The canal inspection roads are provided alongside the canal. Due to unauthorized outlets constructed across the roads, and depositing of desilting materials, traffic by cars on inspection roads is presently difficult.

5.4.2 Drainage

Although drainage is recognized to be a vital element for successful irrigation practice, the past efforts to drainage works in the irrigated land are not sufficiently rendered, compared with the creation of irrigation potentials. The drainage problems, therefore, prevails in irrigated land of the respective Representative Areas with the different characteristics and degrees, such as inundation, waterlogging, or salinity/alkalinity problems. The following shows the extent of those areas in the respective Representative Areas:

Water logging and Salt Affected Area in Representative Area

Unit: ha

Representative Area	Geographical Area	Inundation Area	Water Logging Area	Salt Affected Area	Usar Area
Sarojini Nagar	33,488	11,599	2,166	5,214	992
Sataon	25,763	16,353	915	1,423	635
Sursa	32,269	2,069	1,581	2,317	817
Purwa	20,828	15,026	1,256	3,080	603

(1) Sarojini Nagar Area

The Sai river forms the southern boundary of the Area. The drainage networks connected to the Sai river are not sufficiently provided especially in the central and western parts of the Area. The areas located along the Sai river are suffered from inundation. The water logging and salt affected areas are distributed widely in the central part.

(2) Sataon Area

The Sataon Area is surrounded with the Sai river on the east and Basaha Drain on the south. The central and western parts of the Area are suffered from inundation due to insufficient drainage networks. Stagnant water occurs the inundation and water logging problems and salt problem

(3) Sursa Area

Due to undulation topography, the central and downstream parts of the Badaicha command are suffered from water logging and salt problems. Further, water logging and salt affected areas lie along Hardoi Branch attributed to seepage from Hardoi Branch and less functioning drainage canals for those areas. The groundwater tables in those areas are high as 2 m even in the Rabi season.

(4) Purwa Area

The Purwa Area extends over both banks of Purwa Branch. The left bank area, locating in the northeast of Purwa Branch, is drained to Basaha Drain and the right bank area, lying in the southwest of the Branch, is drained to the Loni river. The area confronts inundation, which attributed to the insufficient drainage system and less functioning existing drainage canals. Due to the specific hydro-geological formation such as thick clay layers of about 30 m in thickness, and the low degree of groundwater development, the groundwater tables in the Area are generally high. As a result, the waterlogging and salt affected areas are widely extended in the Area.

5.5 Constraints and Prospectives for Development

In the Representative Areas, the irrigation farming has been practiced for the long time by use of the canal water and groundwater. The tail end problems are common in the respective Areas with the different degrees of the water shortage. The excessive groundwater extraction for making up the scarce water supply from the Sharda canal system has recently induced the unbalanced groundwater regime. On the other hand, irrigation surplus/canal seepage and insufficient drainage increase in water logging and salinity problems in the irrigated land.

The major constraints lying in the respective Representative Areas are as summarized below.

(1) Sarojini Nagar Area

(a) water shortage in the tail end of Amausi Distributary
(b) declining of groundwater table due to excessive draft in the tailend area
(c) water logging and salinity problems in the central part of the area

(2) Sataon Area

(a) scarce irrigation water deliveries to the area from the Asiwan Branch and Maurawan Distributary
(b) recent sharp decline of groundwater table due to excessive and intensive groundwater use
(c) inundation and water stagnant of central and western parts of the area during Kharif season, inducing salinity/alkalinity problem

(3) Sursa Area

(a) insufficient water to the tail end area
(b) water logging problem along Hardoi Branch due to seepage from the canal
(c) water logging salinity problems in the central part due to undulating topography and insufficient drainage system

(4) Purwa Area

(a) inundation of the wide range of the area in Kharif due to insufficient drainage system
(b) insufficient water supply to the tail end areas in the respective canal systems
(c) clayey textured thick layer leading to water logging and salinity problems

The socio-economic conditions in the respective Areas is generally under the similar conditions. The level of agricultural technology is not so high. Marginal and small land holding farmers remain with the small capital and they normally do not get higher education. They follow in general traditional farming technology. Besides, agricultural extension services do not reach to farmers, resulting from insufficient number of extension workers and extension workers' lacking training.

CHAPTER VI STRATEGY AND OBJECTIVES OF AGRICULTURAL DEVELOPMENT FOR THE REPRESENTATIVE CAD AREAS

6.1 Development Objectives and Strategy

6.1.1 Development Objectives

As seen in the previous section, irrigation water should, first of all, be secured in terms of both timing and quantity, in order to implement CAD works successfully. Restriction of excessive water uptake is an another option to assure even water distribution. Drainage improvement is also pre-requisite for increasing land productivity in light with the fact that there are wide areas of alkaline soils which may induce sodium toxicity and micro-nutrient deficiency, which will result in low production.

Once reliable irrigation water is secured, farmers would be motivated to use canal water for irrigation. On-farm development, followed by the introduction of "Osrabandi", will be meaningful only after getting reliable irrigation water. Farmers' participation on water management would be a key factor for successful implementation. Women's position would be enhanced through education programme in light of their important role on agricultural production. Improvement of farming practices would depend upon the achievement of extension services as well as education. Improvement of drainage systems would contribute to the enhancement of land productivity.

The Draft Eighth Five Year Development Plan of Uttar Pradesh State stated in its purposes: (1) To increase income of rural poor; and (2) To improve the quality of rural life. The project is expected to contribute those purposes much.

6.1.2 Development Strategies

In order to achieve the above objectives, the following strategy for development of four Representative Areas is set out:

(1) Removal of causes for unreliable irrigation water supply and improvement of irrigation efficiency

Direct uptake of water from the branch, distributary or minor canal should be restricted to secure reliable supply of irrigation water. Ground water development is an another option to assure irrigation water volume. Operation loss should be minimized to improve irrigation efficiency. Canal lining may be effective measure.

(2) Even distribution of irrigation water

Direct water uptake from canals should be restricted. Osrabandi should be introduced to get steady irrigation water supply.

(3) Improvement of poor drainage and salinity/alkalinity

Drainage system should be established/improved to reduce waterlogged/marshy area and to improve soil condition.

(4) Improvement of farming technology

Intense agricultural extension services should be extended to increase crop production. Women's role in this type of development should be emphasized.

6.2 Basic Measures to be Taken

The following basic measures will be taken in order to realize the above strategies:

(1) Modernization of existing irrigation facilities
(2) Groundwater development
(3) Irrigation and drainage development at on-farm level
(4) Establishment of drainage system
(5) Establishment of water management system at on-farm level with farmers
(6) Agricultural training including education program for women
(7) Enforcement of the organization of CAD authority

(1) to (4) will be applied to each of Representative Area at different level according to the present situation. (5) to (7) are applied to all of the Representative Areas in the same manner.

Measures to be applied in principle are as follows:

(1) Modernization of Existing Irrigation Facilities
   (a) Provision of gate at offtakes
   (b) Provision of measuring devices
   (c) Provision of additional minor canals along a distributary to avoid direct diversion to outlets.
   (d) Lining of canal at appropriate parts
   (e) Improvement of inspection roads
   (f) Tele-communication system

(2) Groundwater Development
   - Sursa and Purwa Areas only as supplemental water resource

(3) On-farm Development
   (a) Unification of chak with each area of 40 to 60 ha
   (b) Division of each chak into seven sub-chaks
   (c) Lining of canal
   (d) Drainage canal establishment
   (e) Steady flow at outlet
   (f) Road improvement in chaks

(4) Establishment of Drainage System
   (a) Improvement/construction of Main/minor drainage canal
   (b) Improvement of appurtenant structures
   (c) Ground water control

(5) Water Management System
   (a) Introduction of Osrabandi in water management system

(6) Farmers Training and Agricultural Supporting Services
   (a) Establishment of an adaptive trial farms
   (b) Establishment of water management society

CHAPTER VII THE PROJECT

7.1 Irrigation and Drainage Development Plan

7.1.1 General

The original Sharda Canal System has been constructed to serve a CCA of about 2.55 million ha with a design crop intensity of only 29%; 18% in Rabi and 11% in Kharif. This irrigation planning raised development of another water source to overcome the severe shortage of water at the tailend. To improve the bottleneck, Sharda Sahayak Project was implemented, which reduced the CCA of Sharda Canal System by about one million ha from 2.55 million ha to 1.56 million ha. After commissioning of Sharda Sahayak project, the designed crop intensity to CCA of the Sharda Canal System have been increased to 49%; 24% in Kharif and 25% in Rabi under the modernization scheme in 1975.

The present water supply in the Sharda Canal System has been practiced on the basis of the increased irrigation intensity. The actual irrigated areas, however, are far lower than the proposed intensity. Although even irrigation with its low intensity has been extended to a large number of villages and has been intended to reduce adverse water logging and salinity problems, such problems has prevailed in the downstream portion of the command.

To enable to achieve significant improvement in use of water as well as to improve drainage and salinity problems in the Project area, the improvement of the irrigation and drainage systems with on-farm development will be executed. The proposed irrigation and drainage works herein formulated consists of the following components:

(1) Modernization of existing irrigation and drainage systems
  (i) Improvement of existing distributary and minor canal systems
  (ii) Improvement of existing drainage systems
(2) On-farm development
(3) Groundwater development
(4) Establishment of Wireless Communication System
(5) Pilot demonstration farms

7.1.2 Irrigation Plan

(1) Water Supply

The irrigation water has been taken at Banbassa intake and distributed to Hardoi Branch Canal through Main Canal and a bifurcation structure with augmentation of water from Sharda Sagar reservoir.

According to the probability analysis of the diversion volumes at Banbassa intake as well as Hardoi Branch Canal at a head section, the minimum seasonal diversion in 80% of occurrence was occurred in 1989-90.

The irrigation water supply of the Sharda Canal System is practiced in accordance with the so called roster. The seasonal deliveries of the Hardoi Branch Canal system is generally coincided with the scheduled ones at the respective sections. The water deliveries from distributaries and minor canals for the respective Representative Areas, however, much differ from the scheduled deliveries in terms of the volumes and timing.

With implementation of the Project, the reliable water deliveries will be ensured. Thus, the irrigation planning is based on the following scheduled discharges in 1989-90 as summarized below.

Seasonal Water Deliveries in Design Year

Description	Kharif			Rabi		
	Roster MCM	Actual MCM	Rate (%)	Roster MCM	Actual MCM	Rate (%)
Banbassa intake	4,535	4,102	(90)	2,774	3,021	(109)
Hardoi Branch at head	2,211	2,172	(98)	1,490	1,580	(106)
Lucknow Branch at head	723	717	(99)	468	522	(112)
Asiwan Branch at Head	154	158	(103)	103	136	(132)
Purwa Branch at head	187	194	(104)	104	152	(146)
Unnao Branch at head	102	96	(94)	68	98	(144)
Sarojini Nagar Area						
Amausi Dy.	27.4	6.1	(59)	15.1	15.4	(102)
Sataon Area						
Maurawan Dy.	11.9	0.2	(2)	6.1	0.9	(15)
Sursa Area						
Badaicha Dy.	18.6	23.9	(128)	12.1	19.0	(156)
Marsa Mr.	6.5	4.4	(68)	2.7	2.6	(59)
Purwa Area						
Purwa Dy.	10.7	8.0	(75)	7.8	5.3	(68)
Tikar Dy.	5.6	4.3	(77)	3.4	3.8	(112)
Chimyani and Pakra Mr. at head	3.7	5.3	(142)	2.5	4.3	(172)

(2) Water Requirements

Based on the proposed cropping patterns for the respective Representative Areas, the consumptive use of water of each crop in its growing period is estimated and the irrigation water requirements of the composite cropping area are estimated by using the modified Penman method on the basis of the following conditions:

Paddy rice : (ET + PE + PU - ER +NR)/IE

Upland crops : (IN + ET - ER) / IE

where, ET : Evapotranspiration
PE : Percolation
PU : Puddling water requirement
ER : Effective rainfall
NR : Nursery water requirement
IN : Pre-irrigation
IE : Irrigation efficiency

In the above calculation, the following basis is applied:

(a) ET is estimated by product of reference crop evapotranspiration by crop coefficient relating to the crop growth stages. Reference crop evapotranspiration is estimated by a modified Penman method on monthly basis for respective Representative Areas.

(b) PE is determined to be 2 mm/day based on the soil conditions and field investigation results in the Representative Areas.

(c) PU is estimated to be 180 mm for filling a root zone, evaporation, percolation loss and standing water on a field surface.

(d) NR is calculated for land preparation, evaporation, percolation losses for nursing period of 25 days and 5% of the paddy fields.

(e) ER for paddy fields is estimated on the basis of the result of water balance in paddy fields, and ER for upland fields is based on the relationship between consumptive use of water by crops and effective rainfall proposed by USDA.

(f) IE for cropping of paddy rice and upland crops are determined, taking into account the irrigation method to be applied, the extent of improvement of canal systems and lining, etc. The overall irrigation efficiencies for respective paddy and upland crops in the estimate are as follows:

Irrigation Efficiency	Paddy Rice	Upland Crops	Present Condition
Application efficiency	90%	75%	60%
Conveyance efficiency			
- Distributary and minor canals	85%	85%	80%
- Field channel	85%	85%	78%
Overall efficiency	65%	54%	34%

The diversion requirements at the head of the Representative Areas thus estimated are as summarized below.

Diversion Water Requirement

Kharif 1990 Unit : mm

Description	Apr.	May	Jun	Jul	Aug	Sep	Oct	Total
Sarojini Nagar	0	6	174	149	186	66	36	617
Sataon	0	6	130	108	166	117	35	562
Sursa	23	39	212	196	59	144	59	732
Purwa	0	6	179	162	90	190	37	664

Rabi 1989-90

Description	Oct	Nov	Dec	Jan	Feb	Mar	Total
Sarojini Nagar	20	110	125	157	120	38	570
Sataon	21	115	123	157	108	38	562
Sursa	48	117	116	140	116	44	581
Purwa	21	106	125	157	97	38	544

Note : October in Rabi; starting from the middle of October

(3) Water Supply Plan

In order to estimate the irrigation service areas, the water balance study was carried out between the supply and the demand under the following conditions:

1) The design year is set to be 1990 and 1989-90 for Kharif and Rabi seasons,respectively in accordance with the occurrence probability of supply at the Banbassa intake and Hardoi Branch head.

2) The discharges from the canals are those set out in the rosters of the concerned canals in the above-mentioned design year, except Sataon area where no available data exist and is applied new planning by the Study Team.

3) Irrigation deliveries are made in accordance with the full irrigation requirements as estimated as above.

The result of the water balance simulation is summarized below.

Result of Water Balance

Description	Area (ha)	Water supply Roster (MCM)	Water supply Actual (MCM)	D.R. (MCM)	Water Deficit Roster (MCM)	Water Deficit Actual (MCM)
Sarojini Nagar						
CCA	14,862					
PIA,Kharif	3,567	27.38	16.14	22.01	5.37	-5.87
PIA,Rabi	3,716	15.06	15.42	21.18	-6.12	-5.76
Sataon						
CCA	12,874					
PIA,Kharif	3,090	12.32	0.19	17.37	-5.04	-17.18
PIA,Rabi	3,219	6.16	0.94	18.09	-11.93	-17.15
Sursa						
CCA	17,313					
PIA,Kharif	4,065	25.12	28.28	30.41	-5.28	-2.14
PIA,Rabi	4,328	14.86	21.56	25.15	-10.29	-3.58
Purwa						
CCA	12,252					
PIA,Kharif	2,941	20.02	17.65	20.96	-0.94	-3.31
PIA,Rabi	3,062	13.68	13.38	16.90	-3.22	-3.52

To ensure the reliable water deliveries, the following water supply plans are proposed:

(a) Sarojini Nagar Area

The groundwater use is vast and the groundwater table drawdown in the recent year is remarkable. With a view to maintaining groundwater regime, the groundwater development for this area is not promoted by the Project. This area requires the surface water supply from the outside area to supplement the canal water as well as to

augment the recharge of groundwater source. The Sai river provides sufficient irrigation water. The pump lift irrigation by use of the Sai river water is proposed for this area.

(b) Sataon Area

The irrigation of this area has been largely dependent upon the groundwater due to scarce canal water supply for a long period, then the remarkable drawdown of groundwater table has occurred in the recent year. With a view to avoiding an adverse environmental effect, the groundwater development is not promoted with the Project similarly to Sarojini Nagar Area. To secure the irrigation requirements as well as to augment the groundwater recharge, two measures are required in this area,i.e., re-arrangement of canal delivery from the Asiwan Branch being a parent canal of this area and the Sai river water use for making up the further deficit.

(c) Sursa Area

The water balance study shows that a large amount of water shortage occurs. The scheduled deliveries in the roster are small. Thus re-arrangement to increase the roster delivery is required. To improve the water-logging area along Hardoi Branch, a pipe drainage scheme is proposed as a drainage work and it will provide the additional irrigation water by pumping up drainage water. Further, in order to make up the further deficit as well as to alleviate water-logging and alkalinity/salinity affected areas, the groundwater development will be executed.

(d) Purwa Area

The groundwater development is promoted to supplement the canal water deliveries in addition to the re-arrangement of the scheduled discharges within Purwa area. The tubewells is constructed in the water logging and alkalinity/salinity affected areas for alleviation of such problems through conjunctive use of canal water with regulated rostering.

(4) Groundwater development

From the agricultural and ecological point of view, it is noted that the maximum crop production is obtained in those areas where groundwater development lies between 35% and 50% and groundwater table is always kept within the safe zone varying from 5.0 m to

10.0 m below the ground. Under such conditions, ecology is balanced, and water-logging and soil salinity, or declining of groundwater tables are reduced. If the groundwater development is less than 35%, water-logging and salinity may occur. On the other hand, if the groundwater development is more than 50%, groundwater table tends to decline ,which causes degradation of ecology causing drought damage in the groundwater irrigation areas.

The groundwater is taken by tubewells pumps from the shallow aquifers in salinity affected and water-logging areas in the canal command. The water thus taken is supplied to the minor canal systems and the rostering of the minor canal system will be regulated to such extent of the augmented water volume from the tubewells to supplement canal water. The systematic control of groundwater draft and regulating roster will maintain lowering groundwater table within the safe zone, and will be effective for alleviation of water logging and salinity/alkalinity affected areas.

(5) Proposed Modernization of Main Irrigation System

The irrigation water supply of Sharda Canal system is unstable. To ensure the reliable supply of water, the following modernization of the existing irrigation canals and related structures will be proposed:

(i) Improvement of existing irrigation system

(a) Canal lining where the canal runs in high permeable soils and across low-depressed areas

(b) Provision of additional minor canals along with distributary canals to avoid direct diversion by outlets which have been provided on distributaries

(c) Improvement of existing control structures
- provision of steel gate to head regulators
- provision of measuring devices downstream of a head regulators
- replacement of existing off-taking structures for minor canals with the proportional diversion structure according to the required capacities
- replacement of existing outlets on minor canals with the proportional diversion outlet structures according to the required capacities

(d) Improvement of distributary canal inspection road with brick soling

(ii) Sai river pump lift schemes as supplemental water sources development
(iii) Groundwater development
(iv) Establishment of wireless communication system

The general features of the proposed modernization works of the irrigation systems are as follows, and the general layout of the Representative Areas are as shown in Figs. 7.1 to 7.4:

(i) Improvement of existing irrigation system

The improvement works of the existing irrigation canal systems include the following:

Improvement Works of Irrigation System

	Description		Sarojini Nagar	Sataon	Sursa	Purwa
1.	Setting of existing canal section					
	Distributary	(km)	55.0	91.8	34.8	35.3
	Minor	(km)	54.7	19.1	64.9	46.1
2.	Canal lining					
	Distributary	(km)	16.4	38.6	19.5	17.8
	Minor	(km)	16.3	51.6	36.4	20.3
3.	Additional parallel Mr.					
		(nos)	11	27	10	12
		(km)	41.6	104.0	45.0	53.0
4.	Improvement of existing control structure					
	- Replacement					
	Head regulator	(nos)	1	37	2	4
	Offtaking structure	(nos)	29	40	16	18
	Outlet	(nos)	365	768	386	291
	- Provision					
	Measuring device	(nos)	31	45	22	25
	Steel slide gate	(nos)	1	37	2	4
5	Improvement of canal inspection road					
	- Inspection road for Dy	(km)	55.0	91.8	34.8	35.3
	- Inspection road for Mr	(km)	54.7	19.1	64.9	46.1

(ii) Sai river pump lift irrigation scheme

The general features of the Sai river pump lift irrigation schemes for Sarojini Nagar and Sataon Areas are as follows:

(a) Sarojini Nagar Area: The existing pump station located on the left bank of the Sai river in the downstream of Amausi distributary will be improved. The

pumping water will be delivered to Amausi distributary through improved Manoharpur minor. The general features of the pump station are as follows:

(b) Sataon area: The pump station will be constructed on the right bank of the Sai river in Sataon village, of which the pumping water will be delivered to Maurawan distributary through improved Sataon minor. The general features of the pump station are as follows:

Pump Lift Irrigation Plan

Description	Sarojini Nagar	Sataon
Pump command area		
-CCA :	2,167 ha	2,822 ha
-Proposed irrigation area		
Kharif:	520 ha	677 ha
Rabi:	542 ha	706 ha
Pump equipment		
- type	Vertical shaft mixed flow	- do -
- nos	2 nos	2 nos
- discharge	25 m^3/min/no.	34 m^3/min/no
- motor output	68 kw/no.	102 kw/no
- total head	11 m	14.5 m

(iii) Groundwater development

The tubewells to be constructed in Sursa and Purwa Areas are as follows:

General Features of Tubewells

	Sursa	Purwa
Tubewell		
Type :	Shallow tubewell with screen	Shallow tubewell with cavity type
Number	900 nos	280 nos
Location	Salinity/alkalinity affected areas	Salinity/alkalinity affected areas

(iv) Establishment of wireless communication system

In order to achieve the efficient water supply, a reliable and fast communication system is required to collect various information on the water supply and irrigation demand such as sown areas, sowing timing, growth stages,rainfall and available canal discharges. For the purpose of the above, the wireless communication system is established with the following functions:

(a) Operational function

- controlling of water deliveries in main canal and various canals through transmitting the information about the release and the discharges to be maintained at various points and various offtakes
- collection of information about discharges running at different points of canal and offtakes
- instruction regarding correction and modification to be made in the gate operations
- collection of data on irrigation requirements such as cropped areas, time of sowing, rainfall data,etc.

(b) Administrative function

- important messages about the administrative matters having high priority

(c) Emergency case

- messages such as breaches of canals, structure broken

The wireless communication system consists of a main network and a branch network. The main network will be a HF radio link. It connects the Central Control Station with CAD Office, Chief Engineer Office, Superintending Engineers Offices, Executive Engineers Offices, Office in charge of OFD works. The branch network will be a VHF radio link. It connects the Executive Engineers Office with the Sub-divisional Offices, and major offtakes, cross regulators or other discharge control sites in their jurisdiction. It consists of the following:

General Features of Wireless Communication System:

Central control station		
HF radiotelephone	:	1 no.
Data processing unit	:	1 no.
Controlling station		
HF radiotelephone	:	9 nos.
Data processing unit	:	3 nos.
Sub-station		
VHF radiotelephone	:	34 nos.

7.1.3 Drainage Plan

(1) General

The objective of the drainage improvement is to smoothly remove the excess rain water and irrigation excess work and to effectively control canal seepage, water logging and salinity/alkalinityby constructing the drainage network to link the field drains with the main drainage streams. The drainage areas and water logging areas in the Representative Areas are as shown below.

Drainage Areas in Representative Areas

Unit : Ha

Representative Area	Drainage Area	Water logging Area	CCA	Water logging Area in CCA
Sarojini Nagar	25,552	2,286	14,862	1,213
Sataon	19,687	278	12,874	181
Sursa	25,062	1,991	17,313	859
Purwa	22,485	1,256	12,252	745

The drainage works herein formulated consist of the following:

(a) Main and secondary drainage canal network

- improvement/construction of main drainage canals
- improvement/construction of secondary drainage canals to connect tertiary drains with the main drains

- capacity increase of related natural drainage streams
- improvement/construction of outdated drainage structures

(b) Sub-surface drainage system

- establishment of subsurface pipe drainage pilot scheme
- pipe drainage system along Hardoi Branch
- groundwater development for conjunctive use

(2) Proposed Drainage Works

The general features of the drainage works in the respective Representative Areas are as follows:

(a) Sarojini Nagar Area

- construction of three main drainage canals between the Sai river and secondary drainage canals
- construction of the main drainage canal between the Qila Mahmmadinagar drain and secondary drainage canals
- improvement of the downstream portion of the Qila Mahmmadinagar drain
- construction of tertiary drains
- improvement of the existing drainage structures

(b) Sataon Area

- improvement of the existing two drainage canals between the Sai river and secondary drainage canals
- improvement/construction of secondary drainage canals to connect the Sai river or Basaha drain
- improvement of Basaha drain
- construction of tertiary drainage canals
- improvement of the existing drainage structures

(c) Sursa Area

- improvement/construction of two main drainage canals between the Sai river and secondary drainage canals
- construction of one main drainage canal to connect Parchar escape

- improvement of the existing secondary drainage canal to connect the existing Chhoiya drainage canal
- construction of a pipe drainage system along Hardoi Branch with a pumping system for rentilization of drainage water to irrigation
- construction of tertiary drainage canals
- improvement of the existing drainage structures

(d) Purwa Area

- improvement of the existing three main drainage canals and construction of secondary drainage canals
- improvement of Basaha drain
- construction of tertiary drainage canals
- construction of subsurface pipe drainage pilot scheme
- improvement of the existing drainage structures

The general features of the improvement/construction of drainage canals and related structures are as follows:

General Features of Drainage Works

Description		Sarojini Nagar	Sataon	Sursa	Purwa
Main and secondary drainage canals					
Improvement	(km)	32.7	29.7	48.0	79.2
Construction	(km)	49.5	30.6	51.0	36.7
Total	(km)	82.2	60.3	99.0	115.9
Improvement of drainage structures					
Bridge	(no.)	53	39	64	65
Pipe drainage scheme		-	-	1	-
Subsurface drainage pilot scheme		-	-	-	1

7.1.4 On-farm Development Plan

(1) General

In order to successfully introduce osrabandi system in the command areas, the on-farm development is a crucial element. It consist of field irrigation canals, field drainage

canals, related structures such as turnout, road crossing, fall, etc. and farm road within the command.

The command area by an outlet, so called chak, is the irrigation unit within which the rotation irrigation is practiced. Irrigation rotation is planned on the 7-days multiple basis. A chak is, therefore, be divided into 7 sub-chaks. In view of the manageable and efficient water management by farmers, the standard size of the chak is 42 ha of CCA or its multiples. Unification of the existing chak boundaries is required for smaller chak areas.

The capacities of head regulators and their authorized discharges in the respective Representative Areas are fixed, within which water supply and system design are to be planned.

The proposed irrigation system operation is as follows:

The irrigation system of the Project is a structured distribution canal system under which the canal is run either full "ON" or "OFF" and that variations in water requirements are met by timing the intermittent supply. During the peak demand period when crop water requirements are highest, constant and predetermined irrigation streams are delivered continuously to chak rotation units. During non-peak period of demand, the flow to these units are intermittent. Each sub-chak receives the irrigation stream once a week during an "ON" week for a prescribed period in proportion to the size of the sub-chak.

Thus, the chak outlets are not gated as they will run to their capacities whenever the parent canal is "ON". Turnouts serving sub-chaks are gated with on/off gates to enable rotational operation. The discharges of outlet and field irrigation channels are determined by the following peak flow rate to a chak:

Peak Flow Rate

Description		CCA (ha)	Authorized discharge (cusec)	Peak Flow Rate (cusec/ha)
Sarojini Nagar	Amausi Dy	12,532	125	0.0100
Sataon	Maurawan Dy	10,052	75	0.0075
Sursa	Badaicha Dy	15,671	116	0.0074
Purwa	Purwa Dy	5,300	57	0.0108

(a) Field irrigation channel : The field irrigation channel is lined by bricks so as to minimize the conveyance losses to the economical extent of 50 to 60% of the whole reaches of the field channels. The lining section is of rectangular type and the earth canal is of trapezoidal type. The field irrigation channel is constructed up to the outlet to the sub-chak of about 6 ha.

(b) Field drainage canal : The field drainage canal is constructed to collect drain water from the sub-chak. The field drainage canal system are provided with the capacity that 5-year, 3 days rainfall storm is drained within 3 days. The design capacity is fixed to be 5.00 lit./sec/ha. The drainage canal is of trapezoidal earth canal type.

(c) Chak road : To ensure the efficient transportation within the chak, the existing village roads in the chaks are improved with embankment with the width of 4 meter.

(d) Outlet and other related structures : The outlets serving the field irrigation channels are of proportional divisor type without control gate with precast concrete construction. The other related structures are of brick construction.

The on-farm development works include the following:

On-farm Development Works

Description		Sarojini Nagar	Sataon	Sursa	Purwa
Field irrigation canal					
lining	(km)	295	256	344	244
earth	(km)	161	139	187	133
Field drainage canal	(km)	369	320	430	304
Related structures					
turnout	(nos)	2,082	658	2,425	1,716
culvert	(nos)	760	658	885	626
aqueduct	(nos)	198	172	231	163
transition	(nos)	496	429	577	409
drainage culvert	(nos)	925	802	1,078	763
Chak road	(km)	456	395	532	376

7.1.5 Improvement Plan of Water Logging and Salt-affected Areas

To improve the salt affected area to have better crop production, the following technical measures are proposed:

(a) to improve drainage conditions with vertical drainage
(b) to supply and ensure leaching water
(c) to apply improved crop,soil and water management practices
(d) to apply soil amendment
(e) to use organic material and green manuring

Poor drainage conditions has been the main cause of formation of salt affected and water logging areas. Adequate drainage for removal of excess rain water and washing of soluble salts is considered as an important remedial measure for improvement of salt-affected soils and also for preventing rise in water table. The proposed surface drainage systems consisting of field drains, tertiary, secondary and main drainage canals provide a primary function to evacuate the excess drainage water outside the areas immediately after heavy rain. It is also effective that runoff flood water from adjoining fields is prevented from entering the poor drainage areas. In this context, improvement of drainage systems is proposed as mentioned in Section 7.1.3.

The groundwater draft from shallow tubewells in the water logging and salt affected areas will allow the groundwater table to be lowered within the safe zone and help in improving vertical drainage. Leaching is essential for improvement of salt affected areas and removal of salt in order to facilitate crop production. Draft of groundwater is much advantageous in improving leaching and vertical drainage then lowering down the groundwater table. Conjunctive use of groundwater and canal water ensures timely water availability and keep the groundwater table at the safe depth. Under this concept, the groundwater development is proposed as mentioned in Section 7.1.2.

Improvement of alkali soils requires the replacement of excess sodium of the exchangeable complex by calcium and thereafter leaching of the exchanged sodium from the root zone. Gypsum, acids and its forming substances have been used for improvement of sodic soils for a long time in the project areas.

In order to develop the appropriate crop-water-soil management methods to be applicable to farmers, 4 adaptive trial farms are proposed to be established in the respective representative areas. To make optimum use of knowledge and experience available in the

country the adaptive trial programmes should be carried out in close collaboration with the agricultural universities concerned in the project area.

The area of about 10 ha for the adaptive trial farms in the respective Representative Areas will be selected by CAD authority in coordination with Agricultural Department.

The activities to be studied at the adaptive farm include:

- irrigation practice and farming practice in the place of salt affected area
- water-yield relationship as affected by water scheduling and seasonal and periodic water deficits
- irrigation methods including field trials on layout, length of running period and permissible stream size
- irrigation/fertilizer interaction

The results of field experiments on irrigation practice and water/yield relationships are used for formulation of recommendations on water management in the areas.

7.2 Agricultural Development Plan

The proposed agricultural development plan in the Representative Areas is determined as follows:

(1) Selection of Crops
(2) Determination of Cropping Pattern by Land Size Classes
(3) Proposed Farming Practice on the proposed crops

7.2.1 Selection of Crops

The crops to be irrigated in the proposed cropping pattern are selected according to the following procedure:

(1) Analysing the Present Cropping Pattern

According to the Present Cropping Patterns of Representative Areas, main crops in Kharif are staple cereal crops such as paddy, maize and sorghum, followed by pulses and sugarcane. Of these crops, paddy is dominantly irrigated while in Sursa sugarcane is also main irrigated crop. On the other hand, in Rabi wheat is by far cultivated and also irrigated.

Potatoes and other vegetables are also irrigated. Protein crops like gram and pea, and oilseed crop of mustard are also cultivated although its area is small. The present cropping pattern will be taken into account for determining a future cropping pattern.

(2) Farmers' Preferences

Cereal crops are dominantly cultivated both in Kharif and Rabi, no less than 75% of cropped area. Another area of 10% of cropped area is devoted to pulses, protein crops, followed by oilseed crops, vegetables, forage crops, etc. with minimal areas.

As irrigation practices are done mainly for cereal crops, farmers' preference of cultivation is considered to be cereal crops. Farmers with marginal and small holdings in size, especially prefer cereals such as paddy and wheat.

(3) Suitability Crops under Various Soil Conditions

A part of upland soil is not suitable for paddy cultivation. Mid-lowland and Lowland are not suitable for other than paddy. The rest of the area is generally suitable for any kind of crops if proper soil management is made. Since Upland, Mid-upland and Midland are the main land types in any of the respective Representative Areas, serious problems may not exist.

(4) Government Policy on Crop Production

The national and state governments have taken a policy on increased crop production on protein and oilseeds to improve nutrition status of people as well as to save foreign currency. Although farmers prefer cultivating cereals, diversification of a part of excessive amount of cereal products is taken into account.

Based on the above consideration, the following crops to be irrigated are selected by season:

Selected Crops to be Irrigated

Kharif:	Paddy, Pulses, and Oilseed Crops
Rabi:	Wheat, Pulses, Oilseed Crops, Potatoe, Forage Crops
Permanent:	Sugarcane

7.2.2 Determination of Cropping Pattern

The proposed cropping patterns are determined through the following exercise:

(1) Examination of Water Availability
(2) Energy Balance Study of Cereal Supply and Demand

(1) Water Availability

Irrigation Department has set cropwise proposed irrigation areas for each of branch canal as follows:

Name of Branch	Kharif					Rabi		Total	% of
	Sugar cane	Paddy	Other Kharif	Total	% of CCA	Rabi	% of CCA		of CCA
Hardoi Branch	21,803	108,865	43,606	174,274	22	189,443	26	363,717	47
(A) Lucknow Branch	8,412	42,060	16,824	67,296	24	70,100	24	137,396	48
(B) Asiwan Branch	2,496	12,345	4,938	19,752	23	20,576	24	40,328	48
(C) Unnao Branch	2,404	12,019	4,808	19,231	23	20,032	24	39,263	48
(D) Purwa Branch	2,250	11,250	4,500	18,000	24	18,746	24	36,746	48

Based on the above proposed cropping, paddy and sugarcane cultivation will be irrigated not more than 75% of PIA.

(2) Energy Balance Study between Supply and Demand

Cropping intensity of proposed irrigated crops will be determined considering the energy requirement. Staple cereal crops shall be put priority as they are the main energy source of carbohydrates which will share about 65% of the total energy requirement.

Energy requirement from cereals = 2,400kcal/day/capita x 0.65 x Family size

Energy Requirements in Representative Areas

Unit: kcal

Size Class	Sarojini Nagar	Sataon	Sursa	Purwa
Marginal (less than 1ha)	9,672	11,232	10,452	9,984
Small (1 to 2 ha)	12,948	12,636	12,324	12,324
Semi Medium (2 to 4 ha)	17,160	16,380	16,068	14,664
Medium and Large (4 ha and above)	17,472	19,968	17,004	21,528

Based on the target yield of recommended cereal and industrial crops shown below, possible cereal energy supply is calculated.

Paddy: 4.0 ton/ha (unhusked rice)
Wheat: 3.5 ton/ha
Sugarcane: 30.0 ton/ha

Edible portion of harvest is calculated at:

Paddy: 1.92 ton/ha (20% of loss and 60% of milling efficiency)
Wheat: 2.66 ton/ha(20% of loss and 95% of milling efficiency)
Sugarcane: 2.1 - 2.4 ton/ha (7 - 8% of sugar contents)

Based upon the combustion energy of carbohydrate of 3.5kcal/g, and assuming that cultivated crops are paddy in Kharif and wheat in Rabi, respectively, possible energy supply per farm family by land size is estimated at:

Possible Energy Supply by Land Size

Unit: kcal

Size Class	Sarojini Nagar	Sataon	Sursa	Purwa
Marginal (less than 1ha)	6,368	6,368	5,819	6,148
Small (1 to 2 ha)	15,700	15,810	15,371	15,591
Semi Medium (2 to 4 ha)	30,303	31,950	29,315	32,938
Medium and Large (4 ha and above)	61,156	69,610	61,156	60,167

The balance between energy requirement and possible energy supply then is as shown below:

Balance between Requirement and Supply of Energy

Unit: kcal/family/day

Size Class	Sarojini Nagar	Sataon	Sursa	Purwa
Marginal (less than 1ha)	-3,304	-4,864	-4,633	-3,836
Small (1 to 2 ha)	2,752	2,174	3,047	3,267
Semi Medium (2 to 4 ha)	13,143	15,570	13,247	18,274
Medium and Large (4 ha and above)	43,684	49,642	44,152	38,639

As seen from the above, marginal farmers will not be able to produce necessary energy only from irrigated cereals for supporting family. On the other hand, small farmers will be able to get sufficient harvest to supply required amount of energy to all family members although the expected excess of cereals will not be much. Semi-medium size farmers will be able to produce excessive amount, equivalent to 60 to 70% of total requirement while medium and large farmers are expected to produce excessive harvest more than 2 times as much as required amount of cereals.

Not being able to be self-sufficient only in the canal-water-supplied area, marginal farmers will cultivate other cereal crops to supplement carbohydrates, and protein/oil crops in the remaining area, depending upon rainwater or groundwater.

Small farmers, who will be able to produce self-sufficient cereal crops in canal-water-supplied area, will grow protein/oil crops to assure other energy source than carbohydrates, other cereals and vegetables for marketing and other crops for feeding domestic animals in the remaining area.

As they will produce excessive amount of cereal crops in the canal-water-supplied area, semi-medium farmers will diversify some area for oil-seed crops or market a part of excessive cereals. They will also be able to cultivat various crops in non-canal-water supplied area.

Medium and large farmers, as they will produce more than required amount of cereals, would market excessive amount as well as diversify them with oil-seed crops as the government is promoting.

From the above, semi-medium, medium and large farmers would diversify crops with oil-seed crops to contribute to the government policy on oil crops promotion. In Sursa Area, however, currently irrigated sugarcane area with some 500ha would remain, taking into

account the importance of sugar industry on the regional economy. In this case, being carbohydrates, sugarcane will be considered as an alternative crops of cereal crops.

A part of excessive amount of cereals can be diversified. The ratio of required cereal amount for self-sufficiency of farmers to the possible potential cereal production is some 56%. It is therefore necessary to cultivate cereal crops with 56% of irrigated area to meet self-sufficiency of carbohydrates for farmers. Considering 20% more cereals production for food security purpose, about 68% of total irrigated area will be devoted to cereal production.

The remaining 32% will be cultivated with pulses, oilseeds, vegetables, etc. Sugarcane is proposed in Sursa with an area of 10% of total irrigated area as the portion of cereal cultivated area.

(3) Determination of Cropping Pattern under Irrigated Condition

Proposed cropping patterns in canal-water-supply area by Representative Areas are determined as shown in Fig. 7.5 and summarized as follows:

Proposed Crop Intensity and Irrigation Areas

Crops	Sarojini Nagar		Sataon		Sursa		Purwa	
	Intensity (%)	Area (ha)	Intensity (%)	Area (ha)	Intensity (%)	Area (ha)	Intensity (%)	Area (ha)
Kharif	100	3,567	100	3,090	90	3,740	900	2,941
Paddy	68	2,426	68	2,101	58	2,410	68	2,000
Pulses	22	785	22	680	22	914	22	647
Oilseeds	10	357	10	309	10	398	10	294
Rabi	100	3,716	100	3,219	90	3,895	100	3,063
Wheat	68	2,527	68	2,190	58	2,510	68	2,083
Pulses	15	557	15	483	15	649	15	459
Oilseeds	5	186	5	161	5	216	5	153
Potatoes/ Vegetables	6	223	6	193	6	260	6	184
Forage crops	6	223	6	193	6	260	6	184
Permanent								
Sugarcane	-	-	-	-	10	433	-	-

(4) Determination of Cropping Pattern under Non-irrigated Condition

As mentioned before, marginal farmers will not be able to attain self-sufficiency in carbohydrates only in canal-water-supply area. They will have to grow cereal crops also in non-canal-supply area, depending upon the rainwater and/or ground water.

Considering the above and present cropping pattern, proposed cropping pattern under non-irrigated condition is determined as follows:

Crops	Sarojini Nagar	Sataon	Sursa	Purwa
Kharif				
Paddy	50%	50%	50%	50%
Sorghum	10%	15%	5%	20%
Maize	5%	-	15%	-
Pulses	20%	20%	20%	20%
Oilseeds	15%	15%	10%	10%
Rabi				
Wheat	65%	65%	65%	65%
Pulses	15%	15%	15%	15%
Oilseeds	10%	10%	10%	10%
Potatoes/Vegetables	5%	5%	5%	5%
Fodder Crops	5%	5%	5%	5%

7.2.3 Proposed Farming Practice

In order to attain target yields, new farming practices of crops are proposed. Basically proposed farming practices follow the recommendable farming practices by Chandra Shekhar Azad University of Agriculture and Technology, except agro-chemicals many of which recommended commodities have been banned for their toxicity. Proposed farming practice of crops is briefly explained below:

(1) Paddy

There are three categories of paddy varieties according to the growth period: early maturing varieties (100 to 120 days of growth period), medium maturing varieties (120 to 140 days) and late maturing varieties (140 days and more):

Nursery

In May, nursery preparation should be made. Fine textured fertile soil should be selected with irrigation and drainage facilities. 30 to 50 kg of seed according to the grain size

should be sown on 600 to 800 sq.meter of nursery for one hectare of paddy field. 14.5kg of urea and 7kg of triple superphosphate should be applied on nursery bed before sowing seeds. To prevent iron deficiency and zinc deficiency, 300g of zinc sulfate and 2.5% of iron sulphate should also be applied.

Seed should be soaked for 24 hours and dried for 36 to 40 hours in shade for germination, and then broadcasted at the rate of 70 grams per sq.meter. During first week of sowing, water should be available permanently in the field. After first week regular and light irrigations should be given.

Transplanting

Before transplant, basal fertilizer should be applied at puddling. The dosage of fertilizer should be, depanding on varieties, 30 to 60 kgN/ha, 30 to 60 kgP_2O_5/ha and 30 to 60 kgK_2O/ha.

Seedlings at the age of 21 to 25 days for dwarf varieties and 30 to 35 days for deshi varieties should be used for transplanting. Medium maturing varieties should be transplanted between last week of June to 15th of July while early maturing varieties should be transplanted by the third week of June. In case of late maturing varieties, transplanting should be done by the end of Jule. Planting density should be 2 plants per hill with 20cm in row and 10cm in plant to 4 plants per hill with 15cm in row and 10cm in plant, depending upon the field and/or variety conditions. Supplement planting should be done immediately.

Direct Sowing

Direct sowing should be completed by first week of July. Seeding rate should be 75 to 80 kg/ha, and be sown in row with the distance of 20cm.

Weeding

First weeding should be done after one week of transplanting or 20 days after the transplanting. Second weeding should be 40 to 50 days after transplanting.

Top Dressing

Additional fertilizer at a rate of 30 to 60 kgN/ha should be applied at the panicle initiation stage, about 2 weeks before heading.

Water Management

Paddy should be irrigated at the following critical growth stages

- Seedling stage
- Panicle initiation stage
- Flowering stage
- Soft dough or milky stage

Plant Protection

The insects or diseases to be protected are as follows:

(1) insects: stem borer, root borers

(2) diseases: blast, brown spot, blight, stem rot, root rot

(2) Wheat

Land Preparation

Prepare the field at proper good moisture with the help of Disc plough followed by harrowing. In case soil moisture is deficient pre-irrigation is necessary.

Seeding

Seeding rate is about 100kg/ha. First week to 25th of November would be the best time for sowing. Seed should be treated with Thiram at a rate of 2.5g/kg seed. Seeding should be done with row distance of 22cm.

Fertilizer Application

Depending on soil condition, 80 to 120kgN/ha, 60kgP_2O_5/ha and 40kgK_2O should be applied. Half of the nitrogen should be applied at the time of first irrigation. To prevent zinc deficiency, 5kg of zinc sulfate with 2% solution of urea dissolved in 800 liters of water should be sprayed.

Water Management

First irrigation should be given at crown root initiation stage, I.e. 20 to 25 days after sowing. Half amount of nitrogen should be topdressed at this time. The other critical stages are: tillering stage, jointing stage, boot leaf stage, flowering stage, and milky stage.

Plant Protection

The insects or diseases to be protected are as follows:

(1) insects: termites, aphids, hopper, weevil

(2) diseases: blight, rust,

(3) Groundnut

Soil Selection

Sandy loam or loamy soils with good drainage are suitable.

Plant spacing and seed rate:

Depending upon varieties, plant spacing varies from 30x10cm to 45x20cm with the seed rate of 65 to 100 kg per hectare.

Fertilizer application

15kgN/ha, 30kgP2O5/ha, and 45kgK2O/ha should be applied as basal fertilizer. Besides, 200kg of gypsum and 4kg of borax per hectare should be applied. Half amount of gypsum should be applied at basal, and the rest and borax should be applied three weeks after sowing.

Seed treatment

1kg of kernal seed should be treated with 2.5g of thiram. Rhizobium culture should be applied to stimulate symbiotic nitrogen fixation, after treating with thiram.

Weed management

Two weedings and hoeing are recommended. First weeding and hoeing should be done 15 to 20 days after sowing. Second weeding and hoeing should be done at 30 to 35 days after sowing.

Plant Protection

The insects or diseases to be protected are as follows:

(1) insects: white grubs

(2) diseases: rust

(4) Mustard

Fertilizer Application

In irrigated condition, 120kgN/ha, 40kgP2O5/ha and 40kgK2O/ha should be applied. Half amount of nitrogen and full phosphate and potassium should be applied as basal and rest of nitrogen as top dressing at first irrigation.

Seeding

Seeding should be made at a seed rate of about 5 to 6 kg during the first fortnight of October, with planting density of 45x15cm.

Water management

First irrigation should be done 30 days after sowing. Another two irrigation: at flowering stage and pod formation stage should be required.

Plant Protection

The insects or diseases to be protected are as follows:

(1) Insect: saw-fly, aphid, painted bug

(2) Diseases: rust diseases, blight,

(5) Pea

Seeding

In mid-october to mid-November, 75 to 100kg/ha of seed should be sown with row spacing of 30 to 45 cm.

Fertilizer application

10 to 15kgN/ha and 40kgP2O5/ha should be applied as basal fertilizer.

Water Management

First irrigation should be done at flowering stage.

Plant Protection

The insects or diseases to be protected are as follows:

(1) insect Termite, cut-worm, stem-borer, semi-looper

(2) diseases powdery mildew

(6) Green gram

Seeding

From last week of July to the first week of August, 12kg of seed per ha should be sown with a spacing distance of 30 to 45cm.

Fertilizer application

15kgN/ha and 40kgP2O5/ha should be applied as a basal fertlizer. Rhizobium culture should be inoculated before seeding.

Weed management

First weeding or hoeing should be done 20 to 25 days after sowing.

Water management

Irrigation should be done at early growth stage and flowering stage.

(7) Potatoes

Seed preparation

Select out 4 to 5 cm size seeds or 50g seed. Sprouts should be 2 to 3cm long before planting.

Fertilizer application

150kgN/ha, 100kgP2O5/ha and 100kgK2O/ha should be applied as basal fertilizer before seeding.

Seeding

For early varieties, between 15 Sep. and 20 Sep. For main crops between 15 Oct. and 25 Oct. with a seeding rate of 42 quital/ha. Planting density should be 60x20cm.

Plant protection

The insects or diseases to be protected are as follows:

(1) insects: cut worm,

(2) diseases: late blight

(8) Sugarcane

Seeding

There are two seasons for planting: October and March. In both cases, cane is planted at a rate of 50 to 60 quintals/ha, with a spacing of 90 cm in row and 30 cm in line.

Fertilizer application

30 to 40kgN/ha should be applied as basal fertilizer. In spring planted sugarcane, 20 to 30 kgP2O5/ha should be added.

Plant Protection

The insects or diseases to be protected are as follows:

(1) insects: borers, white fly

(2) diseases: pyrilla

7.2.4 Anticipated Yield and Production

The unit yield of crops under future with and without project conditions is estimated. The target yields of paddy and wheat under without project condition are estimated based on the farm economy survey and on available statistics. They are as shown below:

Unit: ton/ha

Crops	Present Condition	Future Condition	
		Irrigated Condition	Un-irrigated Condition
Kharif			
Paddy	2.08-2.57	4.0	3.0
Sorghum	1.1-1.5	-	2.0
Maize	0.7-1.3	-	2.0
Pulses	0.7-1.2	2.0	1.3
Oilseeds	0.5-0.9	1.3	0.9
Rabi			
Wheat	1.73-2.35	3.5	2.5
Pulses	0.4-0.9	2.0	1.2
Oilseeds	0.6-0.7	1.0	0.8
Potatoes	9.0-17.0	18.0	17.0

Those of other crops are estimated based on the present farming technology level and on the existing experiment data. For achieving the target yields, optimum application of farm input is essential along with proper water management. Agriculture extension services is another need to attain the target yields. The target yields of crops will be realized in 5 years after the completion of irrigation and drainage facilities.

Irrigation and drainage development is expected to increase net cultivated area. The incremental production of crops in the project area is estimated at as follows:

Crops	Without Project Condition		Work Project Condition		Incremental Production (ton)
	Cultivated Area (ha)	Production (ton)	Cultivated Area (ha)	Production (ton)	
Kharif					
Paddy	18,700	42,000	30,710	101,000	59,000
Sorghum	5,500	7,300	5,120	10,200	2,900
Maize	2,900	3,700	2,540	5,100	1,400
Pulses	3,600	2,200	11,700	15,900	13,700
Oilseeds	600	400	6,800	6,700	6,300
Rabi					
Wheat	30,000	64,500	37,200	102,400	37,900
Pulses	3,150	2,200	8,600	12,000	9,800
Oilseeds	350	230	5,000	4,150	3,980
Potatoes	800	11,600	3,000	55,900	44,300

7.3 Plan to Actualize Osrabandi

7.3.1 Organizing Farmers' Association on Water Management

Farmers themselves would be the key factor for successful implementation of "Osrabandi". After establishing or completing the on-farm development works and thereby assuring reliable water, the next issue would be how to manage water and maintain field channels. It is farmers who should be responsible for those roles, considering that water management works and maintenance works of field channels require a large number of manpower and that governmental agencies could not be able to handle those works by themselves due to lack of staff as well as budgets. Farmers should be organized to deal with the above works as those works would directly benefit farmers themselves.

The following would be required for smooth execution of "Osrabandi":

- to make water distribution plan
- to determine cropping pattern
- to formulate water management plan
- to execute water management according to the plan
- to maintain field channel

The following societies should be organized in one chak in order to fulfill the above requirement.

- a water management groups in each sub-chak
- a water management society in one chak
- an water management committee in one minor canal

A water management group is to be minimum organization composed of all beneficial farmers in the respective sub-chaks, responsible for determination of cropping pattern and for execution of water management and maintenance works on field channels. The group would be assisted by the CAD Authority. Water charges or irrigation fees would be collected by the group with the proper guidance of a deputy revenue officer.

A water management society would consist of the representatives of each water management group. The society would function as a coordinating body among sub-chaks, and be responsible for (1) determination of water distribution schedule in the chak based on the determined cropping pattern, (2) determination of water management schedule, and (3) supervision of water management and maintenance work on field channel. The society would be assisted by the Irrigation Department as well as the CAD Authority.

Both a water management group and a water management society should be formulated at least a half year earlier than DFD work of its chak are planned. The DFD works of each chak should be explained to beneficiaries through the above organizations to get better understanding and cooperation.

A water management committee consist of the representatives of chaks commanded by one minor canal. The committee function as a counter organization to the Irrigation Department as well as a coordinating body among societies, and be responsible for the supervision of water management works and of maintenance works on field channels.

7.3.2 Pilot Trial for Water Management

In order to execute water management by farmer beneficiaries efficiently, some training should be done. A pilot trial utilizing one model chak will be proposed. The model chak will also function as a demonstration, training and extension farm.

A pilot trial would be planned in the model chak with an area of 40 to 50 ha consisting of 7 sub-chaks. 7 water management groups and a water management society will be organized with the assistance of CAD Authority. Based on the water distribution schedule informed by the Irrigation Department, cropping patterns will be determined by each group. The water management society will determine a water distribution plan within the chak based

on the cropping pattern in sub-chaks. The water distribution will be one week basis: one day per one sub-chak. Within one sub-chak, a detailed water distribution plan will be made on hourly basis. A gate keeper who is responsible for the outlet gate operation will be appointed by the group.

Basarahiya water management cooperative society, located near Lucknow under the Sharda Sahayak CAD Project, is the only successful example in Uttar Pradesh State. The society was launched in 1989, started with five kulabas irrigating an area of 290 hectares, and now expands its scale at 528 hectares with 11 kulabas. Although there are various advantageous factors in this society such as (i) the relatively homogeneity of the group of farmers, (ii) credit or subdues for strengthening the working of the society, and (iii) reliable supply of water, it is worth being example from the viewpoint of operation and management of the society.

7.4 Agricultural Supporting Services

Agricultural supporting services are required to be provided by CADA in order to successfully attain the target yields. Training of farmers including women and linkage between research and extension are given no top priority, matters. Supporting services for supply of certified seeds, marketing and processing are also considered for the future development of farmers associations.

(1) Training, Education, Research and Extension

Training of farmers including women as well as project staffs should be carried out. The low level of present farming technology may be desired from farmers' low education level, especially from lady farmers' situation as mentioned in the section 5.2.3(2). Proper education programme to them should then be planned aiming at making extension work easy as well as at preventing them from being cheated by merchant.

Education programme will be made in the form of circulating class; i.e. visiting village by village, women's for eaning participation under very busy situation. This programme will be carried out in combination with extension programme.

In extension programme, there are mainly two courses; (i) irrigation course including water management and maintenance of field channels, and (ii) agriculture course including farming practice and soil improvement.

The following knowledge should be transferred to farmers:

(i) Irrigation course

a) water management
- crop - water relation
- water requirement
- necessity of "Osrabandi"
- water distribution schedule
- role of farmers
- irrigation fee

b) maintenance of field channels
- necessity of maintenance of field channels
- maintenance schedule
- role of farmers
- share of farmers

(ii) Agriculture course

a) farming practice
- seed selection
- seeding
- fertilizer requirement
- application of fertilizer
- weed control
- pest control
- irrigation
- harvest
- storage
- marketing
- processing

b) soil improvement
- problem soils
- how to solve problems
- drainage
- soil amendment

In the course of extension, site specific problems may be raised by farmers. Extension workers should take note those questions/problems and bring them to research institutes. The linkage between research and extension should then be strengthened.

CHAPTER VIII PROJECT IMPLEMENTATION PLAN AND COST ESTIMATE

8.1 Principal Approach to Project Implementation

The development plan of the Project herein formulated includes various schemes for improvement/establishment of agricultural infrastructures in the command area as well as reinforcement/development of farmers' association and agricultural supporting functions. These development components consist of the following work items :

I. Improvement/development of irrigation and drainage systems

This will consist of the following components;

- Modernization of existing irrigation canal systems
- Provision of adequate drainage systems
- On-farm development woks
- Development of groundwater for conjunctive use

II. Water and Agro-management

The main components of this item will include the followings to attain the intensive development of irrigated agriculture.

- Operation and maintenance of irrigation system from the offtaking to minor canals up to outlets
- Establishment of water users' associations and introduction of warabandi system in the command
- Provision of agricultural extension services and activation/formation of farmers' agro-management societies

III. Training, Adaptive Research,and Monitoring and Evaluation

The main components of this group will include the followings:

- Training of Project staff, farmers including women farmers
- Surface water and groundwater management in the schemes of conjunctive use
- Setting up and operation of adaptive trial farms

- Input and output monitoring of Representative Areas

The implementation of these development components will be arranged so as to effectively realize the development objectives and to ensure the development effects to the other areas in the Sharda Canal CAD project. The following principal approach is adopted in implementation plan :

(1) Early establishment of farmers' association

Farmers' participation to the Project is prerequisite in attaining the efficient water management within outlet command. Prior to the commencement of the construction works, the water user' association is established in every outlet command under the guidance of CADAso that the farmers can participate the project works from the planning stage.

(2) Harmonized sequence of implementation of the Representative Areas

The implementation of construction works of the Representative Areas will be executed with the following concept:

(a) Survey, planning and design will be carried out with employment of technical firms to effectively execute a large amount of those works with the limited time.

(b) Modernization of irrigation and drainage systems will be executed by selected contractor under the supervision of CADA or on the basis of the job order to Irrigation Department.

(c) On-farm development will be executed stagewise according to the progress of the design works.

(d) Groundwater development will first be commenced from pilot demonstration farm, then tubewell construction will follow on the basis of the result of pilot farm operation.

(e) Power distribution lines for shallow tubewell and lift canal schemes will be executed in coordination with U.P.S.E.B.

(3) Operation, maintenance and water management of irrigation system

After completion of modernization works and on-farm works, the operation, maintenance and water management of the minor canal system including shallow tubewells will be carried out by the CADA. In order to effectively execute the water delivery to the every outlet command, osrabandi system will be introduced initially in the every outlet command under the guidance of the CADA.

(4) Agro-management

Immediately after the completion of the improvement of canal system and on-farm works, extension services will be provided by the CADA staff with cooperation of the existing governmental organization concerned.

(5) Training

Training will be provided by CADA during the Project operation period to the farmers including women farmers, canal inspector and CADA staff.

(6) Monitoring and evaluation of irrigated farm

At the final stage, the monitoring and evaluation of agricultural productivity under irrigated farm, conjunctive use of the surface water and groundwater, agro-economic impact will be executed.

8.2 Implementation Schedule

The implementation schedule of the Project is shown in Fig. 8.1. It includes the preparatory works, construction works, research works, guidance services and monitoring and evaluation. The preparatory works include the establishment of farmers associations, survey, design, tendering and project mobilization for implementation, and it will last 22 months in the initial stage. The construction works will last 50 months for the modernization works of the main irrigation and drainage systems and on-farm development works. All the work will be completed in the 6th year.

The topographic survey and subsequent designing work of on-farm works will be continued and the tendering will follow the completion of the design. The design will be completed in the 4th year.

Establishment of the farmers association in the command will also be commenced in the first year with the guidance from the CADA so as to ensure actual participation of the farmers from the planning stage of the on-farm development works. Introduction of the osrabandi will be promoted for the area where the on-farm works have been completed.

Modernization works of irrigation and drainage systems will be started in the second year after selection of the contractors through competitive bidding, and be completed in the last 6th year. All of the work in the respective Representative Areas will be concurrently commenced.

On-farm development works will be implemented with stage wise construction along with the progress of the design works. The result of the design will be brought into the construction step by step. The work will be commenced in the second year and all of the work will be completed in the last 5th year.

Wireless communication system will be established in the 4th year after site investigation and manufacturing and the monitoring and evaluation of the water management of the Sharda canal system will be commenced thereafter.

The groundwater development will first be commenced from the pilot farm construction of the tubewell and pipe drain schemes in the Purwa and Sursa Areas together with observation and evaluation of the investigation results. Then the construction of the tubewells will be executed in the 4th year.

The adaptive trial farms will be established in the second year so as to utilize the result of the investigation in the actual water and farm management in the completed areas of the on-farm development.

The survey and design works will be carried out with employment of the survey and design firms under the supervision of the CADA to utilize the limited time. All the construction works will be executed by the contractor(s) through competitive bidding. On-farm development works for lining canals will be executed by the contractors selected through competitive bidding, whereas earth canals will be executed by the farmers associations concerned for the command areas of on-farm works on the contract basis with CADA. The modernization of irrigation and drainage systems will be executed by the supervision of the CADA or with the job contract with Irrigation Department which is presently conducting O & M of those systems.

8.3 Organization of Project Implementation

Implementation of the Projects as a model development will be managed basically in accordance with the present organization of the CADA.

Implementation of the Project will need the multi-disciplinary working team. The fundamental components of the Project have to be directly performed by the CADA. Some other components will be carried out by the concerned departments and the CADA will prepare the implementation programme and its budget for implementation, and coordinate and monitor the progress of the works in accordance with the present governmental practice rules.

From the view point of the above, in order to effectively implement the Project, the organization structure of the Project is proposed as shown in Fig. 8.2 and it will consist of the following :

The CADA will be headed by the Commissioner/Administrator under the direct supervision of the Uttar Pradesh State Agricultural Production Commissioner. The Commissioner /Administrator will be assisted by the following divisions:

(1) Administration and Accounting Division

This will undertake all administrative, financial,and regal services, i.e., accounting, treasury, personnel, records, other general services.

(2) Construction Division

This Division will consist of the following Sub-divisions which will be directly responsible for construction works of the Project at the respective Representative Areas.

(a) Irrigation and Drainage Modernization Sub-division
- to carry out survey,planning and design
- to supervise the modernization works of irrigation and drainage systems

The staff of this Sub-division have to be arranged from the present working staff of the Irrigation Department.

(b) Canal Maintenance Sub-division

- to provide the maintenance services for the minor canal facilities in the command of the concerned minor canals in coordinating with the operation and maintenence offices concerned of Irrigation Department or in contract with them

The staff of this Sub-division have to be arranged from the presently working staff of the operation and maintenence offices concerned of Irrigation Department

(c) Water Supply Sub-division

- to organize farmers' associations and provide guidance in introduction of osrabandi system
- to carry out water management down from the offtaking structures of minor canals

The staff of this Sub-division have to be strengthened by introduction of the engineering staff from operation and maintenence offices concerned in the Irrigation Department

(3) Land and Water Management Division

This Division will consist of the following Sub-divisions:

(a) Soil Survey Sub-division

- to carry out soil survey
- to carry out the guidance in soil management

The staff of this Sub-division is arranged from the presently working staff of CADA.

(b) On-farm Development Sub-division

- to carry out survey,planning and design
- to supervise on-farm development works

The staff of this Sub-division will be strengthened by transferring technical staff of Sub-divisional offices under the Irrigation Department

(c) Groundwater Sub-division

- to carry out investigation, planning, design and construction supervision of groundwater development in coordination with Groundwater Department, UP.

(d) On-farm Work Maintenance Sub-division

- to carry out the guidance in maintenance works of on-farm works to water users association

(4) Agro-management Division

This Division will consist of the following Sub-divisions to provide intensive agricultural supporting services to farmers' associations.

(a) Crop Loan Sub-division
(b) Farm Input Sub-division
(c) Marketing and Storage Sub-division
(d) Agro-Processing Sub-division

The staff of these Sub-divisions have to be arranged from the Departments of Agriculture Cooperative and other related departments.

(5) Training, Action Research, Monitoring and Evaluation Division

This Division will consist of the following Sub-divisions:

- Extension Sub-division
- Adaptive Research and Trial Farm Sub-division
- Monitoring and Evaluation Sub-division

The function of this unit will be to carry out planning and implementation of:

(i) training of farmers and CADA staff,

(ii) adaptive trial,

(iii) monitoring and evaluation of groundwater development pilot farm for conjunctive use

(iv) monitoring and evaluation of agricultural productivity with the Project.

The staff of this Division have to be arranged from the Department of Agriculture, Groundwater Department and the works are carried out in cooperation with the concerned departments.

8.4 Cost Estimate

8.4.1 General

The costs of implementation of the Project are estimated on the basis of the following conditions:

1) The exchange rate used is :

1 US$ = Rs.25.90

2) The main construction works will be carried out by contractor(s) selected through competitive bidding.

3) The unit price of the works are divided into foreign currency portion and local currency portion. Local currency portion is estimated with reference to the current market prices in the early 1991, and the cost data obtained from similar on-going works around the Project area. Foreign currency portion of materials and equipment to be imported is estimated on the basis of CIF Calcutta.

The classification of local currency portion and foreign currency portion is carried out by the following basis:

Local currency portion
- Land acquisition cost
- Labor force
- Reinforcement bars (Local Currency Portion)
- Structural steel (Local Currency Portion)
- Fuel and lubricants (Local Currency Portion)
- Wooden materials

- Concrete aggregates
- Cement
- Brick
- Pumping equipment
- Supporting equipment
- Inland transportation
- Administration expenses
- Expenses and fees of engineering services by local consultant

Foreign currency
- Reinforcement bars (Foreign Currency Portion)
- Structural steel (Foreign Currency Portion)
- Fuel and lubricants (Foreign Currency Portion)
- Wireless communication equipment
- Depreciation of construction equipment and machinery
- Contractors' general expenses and profit of the contractors
- Expenses and fees of engineering services by foreign consultants

5) Physical contingency of the cost estimate is 10% of the construction cost. Price contingency applied is : 7% per annum for the local currency portion and 3% per annum for the foreign currency portion.

8.4.2 Cost Estimate

The Project cost consists of construction cost, procurement cost of supporting equipment, land acquisition cost, engineering services and administration cost, and contingencies. The total cost is estimated to be Rs. 3,351 million, consisting of the foreign currency portion of Rs. 571 million and the local currency portion of Rs. 2,780 million as summarized below. The breakdown is shown in Table 8.1.

Project Cost

Unit: Rs. million

	Description	Foreign Currency	Local Currency	Total
A.	Wireless Communication System	58.9	6.5	65.4
B.	Representative Areas			
	B-1 Sarojini Nagar Area			
	1. Main system	31.5	148.0	179.5
	2. On-farm development works	33.3	149.0	182.3
	3. Land acquisition	0.0	5.3	5.3
	Sub-total (B-1)	64.8	302.3	367.1
	B-2 Sataon Area			
	1. Main system	32.1	323.1	355.2
	2. On-farm development works	28.9	131.1	160.0
	3. Land acquisition	0.0	7.4	7.4
	Sub-total (B-2)	61.0	461.6	522.6
	B-3 Sursa Area			
	1. Main system	51.4	258.2	309.6
	2. On-farm development works	38.9	180.5	219.4
	3. Land acquisition	0.0	8.6	8.6
	Sub-total (B-3)	90.3	447.3	537.7
	B-4 Purwa Area			
	1. Main system	39.8	155.3	195.1
	2. On-farm development works	27.5	124.8	152.3
	3. Land acquisition	0.0	3.0	3.0
	Sub-total (B-4)	67.3	283.1	350.4
	Sub-Total (B)	283.4	1,494.3	1,777.6
C.	Procurement of Supporting Equipment	0.0	8.4	8.4
D.	Administration Cost	0.0	148.7	148.7
E.	Engineering Service	103.8	118.6	222.4
F.	Contingencies			
	1. Physical	44.6	177.7	222.3
	2. Price	80.3	825.9	906.2
	Total	571.0	2,780.1	3,351.1

(3) Annual Disbursement Schedule

The annual disbursement is worked out according to the implementation schedule as shown below. The breakdown is as shown in Table 8.2.

Annual Disbursement Schedule

Unit: Million Rs.

Year	Foreign Currency	Local Currency	Total
1993	13.8	66.2	80.0
1994	37.5	171.4	208.9
1995	100.6	514.7	615.3
1996	206.6	760.6	967.2
1997	124.4	741.1	865.5
1998	88.2	526.1	614.3

8.4.3 Operation and Maintenance Cost

Operation and maintenance costs at the full operation stage of the Project are estimated to be Rs. 39.1 million , comprising operation and maintenance of the Project facilities. The breakdowns of operation and maintenance cost are as shown in ANNEX-J

8.4.4 Cost of Replacement of Project Facilities

Pumping equipment of irrigation and metal works of irrigation canal related structures are periodically to be replaced. The economic life and the replacement cost used in the estimate are shown in ANNEX-J.

CHAPTER IX PROJECT EVALUATION

9.1 General

The project is to be evaluated through an assessment of its feasibility in view of economic and financial aspects. The economic feasibility is evaluated by calculating the internal rate of return. A sensitivity analysis is also made to elucidate an economic viability of the project against the changes in the benefit and project cost.

Financial evaluation is carried out by analysing the effect of the project on the farm economy for a typical type of farmers and by preparing the repayment schedule of the project capital cost.

9.2 Economic Evaluation

9.2.1 Basic Assumption

The economic evaluation is made on the following basic assumptions;

(1) The economic useful life of the project is 50 years.
(2) All prices are expressed in constant 1990 prices.
(3) The exchange rate of US$1.00=Rs.25.9 is applied.

9.2.2 Economic Factors

Traffic and trade restrictions introduce a distortion in the price relationship between trade goods and non-trade goods. In order to evaluate the project costs and benefits with respect to world market prices, a standard conversion factor of 0.8 is applied to the price of non-traded goods and services.

From the viewpoint of international economy, the transfer of payment such as contract tax, duty, subsidy and interest are considered as a domestic monetary movement without direct productivity. These transfer payment are excluded from the project cost.

Economic prices of traded agricultural output (cereals and pulses) and farm inputs (urea, triple super phosphate (TSP) and potassium chloride (KCl)) are estimated on the basis of IBRD projection of world market prices for 1995 in constant 1985 terms. The domestic

cost elements such as transport, handling and processing down to the farm gate level were multiplied by the standard conversion factor (0.8).

The shadow price of 0.667 is applied for unskilled labors considering the present employment situation.

Economic prices of cereals and pulses, and inputs are shown in Table 9.1.

9.2.3 Economic Benefits

The project benefit is born as a result of irrigation and drainage development as well as agricultural extension works. Present cultivated area is expected to increase productivity while currently fallow land due to water logging or alkalinity problem recovers its fertility.

Expected benefit is defined as the differece of primary profit from crop production between future with project and without project conditions. The benefit is expected to increase year by year and reach the full benefit in certain years after the completion of irrigation and drainage facilities. The build-up period to the full benefit is assumed to be 5 years.

As mentioned in the previous chapter, the area-wise development for the project is planned to be carried out as follows:

Accumulated Development Areas

Unit: ha

Construction year	Sarojini Nagar	Sataon	Sursa	Purwa
1	0	0	0	0
2	594	515	693	490
3	3,566	3,090	4,156	2,940
4	7,727	6,695	9,004	6,371
5	11,888	10,300	13,852	9,802
6	14,862	12,874	17,313	12,252

As a result, irrigation and drainage benefit is expected to be born from the 3rd construction year. The annual incremental benefit at the full development stage is estimated at Rs.488.5 million as shown in Table 9.2.

9.2.4 Economic Costs

The economic project cost is estimated based on the financial project cost, taking account of transfer payment and standard conversion factor for non-traded goods within the financial construction cost. The economic project cost is estimated at Rs.2,124.4 million, and broken down into the following for each of the Representative Areas:

Economic Cost for Initial Investment

Unit: Rs.10^6

Description	Sarojini Nagar	Sataon	Sursa	Purwa	Total
1. Direct Construction Cost	320.3	444.2	463.1	307.4	1,535.1
2. Procurement of Supporting Equipment	1.5	1.3	1.7	1.2	5.8
3. Land Acquisition	4.2	5.9	5.7	2.4	19.4
4. Administration Cost	38.6	33.4	44.9	31.8	148.7
5. Engineering Services	57.7	50.0	67.2	47.5	222.4
Sub-total	422.3	534.8	583.8	390.4	1,931.3
6. Contingency	42.2	53.5	58.4	39.0	193.1
Total	464.5	588.3	642.2	429.4	2,124.4

The total annual economic operation and maintenance cost at the full development stage is estimated at Rs.30.5 million in total, as shown below:

Annual Economic O&M Cost

Unit: Rs.1,000

Description	Sarojini Nagar	Sataon	Sursa	Purwa	Total
1. Main system					
a. Irrigation Facility					
- Canal	1,060	3,930	1,640	980	7,610
- Augmentation Facilities	670	760	3,930	1,150	6,510
b. Drainage Facilites	1,050	610	1,760	1,490	4,910
c. Service Roads	680	1,100	510	420	2,710
2. On-farm system	2,950	2,620	3,600	2,460	11,630
Total	6,410	9,020	11,440	6,500	33,370

Some equipment of the irrigation and drainage system are replaced at certain intervals of periods. Useful life and costs of those equipment are as shown below:

Useful Life and Replacement Costs

Description	Sarojini Nagar		Sataon		Sursa		Purwa	
	Useful life	Cost (Rs.10^3)	Useful life	Cost (Rs.10^3)	Useful life	Cost (Rs.10^3)	Useful life	Cost (Rs.10^3)
1. Irrigation system								
a. pumping equipment	20	10,348	20	13,230	10	28,936	10	7,984
b. Gate	10	16	10	200	10	16	10	24
2. Supporting equipment	10	1,744	10	1,512	10	2,032	10	1,440

9.2.5 Economic Evaluation

The economic internal rate of return for the project is calculated based on the economic cost and benefit and the project implementation schedule. The results are as shown on Table 9.3 and summarized below:

Sarojini Nagar	19.2%
Sataon	13.7%
Sursa	12.0%
Purwa	18.4%
Overall	15.5%

The results show that the project is economically feasible with an internal rate of return of 15.5% for the overall area, ranging from 19.2% for the Sarojini Nagar area to 12.0% for the Sursa area.

9.2.6 Sensitivity Analysis

A sensitivity analysis is carried out to evaluate the soundness of the project against possible adverse changes in the future for the followin cases; (i) reduction of project benefit by 10% due to unexpected decrease in forecast prices, (ii) project cost overrun by 10% and (iii) combination by cases (i) and (ii). The result is presented below:

Unit: %

Description	Sarojini Nagar	Sataon	Sursa	Purwa	Overall
1. Case (i)	17.7	12.5	10.8	16.9	14.1
2. Case (ii)	17.9	12.7	11.0	17.1	14.4
3. Case (iii)	16.4	11.5	9.9	15.7	13.1

The result of sensitivity analysis indicates that the economic viability of the project is rather insensitive to the possible adverse changes.

9.3 Financial Analysis

A financial analysis of the project is made by the analysis of the typical farm budgets and assessment for repayment of the project construction cost.

9.3.1 Farm Budget Analysis

In order to evaluate the project feasibility from farmer's household economy, typical farm budgets of marginal farmers are prepared for the future with and without conditions as shown below:

Unit: Rupees

Area	With Project			Without Project			Incremental Benefit
	Kharif	Rabi	Total	Kharif	Rabi	Total	
Sarojini Nagar (0.58ha)	3,195	3,099	6,294	2,082	2,065	4,147	2,147
Sataon (0.58ha)	3,118	3,001	6,119	910	1,868	2,778	3,341
Sursa (0.53ha)	2,839	2,679	5,518	1,627	2,028	3,655	1,863
Purwa (0.56ha)	3,119	2,818	5,937	2,090	1,785	3,875	2,062

As seen from the above table, the income of marginal farmers is expected to increase by 50% to 120%. Their economic situations are sure to be improved.

9.3.2 Capacity to Pay

After the implementation of the project, operation and maintenance cost of the irrigation and drainage systems as well as of on-farm facilities is shouldered to beneficial farmers. Those costs are estimated as shown below:

Annual Financial O&M Costs

Description	Sarojini Nagar		Sataon		Sursa		Purwa	
	Total ($Rs.10^3$)	Per ha (Rs.)	Total ($Rs.10^3$)	Per ha (Rs.)	Total ($Rs.10^3$)	Per ha (Rs.)	Total ($Rs.10^3$)	Per ha (Rs.)
1. Main System	4,000	276	7,600	590	8,700	502	4,600	375
2. On-farm facilities	3,600	242	3,200	249	4,400	254	3,000	245
Total	7,600	518	10,800	839	13,100	756	7,600	620

O&M costs for the main system will have to be paid as water charge while those for on-farm facilities are recovered as labor force.

On the other hand, incremental benefit of a farmer is estimated at Rs.3,500 to Rs.5,760 per ha. Water charges which farmers will have to shoulder are only 15% at maximum, which proves that farmers could pay water charge easily.

9.3.3 Repayment

Fund requirement for construction of the project is estimated at Rs.3,351 million. Based on the estimated fund requirement, a cash flow statement is prepared under an assumption of the following conditions:

(a) 80% of fund requirement is financed by the international organization with loan service fee of 2.5% per annum and a repayment period of 30 years including a grace period of 10 years.

(b) Remaining local currency is financed by the budget allocation of the Government with no interest and no repayment.

The cash flow statement is shown in Table 9.4.

The project brings about a great improvement in farm budget and gives an incentive to the farmers in the project area. The government should subsidize about Rs.1.6 million to Rs.230.5 million including loan repayment, loan service fee and a part of O&M cost annually for the project during the repayment of 30 years.

9.4 Socio-economic Impact

The following socio-economic impacts are expected through the implementation of the project.

(1) Improvement of nutritious status

Upon attainment of reliable irrigation water supply and introduction of new farming technology with new cropping patterns, productivity of crops remarkably increases, which leads to improvement of nutritious status of people. Even marginal farmer having six family members with 0.4 ha of cultivable land is able to attain self-sufficiency in cereals in calorie basis. Pulses and oilseed crops are also harvested more, which results in the improvement of nutritious status of family.

(2) Employment opportunity

During the construction stage, about 10.3 million man-days, equivalent to Rs.361.0 million of employment opportunity is generated. Laborers are recruited from adjucent villages. This employment opportunity are sure to stimulate economic activity in rural area.

(3) Women's development

As a part of training programme, women are educated to learn how to read and write. Once get educated, they have another incentive to learn more. They are expected to play a vital role in agriculture production through agricultural extension programme.

(4) Enhancement of regional industries

The project requires vast amount of bricks for canal lining, structural material and road pavements. The required amount of bricks are usually produced near the construction sites.

Brick factories produce more bricks as required, which generates other employment opportunities.

(5) Environment

Ground water table in Sarojini Nagar and Sataon Areas has been lowered in recent years. Augmentation of canal water is only a possible way to avoid further deterioration of ground water condition.

Inundation of water in Purwa Area has been a very serious concern from the view point not only of agricultural production but also of the environment of human life. Proposed drainage plan improves present agriculture productivity, and early drainage reduces current problem of higher rate of water-born diseases.

9.5 Project Justification

Internal rate of return (IRR) of the project in respective Representative Areas shows different value ranging from 12.0% for Sursa to 19.2% for Sarojini Nagar. The IRR of overall project shows 15.5%.

The project in the Sarojini Nagar area shows the highest IRR of 19.2% among four Representative Areas. Augmentation of irrigation water supply will increase irrigation area and reduce further deterioration of groudwater level. The project will also contribute to equitable distribution of water through on-farm development and thereby to equitable development which is one of the objectives of State Development Plan.

The project in the Sataon area shows IRR of 13.7%. The project include canal improvement of Asiwan branch canal, whose benefit will be expected to be born from other areas commanded by the branch when on-farm development works will be carried out. If this cost is allocated proportionally to beneficial command areas, the IRR would further be increased. The same effect as Sarojini Nagar area will be expected with regards to even distribution of canal water and preventing the deterioration of ground water level.

The project in the Sursa area shows the lowest IRR of 12.0%, reflecting relatively better yield level of crops under the present condition. Irrigation water supply by canal will be reduced from present over supply condition to the proposed volume determined by the Roster, which may reduce benefit to the area but contribute to the augmentation of irrigation water volume to downstream area. Drainage improvement will increase Kharif cropping area

drastically. Even distribution of water and improvement of nutritious status of farmers are expected from the project.

The project in the Purwa area shows the IRR of 18.4%, following Sarojini Nagar area. Drainage improvement will bring about the increase of cropped area as well as yield increase through the improvement of soil condition. Traffic condition will also be improved, and occurrence of water born diseases will be reduced through the reduction of inundation area and duration.

The IRR of the overall project shows 15.5%. The results of financial analysis reveals the improvement of farm income with repayability of water charge. Considering this IRR and positive socio-economic impacts as mentioned above, in light with the objectives of the State Five-Year Development Plan, all projects can be justified.

CHAPTER X COMPREHENSIVE DEVELOPMENT PLAN OF SHARDA CANAL CAD PROJECT

10.1 Necessity of the Renovation of the Sharda Canal System

(1) Irrigation condition of Sharda Canal system

Sharda canal system is the integrated system served from the Sharda river, Sharda Sagar reservoir, Nanak Sagar reservoir and Baigul reservoir. Total CCA of the Project is 1.612 million ha with the design crop intensity of 49% consisting of 24% in Kharif and 25% in Rabi. The Sharda Sagar reservoir is supplied from the main canal and augments Hardoi Branch canal, and Nanak Sagar reservoir water is utilized in Shahjahanpur Branch system of Sharda canal command through the river Deva and Deva Baigul feeder. Some share of Baigul reservoir water is taken through the Apsara river for Shahjahanpur Branch system.

The Sharda river, which is a main water source, has supplied the irrigation water on an average for the past five years from 1986 with 4,360 MCM and 2,990 MCM in Kharif and Rabi. It corresponds to an equivalent irrigation depth of 0.27 m and 0.19 m to the whole CCA. In the beginning of the Kharif season the river flows are not sufficient and in the other period the river flow occurs more than the canal capacity of 11,500 cusec with an average intake discharge of 9,500 cusec. During the rabi season the river flows reduce and the most of the river flows are diverted to the main canal with an average diversion discharge of 7,000 cusec. The delivery from Sharda Sagar, Nanak Sagar and Baigul reservoirs augments the canal water from the intake.

Hardoi Branch is the largest Branch in the Sharda Canal System with a CCA of 757,772 or 47% of 1.61 million ha of the Sharda Command, and having a head discharge of 5,400 cusec(153 cumec) or 47% of the main canal discharge of 11,500 cusec (325 cumec).

As mentioned in Section 3.1.4 and 7.1.2, the water deliveries of Hardoi Branch has been executed as scheduled in respect of seasonal delivery volume. Purwa and Unnao Branches, which are bifurcated at the end of Hardoi Branch, have received the annual deliveries of about 17% more than those for the scheduled irrigation area with the annual crop intensity of 49% to CCA.

Despite the agreed annual deliveries with the schedule, the annual irrigation area was far less than the scheduled irrigation area, averaged to about 292,000 ha or 39% of CCA for the past five years.

Hardoi Branch runs continuously for 24 weeks in Kharif and intermittently for 23 weeks in Rabi. The offtaking branches are scheduled to be supplied intermittently for 17 to 14 weeks in kharif and 14 to 8 weeks in Rabi. Most of offtaking branches, however, are served continuously from Hardoi Branch.

As mentioned above, the annual water deliveries of the Sharda Canal system and Hardoi Branch system is agreed with the roster deliveries. The weekly discharges in the upstream part of those canal systems generally coincide with the roster. On the contrary, those in the downstream part, much differ from the roster. Further the deliveries to distribution canal systems are apart from the roster to the large extent in volume and timing. This means that the reliable water supply in the command is not attainted. Irrigation service areas are much larger than the scheduled crop intensity in the upstream part and much lower in the downstream part. Those insufficient systematic control of the head regulators to distributary and minor canals and direct outlets causes low utilization of irrigation water.

The Project area, i.e., four Representative Areas, is located in Hardoi Command area. Systematic operation of Hardoi Branch will much contribute to reliable water supply to the Project area. In this context, it is desirable that the following improvement works of control structures of Hardoi Branch are executed as early as possible.

(1) Replacement of head regulator for distributaries and minors located in Hardoi Branch with installation of head gates
(2) Provision of parallel minors along Hardoi Branch to cancel direct outlets from Hardoi Branch
(3) Replacement of direct outlet on Hardoi Branch to parallel minors to be provided
(4) Canal structures related to parallel minors to be provided such as bridges drainage crossing

The required cost for execution of the above works are estimated to be approximately Rs.150 million.

To ensure reliable and equity delivery of water as well as to enable introducing systematic water management of Sharda Canal System, the present system deficiencies such

as outdated control structures, insufficient design discharges of distributary and minor canals, etc. have to be rehabilitated properly through modernization of the Sharda Canal System.

(2) On-farm Development and Water Users Association

The CAD works of the Sharda Canal Command Area Development Project will be completed by the March 1993 in so far as the on-farm works are concerned according to the present schedule. The on-farm works will be provided to the command area of about 552 thousand ha out of about 804 thousand ha irrigation potential. Lining of field irrigation canals is much effective for saving loss of the limited water sources. The present on-farm work can provide only 5 to 10% of the canal length. If the implementation schedule of the works in Representative Areas are compared with the more said target, the real achievement turns to be doubtful.

Besides, establishment of water users association and introduction of osrabandi, which are a vital element for attaining proper water management for raising water use efficiency and crop production, are not realized even in the completed areas of on-farm works.

On-farm systems have to be extended to cover the whole command area and be modernized by means of lining of field irrigation canal at least for 50% of the whole reaches, together with promotion of osrabandi system.

(3) Groundwater Development

The groundwater irrigation are extensively practiced in the related districts of the Sharda Canal Command. The potential development of groundwater in the command areas is estimated approximately to be 2,850 MCM, which corresponds to about 40% of the annual delivery to the main canal from the Sharda river. The groundwater development in the command have to be promoted to make water delivery more reliable through ensuring conjunctive use of canal water and groundwater.

(4) Improvement of Water Logging and Salt Affected Areas

The salt affected areas lying in the related districts of the Sharda Canal Command are counted for about 10% of the geographical areas in the most downstream districts such as Lucknow, Unnao, Rae Bareli and about 5% in the districts in the middle reaches of the canal system such as Hardoi. Remote sensing imaginary data interpretation conducted in this study

showed more severe salt condition in the selected Representative Areas. The groundwater development by shallow tubewells with regulated rostering will result in the alleviation of waterlogging and salt affected areas. On the basis of the result of the implementation of the Representative Areas, improvement of the water logging and salt affected areas will be successfully executed.

10.2 Implementation Plan

The diversity and complexity of the irrigation water supply problems prevailing in the Sharda Canal Command requires urgent solution of its problems through the implementation of the integrated command area development programme. To ensure the early and sustainable growth of the agricultural production through the synchronized development and management of the canal water and groundwater, it is first necessary to formulate the medium and long term comprehensive development plan on the water management of Sharda Canal system and resources development in its command area.

The implementation of the Representative Areas will provide the suggestions on the technical and managerial solutions as to the reliable water supply, and improvement of water logging and salt affected areas.

The comprehensive study covering the Sharda Canal command of 1.612 million ha has to be carried out to identify and formulate, (i) a modernization plan of Sharda canal system, consisting of the systematic water management plan and improvement measures of canal system deficiencies and (ii) a renovation plan of the CAD works. The study will be commenced as early as possible to enable executing the identified plan and measures.

On the basis of the result of the comprehensive study, the modernization works of the irrigation and drainage systems, and the renovation of on-farm works will be commenced with stage wise implementation. The renovation of CAD works of Hardoi Branch command and the modernization of Hardoi Branch system will follow immediately after completion of the development works of the Representative Areas.

The balanced CAD area and canal system such as Kheri branch command, Shahjahanpur branch command,etc. will be implemented in due time in consideration of managerial capacity of the CADA.

The overall implementation plan is as shown in Fig. 10.1.

CHAPER XI MODIFIED PLAN ON THE BASIS OF COMMENTS BY THE GOVERNMENT OF INDIA

11.1 General

The Draft Final Report was submitted to the Government of India in August 1991, describing the result of the study, and the report was discussed in the meeting of the Steering Committee held on September 5, 1991 in Delhi. According to the result of the meeting, the comments on the Draft Final Report was raised by the Government of India on October 31, 1991. This Chapter presents the summary of the reply to the comments and the modified plan according to the result of the further study based thereon. The details is presented in ANNEX L.

The reply to the comments raised by the Government of India is summarized below.

Comment 1: The cost to the project is exorbitant which diminishes its scope for replication. The unit cost per ha can be slashed down by resorting to:

(1) Substitution of metalled canal inspection road by brick soling and deletion of Chak roads
(2) Reconsideration of feasibility of construction 243.6 km of parallel canals owing to insurmountable difficulties in acquiring the land and the social resistance from the traditional users
(3) Restricting canal lining strictly to the zone of highly permeable soil or otherwise vulnerable patches
(4) Reconsideration on feasibility of pipe drainage scheme due to its practical problems of choking etc.

The reply to the comment 1 is as shown below.

(1-1) Metalled canal inspection road and chak roads:

As mentioned in the design drawing of the Draft Final Report, the proposed canal inspection roads was improved with provision of brick pavement (100 mm). The word "metalling" is changed into "brick soling" in the Final Report.

The proposed farm roads are constructed with improvement of the existing Chak roads. The cost required for improvement of the existing farm roads is not so large.The farm roads are indispensable for attaining the proposed production of crops.

(1-2) Parallel canal :

The removal of uncertainty in irrigation water supply is the key element in executing the CAD works. To ensure reliable supply of irrigation water over the command area up to the tailend, direct intake from branch and distributary canals through outlets, so-called Kulaba, is required to be restricted. To attain the even distribution of irrigation water in the distributary command, unification of the existing Kulaba commanding small areas and provision of additional parallel minors were proposed in the Draft Final Report on the basis of the development concept mentioned in the Progress Report (II).

According to the comment, the modified plan is prepared by cancelling the parallel canals as the cost reduction approach. The result is presented hereunder. However, such plan obliges that the certainty in irrigation water supply is largely decreased. Upon implementation of the modified plan, special efforts to solve the social problems should be taken, such as use of the existing field channel routes for the additional minors, actual participation of water users in the beginning of the design stage,etc.

(1-3) Restricting canal lining :

Canal reaches requiring lining was selected in distributary and minor canals for high permeable soils and topographically low depressed areas for the purpose of :

(a) reduction of seepage loss,
(b) reduction of water logging in the area adjacent to the canal where seepage for the canal occurs,
(c) improvement of operation efficiency,
(d) reduction of maintenance cost

With regard to the cost reduction approach as commented, the lining portions are restricted for the most critical reaches of distributaries. However, this plan results in the decrease in irrigation efficiency and increase in O&M cost of canals.

(1-4) Reconsideration on feasibility of pipe drainage scheme :

The following pipe drain schemes were proposed in the Project:

(a) Pipe catch drain scheme along Hardoi Branch in Sursa area
(b) Sub-surface drainage pilot farm scheme in Purwa area

Much seepage loss occurs from Hardoi Branch around Sursa area, resulting in water logging areas along Hardoi Branch and the loss of irrigation water. To improve water logging conditions, as well as to utilize seepage water from Hardoi Branch, a pipe catch drain system with suction pump is proposed. Pumped water is discharged to the adjacent minor canal for augmentation of irrigation water.

Purwa area is characterized by thin shallow aquifer underlain by thick clay layer of about 20 m below the ground surface. The efficiency of drawdown of ground water table by means of shallow tube well for improvement of water logging and salt affected conditions is inherently low. In consideration of the above, pipe drainage pilot farm of about 50 ha was proposed to work out the low cost sub-surface drainage measures by use of locally available materials, such as smashed bricks, chaff,as well as the drain pipe.

It is intended to set up pilot schemes for improvement of water logging and salt affected areas under the different drainage and geo-hydrological conditions. The pipe drain system is provided with manhole and pumping equipment to avoid technical problems of pipe flows. The proposed sub-surface drainage schemes are indispensable as one of the most important components for improvement of irrigation, drainage and salt problems in the project area.

Comment 2: The IRR projected in the reports in 15.8 % which is based on yield estimations as given in the report. However, these yield levels are not likely to be attained under the given situation because the water is not the only determinant of crop yield. Irrigation at proper stage of plants is more valuable than its level or frequency. Moreover, the effect of watering on crop yield is more pronounced when inputs like seeds, fertilizer and other agronomic practices are followed as per recommendations. Use of monetary inputs depends on the economic conditions of the farmers. As a consequence of aforesaid facts the yield estimations as projected in the report are not achievable. These estimations need to be made in consultation with the Directorate of Agriculture statistic, U.P. which is an authorized agency for crop yield estimation in the State.

The reply to the comment 2 is as shown below.

(2-1) Irrigation at the proper stage of plants :

In order to ensure irrigation at the proper stage of plants, the actualization of the Osrabandi mentioned in Chapter VII 7.3 of the Main Report is proposed.

(2-2) Effect of watering on crop yield:

The comment on the effect of watering on crop yield is fully agreed, but the public services are requested to make their utmost efforts to attain the target of the project as well as to promote the sustainable agricultural development by utilizing the available resources. The time requirement to attain this target is set up. The build-up period of five years to reach the target is taken into consideration for respective representative areas as described in Chapter IX 9.2.3.of the Main Report. With reference to the results of the several studies on the degree of factors contributing to growth of rice output, it can be said that the proposed target is not over-estimated in either irrigated condition or un-irrigated condition shown in Chapter VII 7.2.4.of the Main Report.

(2-4) Yield estimations in consultation with the Directorate of Agriculture Statistic, U.P. :

The study team has consulted with the aforesaid Directorate. However the in-situ examination in any place is the indispensable approach to decide the target level of yield.

As mentioned above, the study team maintains the opinion that the proposed target level is as reasonable, but calculate the benefit from the modified one based upon the comments where parallel canals are not planned. It results in the increase of uncertainty as to timely distribution of irrigation water. The decreased coefficient without parallel canal is assumed to be 20%, although this approach to avoid social difficulties as insurmountable should be overcome by utmost efforts during the detailed design period as mentioned above

Comment 3: A plan for energization of tube wells and lifts canals and Operation and management of shallow tube wells by the CADA agency on long term basis.

The power supply plan for the proposed tube wells and lift canals is described in the respective concerned sections of the Final Report. It is described in the Final Report that the CADA is responsible for operation and management of shallow tube wells to be constructed under the Project.

Comment 4: Some of link drains to cross the canals

The water logging areas are extending in the depressed areas surrounded with irrigation canals, roads and/or railway judging from the remote sensing imaginary data interpretation which were prepared for the Kharif and Rabi conditions. The drainage canal layout was selected so as to ensure the delivery of drain water by connecting water logging areas. It is unavoidable for some of drainage canals to intersect irrigation canals to effectively improve the water logging areas.

Comment 5: Provision of land levelling

Paddy is presently cultivated in mid-upland, midland, mid-low land and low land. The canal irrigated area is estimated to be about 25 % of CCA according to the water availability. Paddy area is set to be 65 % of the canal irrigation area in the proposed cropping patten. In the non-canal irrigation area,i.e.,75 % of CCA, which will be irrigated by the private tubewells or under rainfed condition, paddy area is planned for 50 % of the non-canal irrigation area. Major part of the mid-upland, mid-land, mid-lowland and lowland is flat. Paddy cultivation is not planned in steep slopes areas.

Comment 6: The foreign currency requirement

With reference to the statistical data on the production and import of steel goods and petroleum goods (Economic survey 1989-90, Ministry of Finance), the proportions of local currency and foreign currency are determined. Manufactured goods such as pumping equipment, prefabricated concrete units is counted for local currency portion. The proposed wireless communication system consists of not only wireless radio but also data processing facilities, then all cost requirement is counted for foreign currency. On the basis of the following classification, the construction cost is modified in the Final Report.

The modification of classification of the foreign and local currency requirements calls for the change in the economic cost estimate. The economic evaluation is re-calculated accordingly in the Final Report.

Comment 7: The organizational structure of Project Implementation

Based on the result of the discussions and the organization chart supplied by the Sharda CADA in the meeting on 4th September,1991,the organizational structure of the Project is modified in the Final Report.

Comment 8: OFD works in Sharda CADA is likely to be completed by 1995-96

The extended schedule of the present OFD of Sharda CAD program does not affect the implementation schedule of the proposed works, since the construction works are proposed to be executed on the contract basis. The description of schedule of the present OFD of Sharda CAD works is modified in the Final Report according to the revised schedule.

11.2 Modified Project Plan

11.2.1 Irrigation and Drainage Plan

The following modernization plan of the existing irrigation canals and related structures will be proposed:

(1) Improvement of existing irrigation system
  (a) Canal lining of distributaries where distributaries run in high permeable soils and across low-depressed areas
  (b) Unification of outlets on distributary canals commanding at least approximately 40 ha
  (c) Improvement of existing control structures
    -provision of steel gates to head regulators
    -provision of measuring devices downstream of head regulators
    -replacement of existing off-taking structures for minor canals with the proportional diversion structures according to the required capacities
    -replacement of existing outlets on minor canals with the proportional diversion outlet structures according to the required capacities
  (d) Improvement of distributary canal inspection roads by means of brick soling
(2) Sai river pump lift scheme as supplemental water source development
(3) Groundwater development
(4) Establishment of wireless communication system

The proposed drainage plan will consist of the following:

(1) Main and secondary drainage canal network
  -improvement/construction of main drainage canals
  -improvement/construction of secondary drainage canals to connect tertiary drains with the main drains
  -capacity increase of related natural drainage streams

-improvement/construction of outdated drainage structures

(2) Sub-surface drainage system

-establishment of sub-surface pipe drainage pilot scheme

-pipe drainage system along Hardoi Branch

-groundwater development for conjunctive use

The on-farm development works include the following:

(1) Field irrigation channel :

The field irrigation channel is lined by bricks so as to minimize the conveyance losses to the economical extent of 50 to 60 % of the whole reaches of the field channels

(2) Field drainage canal :

The field drainage canal to collect drain water from the sub-chak are provided with the capacity that 5-year, 3 days rainfall storm is drained within 3 days.

(3) Chak road :

The existing village roads in the chaks are improved with earthfilling having the width of 4 meters, to ensure the efficient transportation within the chak

(4) Related structures :

The related structures to the field irrigation and drainage canals consist of turnouts, culverts aqueduct , drainage culverts . Those structures are of brick construction.

11.2.2 Agricultural Development Plan

The agricultural development plan of the revised plan is same as mentioned in the Chapter VII of the Main Report. The unit yields of crops under future with and without project conditions of the revised plan are estimated as shown below.

Those yields are estimated based on the expected irrigation conditions of the modified plan and present farming technology level. For achieving the target yields, optimum application of farm input is essential along with proper water management. Agriculture extension services is another need to attain the target yields. The target yields of crops will be realized in 5 years after the completion of irrigation and drainage facilities.

Unit: ton/ha

Crops	Present Condition	Future Condition	
		Irrigated Condition	Un-irrigated Condition
Kharif			
Paddy	2.08-2.57	3.2	2.4
Sorghum	1.1-1.5	-	1.6
Maize	0.7-1.3	-	1.6
Pulses	0.7-1.2	1.6	1.0
Oilseeds	0.5-0.9	1.0	0.6
Rabi			
Wheat	1.73-2.35	3.2	2.3
Pulses	0.4-0.9	1.8	1.1
Oilseeds	0.6-0.7	0.9	0.7
Potatoes	9.0-17.0	16.2	15.3

Irrigation and drainage development is expected to increase net cultivated area. The incremental production of crops in the project area is estimated as follows:

Crops	Without Project Condition		With Project Condition		
	Cultivated Area (ha)	Production (ton)	Cultivated Area (ha)	Production (ton)	Incremental Production (ton)
Kharif					
Paddy	18,700	42,000	30,710	79,600	37,600
Sorghum	5,500	7,300	5,120	8,200	900
Maize	2,900	3,700	2,540	4,100	400
Pulses	3,600	2,200	11,700	13,400	11,200
Oilseeds	600	400	6,800	5,250	4,850
Rabi					
Wheat	30,000	64,500	37,200	93,900	29,430
Pulses	3,150	2,200	8,600	11,000	8,800
Oilseeds	350	230	5,000	3,750	3,520
Potatoes	800	11,600	3,000	46,600	35,000

11.3. Implementation Plan and Modified Cost Estimate

11.3.1 Implementation Plan

The principal approach to the project implementation, implementation schedule and organization of the project implementation proposed in Chapter VIII of the Main Report are applied to the modified plan without any change.

11.3.2 Construction Cost

The construction cost of the modified plan is estimated on the basis of the revised plan. It is estimated to be Rs.2,914 million, consisting of the foreign currency portion of Rs.549 million and the local currency portion of Rs.2,365 million as summarized below.

Project Cost

Unit: Rs. million

	Description	Foreign Currency	Local Currency	Total
A.	Wireless Communication System	58.9	6.5	65.4
B.	Representative Areas			
	B-1 Sarojini Nagar Area			
	1. Main system	27.9	108.2	136.1
	2. On-farm development works	33.3	149.0	182.3
	3. Land acquisition	0.0	4.6	4.6
	Sub-total (B-1)	61.2	261.8	323.0
	B-2 Sataon Area			
	1. Main system	23.5	201.6	225.1
	2. On-farm development works	28.9	131.1	160.0
	3. Land acquisition	0.0	4.6	4.6
	Sub-total (B-2)	52.4	337.3	389.7
	B-3 Sursa Area			
	1. Main system	48.2	193.2	241.4
	2. On-farm development works	38.9	180.5	219.4
	3. Land acquisition	0.0	8.0	8.0
	Sub-total (B-3)	87.1	381.7	468.8
	B-4 Purwa Area			
	1. Main system	38.2	124.3	162.5
	2. On-farm development works	27.5	124.8	152.3
	3. Land acquisition	0.0	2.8	2.8
	Sub-total (B-4)	65.7	251.9	317.6
	Sub-Total (B)	266.4	1,232.7	1,499.1
C.	Procurement of Supporting Equipment	0.0	8.4	8.4
D.	Administration Cost	0.0	148.7	148.7
E.	Engineering Service	103.8	118.6	222.4
F.	Contingencies			
	1. Physical	42.9	151.5	194.4
	2. Price	77.0	698.7	970.1
	Total	549.0	2,365.1	2,914.1

The breakdown of project cost is described in ANNEX-L.

The annual disbursement schedule is estimated according to the implementation schedule as summarized below. The breakdown of disbursement schedule is described in ANNEX-L.

Annual Disbursement Schedule

Unit: Million Rs.

Year	Foreign Currency	Local Currency	Total
1993	13.8	66.2	80.0
1994	36.7	156.8	193.4
1995	96.4	439.6	536.0
1996	200.5	649.5	850.0
1997	118.1	622.2	740.3
1998	83.6	435.2	518.8

11.4 Project Evaluation

11.4.1 Economic Evaluation

(1) Economic Benefit

Economic benefit is estimated based on the revised unit yield of crops under with-project condition. The economic benefit of the modified plan is presented below .

Annual Incremental Benefit

Unit: Rs.million

Condition	Sarojini Nagar	Sataon	Sursa	Purwa	Total
With Project					
Kharif	75.7	63.9	83.8	68.6	292.0
Rabi	110.7	93.7	130.8	92.3	427.5
Perennial	-	-	2.9	-	2.9
Total (A)	186.4	157.6	217.5	160.9	722.4
Without Project					
Kharif	39.4	25.5	45.5	35.0	145.4
Rabi	54.9	56.1	94.9	36.3	242.2
Perennial	-	-	5.2	-	5.2
Total (B)	94.3	81.7	145.6	71.3	392.8
Incremental (A) - (B)	92.1	75.9	71.9	89.6	329.5

(2) Economic Cost

The economic cost of the Project is estimated on the basis of the revised cost, for the initial investment cost, and annual operation and maintenance cost. The economic cost of the modified plan is as summarized below.

Economic Cost for Initial Investment

Unit: Rs.10^6

Description	Sarojini Nagar	Sataon	Sursa	Purwa	Total
1. Direct Construction Cost	284.4	336.1	408.2	280.5	1,309.1
2. Procurement of Supporting Equipment	1.5	1.3	1.7	1.2	5.8
3. Land Acquisition	3.6	3.6	6.4	2.2	15.9
4. Administration Cost	38.6	33.4	44.9	31.8	148.7
5. Engineering Services	57.7	50.0	67.2	47.5	222.4
Sub-total	385.8	424.4	528.4	363.3	1,701.9
6. Contingency	38.6	42.4	52.8	36.3	170.2
Total	424.3	466.8	581.2	399.7	1,872.1

Annual Economic O&M Cost

Unit:Rs.1,000

Description	Sarojini Nagar	Sataon	Sursa	Purwa	Total
1. Main system					
a. Irrigation Facility					
- Canal	410	1,800	490	490	3,190
- Augmentation Facilities	670	760	3,930	1,150	6,510
b. Drainage Facilities	1,050	610	1,760	1,490	4,910
c. Service Roads	680	1,100	510	420	2,710
2. On-farm system	2,950	2,620	3,600	2,460	11,630
Total	5,760	6,890	10,290	6,010	28,950

Replacement cost for equipment of irrigation and drainage system will not be changed from original plan.

(3) Economic Evaluation

The economic internal rate of return of the modified plan is calculated on the basis of the economic benefit and cost and the Project implementation schedule. The result is as shown below.

Sarojini Nagar	14.8%
Sataon	11.5%
Sursa	8.2%
Purwa	15.2%
Overall	12.2%

The result shows that the Project is economically feasible with an internal rate of return of 12.2% for the overall area, ranging from 15.2% for Purwa area to 8.2% for Sursa area.

A sensitivity analysis is carried out for the cases of: (i) reduction of project benefit by 10 % , (ii) project cost overrun by 10 % and (iii) combination of case (i) and (ii). The result is shown below.

Unit: %

Description	Sarojini Nagar	Sataon	Sursa	Purwa	Overall
1. Case (i)	13.5	10.4	7.2	13.8	11.0
2. Case (ii)	13.7	10.6	7.5	14.0	11.2
3. Case (iii)	12.5	9.5	6.5	12.8	10.9

The result of sensitivity analysis indicates that the economic viability of the modified plan is rather insensitive to the project adverse changes.

11.4.2 Financial Analysis

A financial analysis of the Project is made by the analysis of the typical farm budget and assessment of repayment of the project construction cost.

(1) Farm Budget Analysis

In order to evaluate the project feasibility from farmer's household economy, typical farm budgets of marginal farmers are prepared for the future with and without conditions as shown below:

Unit: Rupees

Area	With Project			Without Project			Incremental Benefit
	Kharif	Rabi	Total	Kharif	Rabi	Total	
Sarojini Nagar (0.58ha)	2,444	2,723	5,167	2,082	2,065	4,147	1,020
Sataon (0.58ha)	2,365	2,625	4,990	910	1,868	2,778	2,212
Sursa (0.53ha)	2,179	2,512	4,691	1,627	2,028	3,655	1,036
Purwa (0.56ha)	2,552	2,323	4,875	2,090	1,785	3,875	1,000

As seen from the above table, the income of marginal farmers is expected to increase by 25% to 80%. Their economic situations will rather be improved.

(2) Capacity to Pay

After the implementation of the project, operation and maintenance cost of the irrigation and drainage systems as well as of on-farm facilities is shouldered to beneficial farmers. Those costs are estimated as shown below:

Annual Financial O&M Costs

Description	Sarojini Nagar		Sataon		Sursa		Purwa	
	Total ($Rs.10^3$)	Per ha (Rs.)	Total ($Rs.10^3$)	Per ha (Rs.)	Total ($Rs.10^3$)	Per ha (Rs.)	Total ($Rs.10^3$)	Per ha (Rs.)
1. Main System	3,200	215	5,000	388	7,300	422	4,000	326
2. On-farm facilities	3,600	242	3,200	249	4,400	254	3,000	245
Total	6,800	457	8,200	637	11,700	676	7,000	571

O&M costs for the main system will have to be paid as water charge while those for on-farm facilities are recovered as labor force.

(3) Repayment

Fund requirement for construction of the project is estimated at Rs.2,914 million. Based on the estimated fund requirement, a cash flow statement is prepared under an assumption of the following conditions:

(a) 80% of fund requirement is financed by the international organization with loan service fee of 2.5% per annum and a repayment period of 30 years including a grace period of 10 years.

(b) Remaining local currency is financed by the budget allocation of the Government with no interest and no repayment.

The cash flow statement is shown in ANNEX-L.

The project brings about a great improvement in farm budget and gives an incentive to the farmers in the project area. The government should subsidize about Rs.1.6 million to Rs.204.7 million including loan repayment, loan service fee and a part of O&M cost annually for the project during the repayment of 30 years.

11.4.3 Socio-economic Impact

The following socio-economic impacts are expected through the implementation of the project.

(1) Improvement of nutritious status
(2) Increased employment opportunity
(3) Women's development
(4) Enhancement of regional industries
(5) Environmental conservation

11.4.4 Project Justification

Internal rate of return (IRR) of the project in respective Representative Areas shows different value ranging from 8.2% for Sursa to 15.2% for Purwa. The IRR of overall project shows 12.2%.

The project in the Sarojini Nagar area shows the IRR of 14.8%, following Purwa. Augmentation of irrigation water supply will increase irrigation area and reduce further deterioration of groudwater level. The project will also contribute to equitable distribution of water through on-farm development and thereby to equitable development which is one of the objectives of State Development Plan.

The project in the Sataon area shows IRR of 11.5%. The project include canal improvement of Asiwan branch canal, whose benefit will be expected to be born from other areas commanded by the branch when on-farm development works will be carried out. If this cost is allocated proportionally to beneficial command areas, the IRR would further be increased. The same effect as Sarojini Nagar area will be expected with regards to even distribution of canal water and preventing the deterioration of ground water level.

The project in the Sursa area shows the lowest IRR of 8.2%, reflecting relatively better yield level of crops under the present condition. Irrigation water supply by canal will be reduced from present over supply condition to the proposed volume determined by the Roster, which may reduce benefit to the area but contribute to the augmentation of irrigation water volume to downstream area. Drainage improvement will increase Kharif cropping area drastically. Even distribution of water and improvement of nutritious status of farmers are expected from the project.

The project in the Purwa area shows the highest IRR of 15.2%, among the Representative areas. Drainage improvement will bring about the increase of cropped area as well as yield increase through the improvement of soil condition. Traffic condition will also be improved, and occurrence of water born diseases will be reduced through the reduction of inundation area and duration.

The IRR of the overall project shows 12.2%. The results of financial analysis reveals the improvement of farm income with repayability of water charge. Considering this IRR and positive socio-economic impacts as mentioned above, in light with the objectives of the State Five-Year Development Plan, all projects can be justified.

CHAPTER XII RECOMMENDATION

12.1 Early Project Implementation

The modified plan was prepared according to the comments by the Government of India as the cost reduction approach. It will reduce the degree of reliable water supply and efficient use of the limited water sources, resulting in the decrease in agricultural production. The economic evaluation of the modified plan shows that the plan is economically feasible and a financial evaluation shows that financial situations of farmers are surely improved. The socio-economic impacts are largely expected through implementation of the plan.

The modified plan obliges that the certainty in irrigation water supply which is the key element of CAD works is decreased to the large extent, although the plan is one of the approaches to solve difficulties in land acquisition and the social resistance from the traditional users. Special efforts to remove the uncertainty in water supply, however, should be taken in the modified plan, such as provision of additional minors on the existing field channel routes, promotion of the actual participation of water users from the beginning of the design stage of the project.

The development plan as originally formulated is technically feasible and economically viable. The plan ensures more reliable irrigation water supply than the modified plan and it contributes to reducing the tailend problems and enhancing the synchronized development of groundwater and surface water in the command. It is recommended that the Government of India/Uttar Pradesh State Government shall make the necessary arrangements for early implementation of the Project so as to effectively demonstrate an impact of implementation of the integrated CAD programme as well as the effect of systematic water management.

12.2 Organization of Project Implementation

The development plan herein conceived includes various components ranging widely in civil works, agricultural research works, and extension works as the integrated command area development programme. It is suggested that the Sharda Canal CADA shall be strengthened with mobilization of the required staff from the concerned departments of UP State. The technical staff engaging in modernization of the irrigation and drainage systems being operated and maintained by the Irrigation Department, and on-farm development works are mobilized from the Irrigation Department. To effectively operate the Project works, the

CADA will also require administrative and technical assistance in executing research works from the CAD participating departments.

12.3 Early Establishment of Farmers Associations and Continuous Guidance for Introducing Osrabandi

It is of vital importance to secure active participation of farmers in the project works to attain the effective utilization of irrigation water. To enable participation of farmers from the initial stage of the Project work, farmers association in the outlet command shall first be organized with sufficient guidance of the CADA in parallel with the survey works. To effectively introduce the osrabandi system under the limited water supply conditions, continuous guidance and training shall be rendered to the farmers on the basis of the captured technologies of the water and crop managements from the research works.

12.4 Environmental Conservation

The tailenders have been suffered from the scarce irrigation water and they have been tried to use groundwater for irrigation by the private tubewells. As a result the groundwater tables in such tailend areas are remarkably lowered and tend to increase in lowering to a large extent in the recent year. This condition is attributed to the lack of interacted management of groundwater development among the government agencies. Thus with the Project, supplemental irrigation water is delivered for such areas to augment the groundwater recharge as well as to the delivery of assured irrigation water. To maintain the groundwater regime in the command area, the synchronized development of groundwater shall be promoted in well coordination among the departments and agencies concerned.

12.5 Water Charge

The collection rate of water charges of the Sharda Canal System is low, which is attributed mainly to low reliability of water supply. The farmers react by constructing private tubewells in their fields, and practice irrigation with conjunctive use of the canal water and groundwater from their own tubewells. Further, with the Project, tube wells will be constructed to supplement canal water for conjunctive use. It is, therefore, proposed that the water charges in case of conjunctive use should be rationalized to raise the collection rates of water charges.

12.6 Comprehensive Development Planning

The diversity and complexity of the irrigation problems in the command area is prevailing. To improve the present conditions, the renovation of the CAD works is necessary for water saving and introduction of osradandi, and modernization of the existing irrigation and drainage systems is required for enabling to introduce systematic water management of the Sharda Canal system. It is herein proposed that the comprehensive development planning should be urgently carried out to formulate the medium and long term comprehensive plan on the water management of the Sharda Canal System, on the resources development, on the renovation of the CAD works.

TABLES

Table 2.1 Gross Domestic Product at Factor Cost by Industry of Origin

(At 1980-81 prices) (Rs. 10^9)

Years	Agriculture, forestry and logging, fishing mining, and quarring		Manufacturing, construction, electricity, gas and water supply		Transport, communication and trade		Backing and insurance, real estate and ownership of dwellings and business services		Public administration and defence and other sevices		Gross domestic product at factor cost (2 to 6)	
1	2	(%)	3	(%)	4	(%)	5	(%)	6	(%)	7	(%)
1964-65	360.68	48.2	160.13	21.4	102.44	13.7	59.21	7.9	66.12	8.8	748.58	100.0
1974-75	409.19	42.5	223.61	23.2	148.43	15.4	80.93	8.4	100.81	10.5	962.97	100.0
1975-76	461.83	44.0	235.07	22.4	161.90	15.4	86.51	8.2	104.07	9.9	1049.68	100.0
1976-77	436.56	41.1	256.58	24.1	169.02	15.9	93.37	8.8	107.27	10.1	1062.80	100.0
1977-78	479.29	42.0	274.37	24.0	180.44	15.8	97.94	8.6	110.13	9.6	1142.19	100.0
1978-79	490.39	40.7	299.59	24.9	195.29	16.2	104.86	8.7	114.91	9.5	1205.04	100.0
1979-80	430.05	37.6	289.63	25.4	193.49	16.9	105.88	9.3	123.31	10.8	1142.36	100.0
1980-81	483.66	39.5	297.47	24.3	204.37	16.7	108.41	8.9	128.35	10.5	1222.26	100.0
1981-82	512.80	39.6	320.00	24.7	216.84	16.7	113.54	8.8	132.82	10.2	1296.00	100.0
1982-83	507.45	38.0	333.69	25.0	228.26	17.1	122.15	9.2	143.14	10.7	1334.69	100.0
1983-84 !	559.76	38.8	365.41	25.3	241.09	16.7	128.59	8.9	148.25	10.3	1443.10	100.0
1984-85 !	560.30	37.4	388.44	25.9	254.75	17.0	137.14	9.1	159.03	10.6	1499.66	100.0
1985-86 !	563.21	35.8	416.19	26.5	275.99	17.5	147.08	9.3	171.01	10.9	1573.48	100.0
1986-87 !	557.60	34.0	446.25	27.2	292.98	17.9	157.91	9.6	184.50	11.3	1639.24	100.0
1987-88 !	561.64	32.9	471.21	27.6	307.99	18.0	167.06	9.8	199.26	11.7	1707.16	100.0
1988-89 @	656.39	34.8	507.34	26.9	331.40	17.6	179.25	9.5	210.43	11.2	1884.81	100.0

Note : ! : Provisional

@: Quick Estimate

SOURCE : ECONOMIC SURVEY, 1989-92, GOI, MINISTRY OF FINANCE

Table 2.2 Gross Domestic Product and Wholesale Price

Years	Gross Domestic Product *1 at Factor Cost		Index Number of *2 Whole Sale Prices	
	10^9 Rs.	Annual Growth Rate (%)	All Commo-dities	Annual Increase Rate (%)
1974-75	963.0	1.2	174.9	25.2
1975-76	1049.7	9.0	173.0	-1.1
1976-77	1062.8	1.2	176.6	2.1
1977-78	1142.2	7.5	185.8	5.2
1978-79	1205.0	5.5	185.8	0.0
1979-80	1142.4	-5.2	217.6	17.1
1980-81	1222.3	7.0	256.2	17.7
1981-82	1296.0	6.0	281.3	9.8
1982-83	1334.7	3.0	288.7	2.6
1983-84	1443.1	8.1	316.0	9.5
1984-85	1499.7	3.9	338.4	7.1
1985-86	1573.5	4.9	357.8	5.7
1986-87	1639.2	4.2	376.8	5.3
1987-88	1707.2	4.1	405.4	7.6
1988-89	1884.8	10.4	435.3	7.4
Average (74-75 to 88-89)		4.7		8.1
(85-86 to 88-89)		5.9		6.5

SOURCE : ECONOMIC SURVEY 1989-90, GOVERNMENT OF INDIA

NOTE : *1 ; AT 1980-81 PRICES
: *2 ; BASE 1970-71 = 100

Table 2.3 External Debts

Unit : US Million

SL. NO.	DESCRIPTION	1984	1985	1986	1987	1988	1989	1990	1991
(A)	MACROECONOMIC AGGREGATES								
1.	GROSS NATIONAL PRODUCT (GNP)	192,538	212,969	227,411	251,669	265,594	260,236	261,957	267,622
2.	EXPORTS OF GOODS & SERVICE (XGS)	16,160	15,420	16,467	19,390	21,610	21,215	24,192	27,451
(B)	SUMMARY DEBT. DATA								
1.	LONG TERM DEBT.(L DOD)	26,545	32,924	40,286	47,783	51,168	58,327	65,500	72,870
2.	INTEREST ARREARSON (L DOD)	0	0	0	0	0	0	0	0
3.	TOTAL EXTERNAL DEBT.(INCL IMF) (EDT)	33,857	40,886	48,351	55,325	57,513	64,050	-	-
4.	PRINCIPAL REPAYMENT ON (L DOD)	1,091	1,309	1,933	2,043	2,117	2,131	2,436	2,610
5.	INTEREST PAYMENT ON (L DOD)	1,025	1,311	1,725	2,090	2,554	3,098	3,649	4,211
6.	INTEREST PAYMENT ON SHORT TERM DEPT.	316	226	225	250	287	378	390	406
7.	TOTAL INTEREST PAYMENTS (INT)	1,340	1,537	1,950	2,340	2,841	3,476	4,039	4,617
8.	TOTAL DEPT. SERVICE (TDS)	2,431	2,846	3,883	4,384	4,958	5,607	6,475	7,227
(C)	IMPORTANT RATIOS								
1.	EDT / XGS	210	265	293	285	266	302	289	282
2.	EDT / GNP	17.6	19.2	21.3	22.0	21.7	24.6	27.0	29.0
3.	TDS / XGS	15.0	18.5	23.6	22.6	22.9	26.4	26.8	26.3
4.	INT / XGS	8.2	10.0	11.8	12.1	13.1	16.4	16.7	16.8
5.	INT / GNP	0.7	0.7	0.9	0.9	1.1	1.3	1.5	1.7

SOURCE : WORLD BANK : WORLD DEPT. TABLES 1989-90--EXTERNAL DEPT. OF DEVELOPING COUNTRIES (IST SUPPLEMENT) ; 1990.

NOTE : * ; PROJECTED FIGURES

Table 2.4 Agricultural Production of India

(Unit: million tons/bales)

Crop	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
Rice	53.77	42.33	53.63	53.25	47.12	60.10	58.34	63.83	60.56	56.86	70.67
	(2.1)	-(21.3)	(26.7)	-(0.7)	-(11.5)	(27.6)	-(2.9)	(9.4)	-(8.1)	-(6.1)	(24.3)
Wheat	39.91	31.83	36.31	37.45	42.79	45.48	44.07	47.05	44.32	46.17	53.99
	(11.8)	-(10.4)	(14.1)	(3.1)	(14.3)	(6.3)	-(3.1)	(6.8)	-(5.8)	(4.2)	(16.9)
Pulses	12.18	8.57	10.63	11.51	11.86	12.89	11.96	13.36	11.71	10.96	13.70
	(1.8)	-(29.6)	(24.0)	(8.3)	(3.0)	(8.7)	-(7.2)	(11.7)	-(12.4)	-(6.4)	(25.0)
Coarsegrains	30.44	26.97	29.20	31.09	27.75	33.90	31.17	26.20	26.83	26.36	31.89
	(1.4)	-(11.4)	(8.6)	(7.1)	(10.7)	(22.2)	-(8.0)	-(15.9)	(2.4)	-(1.8)	(21.0)
Kharif Foodgrains	78.08	63.25	77.65	79.38	69.90	89.23	84.52	85.25	80.20	74.56	96.42
	(0.5)	-(19.0)	(22.8)	(2.2)	-(11.9)	(27.6)	-(5.3)	(0.9)	-(5.9)	-(7.0)	(29.3)
Rabi Foodgrains	53.82	46.45	51.94	53.92	59.62	63.14	61.02	65.19	63.22	65.79	73.83
	(10.9)	-(13.7)	(11.8)	(3.8)	(10.6)	(5.9)	-(3.4)	(6.8)	-(3.0)	(4.1)	(12.2)
All Foodgrains	131.90	109.70	129.59	133.30	129.52	152.37	145.54	150.44	143.42	140.35	170.25
	(4.3)	-(16.8)	(18.1)	(2.9)	-(2.8)	(17.6)	-(4.5)	(3.4)	-(4.7)	-(1.2)	(21.3)
Groundnut	6.21	5.77	5.01	7.22	5.28	7.09	6.43	5.12	5.88	5.85	9.54
	(1.9)	-(7.1)	(13.3)	(44.4)	-(20.9)	(34.3)	-(9.3)	-(20.4)	(14.6)	-(0.5)	(63.1)
Repeseed & Mustard	1.86	1.43	2.30	2.38	2.21	2.61	3.07	2.68	2.60	3.45	4.41
	(12.7)	-(23.1)	(60.8)	(3.5)	-(7.1)	(18.1)	(17.6)	-(12.7)	-(2.8)	(32.7)	(27.8)
Oilseeds@	10.10	8.74	9.37	12.08	10.00	12.69	12.95	10.83	11.27	12.65	17.89
	(4.5)	-(13.5)	(7.2)	(28.9)	-(17.2)	(26.9)	(2.1)	-(16.5)	(4.1)	(12.2)	(41.4)
Sugarcane	151.66	128.83	154.25	186.36	189.51	174.08	170.32	170.65	186.09	196.74	204.63
	(14.3)	-(15.1)	(19.7)	(20.8)	(1.7)	-(8.1)	-(2.2)	(0.2)	(9.0)	(5.7)	(4.0)
Cotton (lint)*	7.96	7.65	7.01	7.88	7.53	6.39	8.51	8.73	6.91	6.83	8.69
	(9.9)	-(3.9)	-(8.4)	(12.4)	-(4.4)	-(15.1)	(33.2)	(2.6)	(20.9)	-(7.7)	(36.2)
Jute & Mesta*	8.33	7.96	8.16	8.38	7.17	7.72	7.79	12.65	8.62	6.78	7.70
	(16.5)	-(4.4)	(2.5)	(2.6)	-(14.3)	(7.7)	(0.9)	(62.4)	(31.9)	-(21.3)	(13.6)

*170 kg each for cotton and 180 kg each for jute and mesta.

@ Nine major oilseeds including groundnut, easterseed, sesamum, rapeseed and mustard, linseed, safflower, nigerseed, sunflower and soyabean.
Figures in brackets are per cent increase or decrease over the year.

Source: Economic Survey of India 1989-90, GOI, 1990

Table 2.5 Share of Agricultural Exports and Imports in the Total Value of Exports and Imports

(Unit: Rs. crores)

Year (April-March)	Exports			Imports		
	Exports of Selected Agri. Commodities	Total Exports from India	% Share of Agri. Exports to Total Exports	Imports of Selected Agri. Commodities	Total Imports into India	% Share of Agri. Imports to Total Imports
1965 - 66	334.9	805.6	41.6	535.7	1,394.1	38.4
1970 - 71	565.3	1,535.2	36.8	604.3	1,634.2	37.0
1971 - 72	585.0	1,608.8	36.4	576.0	1,824.5	31.6
1972 - 73	751.5	1,970.8	38.1	484.3	1,867.4	25.9
1973 - 74	1,006.8	2,523.4	39.9	917.5	2,955.4	31.1
1974 - 75	1,401.5	3,328.8	42.1	1,563.5	4,518.8	34.6
1975 - 76	1,685.5	4,042.3	41.9	2,142.0	5,265.2	40.7
1976 - 77	1,800.6	5,142.3	35.0	1,605.1	5,073.8	31.6
1977 - 78	2,000.3	5,407.9	37.0	1,215.5	6,020.2	20.2
1978 - 79	1,902.6	5,724.6	33.2	1,286.2	6,810.6	18.9
1979 - 80	2,238.3	6,418.4	34.9	1,642.1	9,142.6	18.0
1980 - 81	2,375.7	6,683.2	35.5	2,299.5	12,549.1	18.3
1981 - 82	2,623.2	7,805.9	33.6	2,679.5	13,607.6	20.9
1982 - 83	2,642.8	8,803.4	30.0	1,952.5	14,292.7	13.7
1983 - 84	2,819.4	9,770.7	28.9	2,851.4	15,831.5	18.0
1984 - 85	3,248.0	11,743.7	27.7	3,717.4	17,134.2	21.7
1985 - 86	3,271.5	10,874.6	30.0	3,884.8	19,665.4	19.8

Note: 1) Value figures are not comparable due to devaluation of Indian rupee effected in June, 1966.
2) Exports include re-exports.

Source: Monthly Statistics of Foreign Trade of India.
Volumes I & II, published by Department of Commercial Intelligence and Statistics, Calcutta.
Indian Agriculture in Brief, (22nd Edition), GOI, 1990

Table 2.6 Comparative Growth Rate and Per Capita Income

(at 1970 - 71 prices)

Plan Period	Average Annual Growth Rate (Percent)		Per Capita Income Group (Rs.)		
	U.P.	India	U.P.	India	GAP
First Plan (1951-56)	1.9	3.6	447	508	61
Second Plan (1956-61)	1.9	4.0	453	559	106
Third Plan (1961-66)	1.6	2.2	450	559	109
Thee Annual Plans (1966-69)	0.3	4.0	429	589	160
Fourth Plan (1969-74)	2.3	3.3	436	621	185
Fifth Plan (1974-79)	5.7	5.3	514	717	203
Sixth Plan (1980-85) (1979-80 Base)	8.7	5.3	585	775	190
Seventh Plan (1985-90) Target	6.0	5.0			
1985-86*	3.8	4.7	1,438	1,836	398
1986-87*	5.3	5.1	1,483	1,892	409
1987-88*	2.3	3.4	1,486	1,918	432

* AT 1980-81 prices

Source : State Planning Institute, Government of Uttar Pradesh, 1990

Table 2.7 Crop Productivity Target and Achievement in the Seventh Plan (1985-90) -Uttar Pardes

Crop	1985-86		1986-87		1987-88		1988-89		1989-90		1990-91
	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Proposed Target
FoodGrains											
1.rice	7,500	8,315	8,300	7,511	8,500	6,477	8,900	9,420	9,700	9,362	10,200
2.Jowar	520	420	500	457	500	440	540	502	600	615	480
3.Bajra	920	640	600	774	700	616	740	840	800	873	840
4.Maize	1,140	1,472	1,350	1,493	1,500	1,006	1,600	1,199	1,800	1,523	1,560
5.Kharif Pulays	170	147	200	139	120	134	160	160	200	141	150
6.Others	350	364	370	352	350	230	360	336	400	401	400
Total Kharif Foodgrain	10,600	11,358	11,320	10,726	11,670	8,903	12,300	12,457	13,500	12,915	13,630
7.Wheat	17,500	16,559	18,350	16,237	19,000	16,789	17,500	19,611	18,800	17,786	21,300
8.Barley	820	824	830	800	820	776	800	865	800	717	800
9.Gram	1,420	1,300	1,400	1,233	1,490	1,056	1,330	1,167	1,520	1,010	1,200
10.Peas	430	330	430	286	450	276	380	322	435	331	400
11.Arhar	730	739	740	684	750	605	740	661	845	583	770
12.Lentil	300	316	330	324	340	291	350	352	400	342	400
Total Rabi Foodgrains	21,200	20,068	22,080	19,564	22,850	19,793	21,100	22,978	22,800	20,769	24,870
Total Foodgrains	31,800	31,426	33,400	30,290	34,520	28,696	33,400	35,435	36,300	33,684	38,500
Oilseeds	1,710	872	1,800	800	1,500	859	1,100	1,160	1,200	1,181	1,300
Pulses	3,050	2,832	3,100	2,666	3,150	2,362	2,960	2,662	3,400	2,407	2,920

Source : UP State Government

Table 3.1 Development Potential of Groundwater in Related District in Sharda Canal Command (1/2)

District Name	Block Name	Net Recharge (ha m) A	Net Draft (ha m) B	Stage of Develop. (%) B/A	Develop. Potential (ha m) A/2-B	Geograph. Area (ha) C	Net Rec. Unit (m) A/C	Net Draft Unit (m) B/C	Pre-Mons. W.Table Average (m)	Post-Mons. W.Table Average (m)	Difference Pre-Post (m)
NAINITAL	(Sub.Table)	33,038	6,814	20.62	9,705	68,522	0.48	0.10	4.92	2.74	2.18
	SITALGANJI	14,120	2,302	16.30	4,758	33,210	0.43	0.07	3.08	1.55	1.53
	KHATIMA	18,918	4,512	23.85	4,947	35,312	0.54	0.13	6.75	3.92	2.83
PILIBHIT	(Sub.Table)	141,459	39,685	28.05	31,045	309,372	0.46	0.13	3.44	1.82	1.62
	PURANPUR	52,506	16,083	30.63	10,170	121,574	0.43	0.13	3.08	1.82	1.26
	MARAURI	20,334	5,617	27.62	4,550	29,645	0.69	0.19	3.68	2.02	1.66
	AMRIA	15,326	5,310	34.65	2,353	40,984	0.37	0.13	3.66	1.76	1.90
	LALRURIKHERA	13,917	2,948	21.18	4,011	22,969	0.61	0.13	3.51	1.87	1.64
	BARKHERA	14,441	2,495	17.28	4,726	31,845	0.45	0.08	3.00	1.46	1.54
	BILSANDA	16,246	3,807	23.43	4,316	35,954	0.45	0.11	2.25	0.76	1.49
	BISAPUR	8,689	3,425	39.42	920	26,401	0.33	0.13	4.91	3.04	1.87
BAREILLY	(Sub.Table)	100,361	25,867	25.77	24,314	260,465	0.39	0.10	4.27	2.96	1.31
	NAWABGANJI	15,048	3,949	26.24	3,575	32,985	0.46	0.12	3.37	1.97	1.40
	RICHCHHA	12,332	1,666	13.51	4,500	26,309	0.47	0.06	3.45	1.99	1.46
	SHERGARH	8,471	2,936	34.66	1,300	27,295	0.31	0.11	4.78	3.64	1.14
	FATEHGANJ	6,945	2,302	33.15	1,171	20,056	0.35	0.11	4.54	3.42	1.12
	BHOJIPURA	7,451	1,903	25.54	1,823	19,661	0.38	0.10	4.06	2.75	1.31
	KYARA	6,921	1,342	19.39	2,119	20,805	0.33	0.06	3.28	2.35	0.93
	BITHARI	10,372	2,620	25.26	2,566	25,238	0.41	0.10	7.20	5.78	1.42
	FARIDPUR	8,052	3,175	39.43	851	32,234	0.25	0.10	3.77	2.55	1.22
	BHADPURA	13,406	2,382	17.77	4,321	24,198	0.55	0.10	3.28	1.71	1.57
	BHUTTA	11,363	3,592	31.61	2,090	31,684	0.36	0.11	4.98	3.46	1.52
SHAHJAHAN	(Sub.Table)	148,827	57,378	38.55	17,035	396,531	0.38	0.14	4.21	3.07	1.14
	KHUTAR	18,153	6,547	36.07	2,530	46,545	0.39	0.14	3.90	2.83	1.07
	BANDA	18,908	8,318	43.99	1,136	46,891	0.40	0.18	3.63	2.26	1.37
	PAWAYAN	10,073	5,733	56.91	(697)	30,601	0.33	0.19	4.97	4.13	0.84
	SINDHAUL	8,798	4,496	51.10	(97)	29,160	0.30	0.15	5.79	5.34	0.45
	NIGOHI	11,042	3,637	32.94	1,884	25,449	0.43	0.14	3.08	2.27	0.81
	KATARA	10,272	3,649	35.52	1,487	24,955	0.41	0.15	5.70	3.88	1.82
	BHAWALKHER	10,527	4,084	38.80	1,180	31,928	0.33	0.13	4.21	2.98	1.23
	DADRAUL	12,717	4,181	32.88	2,178	34,790	0.37	0.12	3.18	2.06	1.12
	KANT	15,358	3,380	22.01	4,299	32,745	0.47	0.10	2.73	1.42	1.31
	TIRHAR	11,075	4,725	42.66	813	24,580	0.45	0.19	3.67	2.16	1.51
	JAITPUR	7,126	3,738	52.46	(175)	29,493	0.24	0.13	5.81	4.72	1.09
	JALALABAD	14,778	4,890	33.09	2,499	39,394	0.38	0.12	3.83	2.75	1.08
KHERI	(Sub.Table)	118.437	39,045	32.97	20,174	364,624	0.32	0.11	4.93	3.03	1.90
	BIJUA	22,565	3,190	14.14	8,093	59,083	0.38	0.05	3.72	2.09	1.63
	PHULBEHAR	17,955	3,914	21.80	5,064	40,504	0.44	0.10	4.57	2.42	2.15
	BANKAGANJ	13,494	3,659	27.12	3,088	33,852	0.40	0.11	4.04	1.87	2.17
	LAKHIMPUR	13,043	5,165	39.60	1,357	38,535	0.34	0.13	6.02	4.01	2.01
	BEHJAM	7,190	3,772	52.46	(177)	28,999	0.25	0.13	4.61	2.44	2.17
	MUHAMUDI	7,619	5,643	74.06	(1,834)	42,653	0.18	0.13	6.00	4.49	1.51
	KUMBHA	12,729	4,875	38.30	1,490	36,488	0.35	0.13	5.37	3.17	2.20
	MITAULI	10,156	3,708	36.51	1,370	37,140	0.27	0.10	4.74	2.66	2.08
	PARAGAWAN	13,686	5,119	37.40	1,724	47,370	0.29	0.11	5.30	4.12	1.18
HARDOI	(Sub.Table)	201,047	42,694	21.24	57,830	598,817	0.34	0.07	5.09	3.45	1.64
	PIHANI	11,264	2,145	19.04	3,487	33,685	0.33	0.06	4.80	2.91	1.89
	TODAPUR	13,362	2,214	16.57	4,467	30,621	0.44	0.07	2.78	1.33	1.45
	SHAHABAD	7,481	2,081	27.82	1,660	34,673	0.22	0.06	5.85	4.88	0.97
	BHARKAHANI	13,896	3,181	22.89	3,767	42,427	0.33	0.07	3.83	2.49	1.34
	HARIYAWAN	8,532	1,551	18.18	2,715	29,035	0.29	0.05	4.37	2.76	1.61
	TADIYAWAN	11,380	2,535	22.28	3,155	31,235	0.36	0.08	3.90	2.26	1.64
	BAWAN	11,996	2,586	21.56	3,412	32,827	0.37	0.08	4.53	2.45	2.08
	SANDI	9,643	2,675	27.74	2,147	31,575	0.31	0.08	3.56	2.49	1.07
	HARPARPUR	6,364	2,449	38.48	733	30,891	0.21	0.08	4.60	2.96	1.64
	AHIRAURI	13,539	2,110	15.58	4,660	37,703	0.36	0.06	5.16	3.72	1.44
	SURSA	14,196	3,055	21.52	4,043	33,628	0.42	0.09	3.95	2.58	1.37
	BILGRAM	10,564	3,382	32.01	1,900	33,839	0.31	0.10	7.16	5.54	1.62
	KOTHAWAN	12,469	1,829	14.67	4,406	29,485	0.42	0.06	3.95	1.96	1.99
	KACHHONA	8,520	1,236	14.51	3,024	24,864	0.34	0.05	4.74	3.02	1.72
	MADHOGANJ	12,125	2,564	21.15	3,499	28,916	0.42	0.09	5.20	4.10	1.10
	BHARAWAN	9,001	1,575	17.50	2,926	31,069	0.29	0.05	9.05	6.82	2.23
	SANDILA	9,807	1,876	19.13	3,028	31,362	0.31	0.06	5.51	3.33	2.18

Table 3.1 Development Potential of Groundwater in Related District in Sharda Canal Command (2/2)

District Name	Block Name	Net Recharge (ha m) A	Net Draft (ha m) B	Stage of Develop. (%) B/A	Develop. Potential (ha m) A/2-B	Geograph. Area (ha) C	Net Rec. Unit (m) A/C	Net Draft Unit (m) B/C	Pre-Mons. W.Table Average (m)	Post-Mons. W.Table Average (m)	Difference Pre-Post (m)
	BEHDAR	10,286	1,738	16.90	3,405	27,842	0.37	0.06	4.02	2.71	1.31
	MALAWAN	6,622	1,912	28.87	1,399	23,140	0.29	0.08	9.77	7.20	2.57
BARABANKI	(Sub.Table)	12,757	2,318	18.17	4,061	30,074	0.42	0.08	4.07	1.73	2.34
	NINDURA	12,757	2,318	18.17	4,061	30,074	0.42	0.08	4.07	1.73	2.34
SITAPUR	(Sub.Table)	191,520	37,922	19.80	57,838	567,164	0.34	0.07	5.12	3.37	1.75
	BEHTA	12,709	661	5.20	5,694	36,742	0.35	0.02	4.07	2.72	1.35
	HARGAON	11,099	2,089	18.82	3,461	27,603	0.40	0.08	4.15	2.61	1.54
	ALIA	7,327	2,784	38.00	880	26,713	0.27	0.10	4.91	3.21	1.70
	MAHOLI	8,645	2,527	29.23	1,796	23,277	0.37	0.11	5.97	4.18	1.79
	PISAWAN	8,441	3,016	35.73	1,205	39,780	0.21	0.08	5.98	4.28	1.70
	REOSA	16,547	2,353	14.22	5,921	43,868	0.38	0.05	3.80	1.91	1.89
	SAKRAN	7,840	1,327	16.93	2,593	30,764	0.25	0.04	5.11	3.12	1.99
	LAHARPUR	16,137	1,127	6.98	6,942	22,546	0.72	0.05	3.45	2.21	1.24
	PARSENDI	8,570	1,653	19.29	2,632	27,907	0.31	0.06	4.87	3.21	1.66
	KHAIRABAD	5,199	1,897	36.49	703	23,526	0.22	0.08	7.35	5.42	1.93
	MISRIKH	7,493	2,511	33.51	1,236	30,430	0.25	0.08	5.87	4.43	1.44
	RAMPURMATHURA	10,084	2,492	24.71	2,550	35,116	0.29	0.07	3.60	2.01	1.59
	MAHMUDABAD	11,670	2,100	17.99	3,735	23,431	0.50	0.09	4.11	2.66	1.45
	BISAWAN	15,612	2,339	14.98	5,467	35,421	0.44	0.07	3.76	2.56	1.20
	MACHHAREHTA	7,215	1,934	26.81	1,674	26,739	0.27	0.07	5.73	3.74	1.99
	PAHLA	14,096	1,826	12.95	5,222	27,532	0.51	0.07	5.28	3.37	1.91
	KASMANDA	6,731	1,585	23.55	1,781	27,468	0.25	0.06	6.49	3.56	2.93
	GONDLAMAU	7,052	1,561	22.14	1,965	32,718	0.22	0.05	7.00	4.46	2.54
	SIDAULI	9,053	2,140	23.64	2,387	25,583	0.35	0.08	5.85	4.38	1.47
LUCKNOW	(Sub.Table)	61,708	19,015	30.81	11,839	215,841	0.29	0.09	5.85	4.17	1.67
	BAKSHIKA	15,561	4,422	28.42	3,359	37,782	0.41	0.12	6.77	4.69	2.08
	MAL	6,422	2,258	35.16	953	25,383	0.25	0.09	5.46	3.19	2.27
	MALIHABAD	6,476	2,084	32.18	1,154	21,092	0.31	0.10	5.54	3.27	2.27
	KAKORI	6,415	1,629	25.39	1,579	22,594	0.28	0.07	7.53	6.84	0.69
	SAROJININAGAR	9,409	3,197	33.98	1,508	38,435	0.24	0.08	6.73	5.26	1.47
	MOHANLALGANJI	10,395	3,310	31.84	1,888	35,903	0.29	0.09	5.41	3.84	1.57
	GASAIGANJI	7,030	2,115	30.09	1,400	34,652	0.20	0.06	3.48	2.12	1.36
UNNAO	(Sub.Table)	141,707	26,432	18.65	44,422	458,519	0.31	0.06	5.22	3.89	1.33
	AURAS	7,541	623	8.26	3,148	25,701	0.29	0.02	5.22	3.89	1.33
	GANJIMURADABAD	6,667	1,556	23.34	1,778	23,428	0.28	0.07	5.69	4.56	1.13
	BANGERMAU	7,098	1,434	20.20	2,115	27,990	0.25	0.05	5.37	4.50	0.87
	PATEHAPUR	8,458	1,718	20.31	2,511	27,996	0.30	0.06	3.70	2.40	1.30
	HASANGANJI	10,061	1,469	14.60	3,562	32,177	0.31	0.05	4.07	3.02	1.05
	MAYAGANJI	10,731	1,396	13.01	3,970	27,331	0.39	0.05	3.07	1.96	1.11
	SAFIPUR	10,164	1,358	13.36	3,724	25,683	0.40	0.05	3.77	2.55	1.22
	NAWABGANJI	7,217	1,757	24.35	1,852	27,803	0.26	0.06	4.59	3.40	1.19
	BICHHIYA	12,487	1,251	10.02	4,993	33,483	0.37	0.04	4.20	2.75	1.45
	SIKANDARPUR S.	8,164	1,950	23.89	2,132	33,242	0.25	0.06	7.86	6.92	0.94
	SIKANDARPUR K.	9,368	1,992	21.26	2,692	34,889	0.27	0.06	10.01	8.67	1.34
	ASOHA	8,154	1,763	21.62	2,314	28,893	0.28	0.06	5.67	4.03	1.64
	PURWA	9,441	1,762	18.66	2,959	23,527	0.40	0.07	4.55	2.99	1.56
	HILAULI	9,683	2,518	26.00	2,324	33,881	0.29	0.07	4.15	2.82	1.33
	BIGHAPUR	9,325	1,730	18.55	2,933	25,556	0.36	0.07	5.62	3.72	1.90
	SUMERPUR	7,148	2,155	30.15	1,419	26,939	0.27	0.08	5.91	4.02	1.89
RAEBARELI	(Sub.Table)	38,721	12,305	31.78	7,056	149,762	0.26	0.08	6.35	3.89	2.46
	SATAON*	5,437	2,610	48.00	109	25,550	0.21	0.10	6.40	4.62	1.78
	KHEERO	4,387	2,150	49.01	44	23,204	0.19	0.09	4.72	3.39	1.33
	LALGANJ	5,460	1,818	33.30	912	22,276	0.25	0.08	6.22	4.11	2.11
	SARENI	6,024	2,344	38.91	668	25,511	0.24	0.09	7.60	6.01	1.59
	DALMAU	9,240	1,836	19.87	2,784	26,476	0.35	0.07	4.81	3.36	1.45
	JAGATPUR	8,173	1,547	18.93	2,540	26,745	0.31	0.06	8.33	1.85	6.48
	Total	1,189,582	309,475	26.02	285,316	3,419,691	0.35	0.09	4.57	3.07	1.63

Data Source : Ground Water Development : National Bank, 1990
Water Table Fluctuatation : G.W.D., 1984-1989
Sataon : Changed by Recent Data

Table 3.2 Number of Blocks, Population, Geographical Area etc. by District

SL. NO.	NAME OF DISTRICT	NUMBER TEHSILS (1988)	NUMBER OF C.D.BLOCK (1988)	POPULATION (In Thousand) In 1981	DENSITY PER SQ.Km.	AVERAGE RAINFALL (M.M. per YR.)	GEOGRAPHICAL AREA (SQ. Km.)	TOTAL AGR. REPORTING AREA (Ha)
1.	PILIBHIT	3	7	1,008	288	1,242	3,499	349,469
2.	SHANJAHANPUR	4	14	1,648	360	1,020	4,575	457,444
3.	KHERI	4	15	1,953	254	1,069	7,680	770,076
4.	HARDOI	4	19	2,275	380	879	5,986	598,814
5.	LUCKNOW	3	8	2,015	797	959	2,528	252,122
6.	UNNAO	4	16	1,823	400	838	4,558	458,519
7.	RAE BARELI	6	19	1,887	409	928	4,609	458,372
8.	NAINITAL	6	15	1,137	167	1,566	6,794	699,015
9.	BAREILLY	5	15	2,273	552	1,107	4,120	407,508
10.	SITAPUR	5	19	2,337	407	974	5,743	570,716
11.	BARABANKI	4	16	1,992	453	1,002	4,401	447,160
	TOTAL	48	163	20,348	-	-	54,493	5,469,215

Sourse : U.P. Stastical Dairy 1988 & 89
Government of U.P.

Table 3.3 Number and Operational Holdings in Sharda Canal Command (1/2)

No.	Size Class (Hect.)	NAINITAL				PILIBHIT				BAREILLY				SHAHJAHANPUR				KHERI			
		Number	%	Area	%	Number	%	Area	%	Number	%	Area	%	Number	%	Area	%	Number	%	Area	%
1	Below 0.02	2,306	2.0	34	0.0	1,258	0.7	20	0.0	3,883	1.1	54	0.0	3,415	1.0	37	0.0	4,311	1.0	56	0.0
2	0.02- 0.5	39,408	33.8	9,120	4.3	73,078	39.2	19,496	9.0	157,675	46.2	36,693	11.0	160,801	45.1	40,051	11.4	174,261	41.1	50,711	11.8
3	0.5 - 1.0	19,617	16.8	14,138	6.6	41,281	22.2	28,460	13.1	74,364	21.8	52,702	15.8	82,176	23.0	57,521	16.4	111,239	26.3	76,498	17.7
	Marginal (below 1.0ha)	61,331	52.5	23,292	10.9	115,617	62.0	47,976	22.1	235,922	69.1	89,449	26.8	246,392	69.1	97,609	27.9	289,811	68.4	127,265	29.5
4	1.0 - 2.0 Small	21,694	18.6	31,569	14.8	39,842	21.4	54,251	25.0	59,870	17.5	83,420	25.0	65,485	18.4	90,052	25.7	78,702	18.6	107,363	24.9
5	2.0 - 3.0	13,422	11.5	31,497	14.8	15,940	8.6	37,362	17.2	23,706	6.9	58,796	17.6	22,878	6.4	56,087	16.0	28,291	6.7	66,203	15.4
6	3.0 - 4.0	7,241	6.2	25,804	12.1	6,540	3.5	21,204	9.8	10,698	3.1	36,495	10.9	10,146	2.8	34,457	9.8	13,126	3.1	46,116	10.7
	Semi Medium (2.0 - 4.0)	20,663	17.7	57,301	26.9	22,480	12.1	58,566	26.9	34,404	10.1	95,291	28.5	33,024	9.3	90,544	25.9	41,417	9.8	112,319	26.0
7	4.0 - 5.0	4,158	3.6	18,264	8.6	4,060	2.2	17,139	7.9	5,127	1.5	22,568	6.8	5,417	1.5	23,863	6.8	6,873	1.6	31,723	7.4
8	5.0 - 7.5	5,735	4.9	34,381	16.1	2,851	1.5	16,303	7.5	4,335	1.3	25,602	7.7	4,464	1.3	26,778	7.6	4,550	1.1	26,962	6.3
9	7.5 -10.0	1,804	1.5	14,948	7.0	817	0.4	6,820	3.1	1,087	0.3	9,076	2.7	1,251	0.4	10,126	2.9	1,368	0.3	11,411	2.6
	Medium (4.0 -10.0)	11,697	10.0	67,593	31.7	7,728	4.1	40,262	18.5	10,549	3.1	57,246	17.1	11,132	3.1	60,767	17.4	12,791	3.0	70,096	16.3
10	10.0-20.0	1,187	1.0	14,720	6.9	564	0.3	7,135	3.3	549	0.2	6,867	2.1	666	0.2	8,315	2.4	750	0.2	9,394	2.2
11	20.0-30.0	86	0.1	2,009	0.9	48	0.0	1,136	0.5	36	0.0	864	0.3	56	0.0	1,367	0.4	86	0.0	2,002	0.5
12	30.0-40.0	38	0.0	1,300	0.6	25	0.0	865	0.4	12	0.0	421	0.1	10	0.0	338	0.1	21	0.0	720	0.2
13	40.0-50.0	15	0.0	637	0.3	9	0.0	423	0.2	5	0.0	216	0.1	4	0.0	168	0.0	17	0.0	736	0.2
14	50.0 and above	36	0.0	14,826	7.0	25	0.0	6,705	3.1	3	0.0	366	0.1	12	0.0	964	0.3	13	0.0	1,363	0.3
	Large (10.0 Hect.and above)	1,362	1.2	33,492	15.7	671	0.4	16,264	7.5	605	0.2	8,734	2.6	748	0.2	11,152	3.2	887	0.2	14,215	3.3
	TOTAL	116,747	100.0	213,247	100.0	186,338	100.0	217,319	100.0	341,350	100.0	334,140	100.0	356,781	100.0	350,124	100.0	423,608	100.0	431,258	100.0
Average Holding Size			1.83				1.17				0.98				0.98				1.02		

Source: Number and Area of Operational Holdings, Agriculture Census in Uttar Pradesh 1985-86
Board of Revenue, Uttar Pradesh, 1990

Table3.3 Number and Operational Holdings in Sharda Canal Command (2/2)

No.	Size Class (Hect.)	HARDOI				SITAPUR				UNNAO				LUCKNOW				RAE BARELI				BARABANKI			
		Number	%	Area	%	Number	%	Area	%	Number	%	Area	%	Number	%	Area	%	Number	%	Area	%	Number	%	Area	%
1	Below 0.02	3,328	0.8	49	0.0	3,191	0.6	46	0.0	3,533	1.0	47	0.0	1,681	1.0	25	0.0	3,609	0.9	54	0.0	2,909	0.7	41	0.0
2	0.02- 0.5	201,435	45.6	49,624	11.9	242,459	47.2	59,759	13.1	168,674	46.9	43,480	14.2	71,182	41.6	22,369	13.9	205,816	50.5	55,538	17.9	205,512	52.3	50,587	16.3
3	0.5 - 1.0 Marginal	102,179	23.1	73,734	17.6	125,452	24.4	88,604	19.5	91,744	25.5	62,185	20.4	46,970	27.4	33,965	21.1	106,021	26.0	71,511	23.1	92,497	23.5	64,993	20.9
	(below 1.0ha)	306,942	69.4	123,407	29.5	371,102	72.2	148,409	32.6	263,951	73.4	105,712	34.6	119,833	70.0	56,359	35.0	315,446	77.4	127,103	41.0	300,918	76.5	115,621	37.2
4	1.0 - 2.0 Small	81,290	18.4	108,014	25.8	89,209	17.4	131,506	28.9	61,115	17.0	82,304	26.9	34,279	20.0	48,050	29.8	61,002	15.0	81,689	26.4	59,410	15.1	81,997	26.4
5	2.0 - 3.0	28,691	6.5	66,331	15.9	31,786	6.2	72,058	15.8	19,182	5.3	44,713	14.6	10,645	6.2	25,929	16.1	17,723	4.3	41,523	13.4	18,629	4.7	43,074	13.9
6	3.0 - 4.0 Semi Medium	12,094	2.7	40,998	9.8	10,783	2.1	37,787	8.3	7,332	2.0	24,944	8.2	3,370	2.0	11,473	7.1	6,944	1.7	22,871	7.4	7,237	1.8	24,718	8.0
	(2.0 - 4.0)	40,785	9.2	107,329	25.7	42,569	8.3	109,845	24.1	26,514	7.4	69,657	22.8	14,015	8.2	37,402	23.2	24,667	6.1	64,394	20.8	25,866	6.6	67,792	21.8
7	4.0 - 5.0	5,723	1.3	24,603	5.9	5,067	1.0	23,226	5.1	3,733	1.0	16,098	5.3	1,448	0.8	6,358	3.9	3,186	0.8	14,109	4.6	3,289	0.8	14,830	4.8
8	5.0 - 7.5	5,031	1.1	28,717	6.9	3,941	0.8	22,953	5.0	2,936	0.8	17,363	5.7	1,162	0.7	6,613	4.1	2,276	0.6	13,530	4.4	2,640	0.7	15,762	5.1
9	7.5 -10.0 Medium	1,544	0.3	12,955	3.1	1,285	0.3	10,372	2.3	933	0.3	7,867	2.6	338	0.2	2,902	1.8	608	0.1	5,084	1.6	730	0.2	6,167	2.0
	(4.0 -10.0)	12,298	2.8	66,275	15.9	10,293	2.0	56,551	12.4	7,602	2.1	41,328	13.5	2,948	1.7	15,873	9.8	6,070	1.5	32,723	10.6	6,659	1.7	36,759	11.8
10	10.0-20.0	733	0.2	9,050	2.2	577	0.1	6,761	1.5	445	0.1	5,264	1.7	177	0.1	2,177	1.4	275	0.1	3,434	1.1	397	0.1	5,608	1.8
11	20.0-30.0	56	0.0	1,318	0.3	21	0.0	495	0.1	28	0.0	646	0.2	19	0.0	478	0.3	15	0.0	349	0.1	46	0.0	1,173	0.4
12	30.0-40.0	17	0.0	597	0.1	16	0.0	539	0.1	5	0.0	162	0.1	5	0.0	188	0.1	4	0.0	129	0.0	9	0.0	287	0.1
13	40.0-50.0	6	0.0	266	0.1	2	0.0	88	0.0	0	0.0	0	0.0	2	0.0	88	0.1	3	0.0	132	0.0	2	0.0	92	0.0
14	50.0 and above Large (10.0	16	0.0	1,878	0.4	2	0.0	871	0.2	5	0.0	349	0.1	5	0.0	637	0.4	0	0.0	0	0.0	4	0.0	1,281	0.4
	Hect.and above)	828	0.2	13,109	3.1	618	0.1	8,754	1.9	483	0.1	6,421	2.1	208	0.1	3,568	2.2	297	0.1	4,044	1.3	458	0.1	8,441	2.7
	TOTAL	442,143	100.0	418,134	100.0	513,791	100.0	455,065	100.0	359,665	100.0	305,422	100.0	171,283	100.0	161,252	100.0	407,482	100.0	309,953	100.0	393,311	100.0	310,610	100.0
Average Holding Size		0.95				0.89				0.85				0.94				0.76				0.79			

Source: Number and Area of Operational Holdings, Agriculture Census in Uttar Pradesh 1985-86
Board of Revenue, Uttar Pradesh, 1990

Table 3.4 Some Important Figures for Related Districts of Sharda Canal Command

District	Area (km2)	Population (1,000)	Nos. Blocks	Nos. Holdings	Area of Holdings (km2)	Average Holdings (ha/farm)	Net Sown Area (1,000ha)	Net Irrig. Area (1,000ha)	Irrig. Rate (%)	Length of Canal (km)	Gov. Tubewells (nos.)
1. Nainital	6,794	1137	15	116,747	2,132	1.83	201	157	78.1	1,816	241
2. Bareilly	4,120	2273	15	341,350	3,341	0.98	330	185	56.1	1,360	548
3. Pilibhit	3,499	1008	7	186,338	2,173	1.17	216	147	68.1	595	78
4. Shahjahanpur	4,575	1648	14	356,781	3,501	0.98	351	213	60.7	892	351
5. Kheri	7,680	1953	15	423,608	4,313	1.02	454	206	45.4	1,670	729
6. Hardoi	5,986	2275	19	442,143	4,181	0.95	395	243	61.5	1,310	550
7. Sitapur	5,743	2337	19	513,791	4,551	0.89	414	167	40.3	1,092	544
8. Lucknow	2,528	2015	8	171,283	1,613	0.94	144	86	59.7	656	293
9. Unnao	4,558	1823	16	359,665	3,054	0.85	286	204	71.3	1,869	149
10. Barabanki	4,401	1992	16	393,311	3,106	0.79	290	185	63.8	1,407	198
11. Rae Bareli	4,609	1887	19	407,482	3,100	0.76	266	167	62.8	2,775	371
Total	54,493	20,348	163	3,712,499	35,065	0.94	3,347	1,960	58.6	15,442	4,052

Socio-economic Indicators (1/2)

District	Total Villages	Electrified Villages	(%)	Average Family Size(1981)	Nos. of Gobar Gas Plant	Nos. of Cold Storages	Nos. of School	Literacy Rate (%)	Nos. of Cinema Hall	Nos. of National Bank	Other Financial Banks	Net Deposited in National
1. Nainital	1806	1518	84.1	6.0	5064	5	1746	38	24	155	26	1523
2. Bareilly	1901	1235	65.0	5.0	2505	14	1893	22	16	149	15	1247
3. Pilibhit	1198	721	60.2	6.0	1830	5	950	20	6	79	6	762
4. Shahjahanpur	2124	989	46.6	5.4	3247	17	1327	21	12	113	18	685
5. Kheri	1699	1186	69.8	5.5	2643	3	1917	18	7	181	4	159
6. Hardoi	1881	863	45.9	5.3	4273	13	2065	22	6	148	3	445
7. Sitapur	2330	938	40.3	5.0	4574	8	2139	19	8	193	3	1084
8. Lucknow	899	899	100.0	5.8	3345	28	1792	40	28	233	8	5964
9. Unnao	1687	818	48.5	5.4	2721	7	1772	25	7	122	2	698
10. Barabanki	2043	849	41.6	5.0	n.a.	n.a.	1861	19	10	136	3	437
11. Rae Bareli	1731	1715	99.1	5.0	4867	10	1618	23	7	156	0	1221
Total	19299	11731	60.8				19080		131	1665	88	14225

Socio-economic Indicators (2/2)

District	Nos. of Hospital	Nos. of Hospital per Lakh	Primary Health Centres	PHC per Lakh	Nos. of Post Office	Nos. of Telephone
1. Nainital	159	13.98	28	2.46	286	66
2. Bareilly	117	5.15	64	2.82	298	721
3. Pilibhit	56	5.56	17	1.69	137	1026
4. Shahjahanpur	64	3.88	34	2.06	275	1803
5. Kheri	76	3.89	49	2.51	363	1832
6. Hardoi	139	6.11	57	2.51	302	1074
7. Sitapur	85	3.64	40	1.71	362	1284
8. Lucknow	123	6.10	27	1.34	231	28016
9. Unnao	119	6.53	45	2.47	225	746
10. Barabanki	21	1.05	80	4.02	n.a.	n.a.
11. Rae Bareli	130	6.89	52	2.76	395	90
Total	1089	5.35	493	2.42		

Table 3.5 Cultivated Area, Production and Unit Yield Per Ha By Crop in Kharif Season in Study Area in 1987-89

No.	Name of District	Sown Area (ha)	Paddy			Maize			Jawar			Bajra		
			Area	Pro.	t/ha	Area	Pro.	t/ha	Area	Pro.	t/ha	Area	Pro.	t/ha
1.	Nainital	41,329	40,440	117,276	2.9	816	979	1.2	-	-	-	3	3	1.0
2.	Pilibhit	123,883	118,072	342,409	2.9	1,501	1,501	1.0	988	1,186	1.2	198	218	1.1
3.	Bareliey	124,007	97,132	194,264	2.0	3,382	3,382	1.0	7,744	10,067	1.3	5,915	6,507	1.1
4.	Shahjahanpur	170,566	131,805	329,513	2.5	2,790	2,790	1.0	6,029	7,235	1.2	9,902	11,882	1.2
5.	Kheri	112,163	93,225	195,773	2.1	3,189	2,232	0.7	3,699	5,179	1.4	857	686	0.8
6.	Hardoi	184,923	44,802	76,163	1.7	48,067	62,487	1.3	25,414	38,121	1.5	7,423	5,938	0.8
7.	Sitapur	203,334	122,712	184,068	1.5	21,180	21,180	1.0	13,850	23,545	1.7	3,569	2,855	0.8
8.	Lucknow	56,876	33,052	52,883	1.6	4,157	2,910	0.7	7,385	11,078	1.5	2,380	1,904	0.8
9.	Unnao	185,723	96,129	115,354	1.2	37,235	33,512	0.9	15,823	17,405	1.1	2,841	2,273	0.8
10.	Raebareilly	40,431	22,434	33,651	1.5	70	70	1.0	7,948	8,743	1.1	1,023	818	0.8
11.	Barabanki	13,855	11,781	24,740	2.1	418	460	1.1	658	724	1.1	27	32	1.2
	Total	1,257,090	811,584	1,666,094	2.05	122,805	131,503	1.07	89,538	123,283	1.38	34,138	33,116	0.97

No.	Name of District	Sown Area (ha)	Arhar			Urdmoong			Groundnut			Soyabean		
			Area	Pro.	t/ha	Area	Pro.	t/ha	Area	Pro.	t/ha	Area	Pro.	t/ha
1.	Nainital	41,329	25	20	0.8	39	12	0.3	6	6	1.0	-	-	-
2.	Pilibhit	123,883	1,422	995	0.7	1,560	312	0.2	142	156	1.1	-	-	-
3.	Bareliey	124,007	2,915	3,790	1.3	1,652	496	0.3	5,267	4,740	0.9	-	-	-
4.	Shahjahanpur	170,566	5,075	3,553	0.7	11,876	3,563	0.3	3,089	3,398	1.1	-	-	-
5.	Kheri	112,163	3,813	2,288	0.6	4,175	835	0.2	3,205	3,205	1.0	-	-	-
6.	Hardoi	184,923	11,348	7,944	0.7	27,066	8,120	0.3	20,803	14,562	0.7	-	-	-
7.	Sitapur	203,334	17,771	5,331	0.3	12,714	1,271	0.1	11,538	10,384	0.9	-	-	-
8.	Lucknow	56,876	5,620	6,744	1.2	3,582	716	0.2	700	350	0.5	-	-	-
9.	Unnao	185,723	12,389	14,867	1.2	8,193	1,639	0.2	13,113	11,802	0.9	36	48	1.3
10.	Raebareilly	40,431	4,958	3,966	0.8	3,076	615	0.2	922	461	0.5	-	-	-
11.	Barabanki	13,855	580	464	0.8	258	52	0.2	133	146	1.1	-	-	-
	Total	1,257,090	65,916	49,962	0.76	74,191	17,631	0.24	58,918	49,210	0.84	36	48	1.33

Source: Directorate of Statistic, State Department of Agriculture, 1990

Table 3.6 Cultivated Area, Production and Unit Yield Per Ha by Crop in Rabi Season in Study Area in 1987-89

No.	Name of District	Sown Area (ha)	Wheat			Basley			Gram		
			Area	Pro.	t/ha	Area	Pro.	t/ha	Area	Pro.	t/ha
1.	Nainital	34,192	33,049	69,403	2.1	209	293	1.4	124	87	0.7
2.	Pilibhit	135,103	124,034	235,665	1.9	406	568	1.4	1,034	310	0.3
3.	Bareliey	113,601	104,561	188,210	1.8	1,027	1,438	1.4	1,591	318	0.2
4.	Shahjahanpur	198,282	174,980	402,454	2.3	2,961	6,514	2.2	15,608	12,486	0.8
5.	Kheri	139,245	121,655	218,979	1.8	2,752	3,578	1.3	2,704	1,082	0.4
6.	Hardoi	297,743	222,675	400,815	1.8	15,379	21,531	1.4	36,042	25,229	0.7
7.	Sitapur	220,722	176,399	299,878	1.7	12,960	14,256	1.1	19,726	5,918	0.3
8.	Lucknow	81,242	69,426	131,909	1.9	2,826	3,634	1.3	6,181	5,563	0.9
9.	Unnao	270,654	96,129	173,032	1.8	151,804	212,526	1.4	14,766	13,289	0.9
10.	Raebareilly	63,137	50,163	90,293	1.8	5,657	6,788	1.2	4,291	1,716	0.4
11.	Barabanki	12,854	10,825	22,733	2.1	308	370	1.2	1,183	828	0.7
	Total:	1,566,775	1,183,896	2,233,371	1.89	196,289	271,496	1.38	103,250	66,826	0.65

No.	Name of District	Sown Area (ha)	Pea			Mustard		
			Area	Pro.	t/ha	Area	Pro.	t/ha
1.	Nainital	34,192	83	58	0.7	727	436	0.6
2.	Pilibhit	135,103	297	178	0.6	9,332	5,599	0.6
3.	Bareliey	113,601	1,251	751	0.6	5,171	3,103	0.6
4.	Shahjahanpur	198,282	2,366	1,420	0.6	2,367	1,420	0.6
5.	Kheri	139,245	212	191	0.9	11,922	7,153	0.6
6.	Hardoi	297,743	2,779	2,501	0.9	20,868	14,608	0.7
7.	Sitapur	220,722	2,442	2,198	0.9	9,195	5,517	0.6
8.	Lucknow	81,242	2,074	1,867	0.9	735	441	0.6
9.	Unnao	270,654	2,809	2,528	0.9	5,146	3,088	0.6
10.	Raebareilly	63,137	1,692	1,523	0.9	1,334	800	0.6
11.	Barabanki	12,854	176	194	1.1	362	217	0.6
	Total:	1,566,775	16,181	13,409	0.83	67,159	42,382	0.63

Source: Directorate of Statistic, State Department of Agriculture, 1990

Table 3.7 Irrigation Area of Hardoi Branch Command for Past 5 Years (1/2)

Canal Name	C.C.A. (ha)	Proposed Irrigaion Area(ha)			1985-1986			1986-1987			1987-1988		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
HARDOI BRANCH CANAL													
0 Miles to 23 Miles	34,173	10,252	8,543	18,795	3,202	4,012	7,214	4,120	3,240	7,360	4,047	3,509	7,556
23 Miles to 53 Miles	54,704	13,129	13,675	26,804	16,572	11,959	28,531	18,967	15,893	34,860	12,100	8,635	20,735
53 Miles to 99 Miles	78,681	18,884	19,670	38,554	14,684	18,256	32,940	16,867	18,408	35,275	13,225	17,949	31,174
99 Miles to Tail	70,881	17,012	17,720	34,732	11,089	14,571	25,660	12,477	16,080	28,557	9,350	15,567	24,917
TOTAL	238,439	59,277	59,608	118,885	45,547	48,798	94,345	52,431	53,621	106,052	38,722	45,660	84,382
LUCKNOW BRANCH CANAL													
0 Miles to 72 Miles	112,201	26,928	28,050	54,978	19,623	27,475	47,098	19,623	27,475	47,098	15,856	24,881	40,737
72 Miles to Tail	97,570	23,418	24,392	47,810	17,640	20,805	38,445	19,329	19,171	38,500	12,223	18,603	30,826
TOTAL	209,771	50,346	52,442	102,788	37,263	48,280	85,543	38,952	46,646	85,598	28,079	43,484	71,563
SANDILA BRANCH													
0 Miles to Tail	71,672	17,201	17,918	35,119	8,498	18,015	26,513	9,458	18,049	27,507	7,893	16,320	24,213
ASIWAN BRANCH CANAL													
0 Miles to Tail	85,511	20,542	21,378	41,920	12,656	17,236	29,892	13,789	16,788	30,577	8,245	16,295	24,540
PURWA BARNCH CANAL													
0 Miles to 30 Miles	41,927	10,062	10,482	20,544	10,988	9,940	20,928	10,604	10,529	21,133	6,809	10,687	17,496
30 Miles to Tail	32,638	7,832	8,161	15,993	7,491	9,628	17,119	7,275	7,791	15,066	3,539	6,322	9,861
TOTAL	74,565	17,894	18,643	36,537	18,479	19,568	38,047	17,879	18,320	36,199	10,348	17,009	27,357
UNNAO BRANCH CANAL													
0 Miles to 33 Miles	46,349	11,124	11,587	22,711	8,597	10,611	19,208	9,333	9,625	18,958	4,522	10,547	15,069
33 Miles to Tail	31,465	7,533	7,866	15,399	3,700	4,908	8,608	4,196	5,336	9,532	1,863	4,164	6,027
TOTAL	77,814	18,657	19,453	38,110	12,297	15,519	27,816	13,529	14,961	28,490	6,385	14,711	21,096
GRAND TOTAL	757,772	183,917	189,442	373,359	134,740	167,416	302,156	146,038	168,385	314,423	99,672	153,479	253,151

Table 3.7 Irrigation Area of Hardoi Branch Command for Past 5 Years (2/2)

Canal Name	C.C.A. (ha)	1988-1989			1989-1990			AVERAGE		
		Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
HARDOI BRANCH CANAL										
0 Miles to 23 Miles	34,173	4,208	4,020	8,228	4,423	3,920	8,343	4,000	3,740	7,740
23 Miles to 53 Miles	54,704	10,350	18,962	29,312	12,104	7,753	19,857	14,019	12,640	26,659
53 Miles to 99 Miles	78,681	17,958	18,987	36,945	15,687	17,758	33,445	15,684	18,272	33,956
99 Miles to Tail	70,881	12,929	15,978	28,907	11,358	14,782	26,140	11,441	15,396	26,836
TOTAL	238,439	45,445	57,947	103,392	43,572	44,213	87,785	45,143	50,048	95,191
LUCKNOW BRANCH CANAL										
0 Miles to 72 Miles	112,201	20,815	27,068	47,883	18,917	26,257	45,174	18,967	26,631	45,598
72 Miles to Tail	97,570	20,901	18,713	39,614	16,496	18,509	35,005	17,318	19,160	36,478
TOTAL	209,771	41,716	45,781	87,497	35,413	44,766	80,179	36,285	45,791	82,076
SANDILA BRANCH										
0 Miles to Tail	71,672	9,889	18,074	27,963	8,444	18,103	26,547	8,836	17,712	26,549
ASIWAN BRANCH CANAL										
0 Miles to Tail	85,511	14,156	15,942	30,098	9,951	16,667	26,618	11,759	16,586	28,345
PURWA BARNCH CANAL										
0 Miles to 30 Miles	41,927	11,534	9,863	21,397	8,803	9,942	18,745	9,748	10,192	19,940
30 Miles to Tail	32,638	6,507	8,287	14,794	4,618	8,308	12,926	5,886	8,067	13,953
TOTAL	74,565	18,041	18,150	36,191	13,421	18,250	31,671	15,634	18,259	33,893
UNNAO BRANCH CANAL										
0 Miles to 33 Miles	46,349	9,363	10,627	19,990	6,460	9,341	15,801	7,655	10,150	17,805
33 Miles to Tail	31,465	4,432	5,158	9,590	2,817	4,073	6,890	3,402	4,728	8,129
TOTAL	77,814	13,795	15,785	29,580	9,277	13,414	22,691	11,057	14,878	25,935
GRAND TOTAL	757,772	143,042	171,679	314,721	120,078	155,413	275,491	128,714	163,274	291,988

Note : Irrigation Area Served by Own Canals

Data Source : Irrigation Department, U.P.

Table 4.1 Relation between Basic Factors and Selection Parameters by Matrix

Description	Selection Criteria								Weighting				
	1	2	3	4	5	6	7	8	Irri.	Drain	Soil	Socio	Each item
I. SELECTION PARAMETERS													
A Natural Conditions													
1. Irrigation Condition	X		X						50				100
1) Irrigation Rate						X	X	X					35
2) Canal Conditions				X		X	X						35
3) Irrigation Rate by Government Canal						X							15
4) Dependancy on Ground Water Irrigation						X							15
2. Poor Drainage Condition	X		X							50			100
1) Drainability							X	X					35
2) Poor Drainage Area Rate						X	X						35
3) Drainage Canal Rate						X	X						30
3. Salinity/Alkalinity Affected Condition	X										50		100
1) Alkalinity						X	X	X					60
2) Soil Texture							X	X					20
3) Land Use							X						20
B Socio-Economy Conditions									50	50	50	100	
1. Farm Economy Conditions	X											40	100
1) Farm Income						X	X	X					50
2) Farm Holding						X	X	X					50
2. Agricultural Support Serviece Condition	X											30	100
1) Fertilizer Storage								X					50
2) Fertilizer Use								X					50
3. Social Infrastructure Development Condition	X											30	100
1) Rural Electrification								X					50
2) Rural Water Supply Facility								X					50
Development Conditions													
Total									100	100	100		
II. SCREENING													
1. Progress of CAD Works		X											
2. Adverse Environmental Effects					X								

Remarks : x : item concerned

Selection Criteria

1. Strong development wish of Central and State Government and farmers
2. Non-existence of on-going works of CAD program
3. Representing a model for implementaion of Sharda CAD Project
4. Area requiring modernization of existing irrigation facilities
5. No adverse environmental effect upon implementation
6. Urgency of the development
7. High economic effect of the development
8. Strong development impact from viewpoint of social and economic aspects

Table 5.1 Socio-Economic Indicators of Major Blocks in Representative Areas as of 1987/88

Sl. No.		Sarojini Nagar	Mohanlal Ganj	Sataon	Sursa	Purwa	Hilauli
POPULATION:							
1.	Area (km2)	212	260	235	323	348	316
2.	Total Population of the Block	169027	135824	98771	121674	130500	94686
3.	Population Density Per Square Km	797.3	522.4	420	376.7	375	300
4	Percentage of total Labours in Population	30.5	29.6	30.2	30.5	28.3	29.5
5.	Percentage of Agriculture Labours in total Labours	75.1	84.9	86.3	93.3	90.5	96
6.	Percentage of Literate Persons in Total Population	28	23.9	26.2	19.5	27.3	19.1
7.	The Rate of Increasing Population Per Decades Against Total Population	32.1	15.69	23.37	22.46	1.5	10.78
8.	Total No. of Junior Basic School Per Lakh Population	65.7	93.1	67.9	74.1	94.2	71.2
9.	Total No. of Higher Secondary School Per Lakh Population	1.8	2.9	3	2.5	1.2	0
10	Average Population Per Branch of a Professional Bank	15367	16980	18410	20219	28662	26139
HEALTH:							
1.	No. of Allopethic Hospitals/Dispensaries and Primary Health Centers Per Lakh Population	4.1	5.2	2	3.3	3.5	1
2.	No. of Available Beds in Allopethic Hospitals/ Dispensaries and health Centre Per Lakh Population	84	7.4	10.1	13.1	14	3.8
3.	No. of Primary Health Centre Per Lakh Population	1.8	3.7	2	3.2	3.5	1
4.	Development Blockwise Allopethic Clinic Center in Block						
A.	No. of Hospitals and dispensaries	4	2	0	0	0	0
B.	Primary Health Center	3	5	2	4	3	1
C.	Available Beds in All Above	142	10	10	16	12	4
5.	Development Block Wise Ayurvedic, Yunani and Homiopethic Clinic Center						
A.	Ayurvedic Hospitals and Dispensaries	3	3	5	3	0	3
B.	No. of Available Beds	12	33	20	12	0	8
C.	No. of Doctors	3	4	5	4	0	3
D.	Yunani Hospitals and Dispensaries	1	1	0	0	2	0
E.	Available Beds in all Yunani Dispensaries	4	4	0	0	4	0
F.	No. of Doctors Working in Yunani Dispensaries	1	1	0	1	2	0
INDUSTRIES:							
1.	Cottage Industries	725	491	433	319	504	291
2.	Industries Development Block Wise Running Factories	0	0	0	0	0	0
3.	Factories From Which Returns Were Receiver	76	1	0	0	0	0
4.	Average Daily Workers And No. of Workers	7493	15	0	0	0	0
ANIMAL HUSBANDRY:							
1.	No. of Animal Husbandry, Forestification, Plantation	0	0	0	0	0	0
2.	Total Number of Animal Service Center	4	5	2	4	2	2
3.	Total Number of Artificial Fertilizer Center/Sub-Center	6	7	5	3	2	2
PHYSICAL INFRASTRUCTURE:							
1.	Length of Pucca Road [In Km.] Constructed by P.W.D. Per Lakh Population	77	63	70.9	44	84.44	30.5
2.	Length of Pucca Road [In Km.] Constructed by P.W.D. Per Thousand Square Km.	613	327	297.7	238.4	198	238.4
3.	No. of Police Stations Block-Wise	2	2	1	1	0	0
4.	No. of Post Offices Block Wise	19	16	21	16	13	8
5.	No. of Telephones Block Wise	0	41	29	0	0	0
6.	No. of Telegraph Centers Block Wise	2	2	0	0	0	0
7.	No. of Public Call Office Block Wise	2	3	6	2	0	0
8.	Development Block Wise Transport						
A.	*No. of Railway Stations*	4	3	0	1	0	0
B.	No. of Bus Stations/Bus Stops	5	9	8	4	4	1
9.	No. of Electrified Villages in Block [According to Centerl Electric Authority Definition]	106	112	69	35	47	42
10.	i- No. of Electrified Villages of the Block in which L.T. Mains is Available	93	67	54	25	33	24
	ii- The Percentage of Electrified Villages to Total Residntial Villages	100	100	100	43.9	47	61.8
11.	No. of Private Pumpset and Tube-Wells which are Powered	1062	310	1637	80	348	349
12.	Total No. of Villages	106	113	70	83	112	68
13.	No. of Residential Villages	90	112	69	82	100	68
14.	Total No. of Residential Houses	29998	25086	17153	20871	14254	18494
15.	Total No. of Families	32644	27436	19156	25636	16542	19892
16.	Total No. of Rationing Shops	29	47	17	52	19	19
17	No. of Village Development Officers	15	15	19	12	10	12
18	Number of Villages With Drinking Water Source from Wells	90	112	0	82	0	0
19	The Condition of Drinking Water Facility In Blocks						
A.	Water Supply By Hand Pump In Villages [Total]	0	0	69	40	0	0
B.	Effected Population	0	0	69000	20000	0	0
C.	No. of Village Where Used General Utilized Source of Water Supply By Hand Pumps	0	0	0	0	0	0

Source:- Statistics Patrika, U.P. State Planning Deptt.

Table 5.2 Block-wise Cooperative Development as of 1988-89

Item	Study Area / Block	Sarojini Nagar		Sataon		Purwa	Sursa
		Sarojani Nagar	Mohanlal Ganj	Sataon	Hilauli	Purwa	Sursa
1. Loan Co-operative Union For Agriculture (Primary)							
A. Total No.		13	14	8	9	11	14
B. No. of Members		12,893	7,235	15,998	8,820	9,070	15,500
C. Share Capital In Rs.		865	512	801	768	616	900
2. Distribution of Loan In The Year							
A. Short Term		2,590	886	2,280	2,175	2,131	1,450
B. Medium Term		590	114	62	1,276	398	206
C. Long Term		2,400	1,740				752
3. Number of Co-Operative Banks Branch		1	1	1	1		1
4. No. of Nationalized Banks Branch		11	8	2	1		1
5. No. of Rural Area Bank				4	2	2	5

Source: Various issues of "Sankhyakiya Patrica", State Planning Institute Government of Uttar Pradesh

Table 5.3 Constraints on Agricultural Production in Lucknow Division

NO		CONSTRAINTS	Wheat	Paddy	Sugar cane	Maize	Potato	Mustard	Pea	Gram	Greengram/ Blackgram	Towar	Groundnut	Pegion Pea (Arhar)
1	I	Lack of irrigation sources	x	x									x	
2		No knowledge about the quality of irrigation water to be applied	x	x				x						
3		Irrigation facility is not easily available		x	x									
4		Poor water management		x		x	x							
5		Poor management of drainage	x			x	x		x	x	x			x
6		Unavailability of suitable varieties for waterlogged conditions			x									
7	C	Field preparation			x		x	x	x	x		x	x	x
8		No knowledge about latest crop rotations	x		x			x	x	x				
9		No use of culture								x	x			x
10		No use of dapog nursery		x										
11		Low seed rate per hectare for nursery		x										
12		Untimely planting			x									
13		No proper distance between plant to plant and row to row			x									
14		Optimum plant population is not maintained						x	x	x				x
15		In some cases, over plant population causes overlapping of leaves & shortage of pollen drops in Gynisium, lowers down the yield				x								
16		Lack of proper plant geometry					x							
17		Late transplanting		x										
18		Improper transplanting of seedings		x										
19		Broadcast method of sowing				x		x						
20		Low seed rate per hectare for direct sowing	x	x		x								
21		Sowing is not done at recommended time				x	x	x	x	x	x			
22		Old method of sowing and no suitable distance between row to row & plant to plant			x	x								
23		Thinning is not done at proper time/ Lack of proper thinning						x						x
24		Poor management of hoeing and weeding			x						x			
25		Poor and untimely weed control	x	x	x	x	x				x	x		x
26	F	No application of soil and seed treating chemicals	x		x	x	x				x		x	x
27		Application of fertilizers is not applied on the basic soil PH and regular use of chemical fertilizer	x											
28		Low application of fertilizer as basal and top dressing		x		x								
29		Use of imbalance dose of nitrogen											x	
30		Imbalance use of phosphatic fertilizers							x	x				x
31		Poor knowledge about the application of sulphur, phosphate, borax nitrogen, potash and calcium	x										x	
32		Improper and imbalance use of fertilizers	x	x	x		x	x		x	x	x	x	
33		Non adoption of seed treatments and application of rhizobium culture								x				
34		Poor knowledge about the application of macronutrients					x							x
35		No use of ZnSo4 to the paddy crop in usar soils		x										
36		Lack of using organic manures-like F.Y.M. green manuring, cakes etc.	x											
37	V	No proper selection of varieties according to the classification of the soil	x				x					x		
38		No knowledge of new agricultural technology and improved varieties	x	x	x	x		x	x	x		x		x
39		Lack of suitable and high yielding varieties										x		
40		Early maturing varieties like Upas and T-21 are not being used												x
41		No knowledge about resistant variety of late and early blight					x							
42		Lack of powdery mildew resistant varieties							x					
43		No knowledge about aphids and sawfly resist varieties						x						
44		Use of poor quality of seeds	x				x	x	x	x	x			
45	O	High selling rate of agricultural supplies and facilities	x				x							
46		High interest rate credit from banks	x											
47		Cheating with farmers at purchasing time by brokers			x									
48		By- products is having low selling rate, by the result farmers get low benefit			x									
49		Dependent on nature (Rainy season)		x										
50		Poor management of ratoon			x									
51		No proper knowledge about seed treatment and seed treating chemicals			x									
52		Uncertainty of natural conditions				x								
53		No application of hot weather cultivation					x							
54		Use of improper size and cut tubers					x							
55		Hot treatments is not being practiced					x							
56		Lower/ higher seed rate per hectare					x		x				x	
57		Mostly grown as mix cropping						x		x				
58		Unscientific mix cropping									x	x		x
59	I	Poor and untimely control of diseases and insect pests						x						
60		Improper, suitable arrangement against frost							x					x
61		Non adoption of seed treatments and application of rhizobium culture								x				
62		Cultivation on marginal land & in rainfed condition								x	x	x	x	x
63		Measure of infestations of early and late blight diseases					x							
64		Measure infestation of alternaria white rust and blight						x						
65		Susceptibility to wilt								x				
66		Susceptibility to yellow mosaick & insects									x			
67		Poor nitrification									x			
68		Attack of pod borer								x				
69		Attack of birds and rats on crop		x										
70		Lack of knowledge on how to control insect, pests and weeds diseases	x	x										
71		Measure problem of Redrot, Pyrilla and Rats			x									
72		Problem of powdery mildew & pod borer							x					
73		Measure attack of sawfly and aphids						x						
74		Major infestations of insect, pest & diseases										x		x
75		Problem of white grub											x	
76		Problem of Tikka disease											x	
77		Farmers don't have knowledge about KHAIRI diseases which is caused by Zinc diffeciency; by the result they get poor yield		x										
78		Infestations of bud nichrosis											x	
79		Ratooning invites diseases			x									
80		Poor plant protection measure		x		x						x		

Table 8.1 Project Cost

Unit: 1,000 Rs

Description	Amount		
	Foreign	Local	Total
A. Wireless Communication System			
A-1 HF Radio System	10,350	1,150	11,500
A-2 VHF Radio System	27,450	3,050	30,500
A-3 Data Processing Unit	21,060	2,340	23,400
Sub-Total (A)	58,860	6,540	65,400
B. Representative Areas			
B-1 Sarojini Nagar Study Area			
1) Irrigation System	4,145	63,138	67,283
2) Drainage System	20,035	38,045	58,079
3) Augumentation Facility	1,185	12,741	13,926
4) On-farm Facility	33,345	148,997	182,342
5) Improvement of Service Road	6,032	34,067	40,099
Sub-Total (B-1)	64,742	296,986	361,728
B-2 Sataon Study Area			
1) Irrigation System	10,701	227,665	238,366
2) Drainage System	13,484	21,949	35,433
3) Augumentation Facility	1,480	15,449	16,929
4) On-farm Facility	28,897	131,136	160,034
5) Improvement of Service Road	6,464	58,038	64,502
Sub-Total (B-2)	61,027	454,237	515,263
B-3 Sursa Study Area			
1) Irrigation System	3,904	96,125	100,029
2) Drainage System	35,078	62,641	97,719
3) Augumentation Facility	7,164	75,519	82,683
4) On-farm Facility	38,858	180,471	219,329
5) Improvement of Service Road	5,331	23,951	29,282
Sub-Total (B-3)	90,335	438,707	529,042
B-4 Purwa Study Area			
1) Irrigation System	2,101	58,746	60,847
2) Drainage System	32,865	50,733	83,598
3) Augumentation Facility	465	23,131	23,596
4) On-farm Facility	27,481	124,811	152,292
5) Improvement of Service Road	4,422	22,681	27,103
Sub-Total (B-4)	67,334	280,101	347,435
Sub-Total (B)	283,437	1,470,031	1,753,468
C. Procurement of Supporting Equipment	0	8,410	8,410
D. Land Acquisition	0	24,213	24,213
E. Administration Cost	0	148,700	148,700
F. Engineering Service	103,800	118,600	222,400
G. Contingency	124,873	1,003,597	1,128,470
Physical	44,610	177,649	222,259
Price	80,263	825,948	906,211
Total	570,970	2,780,091	3,351,061

Table 8.2 Annual Disbursement Schedule

Unit: Million Rs.

Description		Amount			1993			1994			1995		
		Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
A. Direct Construction Cost													
1) Irrigation System		20.9	445.7	466.5	0.0	0.0	0.0	0.8	17.8	18.7	4.2	89.1	93.3
2) Drainage System		101.5	173.4	274.8	0.0	0.0	0.0	4.1	6.9	11.0	20.3	34.7	55.0
3) Augumentation Facility		10.3	126.8	137.1	0.0	0.0	0.0	0.0	0.0	0.0	1.7	21.1	22.9
4) On-farm Facility		128.6	585.4	714.0	0.0	0.0	0.0	5.1	23.4	28.6	25.7	117.1	142.8
5) Improvement of Service Road		22.2	138.7	161.0	0.0	0.0	0.0	0.9	5.5	6.4	4.4	27.7	32.2
6) Wireless Communication System		58.9	6.5	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total (A)		342.3	1,476.6	1,818.9	0.0	0.0	0.0	10.9	53.7	64.7	56.3	289.8	346.1
B. Procurement of Supporting Equipment		0.0	8.4	8.4	0.0	4.2	4.2	0.0	4.2	4.2	0.0	0.0	0.0
C. Land Acquisition		0.0	24.2	24.2	0.0	0.0	0.0	0.0	12.1	12.1	0.0	12.1	12.1
D. Administration Cost		0.0	148.7	148.7	0.0	19.7	19.7	0.0	25.8	25.8	0.0	25.8	25.8
E. Engineering Service		103.8	118.6	222.4	11.8	28.6	40.5	20.3	31.4	51.6	24.9	29.3	54.2
Sub-total (A - E)		446.1	1,776.5	2,222.6	11.8	52.5	64.4	31.2	127.2	158.4	81.2	357.0	438.2
F. Contingency													
Physical Contingency	10%	44.6	177.6	222.3	1.2	5.3	6.4	3.1	12.7	15.8	8.1	35.7	43.8
Price Contingency													
F/C	3%	80.3	825.9	906.2	0.8	8.4	9.2	3.2	31.5	34.7	11.2	122.0	133.3
L/C	7%												
TOTAL		571.0	2,780.1	3,351.1	13.8	66.2	80.0	37.5	171.4	208.9	100.6	514.7	615.3

Description		1996			1997			1998		
		Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
A. Direct Construction Cost										
1) Irrigation System		5.8	124.8	130.6	5.8	124.8	130.6	4.2	89.1	93.3
2) Drainage System		28.4	48.5	77.0	28.4	48.5	77.0	20.3	34.7	55.0
3) Augumentation Facility		5.1	63.4	68.6	3.4	42.3	45.7	0.0	0.0	0.0
4) On-farm Facility		36.0	163.9	199.9	36.0	163.9	199.9	25.7	117.1	142.8
5) Improvement of Service Road		6.2	38.8	45.1	6.2	38.8	45.1	4.4	27.7	32.2
6) Wireless Communication System		58.9	6.5	65.4	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total (A)		140.5	446.1	586.5	79.9	418.4	498.3	54.6	268.6	323.3
B. Procurement of Supporting Equipment		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C. Land Acquisition		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D. Administration Cost		0.0	25.8	25.8	0.0	25.8	25.8	0.0	25.8	25.8
E. Engineering Service		21.5	21.1	42.6	14.8	4.8	19.5	10.6	3.4	14.0
Sub-total (A - E)		162.0	493.0	655.0	94.7	448.9	543.6	65.2	297.8	363.0
F. Contingency										
Physical Contingency	10%	16.2	49.3	65.5	9.5	44.9	54.4	6.5	29.8	36.3
Price Contingency										
F/C	3%	28.4	218.3	246.7	20.2	247.3	267.5	16.5	198.5	214.9
L/C	7%									
TOTAL		206.6	760.6	967.2	124.4	741.1	865.5	88.2	526.1	614.3

Table 9.1 Derivation of Economic Farmgate Prices in 1995

for Major Crops

ITEM	Unit	Commodity					
		Wheat	Paddy	Maize	Sorghum	Groundnut	Sugarcane
World Market Price 1995 1/	US$	160	263	98	93	371	173
Quality Adjustment	%	100	75	100	100	100	100
World Market Price, Adjusted	US$	160	198	98	93	371	173
Ocean Freight & Insurance 2/	US$					51	0
Domestic Border Price	US$	160	198	98	93	422	173
Exchange Rate	Rs/US$	25.90	25.90	25.90	25.90	25.90	25.90
Domestic Border Price	Rs	4,138	5,116	2,550	2,415	10,938	4,473
Domestic Handling & Transport 3/	Rs	400	400	400	400	400	400
Wholesale Price	Rs	4,538	5,516	2,950	2,815	11,338	4,873
Processing 3/	Rs	0	-169	0	0	-200	-95
Processing Ratio	%	0	67	0	0	40	7
Sales of By-products	Rs		70			3,281	
Transport from Farmgate 3/	Rs	-80	-80	-80	-80	-80	-80
Economic Farmgate Price	Rs	4,458	3,572	2,870	2,735	7,657	414
Financial Farmgate Price	Rs	2,310	1,880	1,880	1,880	5,150	310
Conversion Factor		1.930	1.900	1.526	1.455	1.487	1.337

Remarks: 1/ From "Commodity Price Forecasts --December 1990 (IBRD, Economic Analysis and Projections Department) commodity prices projected for 1995 in current US Dollars have been deflated by the MUV index to obtain price projections in constant prices of 1990:

Wheat: Canadian No.1, Western Red Spring, FOB Thunder Bay
Paddy: Rice: Thai, milled, 5% broken, FOB Bankok
Maize: US No.2, Yellow, FOB Gulf ports;
Sorghum: US No.2, Milo Yellow, FOB Gulf ports

2/ With India on the margin of self-sufficiency in foodgrains, it is assumed that, depending on the size of the annual harvests, exports or imports will occur in the short- and medium-term, and international transport costs have therefore been omitted.

3/ Adjusted with Standard Conversion Factor of 0.8

for Fertilizer

ITEM	Unit	Fertilizer			
		UREA	TSP	DAP	KCl
Projected 1995 world market price 1/	US$	111	98	125	62
International shipping/handling charge	US$	42	42	44	39
CIF price at Calcutta	US$	153	140	170	102
Exchange Rate	Rs/US$	25.90	25.90	25.90	25.90
Value equivalent to Rs./ton	Rs	3,969	3,633	4,390	2,630
Domestic transport/handling to wholesale point	Rs	400	400	400	400
Price at Lucknow	Rs	4,369	4,033	4,790	3,030
Transport/handling to farmgate 2/	Rs	80	80	80	80
Farmgate economic price	Rs	4,449	4,113	4,870	3,110
Price per ton of nutrient	Rs	9,671	8,569		5,184
		N	P2O5		K2O

Remarks: 1/ From "Commodity Price Forecasts --December 1990 (IBRD, Economic Analysis and Projections Department) commodity prices projected for 1995 in current US Dollars have been deflated by the MUV index to obtain price projections in constant prices of 1990:

2/ Adjusted with Standard Conversion Factor of 0.8

Table 9.2 Breakdown of the Expected Project Benefit

Area	Cropping Season	Project Area (ha)	With Project Condition				Without Project Condition				Incremental Benefit (Rs.million)
			Cultivated Area (ha)	Gross Income (Rs.million)	Production Cost (Rs.million)	Primary Profit (Rs.million)	Cultivated Area (ha)	Gross Income (Rs.million)	Production Cost (Rs.million)	Primary Profit (Rs.million)	
1 Sarojini Nagar	Kharif	14,862	14,862	148.1	42.7	105.4	9,237	62.6	23.2	39.4	66.0
	Rabi		14,862	164.2	37.1	127.1	9,275	76.3	21.4	54.9	72.1
	Annual			312.2	79.8	232.4		138.9	44.6	94.3	138.2
2 Sataon	Kharif	12,874	12,874	128.2	38.7	89.5	7,274	51.7	26.2	25.5	64.0
	Rabi		12,874	142.2	34.3	107.9	9,006	78.7	22.6	56.1	51.8
	Annual			270.5	73.0	197.4		130.4	48.7	81.7	115.8
3 Sursa	Kharif	17,313	16,880	161.7	45.6	116.1	9,834	68.5	23.0	45.5	70.6
	Rabi		16,880	180.1	40.3	139.8	13,280	125.7	30.9	94.9	44.9
	Perennial		433	5.4	2.5	2.9	960	10.3	5.1	5.2	-2.3
	Annual			347.2	88.3	258.8		204.6	59.0	145.6	113.2
4 Purwa	Kharif	12,252	12,252	121.4	34.6	86.8	6,638	51.9	16.9	35.0	51.8
	Rabi		12,252	135.3	29.5	105.8	6,735	48.9	12.7	36.3	69.5
	Annual			256.7	64.1	192.6		100.9	29.6	71.3	121.3
Total		57,301	57,301	1186.6	305.3	881.3	32,983	574.7	181.9	392.8	488.5