the beneficiary households. The considerable decline in advantage, while considered in terms of net income, probably points towards the increasing costs of cultivation associated with the modern water-intensive technology.

2.2.3 Ownership of Assets

Assets may be distinguished under two categories. While the first category of assets is used in agricultural activities, the other category of assets is used

mainly for non-agricultural purposes. Table 2.2.3 suggests that there has been a perceptible rise in the agricultural asset base of beneficiary households. The only agricultural asset to have lost favour is the dug well. The beneficiary households enjoy a clear advantage over the non-beneficiary counterparts in terms of their agricultural asset base. It is to be noted, however, that the average number of pump sets, tube wells and improved tools per non-beneficiary household is higher, probably pointing towards their efforts to take care of water demand through utilization of ground water. An identical trend is observed in respect of ownership of non-agricultural household assets. The beneficiaries are better off than the non-beneficiaries.

Table 2.2.2: Gross and Net Incomes of the Villagers in the Command Area

	Beneficiaries		Non-Beneficiaries	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Average Gross Income in Rs. (current prices)	10677.5	72649.61	12867.02	64384.60
Average Gross Income in Rs. (constant 2003-04 prices)	60092.19	72649.61	72414.65	64384.60
Average Net Income in Rs. (current prices)	N.A.	50175.85	N.A	43218.3
Average Net Income in Rs. (constant 2003-04 prices)	N.A.	50175.85	N.A	43218.3

Table 2.2.3: Asset Profiles of the Villagers in the Command Area

Assets per Household (Number)	Beneficiary		Non-Beneficiary	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Agricultural Assets				
Tractors	0.01	0.11	0.00	0.07
Threshers	0.05	0.23	0.07	0.21
Chaffcutters	0.49	5.02	0.50	0.68
Pumpsets	0.06	0.19	0.07	0.25
Improved tools	0.08	0.20	0.03	0.25
Wells	0.24	0.19	0.19	0.12
Tube wells	0.11	0.38	0.17	0.45
Harvesters	0.00	0.00	0.00	0.01
Non-agricultural Assets				
Own house	0.99	1.13	0.98	1.04
Televisions	0.01	0.33	0.02	0.30
Refrigerators	0.00	0.01	0.01	0.01
Washing Machines	0.00	0.00	0.00	0.00
Air coolers	0.00	0.04	0.00	0.03
Motor cycles	0.02	0.22	0.02	0.17
Four wheelers	0.00	0.01	0.00	0.01
Telephones	0.00	0.05	0.00	0.03
Bullock Carts	0.13	0.03	0.06	0.01

Table 2.2.4: Investment Profiles of the Villagers in the Command Area

Investment per Household (Rs.)	Beneficiaries		Non-Beneficiaries	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Purchase of land	62.1	7007.21	155.8	2188.41
Gold and silver	1733.28	7593.23	1611.59	4744.2
Govt. securities	93	4919.1	210.14	3346.38
Life insurance	229.75	5342.83	55.81	5797.72
Capital investment	15.07	3258.13	545.65	6707.97
Lending	10.3	499.79	0	0
Loan repayment	101.03	1404.2	14.49	886.59
Real estate	21.83	11666.32	10.87	4144.93
Investment on land development	184.35	1552.52	0	1449.28
Other	5.15	909.58	0	217.39
Total	**2455.86**	**44152.91**	**2604.35**	**29482.87**

2.2.4 Investment Profile

A comparative assessment of the investment portfolio of the beneficiaries and the others throws up interesting information (Table 2.2.4). The beneficiaries have made a post-project average investment of Rs. 44152.91 compared to Rs. 29482.87 for the other group — an advantage of a little less than 50 percent. Pre-project, the non-beneficiaries were enjoying a small advantage (6%). A look into the investment profile at a disaggregated level provides further interesting insights. Beneficiaries pay, on an average, a lower insurance premium compared to those by the non-beneficiaries. The non-beneficiaries are found to be having been investing quite heavily on capital goods. Beneficiaries on the other hand are paying more on loan repayment and real estate assets. Investments on land development do not vary much between the two groups. The beneficiaries have invested more on government securities as well.

2.2.5 State of Indebtedness

Investments and procurement of assets are simultaneously accompanied by indebtedness of the households (Table 2.2.5). The beneficiaries are indebted to the extent of a little over 13 percent of their gross average annual income, while the non-beneficiaries are indebted to the extent of almost 16 percent of their gross average annual income. However, the difference is significant in respect of credit requirements for farming, with the beneficiaries going for a higher level of outstanding credit. The beneficiaries are also looking for credit to facilitate their children's education, a feature missing among the non-beneficiaries. The extent of indebtedness to marry off near ones, however, put them on an equal footing.

2.2.6 Irrigation Profile of the Households

An irrigation project is ostensibly designed to facilitate agricultural practices in its command area. SSP is no exception. Expectedly, the operational holding per household is higher for the beneficiaries, even though a tendency towards further fragmentation of holding is observed in terms of the decline in the size of average operational holding between 1979-80 and 2003-04. Interestingly, the average size of holding has increased marginally among the non-beneficiaries— a characteristic feature worth further probing. Table 2.2.6 gives some idea about the nature of difference existing between the beneficiaries and non-beneficiaries in terms of their irrigation profiles. That the irrigation intensity (measured as the ratio of gross irrigated land to operational holding expressed in percentage term) is 83.17 among the beneficiaries compared to 89.19 for the non-beneficiaries throws some doubts about the efficacy of the canal system. Another feature worth enumerating is the fact that water from SSP canals irrigates 70.82 percent of the irrigated lands cultivated by the beneficiaries, with tube wells chipping in with a share of another 36.95 percent, a marginal decline from the pre-project situation. The corresponding figures for the non-beneficiaries work out to be 3.69 percent and 100.57 percent. The share of wells as a source of irrigation declined to a large extent for both the groups. Ground water level had gone up significantly in all 85 villages covered under the present study in some villages the water level of tube wells rose by 30 feet; whereas, the average rise in ground water level in the command villages of SSP was to the tune of 12 Feet. Moreover, as compared to 88.9 percent of beneficiary households having access to irrigation facilities in 2004, there were only 68.7 percent non-beneficiaries that had access to irrigation in the same year.

Table 2.2.5: Debt Profiles of the Villagers in the Command Area

Indebtedness Per Household (Rs.)	Beneficiary		Non-Beneficiary	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Household expenditure	5.15	909.10	140.60	805.80
Farming	320.40	5234.70	539.10	6105.10
Marriage	1168.50	2357.47	426.10	2507.20
Other celebration	1.20	30.90	0.00	0.00
Health expenditure	19.26	877.99	36.20	724.60
Children's education	0.00	60.00	0.00	0.00
Total	**1514.51**	**9470.16**	**1142.00**	**10142.70**

Table 2.2.6: Irrigation Profiles of the Villagers in the Command Area

	Beneficiaries		Non-beneficiaries	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Operational Holding (in ha.)	1488.79	1231.76	172.21	136.79
Arable land (in ha.)	1411.82	1070.60	166.12	130.38
% Share of arable land in operational holding	94.83	86.92	96.46	95.31
Operational holding per household (in ha.)	1.53	1.27	1.25	0.99
Arable land per household (in ha.)	1.45	1.10	1.20	0.95
Non-arable land (in ha.)	76.97	161.16	6.09	6.41
Non-arable land per household	0.08	0.17	0.04	0.04
Fallow/Water-logged land(in ha.)	44.20	40.80	7.63	5.15
Fallow/Water-logged land per household (in ha.)	0.05	0.04	0.06	0.04
%Share of Fallow/Water-logged land in operational holding	2.97	3.31	4.43	3.76
Land under irrigation (in ha.)	1120.20	1024.50	141.08	121.99
Land under irrigation per household (in ha.)	1.15	1.05	1.02	0.88
%Share of irrigated land in operational holding	75.24	83.17	81.92	89.18
Area irrigated by canals (in ha.)	111.84	725.53	5.75	4.50
Area irrigated by well (in ha.)	461.19	11.53	69.80	0.80
Area irrigated by tube well (in ha.)	437.38	378.52	57.55	122.69
Area irrigated by other sources (in ha.)	347.58	10.45	21.27	0.45
% Share of canals as source of irrigation	9.98	70.82	4.07	3.69
% Share of wells as source of irrigation	41.17	1.13	49.48	0.66
% Share of tube wells as source of irrigation	39.04	36.95	40.79	100.57
% Share of other sources as source of irrigation	31.03	1.02	15.08	0.37

2.2.7 Impact on Yield

Sample study across sixteen command districts of SSP revealed that the average yields per hectare for four major crops were higher for the beneficiary farmers of SSP command as compared to those of non-beneficiaries. The table below gives the average yields for four common crops for beneficiaries and non-beneficiaries. There, however, was not very significant rise in the crop yields for

the beneficiary farmers because the non-beneficiary farmers had also benefited indirectly from the canals. Some of the control villages were adjacent to beneficiary villages and general availability of water for irrigation had risen considerably in these villages too due to the SSP based canals. Other control villages too had other irrigation sources.

Table 2.2.7: Comparative Crop Yields for Beneficiaries and non-Beneficiaries

Name of Crop	Yield in Quintal per Hectare (2003-2004)	
	Beneficiary Farmers	Non-Beneficiary Farmers
Paddy	45.71	32.38
Wheat	27.21	19.45
Gram	21.97	18.75
Peppermint	0.65	0.59

2.3: Intertemporal Variations among the Beneficiaries

2.3.1 Variations in Income: Nature, Extent and Source

A further examination of agriculture based sub-sector-wise incomes show that the selected five districts have varying shares of income attributed to agriculture. Agriculture accounts for about 59 percent of total income in Ballia district, followed by Pratapgarh and Sitapur at 45 percent each. Allahabad district's 33 percent of the total income might be attributed to agriculture and finally, in Lucknow district agriculture contributes 29 percent to its total income. It might also be added here that some of the erstwhile crops, like arhar, beans and peas, grams and small millets that happened to be cultivated, in quite a significant area in 1979-80, almost disappeared from the command area by the year 2003-2004. The following table states that the gross agricultural incomes of beneficiaries rose marginally between 1980 and 2004 at constant 2003-04 prices (0.68%). It is interesting to note that there are variations in the source of income over time. Cereals and oilseeds today provide the lion's share of income to an average beneficiary.

Another significant impact of increased irrigation was the way it affected the animal husbandry sector in the command area. The share of income from animal husbandry sector that happened to be around 15 percent of the total annual income in 1979-80, dropped to mere 5 percent of the total in 2003-2004. The species of the livestock that dwindled drastically was that of the cows – both bullocks and *desi* cows. However, the quantity of milk sold by the command beneficiaries has marginally increased, due to the rise in number of buffaloes and exotic breeds of cows.

Table 2.3.1: Comparative Gross Income of beneficiaries from various crops in 1979-80 and in 2003-04 (at constant 2003-04 prices, using Consumer Price Index Number for Agricultural Labourers)

Sources of Income	Gross Income		
	1979-80 (in Rs.)	2003-04 (in Rs.)	% Change
Cereals	20232	26989	33.40
Pulses	16940	6726	-60.30
Oil seeds	8459	15579	84.17
Vegetables	15685	14755	-5.93
Horticulture	14295	12077	-15.52
Gross Income from all Agricultural Sources	75611	76126	0.68

2.3.2 Changes in Agricultural Practice

In the pre SSP phase (1979-80) only 1.7 percent of farmers in the command area used chemical fertilizers and that too in very negligible amounts. However, 92 percent of the same farmers used chemical fertilizers in the post-commissioning phase of the SSP (2003-2004). Similarly, there was a visible spurt in the use of pesticides in the latter phase. About 35 percent farmers used pesticides in the later phase and none used pesticides in the pre SSP phase (1979-80). While, in the post SSP phase the average amount of farmyard manure dropped drastically to the 60 percent level for each household vis-à-vis its amount utilized during the pre SSP phase, it still remained the essential input for enhancing the land fertility, along with the use of chemical fertilizers. Eight percent farmers used only the farmyard manure even during the post SSP phase.

Seed Treatment and Sowing Methods have changed considerably over the 24 years' interval between 1979-80 and 2003-04. Use of fungicides and culture has become very common which did not happen in the pre SSP phase, at all. The pre-dominant use of broadcasting method of sowing still exists, but use of seed drills and row sowing has become quite popular in the latter phase.

The trend of using the hormones and weedicides has been rising gradually. In the pre-SSP phase there were virtually no instances of farmers using hormones and weedicides. But in the post SSP phase, 23 percent farmers used weedicides and 16.5 percent farmers used hormones.

Harvesting practices have not changed much between the year 1979-80 and 2003-04. Manual harvesting is still popular in the first decade of twenty first century as it was in the late 1970s. However, the post-harvesting practices have changed dramatically during this hiatus of 24 years. Wholesale mechanization of post-harvesting operations has taken place. There has been a shift in full circle from bullocks to the threshers. Only seven percent farmers were found using bullocks for post harvesting operations in the post-SSP phase.

2.3.3 Impact of SSP on Settlements

Eighty-one villages were studied in detail. There were 391 settlements in these villages. Or each village, on an average, had 4.83 hamlets. Only 196 of these hamlets or *purvas*, accounting for 50 percent hamlets only, received irrigation from SSP. In other words, if SSP claims to have provided irrigation to a village, it actually means SSP was able to provide irrigation to only two of its four hamlets.

The average household size in these villages was eight. Even the household size of villages, belonging to, control villages, was the same. Average number of households per village was 180 and hence the total average population of a village came to 1440.

Of the total 81 villages 18.5 percent villages were control villages and the remaining project villages. Of these 23 percent villages were located at tail, 12.5 percent villages were located at middle and 47 percent were located at the head region of the canals.

The basic services of public health and education cover almost the entire population. The education facilities seemed to be adequate in the villages. For every 43 villages, there was one-degree college and for every three villages there was one middle school. There were 15 villages with out anganwadi centers. The private health system seems to be satisfactorily well developed in 13 villages, where there were on an average more than 4 health clinics per village. The other villages have to depend on Primary Health Centres (PHCs) and sub-Health Centers, which were far and few in number. The status of veterinary services was relatively poor, as there was only one veterinary hospital located in the entire area

The telephone network and postal service are fairly accessible in the area. Of the 81 villages, almost 70 percent were electrified. The various public services were accessible to almost all the villages, though it had not reached a level where each village or Panchayat unit would have one service provider for itself. There were 6 branches of different banks servicing the area. The connectivity from the main road to many of the villages is still an issue. Land ownership is concentrated in few hands and the proportion of marginal farmers to small and large farmers continues to remain high. There were some villages with some families controlling the entire land of the villages, e.g. in Fatua, Fatehpur and Sahabpur in Allahabad district, where the proportion of cultivators to all other workers ranged between 10 percent and 13 percent. There were also villages like Akbalpur in Azamgarh district and Mohanpur Girant in Ambedkar Nagar district where the proportion of agricultural labourers was unusually low.

The share of paddy and wheat crops rose significantly to 36.76 percent and 43.14 percent respectively in the post SSP stage. Further sugarcane and mentha grew progressively in the command area of SSP. From mere 0.26 percent crop share in 1985-85 mentha went up to 5.9 percent of the total. In comparison, sugarcane rose from 5.4 percent to 8.58 percent in 2003-04. Severe water logging was observed during field visits along the banks of Azamgarh distributary in Gambhirpur village and in village Jangipur in Gazipur district and Indara distributary near village Majholi. Similarly, It was learnt that in Daryabad branch in Barabanki district, 3080 ha land was affected due to seepage and approximately another 7000 ha were affected due to breach in canal. The CCA of the branch was 198674 hectare, in the district, however, mostly on account of the above two factors, the actual irrigated area was being reported 170000 ha.

2.4: Impact of SSP on Women and Landless Households

2.4.1 Impact on Women

Generally, women in the canal irrigated areas do not undertake the hard-core farming activities like ploughing, watering and transporting the produce, hence the total farming load for women is slightly lower than that on men.

There were some selected low-labour farming activities, which were generally undertaken by women alone. These were: weeding, planting, transplanting and harvesting.

In case of those households, which were engaged in both farming and agriculture-labour, women out-worked the men significantly.

Prosperity and increase in work due to introduction of canals positively brought forward the women a lot in terms of decision making for activities like cattle purchase, purchase of assets, household expenditure and family functions like wedding etc in the family. However, it did not authorize their control over income of the family.

Women from canal-irrigated areas enjoyed better mobility in terms of visits to *haat*s and outside the village, but not to banks and block offices.

Canal irrigation did not improve the status of women in the matters of family planning, safe motherhood and their enhanced control over family income.

Canal irrigation has resulted in improved nutritional status of women. The average intake of milk was double for women in the irrigated command area (44%) than that of women in the control villages (20%).

2.4.2 Impact on Landless Households

It was revealed that 77 per cent landless labourers in the control villages were engaged in agricultural or on-farm activities, whereas in the canal-irrigated villages about 88 percent landless labourers were engaged in on- farm labour.

In the project area 53 percent of the total wages to the landless labourers were paid in cash; whereas, the landless labourers in the control villages got only 29 percent of their total wages paid as cash. In the project villages 9 percent of landless labour received their entire wages only in kind, whereas; in the control villages 25 percent of the landless received their entire wages in kind.

Before the introduction of canals 17 percent landless were engaged as contractual and bonded labourers in the project villages. The figure fell to 12 percent later; whereas, in control villages 97 percent farmers were free to choose labourers and only 3 percent engaged contractual labourers.

The gender ratio of the landless in the project villages was found marginally better (as against 781 in control villages it was 820 in project villages), but the literacy rate of the landless remained the same both in a control and project villages (about 52 %). However, in case of landless labourers in the project area, there were about 22 percent of respondents who were either matriculate or graduate (as against no matriculate and graduate in the control villages).

Chapter 3

Impact on Efficiency of the Agricultural Sector in the Command Area

Under the present trend of globalisation and competitive attitude towards the agricultural sector, it is worth noting how SSP contributed towards increasing the efficiency of agricultural production in its command area. The findings are mixed and elaborated in detail. A gist of the argument is provided with the help of the following table. Table 3.1 compares between the yield of the main crops grown in the command area with those obtained in India and tries to link it with the decision of the farmers to go for crop substitution. The last column of the table indicates the percentage change in the area under a particular crop in the SSP command area between 1980 and 2004. A negative sign indicates a shift of area from the crop to another crop. Similarly, a positive sign indicates the other way round —more land has been brought under the particular crop. It is observed that the farmers decided to reduce the areas under Arhar, Gram, Millet and Maize, and even — marginally though—Wheat. By the same token, they increased their coverage of area under Paddy, Sugarcane and Mustard. The comparative yields of the crops during 1979-80 and 2003-04 in India and SSP have been recorded in the rest of the columns. It is revealed that yields of certain crops are higher in SSP compared to that in India. They are Paddy, Gram, Arhar, and Millet. Logic of economic efficiency demands increase in area under these crops should have increased provided there are no diseconomies of scale— i.e. yields per unit of land declines with an increase in coverage. Diseconomies of scale may occur if relevant incentive mechanisms are not in place. Incidentally, it is observed that areas under Gram, Millet and Arhar declined drastically during the period under review. On the other hand, quite logically, the area under paddy has increased. Decline in the area under wheat is also justified under the same logic. But decision to increase area under sugarcane and mustard defies the logic of efficiency. Paddy and sugarcane are highly intensive of water. It is necessary to locate if the farmers opting for increased area under sugarcane are recipients of some subsidies, either in terms of water at less than its economic costs through the canal system or through a supply of complementary inputs at subsidized rate. It may even be questioned if their decision is backed by the informed considerations about possible long term impacts of over utilization of water and other complementary inputs on the productivity of the land under their control. It also requires further investigation to understand whether an irrigation system alone in the absence of supportive incentive-disincentive mechanism that ensures marketing of necessary inputs and outputs in the most efficient manner can meaningfully contribute to the growth of the agricultural sector.

Table 3.1: Comparative Yields of Major Crops in India and SSP

Crop	Yield in qtls/ha 1979-80		Yield in qtls/ha 2003-04		Change in area
	India	SSP	India	SSP	
Wheat	15.68	11.89	27.1	22.77	-5.24
Paddy	10.74	16.00	20.8	32.02	43.73
Maize	9.79	10.14	20.4	15.36	-90.09
Sugar cane	493.58	292.38	591.19	462.24	10.27
Gram	4.81	18.75	7.91	18.79	-91.74
Millet		8.73	4.9	10.57	-94.76
Arhar	6.43	8.97	6.9	8.2	-85.62
Mustard	5.25	9.84	11.52	9.32	63.92

It will be interesting to probe into the efficiency of the agricultural system that developed in the command area of the *Sarda Sahayak Pariyojana* (SSP). Efficiency of the system can be analysed from several perspectives. One may look at it from the perspective of its contribution to the efficiency of the land use pattern in agricultural sector. Efficiency in the use of water may also be considered a reference point. Increased efficiency may also imply increased profitability of the farmers. Profit is the difference between value of the output produced and the value of the inputs consumed. An increase in profit may be possible by higher output and/or higher unit value realisation per unit of output. Similarly, one may minimise the cost of inputs used for production. This reduction in costs may be through reduction in their quantities and/or procuring inputs at lower values. A typical farm level decision to optimise profit considers all the possible production decisions that may reduce cost and increase the value of output.

One may propose to consider efficiency of the agricultural system in terms of the efficiency of the changes in the land use pattern observed in the command area of SSP between 1979-80 and 2003-04. A look at the data gathered during the survey reveals a considerable decline in the quantum of land under cultivation between 1979-80 and 2003-04. The decline has been caused by several factors like conversion of agricultural land for non-agricultural uses, increased salinity of soil, fragmentation of holdings on inheritance etc. However, the decline in cultivated land was not evenly distributed across the eight major crops grown in the command area. While area under paddy, mustard and sugar increased, that under wheat, millet, maize, gram and arhar declined. It is imperative to investigate if such changes in cropping pattern added to the efficiency of the agricultural system as well as the availability of the crops in question in the command area of SSP.

Several methods are available not only to quantify the extent of efficiency change but also to identify the proximate drivers that influenced such changes.

Data Envelopment Analysis (DEA) is one such method. Among its number of advantages over other alternative methods like Stochastic Frontier Analysis (SFA), stands out the fact that DEA is independent of the mathematical specification of the production function. DEA can also be carried out without any information about input prices. We attempt to construct the Malmquist Index was constructed to estimate the extent of changes in total factor productivity (TFP) across the distributaries as well as across the main eight crops that are grown in the command area of SSP. “TFP addresses any effects in total output not caused by inputs or productivity. For example, a year with unusually good weather will tend to have higher output, because bad weather hinders agricultural output. A variable like weather does not directly relate to unit inputs or productivity, so weather is considered a total-factor productivity variable” (quoted from Wikipedia available at http://en.wikipedia.org/wiki/total_factor_productivity).

An increase in TFP over time signifies an increased efficiency in the sense that same level of output can be produced with lesser amount of inputs (land in the context of the present study) or a higher level of outputs can be generated using the same basket of inputs. While the former approach leads to as an input oriented measure of efficiency, the latter yields output oriented measure of efficiency. In this section, the input oriented measure of TFP changes to accommodate the observed decline in the area of land available to grow the major crops in SSP command area has been developed.

Construction of Malmquist index not only gives a quantitative idea about the change in TFP, but also helps identify the factors contributing to the change. A production process involves transformation of inputs into output(s). A typical agricultural production process involves use of a number of inputs — land being the most visible one. Simple analysis of productivity change in agriculture thus concentrates on understanding the changes in land productivity. However, it does not capture the impact of other inputs that might have influenced the apparent change in land productivity. Such inputs may be tangible—not included in the analysis, like, say fertilisers, improved seeds, facilities for irrigation, credit, marketing etc. They may be intangible as well, like, variations in weather, change in the efficiency of the decision-making farmer due to increased access to relevant information that influence the ultimate decision on input-output mix, change in technology, change in the scale of operation etc. Malmquist Index decomposes TFP into two components:

1. Change in efficiency (EFF) and
2. Change in technology (TECH).

TFP is expressed as the product of EFF and TECH. Thus, theoretically TFP may change due to change in either and even both of them. However, the direction of the change may be a bit tricky to understand. A moderate improvement

in technology accompanied by a rapid decline in efficiency will lead to a decline in TFP. EFF may further be decomposed into

1. Change in pure efficiency (PEFF) and
2. Change in scale efficiency (SEFF)

In the context of the present discussion while PEFF refers to the efficiency in the capacity of the decision making farmer to arrive at the optimal mix of the complementary inputs, SEFF indicates her capacity to arrive at the optimal decision on allocating the land among several alternative crops. Mathematically

EFF = PEFF x SEFF.

The direction of change in EFF is again dependent on the relative degree of changes in PEFF and SEFF. A considerable increase in SEFF accompanied by a small decline in PEFF will cause some improvement in EFF. However, the decomposition helps identify the possible sources of improving the overall efficiency in the future.

To facilitate estimation of the Malmquist Indices for each crop across each distributaries we used a simple one output-one input model has been used. Land under a particular crop has been considered the only input in the model, with production, in physical terms, being taken as the output. Thus the impact of the irrigation system in improving the yield of a crop per unit of land between the two points of time under consideration is reflected in the change in TFP. One must add that use of other inputs, like, tractors, fertilisers, credit etc. also contributed to the change in yield of land. It may be safely assumed that availability of assured and cheap irrigation facilities through SSP preceded the decision to apply increased doses of these inputs in production.

Efficiency analysis using Data Envelopment Analysis (DEA) techniques identify the following features in respect of the change in the cropping patterns in the command area between 1979-80 and 2003-04 (Table 1).

— The total factor productivity (TFP) change in land has been recorded to be the highest for maize, improving by about 111.6 percent between the periods under review, followed by wheat — around 102.4 percent.

— On the other hand, there has been around 3 percent decline in the TFP of gram.

— The improvements in TFP for Arhar and Mustard are quite insignificant, while the rest recorded moderate improvements.

— To facilitate comparison, we estimated the corresponding figures for India with data disaggregated at the state level for the comparable period was estimated. The results indicate a higher TFP growth for the country as a whole for all crops other than Maize and Wheat (Table 2). The variations in respect of paddy and millet are not that significant though. This comparison is meaningful keeping in mind the fact that compared to an irrigation intensity of about 43.4 percent for the country as a whole SSP command area enjoys a figure of 83.17 percent. SSP canals irrigate about 47.82 percent of the gross cropped area in the command area!

Table 3.2: Average Change in TFP and its Components in SSP Command Area between 1979-80 and 2003-04

CROP	EFF	TECH	PEFF	SEFF	TFP	ARE
Paddy	1.11800	1.64200	1.01300	1.10300	1.83600	46.00900
Maize	1.22900	1.72200	1.15400	1.06500	2.11600	-90.35805
Sugarcane	1.34224	1.22500	1.29439	1.03685	1.64429	10.21828
Millet	1.49975	1.16200	1.49599	1.00274	1.74364	-94.49360
Wheat	1.06700	1.89600	1.07100	0.99700	2.02400	-5.19071
Gram	0.92201	1.05100	0.94891	0.97174	0.96904	-92.00897
Arhar	0.84800	1.23900	1.01200	0.83800	1.05100	-85.79029
Mustard	0.76371	1.34900	0.91491	0.83465	1.03008	65.58132

Table 3.3: Average Change in TFP and its Components in Indian States between 1979-80 and 2003-04

	EFF	TECH	PEFF	SEFF	TFP	ARE
Paddy	1.337	1.418	1.254	1.066	1.895	7.820318
Maize	1.482	1.287	1.192	1.243	1.907	21.08224
Sugarcane	0.208	5.835	0.372	0.559	1.212	50.88123
Millet	0.254	7	0.655	0.388	1.78	-36.6577
Wheat	0.965	1.519	0.953	1.013	1.467	19.87488
Gram	0.951	1.564	0.956	0.996	1.488	1.965641
Arhar	1.299	0.962	1.271	1.022	1.25	28.88319
Mustard	1.056	1.559	1.051	1.005	1.646	56.42939

We would now look into the contributions of EFF, TECH, PEFF and SEFF towards the change in TFP. The stylised features for SSP are as under:

— All of them contributed positively towards the growth of TFP in paddy, maize, sugarcane and millet, even though the contribution of SEFF— efficiency in identifying an optimal area for cultivation that helps derive maximum return from the land under the particular crop — is the least in case of all the crops.

— Wheat registered a healthy growth in TFP even at the cost of reduction in SEFF, while mustard recorded a decline in all factors excepting in TECH. Apparently, availability of irrigation and the concomitant technological advances contributed to the meagre growth of TFP in mustard.

— Increase in TECH and PEFF helped an insignificant improvement in arhar, while in spite of some improvement in TECH, TFP growth for gram has been negative.

— On comparison with the national scenario TECH recorded higher values in SSP in respect of paddy, maize, wheat and arhar. Those for sugarcane and millet are considerably lower in SSP, indicating the possibility that either irrigation alone cannot help achieve the desired growth in TFP or the irrigation intensity in the land under sugarcane is much higher than those within SSP command area. Focussed investigations into this issue are imperative to an informed and suitable policy decision.

Last columns in both the tables above list a variable named ARE which stands for percentage change in area under cultivation over the period under review. A negative sign indicates a decline in acreage under the particular crop. It is interesting to note that land use pattern under agriculture underwent a perceptible change in the SSP command area. While area under paddy and sugarcane increased to a large extent, those under coarse cereals and pulses recorded almost complete withdrawal. Wheat registered a marginal decline in acreage with area under sugarcane looking upward. In the absence of suitable data set it is hard to conclude about the pattern of crop substitution. The survey data indicates the possibility of a substitution of coarse cereals and pulses with mustard, paddy and sugarcane in the presence of assured irrigation. These crops are well known for their capacity as water guzzlers.

On a comparative scale the extent of crop substitution is not much evident at the national level, probably, due to the possibility that hitherto uncultivated lands are still being brought under the ambit of agricultural practices. Even then the fact that area under millet declined to an appreciable extent is an indicator of the experiences from the command area of SSP are going to be replicated across the entire nation in the days to come.

Another feature of the changes in efficiency matrix of the agricultural system since SSP became operational needs special attention. It is observed that the average change in scale efficiency in SSP command area varied considerably across crops, with paddy recording the highest increase — 10.3 percent — and mustard registering the highest decline — 16.5 percent. Scale efficiency refers to the efficiency in identifying the optimal size of land to be put under a particular crop. The efficiency may increase with an increase in acreage

if the existing size of the area is less than such optimum. Similarly, an increased acreage may lead to decline in scale efficiency if the resulting acreage overshoots the optimum. An examination of the relationship between SEFF and ARE in Table1 reveals:

- Change in acreage for paddy, millet, sugarcane and millet led to increased scale efficiency.
- The effect on scale efficiency in respect of the rest of the crops is just the opposite.

While concentrating on Table 3.3 — to get a national perspective — we observe that the nature of change in scale efficiency does not match the pattern observed in case of SSP command area. Whereas increase in acreage in paddy and maize led to considerable gain in scale efficiency, the impact of increased acreage in sugarcane has been the reverse.

A further disaggregated result is presented below with the distributaries constituting the SSP as the unit of analysis. Table 6.4 provides the estimates of TFP across the distributaries in respect of paddy. It is worth mentioning that the impact of the irrigation system is not felt equally across the distributaries. As one goes down a further disaggregated level distinguishing among farming practices at the head, middle and tail ends of a distributary, the impacts are far more heterogeneous. Farmers with their lands irrigated by water from Pratapgarh and Allahabad distributaries experienced the highest growth in TFP, with those being serviced by Barabanki distributary recorded the minimum growth in TFP. As one goes into understanding the factors responsible for growth in TFP, the extent of heterogeneity is further evidenced. A further disaggregation distinguishing among farming practices at the head, middle and tail ends of a distributary, reveals far more heterogeneous results. Farmers located at the tail end of Barabanki distributary registered the highest TFP growth. Their decision to increase acreage by more than 115 percent has been aptly rewarded with increased scale efficiency. The decision of the farmers residing at the middle end of Barabanki distributary to reduce acreage under paddy led to rapid erosion in scale efficiency. Decline in TFP, incidentally, has only been recorded in the head end of Barabanki, indicating variable impacts even across a distributary.

Similar experiences are recorded for other crops. The relevant estimates have been given in Tables 3.5 through 3.11. Some salient features are worth mentioning.

- A decline in area under maize is generally associated with increased scale efficiency, Haidergarh distributary being the lone exception. Highest TFP growth has been recorded in areas irrigated by Allahabad distributary. Farmers served by Barabanki distributary have stopped cultivation of maize altogether; where as those receiving water from Pratapgarh distributary did not cultivate maize even in 1979-80.

- Significant growth in TFP for sugarcane is estimated for the farms lying at the head end of the Feeder Canal. Farms located at the middle ends of the distributaries registered decline in TFP.
- There has been a drastic fall in the acreage of millet. The lion's share of the acreage under millet is found in the head end of Dariyabad distributary.
- Farms located at the head ends of the distributaries recorded higher TFP growth in general in respect of wheat, with those at the tail ends fairing relatively poor. Acreage more than doubled in farms irrigated by the Feeder Canal.
- Higher TFP growth for gram is registered in the tail and middle ends of the distributaries.
- Higher TFP growth for arhar is registered in the head ends of the distributaries.
- The growth in the TFP of mustard appears to be biased against those lying at the tail ends. While acreage under the crop declined across most of the distributaries, areas irrigated by the head end and middle stretches of the Feeder Canal recorded tremendous relative increase in acreage, unfortunately, accompanied with more than 30 percent decline in scale efficiency.

The results obtained out of TFP analysis lead to the following tentative conclusions. The conclusions are tentative as no benchmark data was available on the quality and quality of water availability in the command area of SSP prior to the initiation of the irrigation project. Data on the then ground water availability at the farm level could not be gathered as well. The results, however, still reflect the impact of SSP as the time points identified for the analysis are spaced apart in link with the implementation of the project. While 1979-80 captures the pre-project situation, 2003-04 captures the features of a post-project situation.

- Barring gram, all crops recorded increase in TFP.
- Contribution of increase in efficiency due to technological change in the increase TFP is consistently higher for almost all the crops, sugarcane and millet being the exceptions.
- The growth in efficiency of the farmers contributed comparatively less to the TFP growth. In fact, it declined for gram, arhar and mustard.
- Change in acreage does not have identical impact on the productivity of land for all crops. While yield improved in case of certain crops, it declined in case of others.
- Land holdings located at the head ends of the distributaries record a tendency of achieving higher growth in TFP. Those at the tail ends seem to enjoy a lower growth and even decline in respect of certain crops.
- The pattern of TFP growth varied across distributaries.

Table: 3.4 Changes in TFP and its Components for Paddy across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	**Head**	1.481	1.642	1.332	1.112	2.432	93.72117
Allahabad	**Middle**	0.843	1.642	0.86	0.98	1.385	416.3455
Allahabad	**Tail**	1.134	1.642	1.109	1.022	1.862	15.125
Allahabad	**Total**	**1.318**	**1.642**	**1.059**	**1.245**	**2.165**	**96.65291**
Barabanki	**Head**	0.552	1.642	0.532	1.037	0.906	108.0144
Barabanki	**Middle**	0.893	1.642	1.852	0.482	1.466	-30
Barabanki	**Tail**	1.787	1.642	0.881	2.027	2.934	115.3846
Barabanki	**Total**	**0.669**	**1.642**	**0.575**	**1.162**	**1.098**	**71.98218**
Dariyabad	**Head**	1.394	1.642	1.03	1.354	2.289	13.20777
Dariyabad	**Middle**	1.213	1.642	0.904	1.342	1.992	8.054795
Dariyabad	**Tail**	1.029	1.642	0.771	1.335	1.69	19.88045
Dariyabad	**Total**	**1.296**	**1.642**	**1**	**1.296**	**2.128**	**13.40698**
Feeder	**Head**	1.284	1.642	1.443	0.889	2.108	350.6071
Feeder	**Middle**	1.415	1.642	1.402	1.009	2.324	10.76531
Feeder	**Tail**	0.993	1.642	1	0.993	1.63	96.97309
Feeder	**Total**	**1.197**	**1.642**	**1**	**1.197**	**1.965**	**129.6236**
Haidergarh	**Head**	1.611	1.642	1.599	1.008	2.646	96.34241
Haidergarh	**Middle**	0.761	1.642	0.692	1.1	1.249	667.3684
Haidergarh	**Tail**	0.658	1.642	0.655	1.005	1.08	164.0132
Haidergarh	**Total**	**1.272**	**1.642**	**1.093**	**1.164**	**2.089**	**134.8892**
Pratapgarh	**Head**	1.373	1.642	1.053	1.304	2.255	300
Pratapgarh	**Middle**	1.304	1.642	1.212	1.076	2.142	477.1429
Pratapgarh	**Total**	**1.32**	**1.642**	**1.376**	**0.959**	**2.168**	**403.3333**
SSP		**1.118**	**1.642**	**1.013**	**1.103**	**1.836**	**46.009**

Table: 3.5 Changes in TFP and its Components for Maize across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	**Head**	1.864	1.722	1.51	1.234	3.209	-99.2461
Allahabad	**Middle**	1.428	1.722	1.177	1.214	2.459	-92.9098
Allahabad	**Tail**	0	NA	0	NA	NA	-100
Allahabad	**Total**	**1.794**	**1.722**	**1.438**	**1.25**	**3.09**	**-97.3915**
Barabanki	**Head**	0	NA	0	NA	NA	-100
Barabanki	**Middle**	NA	NA	NA	NA	NA	NA
Barabanki	**Tail**	0	NA	0	NA	NA	-100
Barabanki	**Total**	**0**	**NA**	**0**	**NA**	**NA**	**-100**
Dariyabad	**Head**	1.259	1.722	1	1.259	2.168	-96.8526
Dariyabad	**Middle**	0.83	1.722	0.83	1	1.429	180
Dariyabad	**Tail**	0.906	1.722	0.738	1.228	1.56	-95.2153
Dariyabad	**Total**	**1.129**	**1.722**	**1**	**1.129**	**1.943**	**-94.9617**
Feeder	**Head**	1.379	1.722	1.237	1.115	2.374	-93.6829
NA **Feeder**	**Middle**	0	NA	0	NA	NA	-100
Feeder	**Tail**	1.251	1.722	1.251	1	2.153	53.84615
Feeder	**Total**	**1.202**	**1.722**	**1.003**	**1.198**	**2.069**	**-77.5169**
Haidergarh	**Head**	1.083	1.722	1.249	0.867	1.864	-58.159
Haidergarh	**Middle**	0	NA	0	NA	NA	-100
Haidergarh	**Tail**	0	NA	0	NA	NA	-100
Haidergarh	**Total**	**1.035**	**1.722**	**1.189**	**0.87**	**1.782**	**-62.8253**
Pratapgarh	**Head**	NA	NA	NA	NA	NA	NA
Pratapgarh	**Middle**	NA	NA	NA	NA	NA	NA
Pratapgarh	**Total**	NA	NA	NA	NA	NA	NA
SSP		**1.229**	**1.722**	**1.154**	**1.065**	**2.116**	**-90.358**

Table: 3.6 Changes in TFP and its Components for Sugarcane across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	**Head**	1.377	1.225	1.377	1	1.687	691.6667
Allahabad	**Middle**	0.731	1.225	0.731	1	0.895	-53.9052
Allahabad	**Tail**	3.11	1.225	3.11	1	3.81	100
Allahabad	**Total**	**0.953**	**1.225**	**0.953**	**1**	**1.167**	**14.53078**
Barabanki	**Head**	1.059	1.225	1.024	1.033	1.297	-42.9825
Barabanki	**Middle**	0.652	1.225	0.652	1	0.799	36.36364
Barabanki	**Tail**	NA	NA	NA	NA	NA	NA
Barabanki	**Total**	**0.889**	**1.225**	**0.894**	**0.994**	**1.09**	**-8.42912**
Dariyabad	**Head**	1.409	1.225	1	1.409	1.726	-33.1686
Dariyabad	**Middle**	1.085	1.225	1.334	0.813	1.329	950.8475
Dariyabad	**Tail**	1.389	1.225	1.374	1.011	1.702	-14.4847
Dariyabad	**Total**	**1.289**	**1.225**	**1**	**1.289**	**1.579**	**52.21468**
Feeder	**Head**	3.188	1.225	2.873	1.11	3.905	-86.2294
Feeder	**Middle**	0.816	1.225	0.816	1	1	650
Feeder	**Tail**	1.441	1.225	1.441	1	1.766	36.75214
Feeder	**Total**	**1.982**	**1.225**	**1.93**	**1.027**	**2.427**	**-57.7853**
Haidergarh	**Head**	1.449	1.225	1.426	1.016	1.775	-39.0385
Haidergarh	**Middle**	NA	NA	NA	NA	NA	NA
Haidergarh	**Tail**	NA	NA	NA	NA	NA	NA
Haidergarh	**Total**	**1.396**	**1.225**	**1.386**	**1.007**	**1.71**	**-31.3462**
Pratapgarh	**Head**	NA	NA	NA	NA	NA	NA
Pratapgarh	**Middle**	NA	NA	NA	NA	NA	NA
Pratapgarh	**Total**	NA	NA	NA	NA	NA	NA
SSP		**1.342**	**1.225**	**1.294**	**1.037**	**1.644**	**10.21828**

Table: 3.7 Changes in TFP and its Components for Millet across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	**Head**	0	NA	0	NA	NA	-100
Allahabad	**Middle**	0	NA	0	NA	NA	-100
Allahabad	**Tail**	1.639	1.162	1.597	1.027	1.906	-76.6791
Allahabad	**Total**	**2.405**	**1.162**	**2.399**	**1.00**	**2.80**	**-95.9323**
Barabanki	**Head**	0	NA	0	NA	NA	-100
Barabanki	**Middle**	0	NA	0	NA	NA	-100
Barabanki	**Tail**	0.97	1.162	0.726	1.336	1.128	400
Barabanki	**Total**	**1.17**	**1.162**	**1.195**	**0.979**	**1.36**	**-60**
Dariyabad	**Head**	1.868	1.162	2.669	0.7	2.172	-76.4861
Dariyabad	**Middle**	0	NA	0	NA	NA	-100
Dariyabad	**Tail**	0	NA	0	NA	NA	-100
Dariyabad	**Total**	**1.213**	**1.162**	**1.241**	**0.978**	**1.41**	**-86.6272**
Feeder	**Head**	1.145	1.162	1.109	1.032	1.331	-98.7593
Feeder	**Middle**	0	NA	0	NA	NA	-100
Feeder	**Tail**	0	NA	0	NA	NA	-100
Feeder	**Total**	**0.772**	**1.162**	**0.464**	**1.666**	**0.898**	**-99.2505**
NA **Haidergarh**	**Head**	0	NA	0	NA	NA	-100
Haidergarh	**Middle**	1.955	1.162	1.925	1.016	2.273	-99.6008
NA **Haidergarh**	**Tail**	0	NA	0	NA	NA	-100
Haidergarh	**Total**	**1.797**	**1.162**	**1.776**	**1.012**	**2.089**	**-99.858**
Pratapgarh	**Head**	0	NA	0	NA	NA	-100
Pratapgarh	**Middle**	0	NA	0	NA	NA	-100
Pratapgarh	**Total**	**0**	NA	**0**	NA	NA	**-100**
SSP		**1.500**	**1.162**	**1.496**	**1.003**	**1.744**	**-94.4936**

Table: 3.8 Changes in TFP and its Components for Wheat across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	Head	1.493	1.896	1.588	0.94	2.831	39.67465
Allahabad	Middle	0.54	1.896	0.637	0.848	1.024	94.30596
Allahabad	Tail	0.833	1.896	0.936	0.89	1.579	18.83469
Allahabad	**Total**	**1.06**	**1.896**	**1.057**	**1.003**	**2.01**	**44.26619**
Barabanki	Head	0.978	1.896	1.152	0.848	1.854	23.68831
Barabanki	Middle	0.739	1.896	0.85	0.869	1.401	-41.1765
Barabanki	Tail	2.38	1.896	2.347	1.014	4.514	-89.2063
Barabanki	**Total**	**0.979**	**1.896**	**0.96**	**1.02**	**1.857**	**-28.3594**
Dariyabad	Head	1.286	1.896	1.121	1.148	2.44	-31.2028
Dariyabad	Middle	0.775	1.896	0.731	1.061	1.47	28
Dariyabad	Tail	0.699	1.896	0.649	1.077	1.326	-8.60758
Dariyabad	**Total**	**1.132**	**1.896**	**1**	**1.132**	**2.147**	**-23.6656**
Feeder	Head	2.193	1.896	2.597	0.845	4.159	68.15781
Feeder	Middle	1.229	1.896	1.449	0.848	2.331	263.0228
Feeder	Tail	0.701	1.896	0.79	0.887	1.329	43.20113
Feeder	**Total**	**1.457**	**1.896**	**1.607**	**0.907**	**2.764**	**115.3172**
Haidergarh	Head	1.082	1.896	1.105	0.98	2.053	-14.7915
Haidergarh	Middle	0.934	1.896	1.031	0.906	1.771	-16.0934
Haidergarh	Tail	0.658	1.896	0.67	0.981	1.247	-23.5211
Haidergarh	**Total**	**0.891**	**1.896**	**0.785**	**1.134**	**1.689**	**-17.5011**
Pratapgarh	Head	1.512	1.896	0.626	2.415	2.868	340
Pratapgarh	Middle	1.323	1.896	1.397	0.947	2.509	2.272727
Pratapgarh	**Total**	**1.443**	**1.896**	**1.629**	**0.886**	**2.737**	**64.81481**
SSP		**1.067**	**1.896**	**1.071**	**0.997**	**2.024**	**-5.19071**

Table: 3.9 Changes in TFP and its Components for Gram across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	Head	0.745	1.051	0.731	1.02	0.783	-99.0991
Allahabad	Middle	1.836	1.051	1.673	1.098	1.93	-96.8153
Allahabad	Tail	1.17	1.051	0.912	1.282	1.229	-86.3014
Allahabad	**Total**	**1.36**	**1.051**	**1.45**	**0.934**	**1.425**	**-98.1041**
Barabanki	Head	0	NA	0	NA	NA	-100
Barabanki	Middle	0	NA	0	NA	NA	-100
Barabanki	Tail	0	NA	0	NA	NA	-100
Barabanki	**Total**	**0**	**NA**	**0**	**NA**	**NA**	**-100**
Dariyabad	Head	0.876	1.051	1	0.876	0.921	-87.421
Dariyabad	Middle	0.499	1.051	0.507	0.985	0.524	-92.9688
Dariyabad	Tail	0.854	1.051	0.934	0.915	0.898	-84.4769
Dariyabad	**Total**	**0.86**	**1.051**	**1**	**0.86**	**0.904**	**-87.6772**
Feeder	Head	0	NA	0	NA	NA	-100
Feeder	Middle	0	NA	0	NA	NA	-100
Feeder	Tail	0	NA	0	NA	NA	-100
Feeder	**Total**	**0**	**NA**	**0**	**NA**	**NA**	**-100**
Haidergarh	Head	0.197	1.051	0.186	1.059	0.207	-95.483
Haidergarh	Middle	0.896	1.051	0.952	0.941	0.942	-62.8906
Haidergarh	Tail	0.915	1.051	0.969	0.944	0.962	-87.1795
Haidergarh	**Total**	**0.807**	**1.051**	**0.9**	**0.896**	**0.848**	**-81.6313**
Pratapgarh	Head	0	NA	0	NA	NA	-100
Pratapgarh	Middle	0	NA	0	NA	NA	-100
Pratapgarh	**Total**	**0**	**NA**	**0**	**NA**	**NA**	**-100**
SSP		**0.922**	**1.051**	**0.949**	**0.972**	**0.969**	**-92.009**

Table: 3.10 Changes in TFP and its Components for Arhar across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	**Head**	0.747	1.239	0.53	1.408	0.926	-89.3869
Allahabad	**Middle**	0	n.a.	0	n.a.	n.a.	-100
Allahabad	**Tail**	0	n.a.	0	n.a.	n.a.	-100
Allahabad	**Total**	**0.75**	**1.239**	**0.509**	**1.462**	**0.923**	**-92.1145**
Barabanki	**Head**	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Barabanki	**Middle**	0.161	1.239	0.161	1	0.2	-50
Barabanki	**Tail**	1.354	1.239	1.354	1	1.677	-41.9355
Barabanki	**Total**	**1.174**	**1.239**	**1.174**	**1**	**1.455**	**-42.8571**
Dariyabad	**Head**	0.718	1.239	0.425	1.69	0.89	-97.575
Dariyabad	**Middle**	0.759	1.239	0.759	1	0.94	-76.3848
Dariyabad	**Tail**	0.924	1.239	0.859	1.075	1.145	-78.2609
Dariyabad	**Total**	**0.789**	**1.239**	**0.839**	**0.94**	**0.978**	**-92.5402**
Feeder	**Head**	2.138	1.239	1.739	1.23	2.649	-92.9872
Feeder	**Middle**	0	n.a.	0	n.a.	n.a.	-100
Feeder	**Tail**	0.483	1.239	0.483	1	0.598	-96.5885
Feeder	**Total**	**1.646**	**1.239**	**1.257**	**1.31**	**2.04**	**-94.2869**
Haidergarh	**Head**	1.495	1.239	3.848	0.389	1.853	-23.4852
Haidergarh	**Middle**	0	n.a.	0	n.a.	n.a.	-100
Haidergarh	**Tail**	0.47	1.239	0.413	1.138	0.583	-69.9418
Haidergarh	**Total**	**0.823**	**1.239**	**1.66**	**0.496**	**1.02**	**-52.7826**
Pratapgarh	**Head**	1.349	1.239	1.349	1	1.672	-92.284
Pratapgarh	**Middle**	0	n.a.	0	n.a.	n.a.	-100
Pratapgarh	**Total**	**0.811**	**1.239**	**0.669**	**1.212**	**1.005**	**-97.7252**
SSP		**0.848**	**1.239**	**1.012**	**0.838**	**1.051**	**-85.7903**

Table: 3.11 Changes in TFP and its Components for Mustard across Distributaries

Distributary	Location	EFF	TECH	PEFF	SEFF	TFP	ARE
Allahabad	**Head**	1.896	1.349	1.894	1.001	2.557	-30
Allahabad	**Middle**	NA	NA	NA	NA	NA	NA
Allahabad	**Tail**	NA	NA	NA	NA	NA	NA
Allahabad	**Total**	**1.868**	**1.349**	**1.894**	**0.986**	**2.519**	**-15.7143**
Barabanki	**Head**	NA	NA	NA	NA	NA	NA
Barabanki	**Middle**	NA	NA	NA	NA	NA	NA
Barabanki	**Tail**	NA	NA	NA	NA	NA	NA
Barabanki	**Total**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Dariyabad	**Head**	0.682	1.349	0.671	1.016	0.92	-92.9204
Dariyabad	**Middle**	0.327	1.349	0.326	1.002	0.441	-9.30233
Dariyabad	**Tail**	0.47	1.349	0.47	1	0.633	70
Dariyabad	**Total**	**0.419**	**1.349**	**0.383**	**1.093**	**0.565**	**-45.2055**
Feeder	**Head**	0.523	1.349	0.774	0.676	0.706	568.6667
Feeder	**Middle**	1.005	1.349	1.56	0.644	1.356	1485.833
Feeder	**Tail**	0.846	1.349	0.846	1	1.141	62.5
Feeder	**Total**	**0.433**	**1.349**	**1.498**	**0.289**	**0.584**	**440.1047**
Haidergarh	**Head**	0.936	1.349	0.935	1.001	1.262	-10.5251
Haidergarh	**Middle**	0.764	1.349	0.764	1	1.031	288
Haidergarh	**Tail**	NA	NA	NA	NA	NA	NA
Haidergarh	**Total**	**0.804**	**1.349**	**0.908**	**0.886**	**1.085**	**63.80572**
Pratapgarh	**Head**	NA	NA	NA	NA	NA	NA
Pratapgarh	**Middle**	NA	NA	NA	NA	NA	NA
Pratapgarh	**Total**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
SSP		**0.764**	**1.349**	**0.915**	**0.835**	**1.030**	**65.58132**

To develop an overall understanding of the impact of SSP on the efficiency of the agricultural system of the command area, we estimated a weighted composite index of change in TFP with the share of the respective crop in total land under cultivation as the weights was estimated. The results are given in Table 3.12 below. As is evident from the table, all the distributaries have been ranked in respect of the change in composite index of change in TFP. The rankings indicate a relatively better performance in villages located at the head ends of the distributaries. It is, however, difficult to comment on the relative performance of villages located at the middle ends compared to those located at the tail ends from the data available at hand.

Table: 3.12 Weighted Composite Index of Change in TFP across Distributaries

Rank	Distributary	Location	Weighted TFP
1	Feeder	Head	3.120394279
2	Pratapgarh	Head	2.660984615
3	Allahabad	Head	2.578171259
4	Dariyabad	Head	2.300342152
5	Pratapgarh	Middle	2.295600829
6	Haidergarh	Head	2.246473819
7	Feeder	Middle	2.204645092
8	Barabanki	Tail	1.929822917
9	Allahabad	Tail	1.770105236
10	Dariyabad	Middle	1.561723289
11	Dariyabad	Tail	1.517166824
12	Feeder	Tail	1.504310183
13	Barabanki	Head	1.467632115
14	Haidergarh	Middle	1.353113987
15	Allahabad	Middle	1.206550400
16	Barabanki	Middle	1.193542636
17	Haidergarh	Tail	1.050647201

Chapter 4

Techno-Economic Findings

4.1: Techno-Economic Findings

Like many canal irrigation projects the gap between the irrigation potential created by SSP and the irrigation potential utilized by it subsequently has been quite considerable. It claims to have the total coverage of 16.74 lac hectares of culturable command area (CCA) but it has actually not been able to cover not more than 11.5 lac hectares (68.7%of designed CCA).

During the course of the study it was observed that most canals were being run at much below their potential. For example, Daryabad canal was running at discharge level of 4,000 cusecs and not at 8,000 cusecs in the last week of May 2004; Barabanki canal ran at discharge level of 700 cusecs and not at 1100 cusecs in June 2004. Moreover, the actual SSP irrigated area fell below the desired levels. For example, while the Sultanpur Branch Canal was supposed to irrigate 4002 hectares per year it actually irrigated 2130 hectares (or 53.2%) between the years of 1999-2000 to 2003-04. Similarly, Faizabad *prakhand*, which was supposed to irrigate 76,142 hectares per year actually irrigated 31869 hectares (or 41.85%) between the same periods.

Besides, a set of interesting and sometimes bizarre happenings were recorded. For example- in some villages of district Azamgarh, Ballia and Gazipur; researchers found that during the first week of July 2004, rains were inadequate and canals did not carry much water. Farmers begged SSP to release water in the canals, but they failed to move the project authorities. But when, by mid September 2004 these farmers were able to grow paddy without much irrigation support from SSP canals, all the canals started running at their flood peak level and washed away the crops. However, in Barabanki district, conditions were found comparatively better in May and June of 2004. Farmers were getting their peppermint crops irrigated with the running canal waters. Researchers also found some minors and distributaries of Hydergarh canal fully choked with silt and luxuriant growth of *sarkanda* plants, another phenomenon observed in a few locations. The slope of the canal beds is less than the mandatory 0.1 percent in the upper course and thus resulted in stagnation, restriction in water flow and early silting. In another location , of Jaunpur district, bending of a minor at 120 degrees created blockades in irrigation flow. The seepage in the reaches of the canals and the increased permeability of the fine *usar* soils of the banks caused water logging along the feeder channel. It also

subsequently, became an instrument for reducing the carrying capacity of the feeder channel from 650 cumecs to about 425 cumecs. Similar conditions occurred in some portions of the main branches, too.

Researchers found that about 150 minors in Jaunpur, Rae Bareli district, along the course of Hydergarh's flow; were going to be handed over to the Water Users Associations (WUA) in near future. But the actual implementation model and its action processes, with WUAs at the helm of affairs, was not made clear to the WUA members. The procedures and formalities of making WUAs seemed more important to the SSP and the World Bank aided UP's Water Sector Restructuring Project than the promotion and development of a situation specific participatory Irrigation management based model for the SSP command; for which no worth while action research project was undertaken.

Segregation of SSP's activities from those of Command Area Development Agency and latter's inability to garner community support and absence of water users' effective body–led to formation of least participatory irrigation management system in the command area of SSP. Lack of respect and say for the most important stake holders of SSP, the farmer beneficiaries, jeopardized the formation of any rational water delivery scheduling system from the very start. Now, when the waters of Sarda Sahayak Project have gone down the Lower Sarda Barrage for 22 years, the simple community equations in UP villages have turned very complex and sour. Villagers are divided across political lines. It might be very difficult for these factions to come together for giving a helping hand for improving the management of the project. Further, the irrational water rates helped the community to turn around and put the department on the dock. Department of irrigation that owns and runs the SSP hardly recovers 33 to 40 percent of the total annual operational cost of the project.

It was also understood by the team that the Feeder channel passed through some sodic or *usar* patches. The channel banks on *usar* soil patches get easily eroded owing to their lightness. Moreover, a considerable chunk of *usar* soil gets dissolved in water. Thus berm formation process along the banks is not accomplished, leading to collapse of banks on the usar patches, causing flooding of many miles within the command area of SSP. However, the area under saline land in SSP command is decreasing. A detailed study of 36th Irrigation Division of SSP was undertaken. It showed that between four years (1997-98 to 2001-02) total loss in irrigated land area was about 39000 hectares, in this division alone.

One of the major reasons for lesser availability of water, increase in maintenance costs and loss of revenue is theft of water from breaches in the distributaries and minors. This can be overcome to an extent by handing over more and more of the minors to the WUAs and at the same time, an increased level of vigilance and patrolling.

The following paragraphs in this section are devoted to a greater and elaborate understanding of the issues involved. Irrigation sector is the largest consumer of the available water and is likely to remain in future. The gap between the irrigation potential created and the potential utilized at times becomes so huge that a number of irrigation projects have been operating at inefficient levels of operation. The Working Group constituted by the Planning Commission, Government of India, on major and minor projects had recommended for regular evaluation (at 5 years interval) of performance of irrigation projects.

The present techno-economic evaluation of the Pariyojana focuses on the following:

– Overall situational analysis (techno-economic) of the Sarda Sahayak Canal system.

– Analysis of irrigation related parameters like canal capacity, silting, waterlogging, water-loss, canal lining, lifecycle, water utilization etc.

– Operations and Maintenance System and

– Management and Information System

– Recommendations for measures to be taken to improve efficiency

4.1.1 Organizational Structure and Functions

We attempt to understand the existing systems in place for the Sarda Canal Pariyojana for different activities like design and network of structures, different constructions, water distribution mechanism, revenue collection, operations and maintenance, institutional arrangements.

The Chief Engineer at Lucknow heads the Sarda Sahayak Project staff and Superintending Offices (S.E.) are located at each of the *mandal* offices, totaling six in number. On an average, one S.E. has 3 to 4 Executive Engineers (Ex.En.). An Ex.En leads a team of 3-4 Assistant Engineers (A.En.) and 15-16 Junior Engineers (J.E.) and an appropriate number of Jiledaars, Ameens, Seenchpals further down the line.

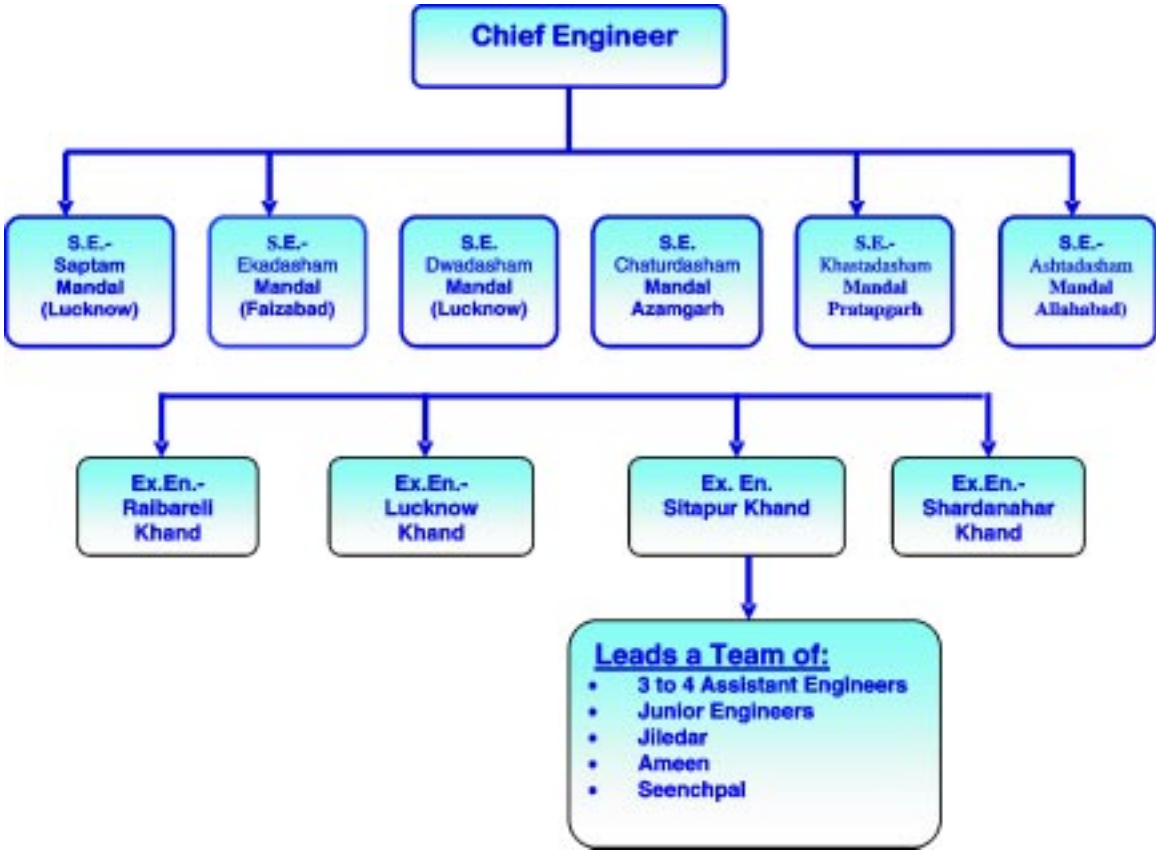
4.1.2 Details of Irrigation System

There are two categories of water sources in the canal system. The **major** sources are:

River Ghaghra from **Girija barrage-** Constructed on the river Ghaghra in district Bahraich, Girija Barrage is the largest barrage in the state of UP of 716 meters length with 35 bays of 18 meters each and has a catchment area of 45550 sqkm.

River Sarda from **Lower Sarda barrage-** The catchment area of the Sarda river up to Banbasa is 14,800 sq km which is entirely hilly. The catchment area below Banbasa up to barrage site is 2880 sq km. comprising of flat low-lying plains. The barrage, with a catchment area of 17818 sqkm has been constructed on river Sarda in district Lakhimpur-Kheri has 20 bays of 18 meters each. The maximum design discharge at head of Sarda Sahayak feeder is 23000 cusecs

Organogram of Technical Staff of SSP



The **minor** sources of water in the canal system are:

– Dal-mau-A pump canal: This pump canal of 840 cusec capacity has been constructed at the left bank of river Ganga at Dalmau in Raibareli district connecting Purva branch.

– Dalmau-B pump canal: The pump canal of 300 cusec capacity has been constructed near keda village in district Unnao on the left bank of river Ganga is connected to Unnao branch.

– Ayodhya Pump canal: The pump canal of 50-cusec capacity has been constructed in tehsil Ayodhya of district Faizabad on river Ghaghra.

– Tanda Pump canal: The pump canal of 450-cusec capacity has been constructed on Ghaghra river in district Ambedkar Nagar.

– Ronahi Pump canal: The pump canal of 376-cusec capacity has been constructed on Ghaghra river in Faizabad district.

– Rampur Pump canal: The pump canal of 10 cusec capacity has been constructed on Sai river in tehsil Lalgunj of district Pratapgarh.

4.1.3 Conveyance & Distribution System

The canal system is designed for easy and efficient conveyance of water for irrigation. Water is diverted from river Ghaghra from Girija barrage and made to flow into river Sarda through **link channel** of 28.7 kms and has a discharge capacity of 480 cumecs.

The diverted volume of water from the **feeder channel** is fed into different areas through the different **branches**[3] of the Sarda Sahayak Canal System, namely the Daryabad branch, the Barabanki branch, the Haidergarh branch, the Pratapgarh branch and the Allahabad branch. The feeder canal has a discharge capacity of 650 cumecs (23000 cusecs). To make available the irrigation water deep into the CCA, a total of 14684 kms of **distributaries**[4] **and minors**[5] have been constructed creating an irrigation potential of 16.74 lac hectares.

To regulate the flow of excess water, **drains** have been constructed to link the tail end to a nearest natural water flow like streams, rivers, rivulets etc. The length of these drains in the Pariyojana is 17752 kms, which is even higher than the length of the entire water distribution system.

[3] Canals with discharge of more than 1000 cusecs are known as branches
[4] Canals with discharge of more than 20 cusecs but less than 1000 cusecs are known as distributaries
[5] Canals with discharge of less than or equal to 20 cusecs are known as minors

The initial plan was to **line** all channels carrying a discharge over 30 cumecs. Of the total length of canal system of 14684 kms, only 203.7 kms have protective lining and pervious pitching and another 131.1 kms has been completely lined all of which lies in the feeder canal.

During the course of the study it was observed that most canals were being run at much below their potential. For example- In Varanasi, the Babatpur canal, though designed with a discharge capacity of 300 cusecs, was being run only at 70 cusecs. Similarly, in village Saraipurwa Muralikathi in district Azamgarh, even though the canal had been cleaned recently, the canals were running dry in the midst of water-abundant kharif season and the farmers were demanding water for the standing paddy crop. However, in Barabanki conditions were comparatively better and water was seen flowing in most canals close to their potential and their maintenance was proper. At a few locations, it was observed that the slope of the canal beds was less than the mandatory 0.1 percent in the upper course and this resulted in stagnation, restriction in water flow and early siltation.

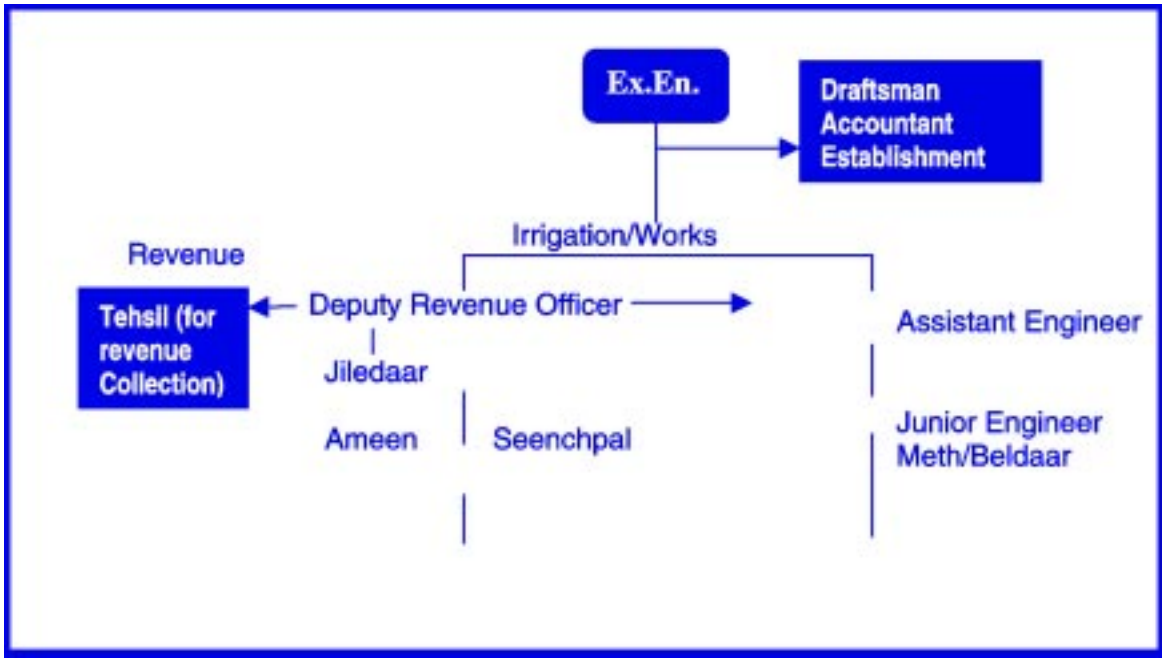
At number of locations it was seen that, when the level of water flow in the distributaries and minors is below the FSL, the farmers construct artificial temporary bunds to block the water and breach the canal banks or outlets for carrying water to their fields.

In Sultanpur Branch, it was reported that during the years from 1999-00 to 2003-04, the actual area irrigated, inclusive of *Rabi* and *kharif* seasons averaged at 2130 hectares (53.2%) out of the estimated area of 4002 hectares. Similarly, in Faizabad prakhand, it was reported that during the years from 1999-00 to 2003-04, the actual area irrigated, inclusive of *rabi* and *kharif* seasons averaged at 31869 hectares (41.85%) out of the estimated area of 76142 hectares.

The above examples make it evident that the water distribution mechanism has been operating much below of the potential. The farmers shared that they were not satisfied with the low discharge and erratic scheduling of water at the outlet. In a village in district Ballia, the farmers showed that the level of the distributaries was lower than the level of the fields and that the natural flow of the water was insufficient to reach into the field channels.

4.1.4 Management and Information System

The management structure at the Executive Engineer level is as follows:



4.1.5 Revenue Generation

Different levels of officers have different functions and responsibilities to perform.

Seenchpal

(i) SSP interface with the farmers

(ii) Records the area irrigated with the SSP water along with Ameen, for each farmer

(iii) Informs about any breach in canal to the supervisor (Jiledar)

(iv) Lodges an FIR with the police about illegal cuts made in the canal

Ameen

(i) Cross-checks the water utilization record prepared by the Seenchpal

(ii) Prepares the bill for the quantity of water availed of by each farmer as per the above record

(iii) Advises the farmers for proper utilization of water and avoid water misuse.

Jiledaar

(i) Inspects the water outlets of the feeder channel and keeps vigilance over its regulation for water distribution.

(ii) Distributes bills and keeps record of the total irrigation in the designated area.

(iii) Has the power to dispose Pariyojana generated products and items worth less than or equal to Rs.1000

Deputy Revenue Officer (DRO)

He reports to the revenue collection and about defaulters, if any to Executive Engineer and District Magistrate.In case of any default he has the authority to take penal action against the defaulters

Lekhpal

(i) To assist the Ameen with the help of land records in identification and collection of revenue from the farmers. Lekhpal is co-terminus with Patwari / Tadvi

Executive Engineer

(i) Rosters for each crop season are prepared by Executive Engineer which are widely circulated to Gram Panchayats to inform the same to all farmers. He is the functional head in the field for the area under his jurisdiction.

Irrigation/ Works

Meth/ Beldar

(i) The meth and beldar are hired on work-charge basis.

(ii) There are a few meths and beldars who are regular employees of the irrigation department and are working on deputation basis in the Pariyojana.

(iii) There main work is to keep records and assist others.

Junior Engineer

(i) Responsible for ensuring that the water reaches up to the tail ends in the distribution System.

(ii) Operates *kulabas* (water outlets).

(iii) Carries out repairs and maintenance of water distribution channels.

Assistant Engineer

(i) Is responsible for security and maintenance of canals in his defined area.

(ii) Ensures availability of water to meet the demand and availability at the tail-ends, cleaning of canals and maintenance of drains.

(iii) Reports to the concerned Executive Engineer about problems arising in functioning of the canals.

Executive Engineer

(i) Ensures smooth operation of all the canals and distribution channels in the area and directs/ executes work orders for construction and maintenance works through contractors or departmental agencies

(ii) Ensures de-siltation and other repairs and maintenance works in the *khand.*

(iii) Authorized to auction the canal property and to issue permits for plying of vehicles on the canal banks:

(iv) Prepares the water release / operation rosters for the *rabi* and *kharif* crops for the assigned *khand*

4.1.6 Operations and Maintenance

Seasonality: Water is distributed through the canal system in two agricultural seasons i.e. *Rabi* and *Kharif*. The *Kharif* season irrigation roster is valid for the period April to October and the *Rabi* season irrigation roster relates to the period November to March.

Water flows from barrage/regulators through main canals and distributaries and is allowed to flow in to the field channels through *kulabas* provided at appropriate locations.

Irrigation in *rabi* season begins after three weeks of sowing of crop and water is applied at the interval of every three weeks. Thus, irrigation is provided to *rabi* crops in four rounds whereas in case of *kharif* crops the application of irrigation water is carried out right from the date of sowing and is discontinued about one week before from the date of harvesting, which is normally done in the month of November or December.

The list of canals and distributaries in different *mandals* are given in the rosters provided for different seasons.

Apart from wheat and paddy, the farmers can avail use of canal water for the production of crops like sugarcane, potato, tobacco, barley, vegetables,

cotton, fodder crops, green manure, pulses and oilseeds and other *rabi* and *kharif* crops. The maximum use of the canal water is in irrigation of principal crops of wheat, paddy, sugarcane and potato. *Therefore, the canal water is available and utilized through out the year and the maintenance can be carried out only during the short intervals when there is lesser demand for water in the intervening periods.*

Water distribution is discontinued for two weeks in the *rabi* season in the months of November and February and March for maintenance purposes for a total period of four weeks. Similarly, in *kharif* season the water distribution is discontinued for two weeks in the months of April and May for the same purpose.

Maintenance of canal and other structure is taken up during the lean period, which normally falls in months of February, April and November.

The Seenchpal keeps vigil on the canals, water flow and other physical structures and reports any kind of breach in canal system or damage to the structures to the concerned J.E. It is the responsibility of the concerned J.E. to carry out the repair and maintenance of the canals and structures, under the supervision of the Assistant Engineer, and with overall approval of Executive Engineer. The team including Executive Engineer, Assistant Engineer, along with Junior Engineer and *Seenchpa*l carry out patrolling of canal in the designated area for ensuring proper functioning of the canal system and smooth distribution of irrigation water to the farmers. Many of the canals, which have discharge of less than 20 cusecs, have been allocated to the WUA (Water User Associations) for operation and maintenance.

Maintenance is an important issue that has not been given its due till now. As it has been previously mentioned the canals and their branches were not in the desired state, the condition of the distributaries and the minors was also no different. Throughout the length of the canal, beam-width is not maintained in the desired measure. Complaints of rat-holes and breaching of canals at some places near Faizabad and Akbarpur have come to notice. It was informed that minor repair and maintenance works are done in-situ while major R&M works are entrusted to Pariyajona workshop located at Kanpur. At many locations, the distributaries and minors had thick growth of tall grasses on both sides. In Azamgarh distributary, a continuous stretch of almost 60 kms had tall grasses and weeds on both the sides and water logging was also observed at number of places.

4.1.7 De-Silting

The water during *kharif* season is laden with heavy silt and causes silting of the canal beds, which in turn reduces the water carrying capacity of canals. As a measure against this problem, the department undertakes silt clearance

programme every year starting from September to December. De-silting is an important on-going activity for maintaining the capacity of the distribution system. This assumes significance in the Sarda canal system, where most of the canals have not been lined and the canal banks are lower than the project design at places. *Problem of silt deposition was reported from all the sites visited.*

In the Project, the provision of de-silting work is much less than the actual requirement. For example: In Haidergarh branch, the discharge capacity of the branch is 20 percent less than the design. This is attributed to heavy siltation, mainly in the first 6km up to Hardoi as there are curves in the alignment. Similarly, at Azamgarh, only an amount of Rs.36.00 lacs was spent on silt reclamation work in 2003-04 whereas the actual requirement was much more. The insufficient de-silting is attributed to insufficient fund availability for maintenance work. This greatly hampers the water carrying capacity of canal system and efficiency of the system is adversely affected.

In the year 2003-04, a total of 3067 kms out of the total 14684 kms of the distribution system were de-silted at an expense of Rs.387 lacs. The details of de-silting work undertaken in the year 2003-04 in different districts are mentioned in the following Table 4.1.

Table: 4.1 De-silting of Canal System during 2003-04

District	Canals	Distri-butary	Minor	Total Length	Desilted length in Kharif	Desilted length in Rabi (Km.)	Treated Length	Amount	Per Km Amount invested
	NA	NA	NA	Kms.	Kms.	Kms.	Kms.	Rs. lac	Rs lac
Sitapur	4	1	3	16.40	10.00	1.00	11.00	1.91	0.174
Lucknow	32	5	27	121.88	18.20	61.02	79.22	20.15	0.254
Raibarely	100	12	88	476.08	63.18	228.00	291.18	40.92	0.141
Barabanki	154	19	135	648.23	74.10	264.31	338.41	48.81	0.144
Sultanpur	81	9	72	362.11	30.40	124.65	155.05	19.46	0.126
Faizabad	63	5	58	273.68	22.00	118.70	140.70	19.37	0.138
Ambedkar Nagar	66	4	62	272.15	9.30	164.60	173.90	21.97	0.126
Pratapgarh	155	14	141	623.41	138.90	244.65	383.55	42.58	0.111
Allahabad	56	10	46	325.30	0.00	219.35	219.35	28.44	0.130
Azamgarh	234	10	224	896.12	49.88	471.75	521.63	50.58	0.097
Mau	24	1	23	122.80	0.00	57.80	57.80	5.41	0.094
Ballia	3	1	2	26.50	0.00	3.50	3.50	1.05	0.300
Jaunpur	194	18	176	848.38	72.85	341.78	414.63	49.37	0.119
Varanasi	17	3	14	87.97	6.80	38.15	44.95	6.53	0.145
Gazipur	26	3	23	114.85	23.60	44.00	67.60	9.09	0.134
Chhatrapati Sahujinagar	78	2	76	239.94	16.70	147.79	164.49	20.92	0.127
Total	**1287**	**117**	**1170**	**5455.80**	**535.91**	**2531.05**	**3066.96**	**386.56**	**0.126**

The Sarda, the Sarda Sahayak and the Sarju River based canal systems, with a cumulative command area of 35 lac hectares over 26 districts, is the largest canal conglomeration in India. However, it has been observed that due to the choking and silting of these old canals the command area has actually shrunk on to 15 lac hectares. With renovation, restructuring and streamlining of these canals, including the introduction of participatory irrigation management and tariff revision, the effective command area of 35 lac ha can be regained on a long-term basis.

The recent developments in the context of de-silting have been encouraging. The Government of Uttar Pradesh has opted to go in for open canal surgery from October 2004 for removing the blockages from the choking irrigation system. In fact, a master plan for this purpose has been prepared to begin the de-silting and cleaning of main canals and its minors at the scheduled time and an amount of Rs.28 crores has been released for the purpose. Efforts are also being made to raise an additional amount of Rs.20 crores that was the estimated requirement for this purpose.

4.1.8 Water Management at Farmers Level

The cultivators by far have a perception that water management is not their responsibility as the department has always been doing it. They consider themselves as users and that they do not have any stake in water management component. Hence, issues like water wastage, system inefficiencies, repairs and maintenance never bothered them. Thus, induction of water with constantly running channels resulted in wastage of water by the cultivators in the field *guls* as well as in application of water in the fields. The agricultural extension services have not been able to meet the resulting demand for propagating the suitable agricultural practices in the command prior to the induction of extra water. The command area development authority is making efforts to educate the farmers for improved water application practices. However, given the marginal increase in the real incomes of the farmers, it is doubtful if they are really in a position to bear the cost of maintenance of the canals on their own.

4.1.9 Seepage and Water-logging

Sarda Sahayak Feeder was commissioned in June 1974 and it was envisaged to put additional 11000 million cumecs of canal water in 2 million hectares command area in a year. The water-logging problem gradually developed in the command area. In 1983, it was estimated by the Command Area Development Authority that 5 lac hectares of land was waterlogged. The problem of seepage also came to be noticed in the course of operation. The reasons behind seepage[6] are as follows:

[6] Singh, Sher.1985. *Seepage from canals consequent water logging and remedial measures: case study of Sarda Sahayak Feeder,* WALMI, Lucknow.

– Drainage system was not constructed from downstream upwards.

– Drains not dug to the required level

– Prominence of weeds in almost all the drains observed

– Available outfalls not utilized for effective drainage

– Continuous running of channels with full supply level both during kharif and rabi.

– High seepage losses in Sarda Sahayak feeder.

– Water logging due to inundation from tails of channels.

– Flow obstruction by road and railway bridges.

– Absence of *pucca gul* (very small sized irrigation channel)

The problems of water logging and salinity in the canal system mainly develop due to seepage from unlined earthen canal systems, poor water management practices and inadequate provision of drainage.

Extreme conditions of water logging were observed during field visits along the banks of Azamgarh distributary near Gambhirpur village and near village Jangipur in Gazipur district and Indara distributary near village Majholi. Similarly, It was informed that in Daryabad branch in Barabanki district, 3080 ha land was affected due to seepage and approximately another 7000 ha were affected due to breach in canal. The CCA was 198674 hectare, however, mostly on account of the above two factors, the actual irrigated area was being reported 170000 ha.

The seepage in the reaches of the canal and the permeability of the soil of the banks was leading to waterlogging condition in the immediate vicinity of the feeder channel. It also resulted in further reducing the already reduced carrying capacity of the feeder from 650 cumecs to about 425 cumecs. Similar conditions occurred in some portions of the main branches. The command Area Development Authority has taken up lining of watercourses to reduce wastage of water and consequent tendency of water logging in the command.

The reaches of feeder channel which are passing through *usar* tracts with banks of the same type of soil are facing a different type of problem. The *usar* soil being very light gets eroded on the inner slopes by water and part of the soil gets dissolved in water gradually hence berm formation does not take place. These have caused several breaches in *usar* reaches resulting in flooding in

huge areas and consequent water logging. The quantum of seepage through bed is not high as intrinsically. The fineness of the soil particles reduces the permeability of the soil. A vast network of field drains and link drains have been constructed by command area development authority to dry out irrigation surplus inducted in the fields into the main drain. Improvement in the drainage network reduces the extent of water logging to a great extent.

High salt and water stress affect the crop growth, reducing the actual cropped areas. This becomes evident from the data presented in the following table. The overall effect of soil salinity can affect the yield up to 50 percent as it was for paddy in the Project. The area characterized as waterlogged, showed further decline in yield to an extent of about 60 to 80 percent for wheat.

Table: 4.2 Yield of Important Crops in Different Types of Soils (kg/ha) in Sarda Sahayak Pariyojana

S. No.	Crop	Normal Soils	Salt affected Waterlogged soils	Waterlogged soils
1	Paddy (HYV)	2773	1349	1630
2	Paddy (Local)	1958	1067	1450
3	Wheat	2596	1139	580

Source: Haryana Operational Pilot Project- Drainage Master Plan

4.1.10 Salinity

The problem of salinity and *usar* tracts in the command existed even before the commissioning of the project. The area under saline land instead of increasing has shown a declining trend. It has been due to the induction of heavy doses of water in some of the usar land, which could be used for the rice cultivation, and thus the introduction of irrigation helped to leach the salts in such tracts. This process is considered as one of the effective methods for reclaiming *usar* land with not too much salinity. This has become possible only after the introduction of irrigation by this project. The *usar* land soil borrowed from the neighbouring area was used for construction of the banks of main feeder channel in about 50km.of the total 258.8 km, length.

4.2: Financial Return and Benefits

Sarda Sahayak Pariyojana completed at the cost of Rs.1276.17 crores provides irrigation to 16.55 lac hectares of agriculture land. It is one of the cost-effective canal irrigation projects in terms of capital expenditure compared to the norms prescribed by Planning Commission for major irrigation projects. The gross revenue based on irrigation rates, as applicable, stood at Rs.5103.18 lacs in the year 1998. Against this revenue generation, the annual working expenses stood at Rs.926.50 lacs for that year thereby generating net revenue of Rs.4140.68 lacs.

Therefore, it is understood that the return on investment of the project would be economical only if the capacity generated is utilized fully. The volume of water available and the irrigation potential has not been exploited to its potential. The benefits of the project are sufficient to cover the capital and the running costs and viability of the project lies with efficient management.

One of the critical reasons for inefficiency in use of water is subsidized rate of water charges. Water rates in India are so low as to make irrigation water available almost at negligible cost to the farmer. In this context, previous studies indicate that in canal-irrigated areas, less than one percent of the cost of farming is due to water charges, which are very low when compared to areas, which are irrigated from other sources. In addition, currently applicable water charges are crop and area based and not volumetric. This does not reflect the scarcity value of water and has some extreme consequences:

– The low cost of water does not encourage the farmer to save water;

– A crop/area based water charge actually discourages saving of water. A farmer who saves water and irrigates a larger area has to pay a higher price for water as the charges are based on the crop area and the type of crop.

However, application of water charges on volume basis is one of the most difficult propositions considering its mass reaction and fallout.

One way out is to rationalize the water rates so that the farmer pays a smaller charge for an initial quantity of water which is need based but he has to pay a much higher charge if he uses more water than what is considered necessary (a cascading rate structure). If this were done the farmers at head reaches would use much less water, as wastage of water would be an expensive proposition. The water thus saved could be used in the tail or even to irrigate the total command.

Therefore, it is safely concluded that the most significant reform in the water sector and one that needs to be immediately implemented, is a change over from the current systems of area/crop based water charges to a volumetric system. This will need proper metering and monitoring systems but the cost would prove to be negligible when compared to the benefits that can accrue.

It has been observed that a 30 percent improvement in water use efficiency in the Indira Gandhi Canal Project in Rajasthan could lead to an additional command of more than four lac hectares.

4.2.1 Irrigation Scheduling

Irrigation scheduling is a means of conserving water that helps in making decisions on allocation of quantity and timing of water supply commiserating with crop needs. It is one of the key activities that have the potential to improve performance of the system, especially its productivity, equity and stability (Chambers, 1988)[7].

It has been noticed that the main system scheduling done by the irrigation department and the on-farm scheduling practices adopted by the farmers do not match in terms of time of operation. The affects of erratic irrigation schedule for the farmers are;

- Excess and inefficient utilization of water.
- Farmers are unable to prepare an irrigation linked crop plan.
- Crops with low dependence on irrigation are encouraged thus there is a little incentive to innovation and experience.
- Untimely and uninformed release of water causes severe damage to standing crops.

4.2.2 Role of Institutions

Currently there are three different institutions, which have important roles to play in the operations, maintenance and management of canal irrigation system. The Sarda Sahayak Pariyojana, which took up the construction of the canal irrigation structures, is continuing with the operations and maintenance components. Revenue collection is being done through the revenue department of the concerned district administration. Command Area Development Authority (CADA) has been assigned with the responsibility of developing systems for effective utilization of water and introducing suitable agricultural practices. The most important institution in this context is the farmer's body, known as the Water User's Association (WUA), which has to be handed over the operation and maintenance of the distribution system in the long run with supportive supervision by the irrigation department and assisted by other concerned agencies. There are other agencies like Water and Land Management Institute (WALMI) that have been engaged for providing specific need-based trainings to WUAs.

[7] Chambers, Robert (1988) *Managing Canal Irrigation,* Oxford and IBH Publishing Co.Pvt.Ltd. New Delhi

4.2.3 Water Users Association (WUA)

The Water Users Associations (WUAs) is a farmer's body at the village level for managing the minors, which are of carrying capacity of less than 20 cusecs. With a general consensus of at least 51 percent of the farmers of the command area of the minor, a WUA of seven members is formed. The WUA should be registered with the irrigation department to begin with, however, in due course of time they are supposed to be registered under UP Cooperatives Act or Society Registration Act.

The Pradhan of the concerned Gram Panchayat is the president of a WUA and the concerned Junior Engineer is the secretary of the WUA. Membership is reserved for each of the following- women, SC candidate and a socially acclaimed farmer of tail end. The WUA is supposed to play key role in maintenance and revenue collection.

The WUAs are responsible for managing the minors and irrigation department provides funds for repair and maintenance of the minors. The WUAs are extended full cooperation by the department. In the Project, the WUA are being formed in two branches on pilot basis and it is proposed to involve WUAs in at least one minor in each Khand.

In the proposed set-up, the members of the WUAs would share the following powers:

– To develop the command area.

– To obtain work under other proposed government projects.

– To obtain information about the minors from the irrigation department.

– To correspond with different government departments for the purpose and problems of the association.

– Revenue collection and take penal action after confirmation.

Similarly, the key responsibilities of the WUA in coordination with the *kulaba* samitis are as under:

– Prepare the crop rotation and other allied works in consultation with agriculture officer so that demands of water do not accumulate at the same time.

– Purchase of water from the department on the basis of volume and its distribution among the members.

– Issue bills to the members within one month when the crop season is over.

– Revenue collection and to deposit money collected in cooperative bank account after making payments of the bills to the department.

– Utilization of funds received from the department for the maintenance of the canals and keeping a complete account of fiscal and financial works.

– Cleaning, repairing and maintenance of the minor and the drainage in the command area according to the roster.

– Post-harvest management of crops and effecting coordination in development works in the command area in consultation with the government departments.

– Reading and Maintenance of flow meters installed at the head end of the canal.

4.2.4 WUA's Training

Water and Land Management Institute (WALMI), is providing training in organization of Water Users Associations as also about the extent of irrigation, rostering, crop variety, significance of drainage and other related topics without any charge from the farmers. It has been appointed as nodal agency for monitoring, evaluation and documentation of participatory irrigation management. Trainings were provided to 19 WUAs from 19 blocks in Sarda Sahayak *Khand*-36, Jaunpur on participatory irrigation management.

During the course of the study these committees were not found functional. Many of the members were not aware about the bylaws and majority of the middle level officers were found unaware of their responsibilities. The farmers did not receive any kind of extension service from the different development departments concerned.

4.2.5 Command Area Development Authority (CADA)

CADA was formed by drawing staff from the agriculture department for purposes of development of command area of an irrigation system unit. 46 units of CADA were deployed for lining of watercourses, and thereby reducing wastage of water and water logging in SSP's command area. Of them 36 are soil conservation units and 10 *osrabandi* units. The important roles and responsibilities of CADA have been outlined as under:

– To educate the farmers in developing their fields in such a way that irrigation water is best utilized and wastage of water from *kulabas* is fully avoided.

– To assist farmers in construction of field channel lining and provide drainage.

– To educate farmers in adopting suitable cropping patterns and use of proper agricultural practices.

4.2.6 Situation Analysis of Sarda Sahayak Khand-36

The status of one small section of the irrigation system was examined by conducting a study of Sarda Sahayak Khand 36, Jaunpur. The salient features are documented below.

Profile: Sarda Sahayak Khand 36, Jaunpur, provides irrigation water to five districts namely Pratapgarh, Sultanpur, Jaunpur, Azamgarh and Gazipur. It covers the command area of two distributaries Jaunpur and Sultnapur. The former originates from Haidargarh branch and the latter from Daryabad branch and together they run for 847.05 kms. There are 161 canals in this khand.

Potential and Actual Irrigation: With a total CCA of 93294 ha, both the distributaries together have the potential to irrigate 107288 ha of which 62507 ha falls in the *kharif* season and 44781 ha fall in the *rabi* season.

The data available (Table 4.3) for the period from 1997-98 to 2001-02 indicates that the actual irrigation has been much below the potential of the distributaries. Between the two crop seasons, the actual irrigation coverage has been higher in the *rabi* season each year. However, the combined irrigation potential utilization has never gone beyond 40 percent of the potential during this period. The average annual actual irrigated area has been approximately 30 percent in this period and there is a tremendous shortfall in water utilization efficiency.

Table: 4.3 Year wise status of Irrigation in Khand-36

Year	Irrigated Area (in ha.)		Percentage of Irrigation to CCA	
	Kharif	Rabi	Kharif	Rabi
1997-98	17902	13304	28.6	29.7
1998-99	18204	22043	29.1	49.2
1999-00	14431	17114	23.1	38.2
2000-01	11500	9513	18.4	21.2
2001-02	20141	21030	32.2	47.0

Probing deeper into the reasons for this shortfall, a close analysis of the data available for Jaunpur distributary of Khand 36, reveals the following (All figures are in ha):

(i)	Culturable Command Area	44528
(ii)	Actual CCA (as per Outlet Records)	39056
(iii)	Proposed Kharif	29834
(iv)	Proposed Rabi	21373
(v)	Actual irrigation in Kharif	5574
(vi)	Actual irrigation in Rabi	6695
(vii)	Decrease in Irrigation in Kharif	
(viii)	Decrease in Irrigation in Rabi	24260
(ix)	Total decrease	14678
(x)		38938

Revenue Collection: The revenue receipts per hectare over the past five years (from 1997-98 to 2001-02) have been less than Rs.4 except for 1997-98 when it was Rs.29.94 and in 2000-01 Rs.8.49. This is in spite of the fact that the water made available for irrigation in these five years was much costlier. When we compare it with the applicable irrigation rate of Rs.49 per ha, the lowest rate applicable for fodder crops the extent of deficit becomes clear. As a matter of fact, most of the area brought under irrigation has been put under either paddy or rice crops. This implies that there is a huge gap in the revenue generated and the revenue collected. This is attributed to either water utilization inefficiency or poor revenue collection mechanism. For both kinds of incidences, stringent measures are required for rectification.

Water Distribution System: Jaunpur distributary consists of 3 distributaries and 50 minors with a total network length of 343 kms. In the year 2001-02, the percentage of command area irrigated in Kharif by these three distributaries was 13, 23 and 51 respectively and the irrigation efficiency of the minors ranged from 0 to 33 percent. Of the 50 minors, 48 had efficiency level of less than 20 percent. The actual area irrigated in *kharif* season was 20141 hectares (32.2%) out of an estimated area of 62505 hectares. Similarly, in *rabi*, the percentage of command area under actual irrigation was very low for minors. 43 of the minors ran with efficiency levels of less than 30 percent.

WUAs: There are 147-water user's associations (WUAs) formed till now for *alpikas* and an equal number of WUAs formed for *rajwahas* on a pilot basis. These WUAs would obtain water from irrigation department or other bulk water suppliers and distribute among the farmer members and maintain minor systems in the boards, JBSDMB[8] and IBSDMB[9]. These boards have been created for

[8] JBSDMB- Jaunpur Branch Sub-basin Development and Management Board
[9] IBSDMB- Imamganj Branch Sub-basin Development and Management Board
The two boards have been formed under the Piloting Reform Options in Water Resources Management (PRoWaRM) component of UPWSRP, which aims at restructuring the Sarda Sahayak Paiyojana, along with other objectives.

water resource planning and management in the selected sub-divisions and for this they would be supported in infrastructure, technical advisory services and operating costs. To further strengthen the efforts, 19 block level trainings have been organized on participatory irrigation management in the *khand*.

Regarding Institutional Policy and legal analysis of Sarda Sahayak Pariyojana, it might be construed through developing a close understanding of structural and non-structural initiatives undertaken under this Pariyojana. The structural initiatives include SSP command area development project established in 1973-74, full utilization of the intended irrigation potential leading to creation of field channels, lining of channels and creation of water control structures under On Farm Development Programme (OFP). Performance of SSP in terms of undertaking such structural initiatives could be termed adequate. Whereas, the performance of SSP in terms of undertaking non-structural initiatives constituting development of Osrabandi, Wara bandi scheme, the creation of farmer's association for allotment of irrigation water or water user association, the identification of beneficiaries as per their landholding, the role of *Panchayati Raj* Institutions and in particular *Jal Prabandhan Samitis* at the village level; has particularly been lacking and need further tightening up.

4.3: An Analysis of the Costs and Benefits and Time Overrun

The Planning Commission cleared Stage-1 of SSP at an estimated cost of Rs. 64.84 crores. The construction work was commenced in October 1968. It, however, took almost 35 years to complete. In terms of the volume and quantity of water it carries, it is one of the largest irrigation projects of India.

The initial projections and estimates in 1966-67 for the canal were for Rs. 99.61 Crores, which ultimately rose to actual investment of Rs. 1299.12 Crore, by March 2001. During this period the project witnessed many revisions in terms of cost and scope.

4.3.1 Changes in the Cost Estimates and Scope over the Time

The original Sarda Sahayak Project envisaged increase in annual irrigation intensity to 70 percent of its a CCA (culturable command area) of 16.77 lac hectares at a cost of Rs.99.61 crores in 1967.

First Revision in Cost

The first revision in project cost estimate was done in October 1972 and the same was cleared by CWC (Central Water Commission) for Rs.199.87 crore in January 1976. The reasons attributed for the change related to rise in the cost of labour and construction material and some changes in the extent and scope. This project estimate envisaged enhancement of annual irrigation intensity from 70 percent to 85 percent.

Second Revision in Cost

The estimated cost of the project was updated to Rs.314.85 crores in October 1976 based on the factors mentioned below. During the course of execution, extending the culturable command area to 20 lac hectares and increasing the annual irrigation intensity to 96 percent further enlarged the scope of the project. Remodeling of the old Ghaghra and the Tanda Pump Canals was also incorporated in this project.

Third Revision of Cost

Due to a combination of factors, a need was felt to revise the project cost again. Theses factors included steep rise in the cost of labour and materials and change in design of some major structures after detailed investigations. The concept of selective lining of feeder channel changed and it was decided to increase the length for lining up of feeder channel up to 99 km in order to provide required conveyance capacity, reducing water logging problems and saving irrigation water for *usar* reaches totaling to 50 kms. Length of channels in distribution system was increased considerably in order to serve the command area for better distribution of water. Dalamau-B Pump canal in Ayodhya Pump canal was included in the project. The provision for drainage was increased manifold. With all there provisions, the project was revised in 1985, costing Rs.733.23 crore.

In the meanwhile, CWC asked the state government to rework the basis of cost calculation for the project update and in 1990 the project estimate was revised to Rs.1013.84 crore but was not sent to CWC. Then the project was further revised in 1995 on the basis of prices of 1995 resulting in a revised cost of Rs.1584.48 crore and sent to CWC in March 1995 but was called back. The project estimate was reframed in Aug.1999 and the total project cost was fixed at Rs.1276.17 crore.

At the close of the project in 2000, the total project capital cost stood at Rs.1299.12 crore with a CCA of 16.55 lac ha creating irrigation potential of 19.033 lac ha with a distribution system of 14684 kms. The surface water demand for irrigation in UP in the year 2000 stood at 42 million hectares, and this project contributed up to 4 percent in fulfilling it.

Table 4.4 Change in Cost: Initial and Final Scenario

Particulars	1972 Cost Estimates (in lac Rs.)	1998 Cost Estimates (in lac Rs.)	Changes in Estimates (in lac Rs.)	Percent Changes
Direct Charges				
Head Works				
Head Works On Ghaghra And Sarda Barrages	3350	6332.77	2982.77	
Head Works On Link Channels	700	1610.63	910.63	
M.C And Branches				
Feeder Channel	9264	38777.35	29513.35	
Branches	2223	20477.75	18254.75	
Inclusion Of Pump Canals	0	3449.26	3449.26	
D.Ys And Minors	2137	33265.72	31128.72	
Drains	200	12502	12302	
Water Courses	200	0	-200	
Sp. T & P	400	564	124	
Losses On Stock	42	284.90	242.90	
Establishment	1458.44	9056.42	7597.98	
Tools And Plants	185.56	586.32	400.76	
Rr On Ca	-455	-597	-142	
Total Direct Charges	19705	126310.12	126309.80	539.71
Indirect Charges				
Audit And Accounts	185.56	1172.64	987.08	
Capitalised Abetment Of Land Revenue	56	134	78	
Total Indirect Charges	241.56	1306.64	1065.08	440.91
Grand Total	19946.56	127616.44	107630.2	538.51

If we compare the cost estimates of the revised proposals of 1998 with the original cost estimates of 1972, the total cost estimates have risen to Rs.127616.76 lacs from Rs.19986.56, an increase of 538.5 percent. The reasons for the increase vary if we break up the costs into further heads and subheads. While rise in prices were responsible to a very large extent, changes in scope of the work have also contributed substantially to increase in the cost. Inadequate provisions for some work and inadequate investigations have also been causal factors in some cases.

4.3.2 Increase in Direct and Indirect Charges of the Project

The total direct charges for the project witnessed an increase of around 539 percent as compared to the 1972 estimates. About 30 percent of this increase was due to price rise over the period. The major reason for the change in the cost estimates was due to change in scope as compared to what was

envisaged in 1972. It contributes to almost 48 percent of the increase of direct charges to the project. Inadequate provisions and inadequate investigations taken together also are responsible for the rest of the increase. Increase in indirect charges has been to a tune of almost 441 percent. Increase in prices has been the only reason responsible for it.

4.3.3 The Envisaged Benefits

There has been an overall increase of 7.5 lac hectares in irrigation potential over the original 1972 project with an increased irrigation intensity of 96 percent from 70 percent as compared to the original project. The project, with its full development and utilization of irrigation capacity, would result in additional food production of 9.73 million tones annually and the total annual additional value of food and non-food produces is expected to be about Rs.2278.15 crores. The capital investment works out to Rs.6629.44 per hectare. Of the benefited area, while the return on capital is 3.25 percent the benefit cost ratio works out to 7.08. The table below gives the calculation for the benefits cost ratio.

Table 8.2 Calculation of Benefit Cost Ratio

Srl.		Particulars	Amount (in lac Rs.)	Amount (in lac Rs.)
I		Estimated Cost of Project	127616.76	
	Add:	Cost of land development (Rs. 2000 per ha for CC of 16.74 ha)	33480.00	
				161096.76
II		**Annual Benefits**		
		Gross value of the product Post Project (Net benefit after irrigation)		172199.98
		Gross value of the produce (Net benefit before irrigation)	40495.54	
	Add:	Loss in agriculture production in area covering under submergence and laid going out of cultivation in project area	671.80	41167.34
		Net estimated value of benefits		**131032.64**
III		**Annual Costs**		
		Interest @ 10% of the estimated total cost		16109.67
		Depreciation of the project @ 1% of the cost of the project assuming life of 100 years		1276.17
		Depreciation of the pumping system @ 8.33% of the estimated cost of the pumping system assuming life of 12 years		17.22
		Depreciation of the rising Mains @3.33% of the estimated cost assuming life of 30 years		4.86
		Charges of power for lift irrigation at Rs. 90 per hectare for 70000 hectares		63.00
		Annual operation and maintenance charges @Rs. 50 per hectare for 18.481 lac hectares		962.5
		Maintenance of head works @1% of its cost		79.43
		Annual estimated costs		**18512.85**

Benefit Cost Ratio

Net estimated value of benefits / Annual estimated costs = 131032.64 / 18512.85 = 7.08

4.4.4 Critiquing Cost-Estimates of Sarda Sahayak Pariyojana(1998)

The project estimate was revised substantively in October 1972 and was cleared by CWC (Central Water Commission) for Rs.199.87 crores in January 1976. This project estimate envisaged enhancement of annual irrigation intensity from 70 percent to 85 percent, besides undertaking some pump canals. But this estimate too was further revised and a much larger project proposal was presented for SSP in 1998. And what was achieved by the end of March 2001 was again marginally different from what was proposed in 1998. This part of the report critiques the cost differentials between the 1972 approved budget and the 1998 proposed budget for SSP.

The office of Sarda Sahayak Pariyojana, Lucknow, has provided the study team with six exhibits for explaining the cost escalation between what was approved in 1972 and what extra they required as per the 1998 estimates. The first exhibit gives the cost for developing a barrage (Girija barrage, the largest barrage in UP) at Katarnia Ghat (in Bahraich district of UP) and another barrage at Sarda Nagar (in Lakhimpur Khiri district). Let us look at the exhibit (1).

(1) Exhibit 1 tells us that the Ghaghra and the Sarda barrages were scheduled to be completed, with the total cost of Rs. 3350 lacs, as per the 1972 proposal (barrages were built between 1968 and 1975); however the fresh proposal sought additional amount of Rs. 2982.77 lac or about 89 percent upwards revision. It was found that a new line cost item, under the sub- head Q of Spl.T& P worth Rs. 172.19 lac was introduced, anew, in 1998. However, the sub heads under C-works and P-Maintenance, followed by the sub-heads of K for Building, O for Miscellaneous were the major items contributing to the cost escalation. Whereas, land costs and communication costs were smaller cost-escalation based sub-heads.

One significant conclusion that could be drawn from this exhibit of barrage estimates is - even though the actual barrage building activity was completed in early 1970s, some of the operating costs have been added and capitalized, after the completion of the activity. Of the seven causes attributing to the cost escalation, price rise (it seems to have happened due to over-shooting the planned timeframe) and inadequate provision in the previously developed proposals - were the two most substantive causes. These two causes together accounted for the cost rise to the tune of 87.18 percent. Price rise was most significant because it alone contributed to about 52 percent of cost escalation. Whereas; inadequate provision of costs in the earlier proposals contributed for rise in costs by 35.18 percent.

(2) The second exhibit explains the formatted reasons (under seven heads) for incurring additional expenditure of Rs. 910.63 lac on building the Link Channel, between the Ghaghra Barrage and the Sarda Barrage, for a total distance of 28.7 Km.

It was found that the cost of building a 28.4 Km. long Link Channel (for carrying 480 Cumecs of water) between Katarnia Ghat and Sharda Nagar was initially proposed and sanctioned for Rs. 700 lacs (as approved by CWC in 1976). The new proposal of 1998 sought a substantial upward revision (by 137.23percent more than the initial cost) or for Rs. 1610.93 lacs for the same. We further find than no new line cost-item has been added in the fresh proposal. The cost differential of 66 percent could be attributed mainly to two factors, viz. further investigation and improved design of the link channel. Both these reasons seem to be very sound and could always be defended, successfully. However, this exhibit also attributes 18.7 percent of the total escalated proposed amount to the price rise factor, too. It could also be defended because with the improved designs, the time factor becomes important. Additional cost of Rs.1.22 crores for new provisions could be attributed to new designs subsequent to further investigations. It was found that three line items of cross drainage, earthwork and maintenance together accounted for 71.35 percent of the total escalated amount. And it seems illogical to believe that the earlier designers could not visualize the needs for cross drainage, earth work and maintenance rationally. In any case, the link channel had to make provisions for cross-drainage of Soti and Suheli rivers; but building those huge siphons as the best and effective cross-drainage pattern - could be challenged. Similarly, incurring an un-productive overhead like maintenance cost of Rs.150.25 lacs, will be difficult to defend. Moreover, it came to a high proportion of about 16.5 percent of the total escalated cost. Capitalizing it was also a mistake, because it adversely affected the cost benefit ratio of the structure.

Table: 4.5 Differences between Proposed and Actually Achieved Targets for SSP

Item No.	Item	Proposed in 1972	Actually Achieved by March 2001
1	Ghaghra Barrage	Yes	Yes
2	Sarda Barrage	Yes	Yes
3	Link-Channel	28.4 Km. long and carrying 480 Cumecs of water	28.7 Km. Long and carrying 480 Cumecs of discharge
4	Feeder Channel	250 Km. & 650 Cumecs	250.8 Km. & 650 Cumecs
5	Lining of Feeder Channel	136 Km. – Complete Lining	131.1 Km. – Complete Lining 64.87 Km. – Protective Lining 7.10 Km. – Pervious Pitching
6	Length of Canals	1336 Km.	1378 Km
7	Length of Distributaries and Minors	7680 Km.	14684Km.
8	Length of Drains	640 Km.	17752 Km.
9	CCA	18.21 Lac Ha , irrigation Intensity of 85 %	16.55 Lac Ha , irrigation Intensity of 115 %
10	Proposed Irrigation	17.12 Lac Ha	19.033 Lac Ha*
11	Capital cost of Construction	Rs.199.87 Crores	Rs.1299.12 Crores
12	Annual Revenue Return	3.37 %	3.19 %
13	B.C. Ratio	13.28: 1	6.98: 1**

(Source: irrigation Department, GOUP, 2001) Actual irrigation up to 19.033 Lac ha might have been achieved some time during fiscal 2000-2001, but this study revealed that the actual area irrigated during the year 2003-2004 and 2004-2005 was closer to 13 Lac ha per annum.
** The study team calculates the BC ratio as - 7.08: 1.

(3) The third exhibit pertains to the escalated costs of Main Feeder Channel (258.8 Km. long, 131 Km. of which has been provided with lining). CWC had approved the 1972 estimates of Rs. 9264 lacs for Feeder Channel in 1976. But the government of UP sought an additional amount of Rs. 29513.35 lacs for the Feeder, based on actual incurred expenditure.

Exhibit-3 tells us that new line items of Dalmau –A and Dalmau-B pump canals and modernization of old Sarda Canals worth Rs. 3086.5 lacs were added in the fresh proposal. Actually, these were added due to the popular demand from the communities. However, these costs together constituted for about 10.39 percent of the total escalated cost. The most important and hereto un-conceived cause for cost escalation was that the irrigation department of UP had to undertake lining of Sarda Sahayak Feeder Channel. This led to an additional cost burden upwards of Rs. 156 crore, leading to escalation by 52.9 percent of the total, and being Rs. 295.3135 crore. Actually, the channel lining cost was 692 percent over and above the previously budgeted amount of Rs.26.36 crore for undertaking Main Feeder Channel Works.

Exhibit 3 (b) presents the cost sub-heads that appeared for 1972 and 1998 respectively as budgeted cost-items and the cost differential as the variance in budget. Earth work and cross drainage are variable costs hence the cost variance for these two heads will appear as the variable variance; but the variance in maintenance is the variance in recurring cost which is either semi-variable or fixed in nature. Variance analysis of cost could have been used for determining the effectiveness and efficiency of these escalations. But the proposal lacks enough relevant data to determine the cost effectiveness or cost efficiency. The given information (and the evidence below) is however, enough to suggest that the construction work for the Girija barrage and the Sarda barrage were completed by January 1974 and the feeder channel was built up to the 105 Km. point, by then (as per the News Bulletin of Irrigation Department, GOUP on SSP). It was only after the completion of the two barrages and the single feeder channel to the 105 Km. level was completed that the deficiency of lining (a heavy water seepage and extensive water-logging on the left flank of the feeder channel, see attached photographs) and undertaking construction of twin-channels (and canals, for example, Daryabad canal also constructed subsequently as two parallel running - twin canals, very much like the feeder channel) was realized by the department. Hence this huge cost escalation of > Rs.295 crore for feeder channel had to be borne.

It might be reiterated here that after the construction of barrages and feeder channel up to 105 Km., many design flaws and inadequacies came to light. But including maintenance cost after a part of the SSP got operational, as the capitalized cost was a wrong decision, conceptually, because maintenance of the channel should have been defrayed with the revenues that it started generating from 1976. Meanwhile, the irrigation department failed to make the

irrigating water safe enough for its users. Despite construction of silt ejectors (again, conceived in the latter phase) the water of Sarda Sahayak Canals carry more than 4000 parts per million of silt amidst its water; which causes very serious problems of choking of canals and change in the soil quality of fields. Even though, one knows now that if the barrage would have been built about ten Km. upstream on the Ghaghra, closer to the hills, above Katarnia ghats, silt contents of Sarda Canal could have been contained, as was done in case of Sarda canal's Upper Barrage at Banbasa. This flaw was however, never corrected.

(4) The fourth exhibit gives the detailed estimates regarding the five (branch) canals, viz. Daryiabad, Barabanki, Hydergarh, Pratapgarh and Allahabad – all of these emerge from the Main Feeder Channel from five different locations. Actually the Feeder Channel ends as the Allahabad canal. This exhibit also contains the cost details of the four pump canals that SSP undertook, as per a very belated decision.

Building a 258.5 Km. long Feeder channel and carrying 23,000 cusecs of water without lining of its bed taught the irrigation department a very important lesson that it will have to undertake lining of its largest canal's bed, as well. Hence the Daryabad canal had to be lined. It led to cost escalation to the tune of about Rs. 30 crores. But no satisfactory reason was given for the unprecedented rise in earth-work of canals from about eight crores to 92 crores, > 11 times the initial budget. Three reasons furnished do not answer the question, fully. Well, owing to delays, cost escalation of 24 crores has been budgeted. How could there be three times escalation of the original cost? Other two reasons cited for cost escalation are: change in scope and inadequate provisions in the previous proposal. If one were to look at it critically, one finds that it was rather the political expediency than in the expansion of scope which caused undue expansion in the cost of earth work, bridges and regulators. The long stretches of Dariabad and Hydergarh branches have actually eaten into the coffers of state government and left the farmers high and dry (in remoter areas of Azamgarh, Mau, Gazipur and Ballia).

Taking the Daryabad canal up to Ballia and even beyond Azamgarh district was not a very wise decision as it did not fully serve the purpose of irrigating the far-flung fields of Ballia, Azamgarh and Gazipur districts. Similarly, over-stretching the potential of Hydergarh branch and taking it beyond Rae Bareli and Sultanpur and up to the tails of Jaunpur has certainly not mades irrigation department a cynosure in farmers' eyes.

(5) The fifth and sixth exhibits give the detailed estimates of construction on DYs and Minors. The variance in three budget items appears to be the most severe. These are: (a) new construction of canals (and not remodeling of the existing branches of Sarda Canal); (b) Building Drains and (c) cost escalation on

building DYs and Minors. As in previous structures, here too the cost escalation has occurred owing to the desire of the irrigation department to promise more than it could actually deliver. Irrigation department officials told the survey team that there were at least fifty Minors that never got enough water to carry to their destinations. Besides, there were, at least five Dys from the Feeder Channel, on the right flank, that were later closed down. As far as the sixth exhibit is concerned, only two cost items seem sufficient to raise eye-brows. These are the high cost of establishment, though well within 10 percent limit of the total cost and deferment or abetment of water cess / revenue, which led to capitalizing this cost and hence caused its further escalation.

Notwithstanding these flaws, it is a great achievement of Govt. of UP to provide irrigation to 13 lac hectares of land in about 170 blocks and 12 districts of the state.

Chapter 5

Conclusions and Suggestions

To conclude the following findings are necessary to be emphasized. The findings may be categorized under three distinct components, namely, technical, financial and institutional.

5.1: Technical Attributes

If one has to deduce the gross cropped area of SSP's command area, then one shall have to look at the ratio of kharif and rabi crops in the post-canals scenario. Actually the area under rabi crop is about 25 percent more than the Kharif crop area. Hence, if we count double the cropped area in these districts and add 20 percent of jayad crops in the command area, the total figure will come between 12.5 to 13 lacs ha of the total canal irrigated area in the SSP command.

With the commissioning of SSP the command districts have been able to irrigate 84 percent of their arable area, with the canal system accounting for less than half of the area irrigated. In reply to the queries regarding the adequacy, timeliness and silt-free nature of water provided by SSP, only 57.22 percent farmers said that they were satisfied with the water resource, for its adequacy, timeliness and de-silting efforts. Non- availability of enough water in time has been the major problem of most of the dissatisfied farmers. Silting and clogging of canals was articulated as the second biggest problem of the farmers. The upstream farmers sometimes caused the problem to the farmers at the tail end due to their deliberate cutting and bunding of canals thereby stopping water to reach the downstream farmers, at the tails. But, SSP's technical failure to reach the tail ends could not be condoned, which occurred due to a bevy of problems, including- water logging, high conveyance losses, faulty designs and cutting at the up streams.

One very interesting conclusion becomes apparent that in spite of all the hype created by SSP that it would bring adequate water to Purvanchal region of Uttar Pradesh or the districts of Ballia, Gazipur, Jaunpur, Mau and Azamgarh; it could actually deliver only 50 percent of what it was set out to achieve. Many farmers in Ballia, Gazipur, Azamgarh and Mau still await the promised water to reach their fields. Rather, the lands of these farmers have become the ready flooding grounds for the swollen waters of rainy season. Now, with the basins approach being mooted, probably, the policy makers and engineers will focus on

the Sarju-Ghaghra sub-basin of Ganga basin also and try to reach its saturation level, as early as possible. However, the gap between water required and water available is quite big to fulfill unless 8,000 Cusecs of water is earmarked for these four eastern UP districts.

The engineers appear to have committed a mistake in locating the diversion of Ghaghra channel at Katarnia Ghat. If diversion were made eight kilometers upstream, while Ghaghra was still traversing the rocky surface and not the alluvial plains, it would have contained as little silt as did the Sarda Canal. It was observed by the researchers that in eight out of the 55 villages the bed level of canal minors was lower than that of fields at multiple sites, which made the flow irrigation redundant unless one embanked the channel's flow through land-filled abutments and water spilled over the canal banks, causing damage to banks of canal.

There does not seem to be any reasonable justification for not undertaking conjunctive irrigation methods in the initial phases of SSP implementation. It would have contained a lot of sodicity related problems that ruined thousands of hectares worth good land in the districts of Rae Bareli, Pratapgarh, Sultanpur, Barabanki, Faizabad and Allahabad in late 1970s and early 1980s. Nevertheless, it needs to be pursued more vigorously, now. Similarly, SSP top management's inability to develop and package an indigenous participatory irrigation management (PIM) based model in its early phase of implementation– was another major oversight; which needs to be corrected soon.

Over eleven cost iterations were made for SSP, resulting in escalations in its estimates. The projections and estimates of SSP at the initial stage in 1966-67 were for Rs. 99.61 Crores, which ultimately rose to actual investment of Rs. 1299.12 crores, by March 2001.

One very significant aspect of SSP that needs reiteration here is that a large part of Feeder Channel, as well as the main canals was not lined because of the cost escalation factor. However, non-lining of the canal has made the Sarda Canal System a high water conveyance loss system. Only 56 percent of the total volume of water that it carries actually reaches the users.

5.2: Financial Attributes

There might be many genuine reasons for cost escalation of SSP over its eight estimates. However, one can't gainsay the fact that due to a large amount of maintenance and operating costs that accrued between 1968 and 2001 have been added over the years and capitalized. Hence the fixed cost of SSP seems inflated by a margin of about 16 percent. Of the several causes attributing to the cost escalation and price rise - over-shooting the planned timeframe and inadequate provision in the previously developed proposals - were the two most

substantive causes. These two causes together accounted for the cost rise to the tune of 87.18 percent. Price rise was most significant because it alone contributed to about 52 percent of cost escalation. The inadequate provision of costs in the earlier proposals contributed for rise in costs by 35.18 percent. Similarly, the reasons for cost escalation explained in building the link channel of 28.4 Km also seem difficult to digest. We find that three line items of cross drainage, earthwork and maintenance together accounted for 71.35 percent of the total escalated amount. And it seems illogical to believe that the earlier designers could not visualize the needs for cross drainage, earthwork and maintenance rationally. In any case, the link channel had to make provisions for cross-drainage of Soti and Suheli rivers; but building those huge siphons as the best and effective cross-drainage pattern – one could do without and go for cheaper alternate solutions. Another factor that led to an extra ordinary rate in cost-swell was the lining of feeder- channel in a very late phase of the project implementation, costing additional amount of Rs. 156 crores. Yet, only a very small fraction of the feeder channel was lined, that hardly reduced the conveyance losses, in any significant way. Finally, the escalation of costs owing to the changed estimates in construction of five main canals from the feeder channel too needs critiquing. Building a 258.5 Km. long Feeder channel and carrying 23,000 cusecs of water without lining of its bed taught the irrigation department a very important lesson that it will have to undertake lining of its largest canal's bed, as well. Hence the Daryabad canal had to be lined. It led to cost escalation to the tune of about Rs. 30 crores. But no satisfactory reason was given for unprecedented rise in earthwork of canals from about eight crores to 92 crores, more than 11 times the initial budget. Three reasons furnished do not answer the question, fully. Well, owing to delays, cost escalation of 24 crores has been budgeted. How could there be three times the escalation of the original cost? Other two reasons cited for cost escalation are: change in scope and inadequate provisions in the previous proposal. If one were to look at it critically, one finds that it was rather the political expediency than in the expansion of scope, which caused unduly expansion in the cost of earthwork, bridges and regulators. The long stretches of Dariabad and Hydergarh branches have actually eaten into the coffers of state government and left the farmers high and dry (in remoter areas of Azamgarh, Mau, Gazipur and Ballia).

The Sarda Sahayak Project, with its full development and utilization of irrigation capacity, has resulted in additional food production of 9.73 million tones annually and also it has added significantly to the production of some non-food items as well. The expected increase in revenue owing to SSP was expected to be worth Rs.2278.15 crores per annum. But it achieved only about 40 percent of the expected revenues per annum. The minor increase in the real income of the farmers in the command area compared to those residing off it also does not speak volumes about the effectiveness of SSP. The lack of access to information and other complementary inputs on the part of the farmers have led to changes in cropping patterns that have not always been scale efficient.

Sarda Sahayak Pariyojana is one of the biggest initiatives in canal irrigation in Asia. Considering the macro-level social, economical and environmental impact issues, the canal system has contributed to some betterment of the lives of the farmers and others in its command area, despite the fact that it has never been possible to utilize its 100 percent potential. However, the system is yet to gear up to meet the present day challenges. Parts of the systems, many of which have been in operation since decades, have become out of date leading to system inefficiencies. An overview of the project shows the renovation demand of physical structures, the gaps in the skill level of staff, inadequacies in the water distribution and revenue collection structure. Farmers, as a community, remain an ill-informed and unorganized lot and it would not be too far from truth to state that the existing systems have not yielded the desired results and on the whole the canal system is operating much below its potential

5.3: Institutional Attributes

Policy makers will have to make hard decisions soon to help turn around the management of SSP, both operational and strategic. There have though been instances of irrigation department seeking inputs from IIM, Lucknow and TCS; but these seem to be thematically and operationally very limited and narrow, despite not seemingly sounding so. Because these were minor palliative measures and not long-term perspective based overhauling mechanisms. Moreover, it might not be possible anymore for Uttar Pradesh Government to keep subsidizing enormous quantities of water to a section of the society indefinitely. Besides, it is time now to introduce PIM in the SSP command area, with open door policies, whereby, the SSP Management invites NGOs to help develop and implement PIM modules in various irrigation sections of the *pariyojana*. Rediscovering issues related to osrabandi and warabandi and redefining the role of CADA in the newer set up are also very germane to the PIM agenda. Then comes the issue of identifying cost and responsibility centers of SSP and redesigning of entire organizational structure around these seems to be the need of the hour. Further, any overhaul without retraining and re-inducting schedules of the staff is not going to work. Hence it is a tall but necessary order.

5.4: Possible Remedial Measures

It has been experienced that a combination of technical changes with institutional and policy reforms has been greatly responsible for the success of reform programmes in irrigation. Following points have been observed and wherever possible measures are being suggested correspondingly for overall increase in the efficiency of the canal system:

5.4.1 Technical Measures

– Improved efficiency of water utilization at farmer's level—Field channels must be maintained to reduce wastage of water. Cropping pattern needs to be changed in command area for optimum utilization of water, without bringing in the waterlogged conditions. Excessive and useless irrigation should be discouraged through extension work and wastage of water penalized. Efficiency analysis of the changes in cropping pattern should be taken up periodically, say, every five years.

– To overcome the problem of lack of water or less water availability, which is being repeatedly experienced by the farmers, it is necessary to enhance the water discharge rate, more so in the tail ends of the canal system. Improvement in the maintenance practices like cleaning of canals, de-silting and plugging the water leakage points like rat holes, breaches etc. would also be of immense help in this matter.

– The water resource is limited hence it has to be used with optimum care and with minimum wastage. The Sarda Sahayak Pariyojana urgently needs to upgrade the conveyance and distribution system to bring in efficiency in water distribution. For example- at present, only 203.7 kms of the total 14684 kms of canal are lined. The canal system needs to be lined especially when there are bends in the canal. This would check the soil erosion on the canal banks. In waterlogged areas, the minors and the watercourses should also be lined along with the distributaries. It would be desirable that all constantly running major channels should be lined, or, at least 60 percent length of the watercourses should be lined for improved results.

– A network of drains must be provided with pump wells at different points so that the collected water can be pumped out for irrigation purposes, wherever feasible, and the excessive water could be discharged into the natural outfalls.

– Improvement in the drainage network in the command should be implemented simultaneously with construction of channels. Moreover, adequate number of escape channels is also required at regular intervals along the distribution system and tail escape channels need to be constructed simultaneously and connected to drainage lines in command.

– Presence of weeds greatly hampers the smooth flow of water and this problem is very much prevalent in the Sarda canal system. To

check wild growth of weeds in drains, regular weeding and cleaning operations are necessary to be carried out. Periodic repairs and maintenance should be carried out during November to June, preferably with the involvement of the members of the WUA.

– The farm scheduling and irrigation scheduling remain very erratic even though rosters have been prepared for *kharif* and *rabi* season by the irrigation department. As a consequence the farmers suffer loss to their standing crop. This has not allowed the farmers to workout an irrigation-linked crop plan. This also leads to excess and inefficient utilization of water.

– Micro-irrigation is one measure, which can lead to more efficient and equitable use of water. It includes number of water management technologies like drip irrigation, sprinkler irrigation, plastic mulching, green house cultivation etc. Considering the facts like inconsistencies in rainfall and the sinking of the under ground and surface water table, water-conservation has to be made an inherent policy in irrigation projects. The revolutionary drip irrigation system developed by Israeli engineers and agriculturists has reduced water consumption by 50-70 percent when compared with gravity irrigation and by 10-20 percent when compared with sprinkler irrigation. Reduction in water-use in agriculture and a conscious pursuit of the objective of maximum value per unit of water, have to be major elements in any future water planning and the driving force to be 'More crop per drop'.

– The experience of Israel can be a case for study: Israel does not get more than ½ inch of rainfall per annum and two-third of the country is desert. Yet, Israel exports agricultural products worth millions of dollars every year. The water is recycled and incentives mechanisms are in place for economical use of water and its wastage. Micro-irrigation coverage is 100 percent. As a result, Israel is regarded as most advanced in agriculture and known for efficient utilization of its water resources.

– Another issue that needs to be examined for possible applicability on the canal command is that of conjunctive use of ground and surface water. In most canal irrigation projects, as is evident in case of Sarda canal project, a large chunk of the canal waters seeps underground. This, and excessive use of water, are identified as the primary causes for salinity-alkalinity and water logging. It is possible to address both these problems. Only 70 percent of water requirements of the farmer are met through flow irrigation and he meets the balance through installation of shallow tube wells. This combination of ground and surface waters can also increase the local water use

efficiency, thereby allowing increase in the total command area. It must however be borne in mind that neither rationalization of water rates nor conjunctive use of water by reducing water availability will be easy to implement. There is likely to be opposition from the farming lobby, which used to enjoy easy and almost free access to water. Nevertheless, it is imperative that significant improvement in the use of stored water is to be achieved. It is necessary to plan for increased ground water recharge by development of conjunctive use of surface and ground waters, with necessary checks and balances to ensure that neither of them are over utilized and hence create problems in the longer run.

– The roster system requiring the irrigators to take water on a fixed schedule can be replaced by water-on-order system allowing the farmers to better meet the needs of their crops, make more efficient use of water and reduce pumping costs. The Irrigation Department needs to look in to this suggestion, carry out necessary experiments, arrange for demonstration programmes and small duration trainings for farmers.

– Delivery of water should be made on an appropriate volumetric basis in order to improve system performance, cost recovery and accountability. A volumetric charge, which encourages efficiency of water use, could have two other major benefits:

  - It could reduce water charges since the same water can be used to cover much larger area and therefore the cost of irrigation would decrease;

  - It could reduce the need for storage, as lesser water would be required to cover the same area.

– To offset the increase in input costs, it is imperative that the water tariff must be raised to a higher level at which it begins to meet its supply costs.

– The senior officers of the department suggested reducing the staff strength at current levels of work as a method to cut down the costs. The high cost of the project is illustrated by the fact that the establishment cost in 1997 stood at Rs.4 billion (approx.) out of the total Rs.7 billion (approx.) expenditure of UP irrigation department.

– The personnel assigned with the responsibility of managing the major branches and distributaries must be provided with adequate training. Similarly, the irrigation engineers should acquire basic and practical

knowledge of crop irrigation management, water conservation and husbandry practices so that they are able to transfer the basic skills and knowledge to the farmers. Having a multi-disciplinary staff can bring the required technical competence for the different functions. In this regard, recruitment of agronomists, farm technologists, and agro-economists in large irrigation projects may be more fruitful to enhance the topical efficacy for better and quicker working arrangements.

– Canal roads and link roads should be maintained to rush men and materials for repairing canal branches which otherwise causes flooding of the nearby fields and aggravate the problems of water-logging. It may also be examined if water transport can be a cheaper, quicker and easier alternative for road transport. This, atleast, would not require construction and maintenance of roads (kuccha and pucca) and losing land therein. This may also be helpful in attracting tourist traffic, an additional source of income with minor investment specially therefore.

– Undertaking afforestation activities with suitable species of trees along the banks of the canal for checking the trans-evaporation losses is suggested. This would have incremental benefits by strengthening the canal bank and at the same time generating additional revenues. Similarly, promoting fisheries in the areas having serious waterlogging conditions may benefit the farmers.

5.4.2 Institutional Measures

– Currently, the role of irrigation department has been limited to making water available to the farmers for irrigation. Issues like how the water is being utilized and against it how much revenue is being collected have been largely kept beyond its purview. These roles have been assigned to CADA and district revenue department respectively. For optimum water utilization and higher operational returns, there must be perfect coordination among these three agencies in so that supply-utilization-revenue realization functions are synchronised.

– One of the major reasons for lesser availability of water, increase in maintenance costs and loss of revenue is theft of water from breaches in the distributaries and minors. This can be overcome to an extent by handing over more and more of the minors to the WUAs and at the same time, more and more vigilance (patrolling) should be exercised.

– The members of WUAs are required to be trained for organization of meetings, upkeep of records and knowledge of bylaws. Hence all the

officials should be adequately educated for being trained periodically to make them clear of their responsibilities to strengthen the effective functioning of WUAs. The members of the WUAs are mostly not aware about the bye-laws & memorandum of association (MOA) signed between the WUA and the irrigation department. The members need to be trained and tested for handling canal operation and its maintenance jobs. The officials should also be trained and tested periodically to make them clear their responsibilities to strengthen effective functioning of WUAs.

– The farmers should be trained thoroughly in extension services of different development departments and the personnel from departments like agriculture, horticulture, soil conservation, forest, micro-irrigation practices etc. must be engaged for this purpose so that the farmers learn to harvest higher level of outputs while maintaining the same level of inputs.

– The present attitude of a majority of the principal stakeholders i.e. the farmers, is that of isolation. They believe that water is government's business. This needs to be replaced by a model in which the major stakeholders participate at all levels. This change could be brought about by public awareness, education, identification and dissemination of best practices and incentives for action, thereby facilitating conservation of the precious resource and equitable distribution among the needy people.

– As the WUAs are being given more and more water management responsibilities, the successes must be documented for dissemination and demonstration. Simultaneously, efforts should be made to conduct periodical research studies for identification of constraints in implementation of participatory irrigation management.

– At present, even though the irrigation department is a bank of project data, the condition of data management is relatively inadequate as was evident in a case where the same data appeared for two consecutive years for irrigation and revenue collected. An effective MIS (management information system) with complete records of water need, water volume flow, and flow-rosters need to be maintained along with the records on rainfall, crop sown, area irrigated and depth of water provided. This would make the water distribution-irrigation-revenue collection process smoother ensuring higher returns for the farmers as well as the irrigation department.

5.5: Final Words

Optimum water utilization and efficient management of water resources is an urgent need in today's world. To make different stakeholders aware of the environmental and social equity, economic and developmental needs for effective water distribution and consumption are other strategic issues. People's initiative and their ability to manage their own affairs must be given its place and kept at the centre of planning and action. It is to be realized that if every drop of water that is drained or wasted is recycled, the system can irrigate many more hectares of cultivable land.

There is an urgent need for improving irrigation efficiencies for saving water and protecting the land. A few innovative methods of irrigation could be the innovative changes in cropping pattern, introduction of artificial recharge and retrieval mechanisms, new integrated water-harvesting technique, micro irrigation techniques, etc.

The major issues for efficiency of water resource utilization identified in Sarda Sahayak Pariyojana are–partially utilized physical structures, operation, maintenance, cost recovery, coordination between irrigation and agriculture departments, and water delivery efficiencies.

Subsidized supplies of irrigation, drinking and industrial water has affected the financial status of the department. Once viability is ensured, efforts need to be concentrated on proper maintenance of the created infrastructure.

Encouraging participatory irrigation methods is imperative as a step towards sustainability and bringing efficiency pressures from the water users end. For this different water management functions must be handed over to the Water User Associations. People's involvement in operations, maintenance and revenue collection has to be encouraged so that they not only become familiar with the problems involved but also suggest solutions and participate in creating awareness about proper utilization of the facilities created.

List of Appendix Tables

Appendix-1

Statement of increase in Cost (all figures in Lac Rs.)

Head /Sub-Head	Provisions in Sanctioned Project – 1972	Provision in Revised Project - 1998	Increase in Cost (Cost - Differential)	Increase in Cost Due to				Changes in Design	Other Causes
				Rise in Prices	Change in Scope	Inadequate Provisions in the earliest	Inadequate Investigation		
1	2	3	4	5	6	7	8	9	10
1- Head Works									
A. Preliminary	27	29.44	2.44	2.44	—		—-		
B. Land	99	356	257	—-	—	257	——		
C. Works	2736	3479.50	743.50	313	—	57.50	65.00	270.00	38
K. Building	157	684	527	250	—	277	—-		
M.Plantation	2	8	6	6	—	——-	—-		
O.Miscell.	169	649.34	480.34	280.34	—	200	——		
P Maintenance	32	770.10	738.10	646.10	—	35.50	—-		6.50
Q. Spl. T & P	-	172.19	172.19	—-	—	172.19	——		—-
R. Communication	128	184.20	56.20	50	—	—-	——		6.20
Total	3350	6332.77	2982.77	1547.88	—	1049.19	65.00	270.00	50.70

Statement of increase in cost (All Figures in Lac Rs.)

Head/ Sub-Head	Provisions in Sanctioned Project – 1972	Provision in Revised Project - 1998	Increase in Cost (Escalated Cost/Cost - Differential)	Increase in Cost Due to				Change in Design	Other Causes	Remarks
				Rise in Prices	Change in Scope	Inadequate Provisions in the earliest	Inadequate Investigation			
1	2	3	4	5	6	7	8	9	10	11
2. Link Channel										
A. Preliminary	3	9	6	6	—	-	—-			
B. Land	21	21	-	-		-				
F. Cross Drainage	262	865	603	-	—	-	——			
G. Bridges	36	41	5	-	—	5	300.00	302.00	1	
K. Building	6	13.5	7.5	0.3	—	7.2	—-			
L. Earth-Work	341	444.5	3	103		-				
M. Plantation	1	1	-	-	—	-	—-			
O. Miscellaneous	21	35.88	14.88	4.88	—	10	——			
P. Maintenance	7	150.25	143.25	73.25	—	70	—-			
R. Communication	2	30	28	-	—	28	——			
Total	**700**	**1610.63**	**910.63**	**187.43**	—	**120.2**	**300.00**	**302.00**	**1.00**	

Link Channel

Cost Heads	1972	1998	Escalated Amount
F. Cross Drainage	Rs.262 Lacs	Rs. 865 Lacs	Rs. 403 Lacs
L. Earth-work	Rs. 341 Lacs	Rs. 444.5 Lacs	Rs. 103.5 Lacs
P. Maintenance	Rs. 7 Lacs	Rs. 150.25 Lacs	Rs. 143.25 Lacs

Total = Rs. 649.75 Lacs

Appendix-3

Statement of increase in cost (All Figures in Lac Rs.)

Head/ Sub-Head	Provisions in Sanctioned Project – 1972	Provision in Revised Project - 1998	Increase in Cost (Escalated Cost/Cost - Differential)	Increase in Cost Due to				Change in Design	Other Causes	Remarks
				Rise in Prices	Change in Scope	Inadequate Provisions in the earliest	Inadequate Investigation			
1	2	3	4	5	6	7	8	9	10	11
3. FEEDER CHANNEL										
A. Preliminary	45	160	115	79	-	36				
B. Land	303	678	375.3	375.3	-	-				
C. Works	2636	18242	15606	-	15606	-				Lining of the Channel
D. Regulator	333	932	599.1	359		240.1				
F. Cross-Drainage	2187	4322	2135	750	100	980	30	240	35	For capacity enhance-ment
G. Bridges	570	1038.4	468.4	231.4	-	150	75		12	
H. Escape	118	386.5	268.5	188	80.5	-	-			
K. Building	241	597	356	-	-	356	-			
L. Earth-Work	2241	4944	2703	694	600	475	350	450	134	
M. Plantation	5	30.5	25.5	25.5	-	-	-			
O. Miscellaneous	260	354	94	94	-	-	-			
P. Maintenance	57	2580	2493	1640	-	853	-			
R. Communication	238	486.5	248.5	100	-	148.5	-			
Dalmau - A	-	1515.08	1515.08	—-	1515.08	-	-			Both of these are pump canals
Dalmau - B	-	1571.67	1571.67	-	1571.3	-	-			
Modernization of Sarda Canal System		939.3	939.3	-	939.3					
Total	**9264**	**38777.35**	**29513.35**	**4536.2**	**20411.55**	**3238.6**	**455.5**	**690.00**	**181.00**	

Appendix 3 (a)

Major Cost Escalation Items for Main Feeder Channel

Cost Heads	Provisions in 1972	Budget sought in 1998	Escalated Amount	Percent Increase
1) **Cost Set-A -** New Cost heads of Dalmau A and B and Modernization of Old Sarda Canal System	Nil	Rs. 3086.5 Lacs	Rs. 3086.5 Lacs	10.39 %
2) **Cost Set –B:** Works & Lining of 131 Km. of Main Feeder Channel	Rs. 2636 Lacs	Rs. 18242 Lacs	Rs. 15606 Lacs	52.9 %
3) **Cost set –C**: Cross Drainage, Earth work & Maintenance	Rs.4385 Lacs	Rs.11846 Lacs	Rs. 7331 Lacs	24.8%
Total = 7021	**Rs.33174.5 Lacs**	**Rs. 26153.5 Lacs**	**8.09%**	

Earth work, Cross-drainage and Maintenance were also three major cost heads that together accounted for Rs.7331 lacs or 24.8 percent. Exhibit 3 (a) captures these three sub-sets of costs that largely cause hike in the cost of the feeder canal.

Appendix 3 (b)

Variance Analysis Feeder Channel

Cost –Items/ Sub-Heads	Budget-1972 (in lacs)	Budget-1998 (in lacs)	Variance (in lacs)
Cross Drainage	2187	4322	2135 – variable variance
Earth Work	2141	4944	2703 – Variable Variance
Maintenance	57	2580	2493 Fixed- Variance
Total	4385	11846	7331

Appendix-4

Statement of increase in cost (All Figures in Lac Rs.)

Head/ Sub-Head	Provisions in Sanctioned Project – 1972	Provision in Revised Project - 1998	Increase in Cost (Escalated Cost/Cost - Differential)	Increase in Cost Due to				Change in Design	Other Causes	Remarks
				Rise in Prices	Change in Scope	Inadequate Provisions in the earliest	Inadequate Investigation proposal budget			
1	2	3	4	5	6	7	8	9	10	11
4.CANALS										
A. Preliminary	11	89.22	78.22	58.22	-	20	-	-		Lining in full length of Dariyabad br. And lining in user reaches & weak reaches of other br.
B. Land	181	1112.15	931.15	445.15	440	-	-	46		
C. Works	46	3082.55	3036.55	30	3006.55	-	-	-		
D. Regulator	40	1859.76	1819.76	240	400	1111.3	50	18.46		
E. Fall	40	338.22	298.22	158.64	86	50	-	3.58		
F. Cross Drainage	20	784.38	764.38	335	150	150	129.38	-		
G. (i) Bridges	692	1634.43	942.43	442.43	150	350	-	-		
G (ii) Rly .X-ing	100	288.9	188.9	88.9	-	100	-	-		
H. Escape	120	637.14	517.14	290.58	80.6	100	45.96	-		
K. Building	55	697.85	642.85	-	-	642.85	-	-		
L. Earth-Work	774	9218.43	8444.43	2400	2000	3758.73	135.7	150		
M.Plantation	-	17.84	17.84	-	-	17.84	-	-		
O.Miscellaneous	22	178.44	156.44	156.44	-	-	-	-		
P Maintenance	22	178.44	156.44	156.44	-	-	-	-		
R.Communication	100	360	260	260	-	-	-	-		
Total	**2223**	**20477.75**	**18254.75**	**5061.8**	**6313.15**	**6300.72**	**361.04**	**218.04**		
Ghaghra Pump Canal	-	44.20	44.20	-	44.20	-	-	-		
Tanda Pump Canal	-	1460.61	1460.61	-	1460.61	-	-	-		
Ayodhya Pump Canal	-	1100.67	1100.67	-	1100.67	-	-	-		
Rampur Pump Canal	-	843.78	843.78	-	843.78	-	-	-		
Total	**2223**	**23927.01**	**21704.01**	**5061.80**	**9762.41**	**6300.72**	**361.04**	**218.04**		

Five Major Cost Escalation Heads of Feeder Channel are

(All costs are in Lac Rupees)

Name of the Work	1972 Budget	1998 Proposal	Cost Escalation	Percent Rise in Cost
1) Earth Work	774	9218.43	8444.43	46.25
2) Pump Canals	0	3449.26	3449.26	18.90
3) Works	46	3082.55	2936.55	16.08
4) Regulator	40	1859.76	1819.76	9.97
5) Bridges	692	1634.43	942.43	5.16
Total	1552	19244.43	17592.43	96.37

Appendix 5

Statement of increase in cost (All Figures in Lac Rs.)

Head /Sub-Head	Provisions in Sanctioned Project – 1972	Provision in Revised Project - 1998	Increase in Cost (Escalated Cost/Cost Differential)	Increase in Cost Due to				Changes in Design	Other Causes
				Rise in Prices	Change in Scope	Inadequate Provisions in the earliest proposal/ budget	Inadequate Investigation		
1	2	3	4	5	6	7	8	9	10
III Dys & Minors Feeder Channel:									
a. Remodeling	1347	5650	4303	1623	1700	800	-	-	180
b. New Construction	790	27615.72	26825.72	6462.72	16000	1000	1500	1838	25
c. Total	2137	33265.72	31128.72	8085.72	17700	1800	1500	1838	205
IV – DRAINS	200	12502	12302	4000	3000	5102	2000	-	-
V – Water Courses	200	-	(-) 200.00	-	-	(-) 200.00	-	-	-
VI – Spl. T & P	400	564	124	-	-	124	-	-	-
VII – Losses on Stock	42	284.9	242.9	242.9	-	-	-	-	-
Total	**18556**	**117264.4**	**98708.38**	**23661.93**	**50873.96**	**17534.71**	**2881.54**	**3318.54**	**437.7**
Grand Total	**19986.56**	**127616.8**	**107630.2**	**32583.75**	**5087.96**	**17534.71**	**2881.54**	**3318.54**	**437.7**

Statement of increase in cost (All Figures in Lac Rs.)

Head/Sub-Head	Provisions in Sanctioned Project – 1972	Provision in Revised Project - 1998	Increase in Cost (Escalated Cost/Cost Differential)	Increase in Cost Due to				Changes in Design	Other Causes
				Rise in Prices	Change in Scope	Inadequate Provisions in the earliest proposal	Inadequate Investigation		
1	2	3	4	5	6	7	8	9	10
B.F.	18556	117264.4	98	23661.93	50873.96	17534.71	2881.54	3318.54	437.7
ii. Establishment	1458.44	9056.42	7597.98	7597.98	-				
iii. Tools & Plants	185.56	586.32	400.76	400.76	-				
iv. Suspense	-	-	-	-	-				
v. R.R. On C.A.	(-) 455.00	(-) 597.00	(-) 142.00	(-) 142.00	-				
Total Direct Charges	**19745**	**126310.1**	**106565.1**	**31518.67**	**50873.96**		**2881.54**	**3318.54**	**437.7**
Indirect Charges (A) Audit& Account	185.56	1172.64	987.08	987.08	-				
(B) **Capitalized abatement of Land Revenue**	56	134	78	78	-				
Total	**241.56**	**1306.64**	**1065.08**	**1065.08**	**-**	**-**	-	-	-
Grand Total	**19986.56**	**127616.8**	**107630.2**	**32583.75**	**50873.96**	**17534.71**	**2881.54**	**3318.54**	**437.7**

May, 2007 (Reprint)	**May, 2007 (Reprint)**	**May, 2007 (Reprint)**	**May, 2007 (Reprint)**
May, 2007 (Reprint)	**May, 2007 (Reprint)**	**May, 2007 (Reprint)**	**May, 2007 (Reprint)**
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June, 2007 (Reprint)	**June, 2007 (Reprint)**	**June, 2007 (Reprint)**	**June, 2007 (Reprint)**

Glossary of Terms

Alpika	Minor canal
Ameen	Staff responsible for preparing bills against water utilization
Beldaar	Wage/regular labor assisting in repair and maintenance work
Doab	Area between two rivers just before they join together
Gul	Small irrigation channel
Jiledaar	Staff responsible for overall operation of irrigation channels and Inspection of canal network.
Kharif	Agricultural Season from May to October mostly coinciding with onset of monsoons
Khand	Division; a geographic area assigned to one Executive Engineer for overall supervision of works.
Kulaba	Water outlets from minor and distributaries canals
Mandal	Circle; an geographic area assigned to one Superintending Engineer for overall supervision of works
Meth	Personnel appointed for supervising the beldars
Osrabandi	Distribution of water on rotational basis
Pariyojana	Project
Patraul	Personnel responsible for recording the total and individual area irrigated; same as Seenchpal
Pucca	A civil construction using a combination of bricks, cement and mortar
Rabi	Agricultural Season from October to April coinciding with winters
Rajwaha	Distributaries
Seenchpal	Same as Patraul
Usar	Sodic soil