

INDIA

**MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA**

**DEPARTMENT OF AREA DEVELOPMENT
STATE GOVERNMENT OF UTTAR PRADESH**

**FEASIBILITY STUDY
ON
IRRIGATION AND DRAINAGE
DEVELOPMENT OF
SHARDA CANAL CAD PROJECT**

EXECUTIVE SUMMARY

NOVEMBER 1991

Japan International Cooperation Agency



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PREFACE

In response to a request from the Government of India, the Government of Japan decided to conduct a feasibility study on the Irrigation and Drainage Development of Sharda Canal CAD Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to India a study team headed by Dr. Yasuhiko KUNIHURO, Nippon Koei Co., Ltd., two times between September 1990 and March 1991.

The team held discussions with the officials concerned of the Government of India and the State Government of Uttar Pradesh, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of India and the State Government of Uttar Pradesh for their close cooperation extended to the team.

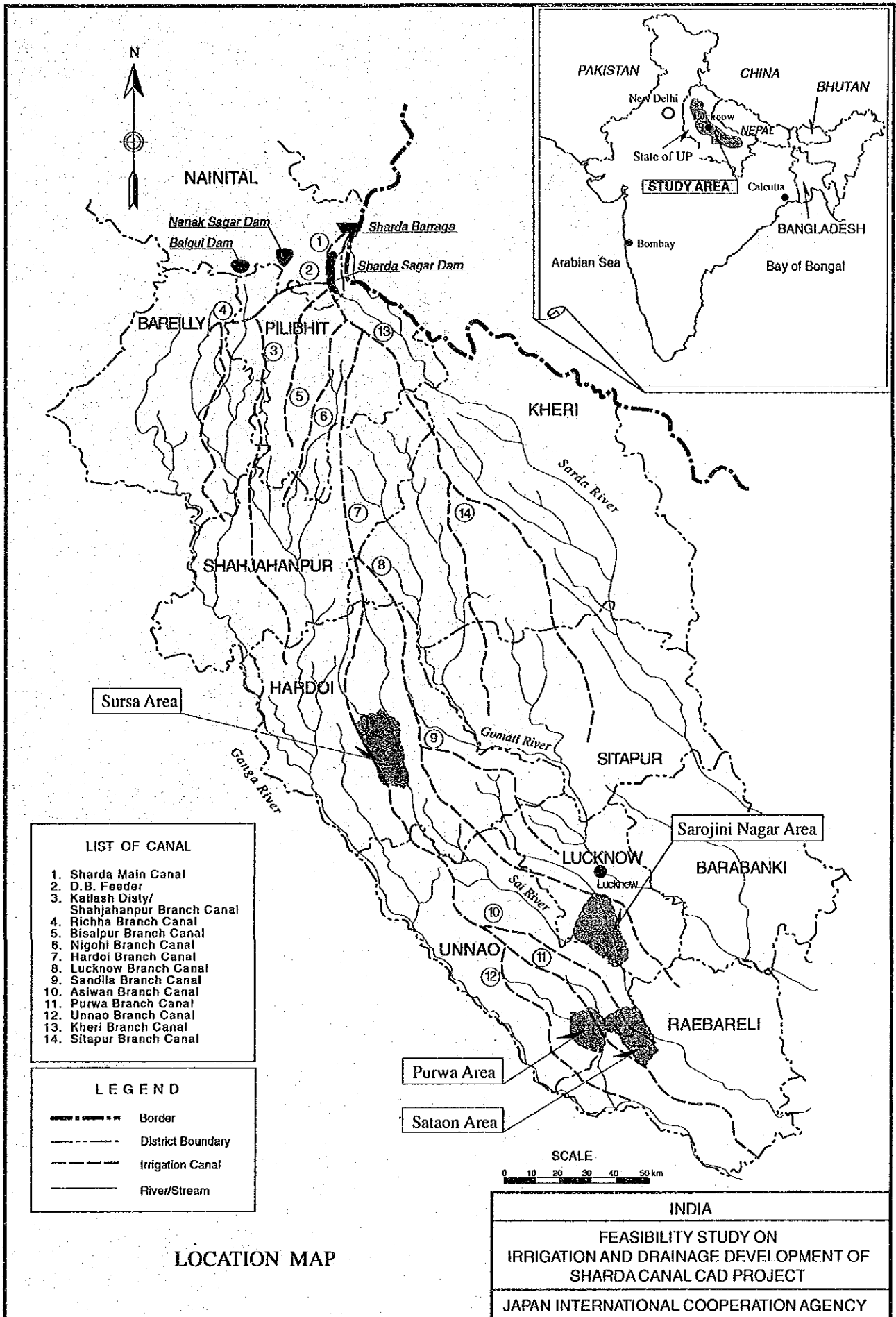
November 1991



Kensuke Yanagiya

President

Japan International Cooperation Agency



- LIST OF CANAL**
1. Sharda Main Canal
 2. D.B. Feeder
 3. Kailash Disty/ Shahjahanpur Branch Canal
 4. Richha Branch Canal
 5. Bisalpur Branch Canal
 6. Nigohi Branch Canal
 7. Hardoi Branch Canal
 8. Lucknow Branch Canal
 9. Sandila Branch Canal
 10. Asawan Branch Canal
 11. Purwa Branch Canal
 12. Unnao Branch Canal
 13. Kheri Branch Canal
 14. Sitapur Branch Canal

- LEGEND**
- Border
 - - - District Boundary
 - - - Irrigation Canal
 - River/Stream

SCALE
0 10 20 30 40 50 km

INDIA

**FEASIBILITY STUDY ON
IRRIGATION AND DRAINAGE DEVELOPMENT OF
SHARDA CANAL CAD PROJECT**

JAPAN INTERNATIONAL COOPERATION AGENCY

LOCATION MAP

**FEASIBILITY STUDY ON
IRRIGATION AND DRAINAGE DEVELOPMENT OF
SHARDA CANAL CAD PROJECT**

EXECUTIVE SUMMARY

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SUMMARY AND RECOMMENDATIONS

I. HISTORY OF THE PROJECT

1. The Government of India has put the priority to the agricultural development, especially the expansion of irrigation since the First Five Year Plan in 1951. However irrigation utilization and productivity under irrigated agriculture was still low. With a view to improve these aspects, the Command Area Development Programme was launched in 1974-75 by the Government of India.
2. The Government of India requested the technical assistance to the Government of Japan to undertake the feasibility study in February 1988. In reply to the request, the Government of Japan decided to provide the assistance for the study for the Sharda Canal CAD Project through the Japan International Cooperation Agency (JICA).
3. JICA sent the preliminary study team and the Scope of Work (S/W) for performing the feasibility study on the subject project was agreed upon between JICA and the Ministry of Water Resources of Government of India and the Department of Area Development of Uttar Pradesh State Government on April 19, 1990.
4. JICA organized a study team according to the S/W and commenced the feasibility study from September 5, 1990. The first stage of the study was carried out between September 5, 1990 to December 22, 1990 and the second between December 23, 1990 and July 31, 1991.
5. The Draft Final Report was submitted to the the Government of India in August 1991, and the report was discussed in the meeting of the Steering Committee held on September 4 and 5, 1991. According to the result of the meeting, the comments on the Draft Final Report were raised by the Government of India on October 31, 1991. This report was finalized on the basis of the further study.

II. BACKGROUND OF THE PROJECT

6. Current Situation of the National Economy

India is the seventh largest country in the area with a population over 800 million, being the second most populous. Agricultural sector accounts for about 70% employment .

The Gross Domestic Product (GDP) in 1988-89 was Rs.1,885 million, out of which the agricultural sector shares 38.4%. The annual GDP growth averaged 5.9% for the first four years of the Seventh Five Year Plan (1986-1989). The wholesales price index in the corresponding period rose by an average of 6.5%. GNP in 1988 attained about US\$265,600 million. The long term debt went up rapidly from US\$26,545 million in 1984 to US\$51,168 million in 1988. The total debt service went up similarly from US\$2,431 million to US\$4,958 million during the same period, which correspond to 17.6% and 21.7% to the GNP in the respective year. The export value of goods and services could not, however, keep with up the pace of the above.

7. Socio-Economic Features of Uttar Pradesh State

The total population of the UP State is estimated to be 138.5 million in 1991 on the basis of 25% growth rate during 1971-81 and population of 110.86 million in 1981. Population density in 1981 stood at 377 per square kilometer, compared to 216 for all India average. The farmers constitute about 58.5% of the total work force, and landless agricultural laborers corresponding to 16%, thus about 74% of the State population is directly dependent on the agricultural economy in 1981. The percentage of population below poverty line was 45.3% in 1983-84 in the UP State as against 37.4% in the country. Agriculture with an allied sector constitute about 46% of the State Domestic Product at 1980-81 price as against 34% of the country. The main crop of the UP State is paddy rice with annual production of 9,420 thousand ton in Kharif and wheat of 19,610 thousand ton in Rabi in 1988-89.

8. Command Area Development Programme

Despite undertaking irrigation development measures since 1951, there was much gap between irrigation potential created and utilization thereof, and agricultural production under irrigated land was lower than anticipated. With a view to improving the situation, the Centrally Sponsored Command Area Development (CAD) Programme was launched in 1974-75. To execute the CAD programme, 38 CAD Authorities have been established for 60 irrigation projects in 13 states with CCA of about 15 million ha in the initial stage. Presently 54 CADA are operating for 131 CAD projects in 22 states with CCA of about 18.5 million ha. Since 1974 the CAD programme has been executed and considerable financial assistance has been rendered. A number of the evaluation studies on the impact of the CAD works has been carried out. On the basis of the studies, it was recognized that the key element in executing the CAD Programme is the removal of the uncertainty in irrigation water supply attributable to

- lack of unified control of water management from the head to outlets
- lack of control structures, measuring devices and distribution canal system
- lack of proper operation and maintenance of the water distribution system
- lack of farmers' participation in irrigation management

III. PRESENT CONDITIONS OF SHARDA CANAL COMMAND AREA

9. Physical Environment

The UP State is located in the north-eastern part of India along the border of Nepal and China with the geographical extent of 300 thousand km². The capital of the State is Lucknow, lying 500 km east of New Delhi. The study area extends in the vast plain with altitudes of 100 m to 200 m sandwiched by the Ganges and the Sharda rivers. The study area is gently sloping from the northwest to southeast.

The UP State lies under a semi-arid climate zone of a semi-tropical area, characterized by four distinctive seasons, i.e., dry winter season (January to February), dry but hot season (March to May), monsoon season (June to September) and post monsoon season (October to December). January is the coldest month, with the minimum temperature below 10 degree centigrade. May is the hottest month having the maximum temperature over 40 degree centigrade. The annual rainfall varies considerably between 800 mm to 1,500 mm. This is a serious physical constraint on the agricultural production.

Sharda Canal Command Area consists of broad alluvial plains. The flat land is composed of unconsolidated thick layers, and forms a large groundwater basin holding abundant groundwater reserves. The aquifers have 1-5 layers with thickness of 10-50 m lying below 30 m from the ground surface.

Soils in the Sharda Canal Command area are formed by alluvial deposits by the Sharda river, the Ganga river and their tributaries. Coarse soils occur in the upstream area and fine soils exist in the lower part of the command

10. Socio-Economical and Administrative Setting

The Sharda Canal Command Area is constituted by partial or full inclusion of areas from 11 districts of Nainitar, Bareilly, Pilibhit, Shahjahanpur, Kheri, Sitapur, Barabanki, Hardoi, Lucknow, Unnao and, Rae-Bareilly. An average land holding size is different in district by district. Nainitar has the largest average holding size of 1.83 ha, while Rae Bareilly has the smallest with 0.76 ha as the data in 1985-86. In spite of the continuous decline of its share in the State Product, agriculture sector still shares of 42% to the total State Product in 1987. The number of the workers in agriculture sector accounts for 79 % of the total workers or 23.45 million as of 1981.

11. Present Agricultural Setting

The net cultivated areas in the related districts of Sharda Canal Command and Hardoi Branch command are 2,392 thousand ha and 1,023 thousand ha, respectively, or about 70% of the total land. Out of the net cultivated areas, about 50% are irrigated. Major crops in Kharif are paddy, followed by maize and jowar, while wheat and barely are dominantly cultivated in Rabi. Crop yields are generally low with the average of 2.05 ton/ha of paddy and 1.9 ton/ha of wheat. Most serious problem on crop production is insufficient irrigation water in particular in transplanting period for paddy. Water logging and alkalinity problems is another constraints to get better yield.

On-farm level extension activity is shouldered to village development officers and assistant development officers in each block development office. Extension workers encounter constraints such as insufficient number of staff, lack of mobility to reach farmers systematically, etc.

There are three types of credit through national, district and cooperative banks to farmers:

- Short term loan : for field improvement and agricultural inputs
- Mid-term loan : for animal husbandry, agricultural equipment, small irrigation works, etc.
- Long-term loan : for small irrigation, well boring, pump sets, tubewell, agricultural machinery

12. Command Area Development Works

Under the U.P. Area Development Act, 1976, Sharda Sahayak CAD Authority has been set up. After finishing the CAD works of the Sharda Sahayak Project, Sharda Canal CAD Project for 1.612 million ha was commenced in 1989. The Sharda Canal CAD works are scheduled to be completed by March 1993 so far as the on-farm works (OFD) for about 550 thousand ha are concerned. The present Sharda Canal CAD works are concentrated on OFD. Osrabandi is, however, not introduced yet in the completed areas of OFD, and extension services are limitedly provided. The Progress of Sharda Canal CAD works is as shown in Fig. 1.

13. Irrigation Works

The Sharda main canal takes off from the Sharda river through an intake at Banbassa in the district Nainitar near the border of Nepal, with the present head capacity of 11,500 cusec or 325.5 cumec for culturable command area (CCA) of 1.612 million ha. The irrigation potential is 804 thousand ha, and annual irrigation area averaged to 631 thousand ha or 39% crop intensity to CCA for the recent five years. The Sharda main canal bifurcates into Hardoi Branch and Kheri Branch at the tailend. The Sharda Sagar reservoir locating downstream of the main canal augments discharges of Hardoi Branch especially in Rabi season. The Hardoi Branch serves a CCA of 757,772 ha by the head capacity of 5,400 cusec or 152.8 cumec with the canal length of 250 km. The annual irrigation area was 292,000 ha or 39% crop intensity to CCA on an average for the recent five years.

Irrigation deliveries are practiced according to rostering on the basis of 27 and 25 weeks in respective Kharif and Rabi seasons. Actual seasonal deliveries at the respective sections of Hardoi Branch are generally agreed with the schedule in the roster as shown in Fig. 2, whereas, the timing of supply much differs in the downstream reaches and offtaking branches in which the ON/OFF operation is made as shown in Fig. 3. Reliability of water supply is low, which is attributed to the lack of the overall systematic water management. The present irrigation efficiency of the Sharda Canal system is estimated as follows:

Canal System	Rabi	Kharif
Main canal	0.92	0.95
Hardoi Branch	0.74	0.70
Distributary/Minor	0.80	0.80
Field channel	0.78	0.78
Application efficiency	0.55	0.65
Overall efficiency	0.23	0.27

14. Drainage Works

The geographical gradient is gentle, which results in a poor drainage condition. It allows rainfall and irrigation excess stagnate at the tail, then such condition results high groundwater table occurring water logging and salt affected areas. The water logging and salt affected areas are located mostly in the downstream part of the command. Drainage works are not sufficiently provided.

15. Groundwater Use

The groundwater is highly utilized in the command area. About 80% of the annual draft is made by the private shallow tubewells. The annual net draft in the related Districts to Sharda Canal command is estimated to be 3,100 MCM in 1989. The net recharge of groundwater in the same area is estimated to be 11,900 MCM. Development potential of the same area will be 2,860 MCM on condition of development stage of 50%.

16. Transportation

The national highway No.23 connect Lucknow with Delhi with about 500 km in length. The railway is available from Lucknow to Delhi and/or Calcutta. The domestic airway connects directly with Delhi and other major cities .

IV. SELECTION OF THE REPRESENTATIVE CAD AREAS

17. Selection Criteria

The representative CAD areas, to which the agricultural development plan will be formulated, are selected from the Hardoi Branch command in accordance with S/W through the following steps:

- (1) Categorization of Blocks by Natural and Socio-economic Conditions
- (2) Priority Ranking by Scoring of Parameters
- (3) Screening for the CAD Progress and Adverse Environmental Impact upon Project Implementation

18. Selected Areas

The selected areas are as follows including the discussion result of Steering Committee dated on December 29,1990:

(1) Representative Area for Improvement of Irrigation Condition

(i) Area-1

District : Lucknow
Block : Sarojini Nagar
Canal system : Amausi distributary of Lucknow Branch system

(ii) Area-2

District : Rae Bareli
Block : Sataon
Canal system : Maurawan distributary of Asawan Branch system

(2) Representative Area for Improvement of Poor Drainage Condition

District : Hardoi
Block : Sursa
Canal system : Badaicha distributary of Hardoi Branch system

(3) Representative Area for Improvement of Salt Affected Area

District : Unnao
Block : Purwa
Canal system : Purwa distributary of Purwa Branch system

V. PRESENT CONDITIONS OF THE REPRESENTATIVE CAD AREAS

19. Natural Conditions

(1) Location and Topography

The Sarojini Nagar area is located just in the south of Lucknow city which is the capital of Uttar Pradesh State. The Amausi Distributary is the principal irrigation system which is served from Lucknow Branch. The geographical extent of the area is 33,488 ha and CCA is 14,862 ha.

The Sataon area is located in the down-most reach of Asiwan Branch and Maurawan Distributary in District of Rae Bareli. The geographical extent of the area is 25,763 ha and CCA is 12,874 ha.

The Sursa area is located in the southeast of Hardoi city in Hardoi district. The Badaicha Distributary taking off from Hardoi Branch is the main irrigation system of the area. The geographical extent of the area is 32,269 ha and CCA is 17,131 ha.

The Purwa area is located south of Purwa town in Unnao District. Purwa distributary and Tikar Distributary which are diverted from Purwa Branch are the main irrigation system of the area. The geographical extent of the area is 20,828 ha and CCA is 12,252 ha.

(2) Climate

The general climatic characteristics of the Representative Areas is similar to the Hardoi command. The coldest month is January when minimum temperature goes down to 8 degree centigrade. The hottest month is May when the maximum temperature goes up to 40 degree centigrade. The annual rainfall varies widely from 300 mm to

1,400 mm. About 75% of the annual rainfall occurs in July to September and 90% of that comes during four months from June to September.

(3) Soils

Soils in the Representative Areas are classified into five categories; a) upland, b) mid-upland, c) midland, d) mid-lowland, and e) lowland. About 70% of the geographical area belong to mid-upland and midland which have high crop productivity, except the Sataon area.

(4) Geo-hydrology

The strata of the Representative Areas generally consist of alternating layers of clay and sand materials. The groundwater lies in sandy layers at about 20 to 30 m below the ground surface. Groundwater tables in Sataon and Sarojini Nagar tend to lower, while those in Sursa and Purwa are not significantly lowering.

20. Socio-economic Conditions

Each of Representative Areas consists of several administrative blocks to which many panchayats and villages belong. The total geographical area of the related blocks is 112,348 ha which includes 57,301 ha of CCA. Total population is about 750,000 with the population density of 680 per km². The rate of labor engaging in agriculture sector to total laborers in Sarojini Nagar is about 75%, while other blocks are higher with the rates of 85% to 96%. The socio-economic indicators of major administration blocks in the Representative Areas are as shown in Table 1.

21. Agriculture

About 60% of the total land is cultivated, of which 60 to 80% are irrigated. Rate of irrigated land is low in Sataon and Sarojini Nagar area. Comparing to all of Hardoi Branch command, the rate of current fallow land is higher in the Representative Areas. Main crops in the Representative Areas are paddy in Kharif and wheat in Rabi. Cultivated crops are well diversified in Sursa area, while paddy and wheat are dominant in Purwa. Sorghum is second important Kharif cropping in Sarojini Nagar, Sataon and Purwa areas, while maize is rather important in Sursa area. Post harvest facilities such as warehouse, godown, mill, etc. have been established by the central and state warehouse corporation. Smaller farmers tend to keep their harvested grains for

domestic consumption, 70% of paddy and 80% of wheat produced by marginal farmers are consumed by themselves. Smaller scale farmers are likely not to be able to live only on agriculture.

There are no farmers' organization in the Representative Areas except cooperatives related to credit input supply and marketing. Agricultural extension is not so active. Constraints on agricultural production are indicated in Table 2 as the case of Lucknow Division.

22. Irrigation and Drainage

The actual irrigation intensities of the Representative Areas are as summarized below. The irrigation intensities in Sataon and Sarojini Nagar is extremely low compared with other areas.

Area	CCA	Irrigation Area			
		Kharif		Rabi	
		(ha)	(% to CCA)	(ha)	(% to CCA)
Sarojini Nagar	14,862	1,342	9.0	1,821	12.3
Sataon	12,874	259	2.0	404	3.1
Sursa	17,313	2,595	15.0	4,827	27.9
Purwa	12,252	2,908	23.7	3,103	25.3
Total	54,301	7,104	12.4	10,155	17.7

The water deliveries for the respective Representative Areas are summarized below with comparison to the scheduled deliveries in the roster.

Area	Canal System	89/90 Rabi			Kharif		
		Schedule (MCM)	Actual (MCM)	(%)	Schedule (MCM)	Actual (MCM)	(%)
Sarojini Nagar	Amausi Dy.	12.3	16.4	133	18.5	15.8	85
Sataon	Maurawan Dy.	45.2	26.6	59	65.7	37.5	57
Sursa	Badaicha Dy.	7.5	24.4	324	16.6	28.0	169
Purwa	Purwa Dy.	7.8	5.3	68	10.7	8.3	77

The drainage conditions of the Representative Areas are as summarized below.

(Unit: ha)

	Study Area	Inundation Area	Water Logging	Salt Affected	Usar
Sarojini Nagar	33,482	11,599	2,268	5,214	992
Sataon	25,763	16,113	915	1,423	640
Sursa	32,269	2,069	1,991	2,317	817
Purwa	20,828	15,990	1,256	3,080	669

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

23. Development Strategies and Objectives

To improve the socio-economic conditions, the draft Eighth Five Year Plan of Uttar Pradesh State sets the following purposes relating to the agricultural development:

- (1) to increase income of rural poor
- (2) to improve the quality of rural life
- (3) to maximize productivity in agriculture along with diversification and mixed farming in small and marginal holdings and in areas of low productivity.
- (4) to consolidate gains from and to improve efficiency and productivity of past investment and of the existing assets

The principal strategies for achieving the above development objectives emphasize the following activities:

- (1) Removal of causes for unreliable irrigation water supply and improvement of irrigation efficiency
- (2) Even distribution of irrigation water
- (3) Improvement of poor drainage and salinity/alkalinity
- (4) Improvement of farm technology

24. Basic Measures for Each Representative CAD Areas

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

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

VII. THE PROJECT

25. Irrigation Plan

The proposed irrigation works are summarized as follows, and the general layouts of the Representative Areas are as shown in Fig. 4 to 7:

(1) Improvement of Existing Irrigation System

Description	Sarojini Nagar	Sataon	Sursa	Purwa
- Setting of existing canal section (km)				
Distributary	55.0	91.8	34.8	35.3
Minor	54.7	19.1	64.9	46.1
- Canal lining (km)				
Distributary	16.4	38.6	19.5	17.8
Minor	16.3	51.6	36.4	20.3
- Additional parallel Mr.				
(nos.)	11	27	10	12
(km)	41.6	104.0	45.0	53.0
- Improvement of existing control structure (nos.)				
Replacement				
Head regulator	1	37	2	4
Offtaking structure	29	40	16	18
Outlet	365	768	386	291
Provision				
Measuring device	32		26	26
Steel slide gate	1	27	2	4
- Improvement of canal inspection road (km)				
Inspection road for Dy.	55.0	91.8	34.8	35.3
Inspection road for Mr.	54.7	19.1	64.9	46.1

- (2) Sai River Pump Lift Irrigation Scheme
- (i) Sarojini Nagar Area : 1 pump station for CCA of 2,167 ha
 - (ii) Sataon Area : 1 pump station for CCA of 2,822 ha
- (3) Groundwater Development
- (i) Sursa Area : 900 nos. of shallow tubewells
 - (ii) Purwa Area : 280 nos. of shallow tubewells
- (4) Establishment of Wireless Communication System covering Banbassa intake to four Representative Area

26. Drainage Plan

Principal features of drainage works are as follows:

Description	Sarojini Nagar	Sataon	Sursa	Purwa
Main and secondary drainage canals (km)				
Improvement	32.7	29.7	48.0	79.2
Construction	49.5	30.6	51.0	36.7
Total	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

27. On-farm Development Plan

The on-farm development works are summarized below.

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

28. Improvement Plan of Water Logging and Salt Affected Areas

To improve the water logging and salt affected areas 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

In this context, the improvement of drainage systems, development of groundwater and trial farms are proposed.

29. Agricultural Development Plan

The crop production plan in Kharif and Rabi is summarized below, and the Proposed Cropping Patterns in canal irrigated area and in non-canal irrigation area are as shown in Figs. 8 and 9.

Crop Yield	Sarojini Nagar		Sataon		Sursa		Purwa		Total	
	(ha)	(ton)	(ha)	(ton)	(ha)	(ton)	(ha)	(ton)	(ha)	(ton)
Kharif										
Paddy	8,073	26,645	6,993	23,080	8,989	29,377	6,656	21,965	30,710	101,067
Sorghum/Maize	1,695	3,389	1,468	2,935	2,632	5,263	1,862	3,725	7,655	15,311
Pulse	3,044	4,114	2,637	3,564	3,546	4,792	2,509	3,391	11,735	15,861
Oilseeds	2,051	1,989	1,777	1,723	1,732	1,724	1,225	1,220	6,784	6,656
Rabi										
Wheat	9,772	26,956	8,465	23,350	10,950	29,886	8,056	22,222	67,242	102,415
Pulses	2,229	3,121	1,931	2,704	2,597	3,635	1,837	2,573	8,595	12,033
Oilseeds	1,301	1,078	1,127	933	1,514	1,255	1,072	888	5,014	4,154
Potatoes	780	14,491	676	12,552	909	16,880	643	11,946	3,009	55,869
Permanent										
Sugarcane	-	-	-	-	415	12,450	-	-	415	12,450

30. Plan to Actualize Osrabandi

The farmers' association will first be organized under the guidance of the CADA on the chak basis in the early stage of the project work. The training of farmers on the water management will be made in the selected model chak.

VIII. PROJECT IMPLEMENTATION PLAN AND COST ESTIMATE

31. Implementation Schedule of the Project

The Project works will last for 6 years, including the survey, design and other preparatory works as shown in Fig. 10. In the first year, the establishment of farmers associations is firstly conducted together with survey and design. In the second year, the drainage pilot farm and adaptive trial farms are established so as to early utilize and demonstrate the result of the investigation and trials in the command areas. The modernization and on-farm development works will be started in the second year immediately after selection of the contractors.

32. Organization of the Project Implementation

Implementation of the Projects 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. The following divisions will be required for performing the project works, with mobilization of the staffing from the concerned departments as shown in Fig. 11:

- (1) Administrating and Accounting Division
- (2) Engineering Division, consisting of:
 - (a) On-farm Development Sub-divisions
 - (b) Irrigation and Drainage Modernization Sub-divisions

- (3) Water Management Division, consisting of :
 - (a) Water Supply Sub-divisions
 - (b) Maintenance Sub-divisions
- (4) Agro-management Division, consisting of:
 - (a) Crop Loan Sub-divisions
 - (b) Seeds, Fertilizer and Storage Sub-divisions
 - (c) Marketing and Storage Sub-divisions
 - (d) Agro-Processing Sub-divisions
- (5) Training, Action Research, Monitoring and Evaluation Unit

33. Project Cost

The Project cost is as shown in Table 3 and is as summarized below:

Unit: Rs. million

	Sarojini Nagar	Sataon	Sursa	Purwa	Total
1 Direct Construction Cost	398.7	530.0	548.8	361.4	1,818.9
2 Procurement of Supporting Equipment	2.2	1.9	2.5	1.8	8.4
3 Land Acquisition	5.2	7.4	8.6	3.0	24.2
4 Administration Cost	38.6	33.4	44.9	31.7	148.6
5 Engineering Service	57.7	50.0	67.2	47.6	222.5
Sub-total	<u>482.9</u>	<u>622.7</u>	<u>672.0</u>	<u>445.5</u>	<u>2,222.6</u>
6 Contingency	240.6	327.0	338.5	222.3	1,128.4
Total	723.0	949.7	1,010.6	667.8	3,351.1

IX. PROJECT EVALUATION

34. 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. The annual incremental benefit at the full development stage is estimated as shown in Table 4 and summarized below:

Area	Cropping Season ⁰	With Project Condition			Without Project Condition		Incremental Benefit (Rs.million)
		Project Area (ha)	Cultivated Area (ha)	Primary Profit (Rs.million)	Cultivated Area (ha)	Primary Profit (Rs.million)	
1 Sarojini Nagar	Kharif	14,862	14,862	105.4	9,237	39.4	66.0
	Rabi		14,862	127.1	9,275	54.9	72.1
	Annual			232.4		94.3	138.2
2 Sataon	Kharif	12,874	12,874	89.5	7,274	25.5	64.0
	Rabi		12,874	107.9	9,006	56.1	51.8
	Annual			197.4		81.7	115.8
3 Sursa	Kharif	17,313	16,880	116.1	9,834	45.5	70.6
	Rabi		16,880	139.8	13,280	94.9	44.9
	Perennial		433	2.9	960	5.2	-2.3
	Annual			258.8		145.6	113.2
4 Purwa	Kharif	12,252	12,252	86.8	6,638	35.0	51.8
	Rabi		12,252	105.8	6,735	36.3	69.5
	Annual			192.6		71.3	121.3
Total		57,301	57,301	881.3	32,983	392.8	488.5

35. Economic Cost

(1) Economic Capital Cost

The economic capital cost is estimated at Rp.2,124 million as shown below:

Unit: Rs.10⁶

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	<u>422.3</u>	<u>534.8</u>	<u>583.8</u>	<u>390.4</u>	<u>1,931.3</u>
6. Contingency	42.2	53.5	58.4	39.0	193.1
Total	464.5	588.3	642.2	429.4	2,124.4

(2) Annual Economic O&M Cost

The total annual economic operation and maintenance cost at the full development stage is summarized below:

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 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	6,410	9,020	11,440	6,500	33,370

(3) Annual Replacement Costs

Annual replacement cost in terms of economic value is estimated as shown below:

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

36. 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 below:

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

37. Sensitivity Analysis

A sensitivity analysis is as shown below:

		Unit: %				
Description		Sarojini Nagar	Sataon	Sursa	Purwa	Overall
1.	Case i (10% down on benefit)	17.7	12.5	10.8	16.9	14.1
2.	Case ii (10% up on cost)	17.9	12.7	11.0	17.1	14.4
3.	Case iii (10% down on benefit & 10% up on cost)	16.4	11.5	9.9	15.7	13.1

38. Financial Evaluation

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.

(1) Farm Budget Analysis

Typical farm budgets of marginal farmers are prepared for the future with and without conditions. The income of marginal farmers is expected to increase by 50% to 120%. Their economic situations are sure to be improved.

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

(2) Capacity to Pay

Operation and maintenance cost of the irrigation and drainage systems as well as of on-farm facilities is shouldered to beneficial farmers. Incremental benefit of a farmer is estimated at Rs.3,500 to Rs.5,760 per ha. Water charges shown below are only 14% at maximum, which proves that farmers could pay water charge easily.

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	7,700	518	10,800	839	13,100	756	7,600	620

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

39. Socio-economic Impact

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

- Improvement of nutritious status
- Generating of employment opportunity
- Women's development
- Enhancement of regional industries
- Improvement of environmental conditions

40. 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%.

Sarojini Nagar Area:

The development plan 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 ground water level. It will also contribute to equitable distribution of water through on-farm development.

Sataon Area:

The development plan shows IRR of 13.7%. 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.

Sursa Area:

The development plan shows the lowest IRR of 12.0%, reflecting relatively better yield level of crops under the present condition. Drainage improvement will increase Kharif cropping area drastically. Even distribution of water and improvement of nutritious status of farmers are expected from the project.

Purwa Area:

The development plan shows the IRR of 18.4%. 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 of the objectives of the State Five-Year Plan, the project is viable.

X. COMPREHENSIVE DEVELOPMENT PLAN OF SHARDA CANAL CAD PROJECT

41. To ensure reliable and equitable delivery of water as well as to enable to introduce systematic water management, the present system deficiencies have to be rehabilitated properly through modernization of the Sharda Canal system. To secure the active participation of the farmers in water management through reliable water deliveries, on-farm systems have to be extended to the whole command and be modernized. To make water deliveries more reliable through ensuring conjunctive use of canal water and groundwater, as well as to alleviate the water logging and salt problems in the command, the development of groundwater has to be extended.
42. The comprehensive study covering the Sharda Canal command area has to be carried out to identify and formulate the medium and long term development plan on modernization of the canal system and renovation of on-farm works. The overall implementation plan is as shown in Fig. 12.

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

43. 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 to be accrued from the modified plan.
44. The economic evaluation of the modified plan shows that the plan is economically feasible with an internal rate of return of 12.2% for the overall area. A financial evaluation is made by the analysis of the typical farm budgets, showing that their financial situations are surely improved. The socio-economic impacts are largely expected through implementation of the plan.
45. The modified plan obliges that the certainty in irrigation water supply which is the key element of CAD works is decrease 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. Upon implementation of the project with the modified plan, special efforts to remove the uncertainty in water supply should be taken, 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.

XI. RECOMMENDATION

46. Early Project Implementation

The development plan is technically feasible and economically viable. 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.

47. 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 to be engaged in modernization of the irrigation and drainage systems 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.

48. Early Organization of Farmers Associations and Continuous Guidance for Introducing Osrabandi

To secure active participation of farmers from the initial stage of the Project work, farmers associations in the outlet command shall first be organized with sufficient guidance of the CADA. To effectively introduce the osrabandi system, continuous guidance and training shall be rendered.

49. 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. To maintain the groundwater regime in the command area, the synchronized development of groundwater shall be promoted in well coordination between the departments and agencies concerned.

50. 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. 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. 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.

51. 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 for water saving and the introduction of osrabandi, and the modernization of the existing irrigation and drainage systems for enabling to introduce systematic water management of the Sharda canal system are required. It is 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, and on the renovation of the CAD works.

TABLES

Table 1 Socio-Economic Indicators of Major Blocks in Representative Areas as of 1987/88

Sl. No.	Sarojini Nagar	Mohantal Ganj	Sataon	Sursa	Purwa	Hilauli
POPULATION:						
1. Area (km ²)	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 Allopathic 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 Allopathic 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 Allopathic 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 Homiopathic 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 Central 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 Residential 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 2 Constraints on Agricultural Production in Lucknow Division

NO	CONSTRAINTS	Wheat	Paddy	Sugar cane	Maize	Potato	Mustard	Pea	Gram	Greengram/Blackgram	Towar	Groundnut	Pigeon 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 seedlings		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	x	
26	F No application of soil and seed treating chemicals	x		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 wear 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 Ulas 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	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 KHARRI diseases which is caused by Zinc deficiency; 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		

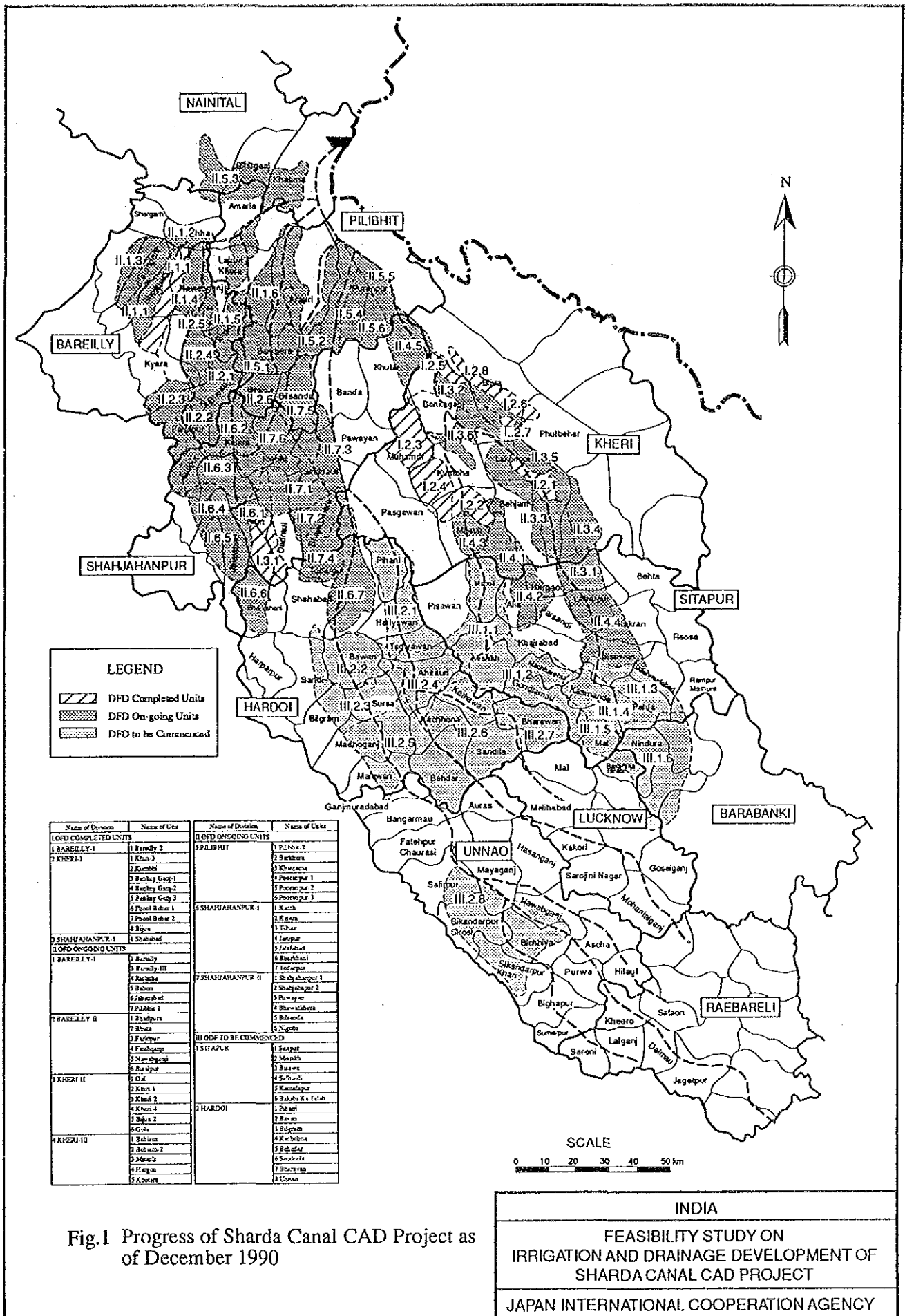
Table 3 Project Cost

Description	Unit: 1,000 Rs		
	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)	<u>58,860</u>	<u>6,540</u>	<u>65,400</u>
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)	<u>64,742</u>	<u>296,986</u>	<u>361,728</u>
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)	<u>61,027</u>	<u>454,237</u>	<u>515,263</u>
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)	<u>90,335</u>	<u>438,707</u>	<u>529,042</u>
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)	<u>67,334</u>	<u>280,101</u>	<u>347,435</u>
Sub-Total (B)	<u>283,437</u>	<u>1,470,031</u>	<u>1,753,468</u>
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	<u>124,873</u>	<u>1,003,597</u>	<u>1,128,470</u>
Physical	44,610	177,649	222,259
Price	80,263	825,948	906,211
Total	<u>570,970</u>	<u>2,780,091</u>	<u>3,351,061</u>

Table 4 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 Annual		433	5.4	2.5	2.9	960	10.3	5.1	5.2	-2.3
				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

FIGURES



LEGEND

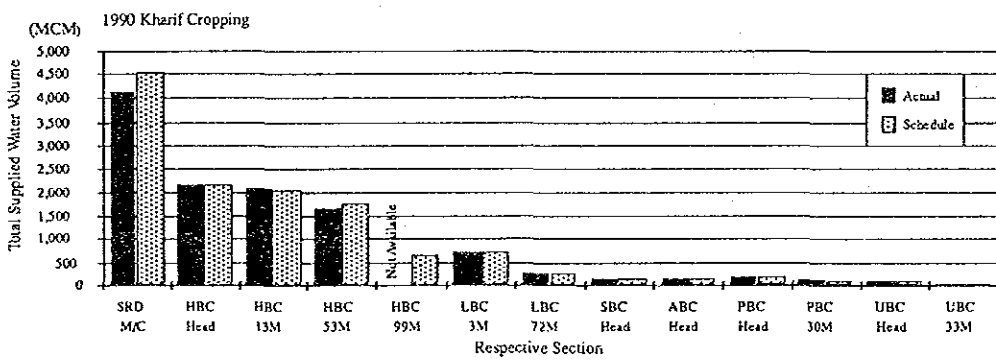
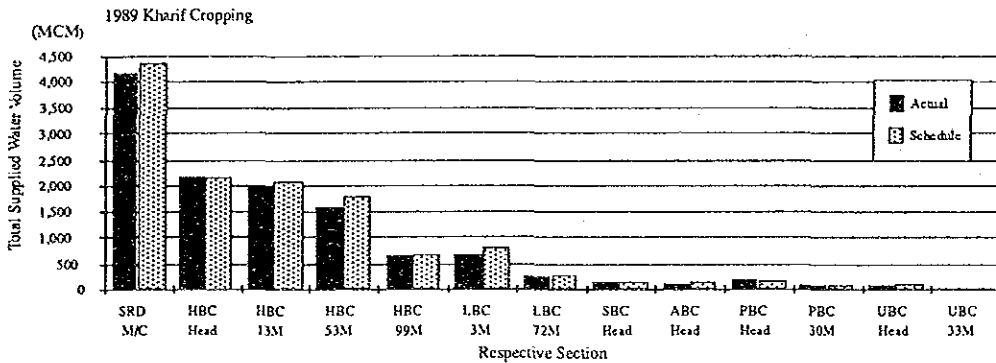
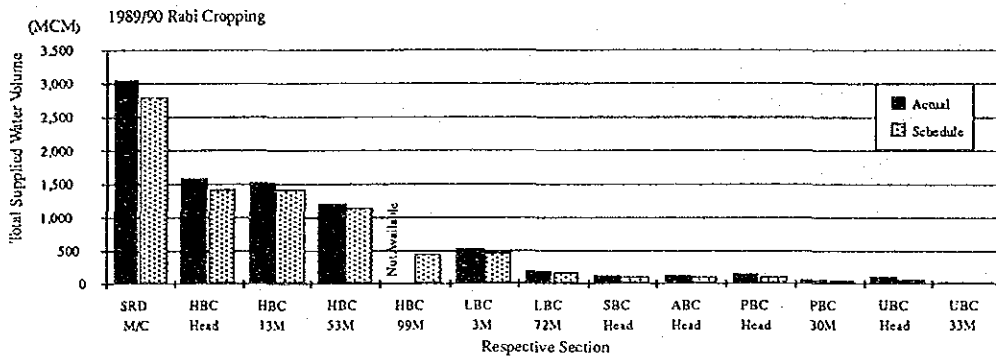
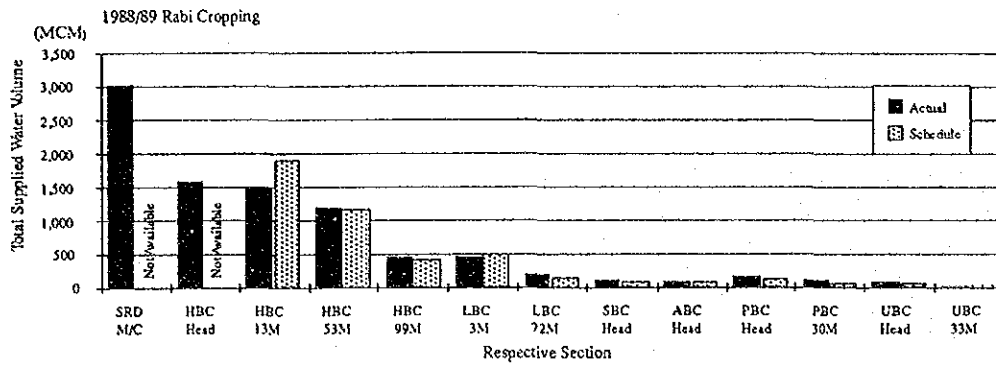
- DFD Completed Units
- DFD On-going Units
- DFD to be Commenced

Name of Division	Name of Unit	Name of Division	Name of Unit
DFD COMPLETED UNITS			
1 BAREILLY-I	1 Bimally 2	2 PILIBHIT	1 Pabbe 2
	1 Khan 3		2 Bethwa
	2 Kumbha		3 Shweta
	3 Kalyan Gup 1		4 Poonpur 1
	4 Kalyan Gup 2		5 Poonpur 2
	5 Kalyan Gup 3		6 Poonpur 3
	6 Flood Behar 1		7 Flood Behar 2
7 Flood Behar 3	8 Bijay	3 SHAHJAHANPUR-I	1 Kach
8 Bijay	2 Kach		
9 Bijay	3 Taba		
10 Bijay	4 Taba		
11 Bijay	5 Taba		
12 Bijay	6 Taba		
13 Bijay	7 Taba		
DFD ONGOING UNITS			
1 BAREILLY-I	1 Bimally	3 SHAHJAHANPUR-II	1 Totpur
	2 Family III		2 Shweta 1
	3 Bimally		3 Shweta 2
	4 Bimally		4 Shweta 3
	5 Bimally		5 Shweta 4
	6 Bimally		6 Shweta 5
	7 Bimally		7 Shweta 6
2 BAREILLY-II	1 Bimally	3 SHAHJAHANPUR-III	1 Saurat
	2 Bimally		2 Manab
	3 Bimally		3 Manab
	4 Bimally		4 Manab
	5 Bimally		5 Manab
	6 Bimally		6 Manab
	7 Bimally		7 Manab
3 KHERI-I	1 D.M.	2 HARDOI	1 Bimally
	2 Kheri 1		2 Bimally
	3 Kheri 2		3 Bimally
	4 Kheri 3		4 Bimally
	5 Kheri 4		5 Bimally
	6 Kheri 5		6 Bimally
	7 Kheri 6		7 Bimally
4 KHERI-II	1 Bimally	3 UNNAO	1 Saurat
	2 Bimally		2 Manab
	3 Bimally		3 Manab
	4 Bimally		4 Manab
	5 Bimally		5 Manab
	6 Bimally		6 Manab
	7 Bimally		7 Manab

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Remarks : HBC : Hardoi Branch Canal LBC : Lucknow Branch Canal SBC : Sandila Branch Canal
 ABC : Asiwari Branch Canal PBC : Purwa Branch Canal UBC : Unnao Branch Canal

Fig.2 Comparison between Schedule and Actual Water Supply .

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Fig.3 Comparison of Weekly Discharge between Schedule and Actual Supply (Kharif) (1/2)

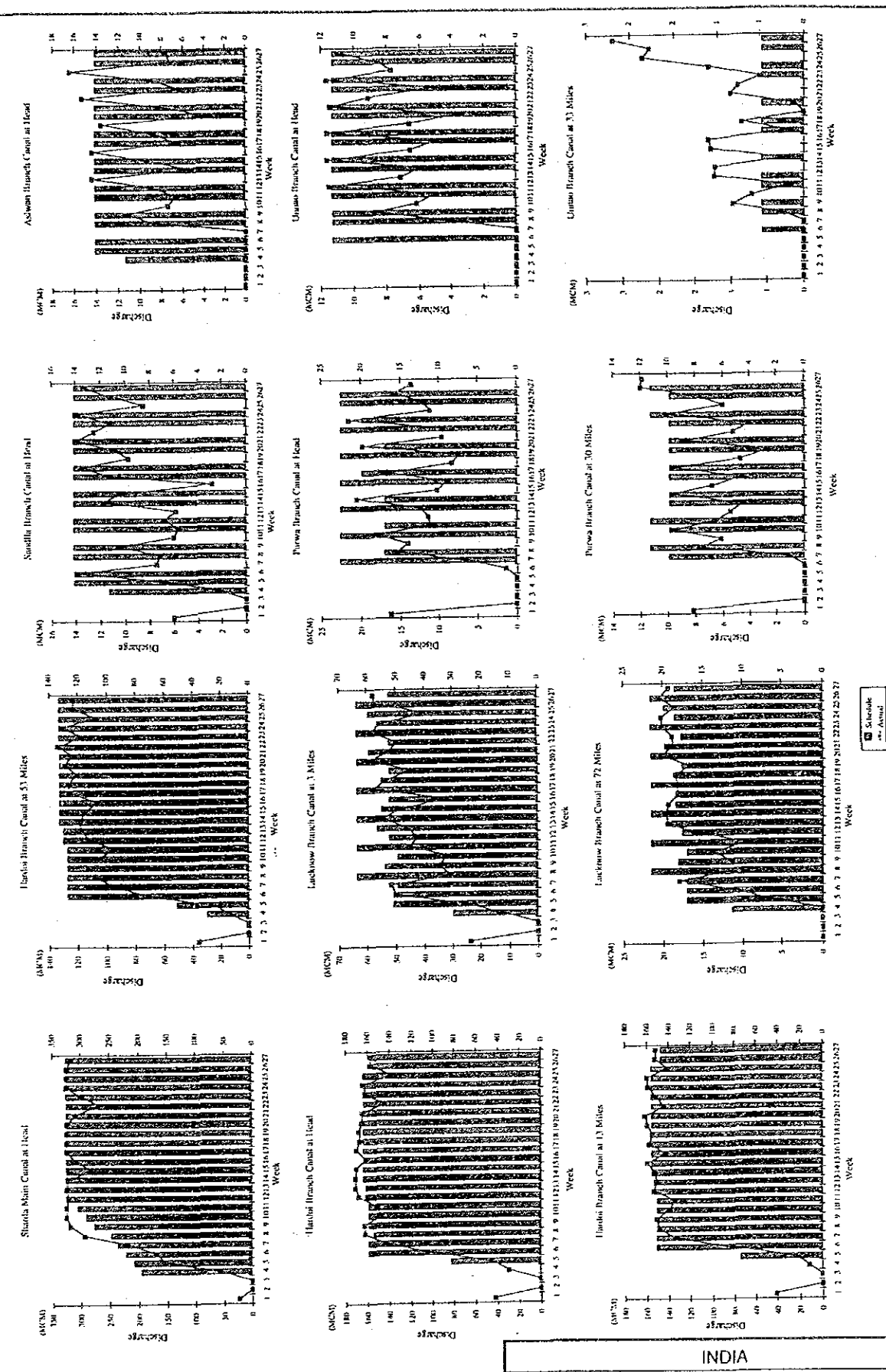
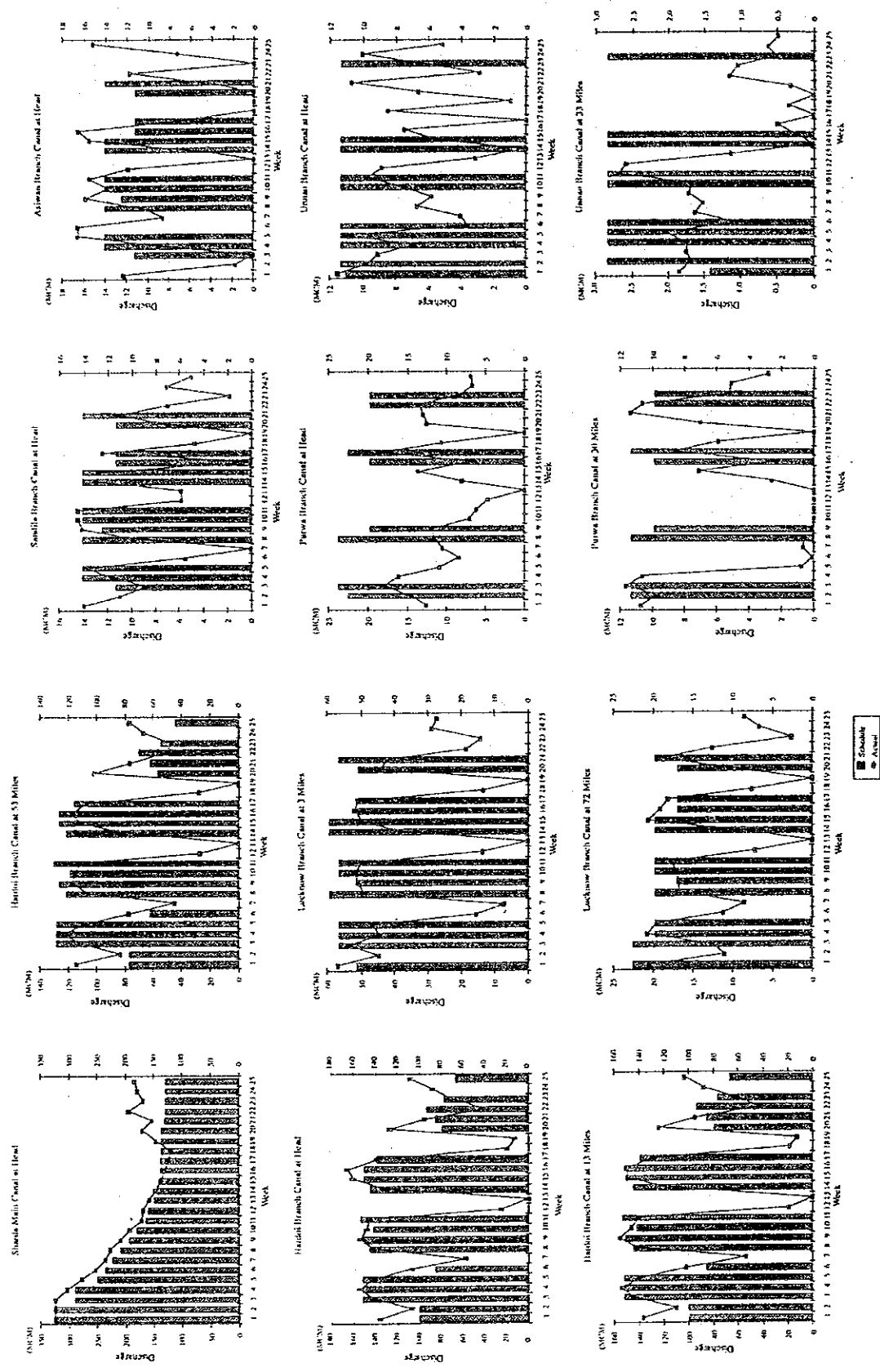


Fig.3 Comparison of Weekly Discharge between Schedule and Actual Supply (Rabi) (2/2)



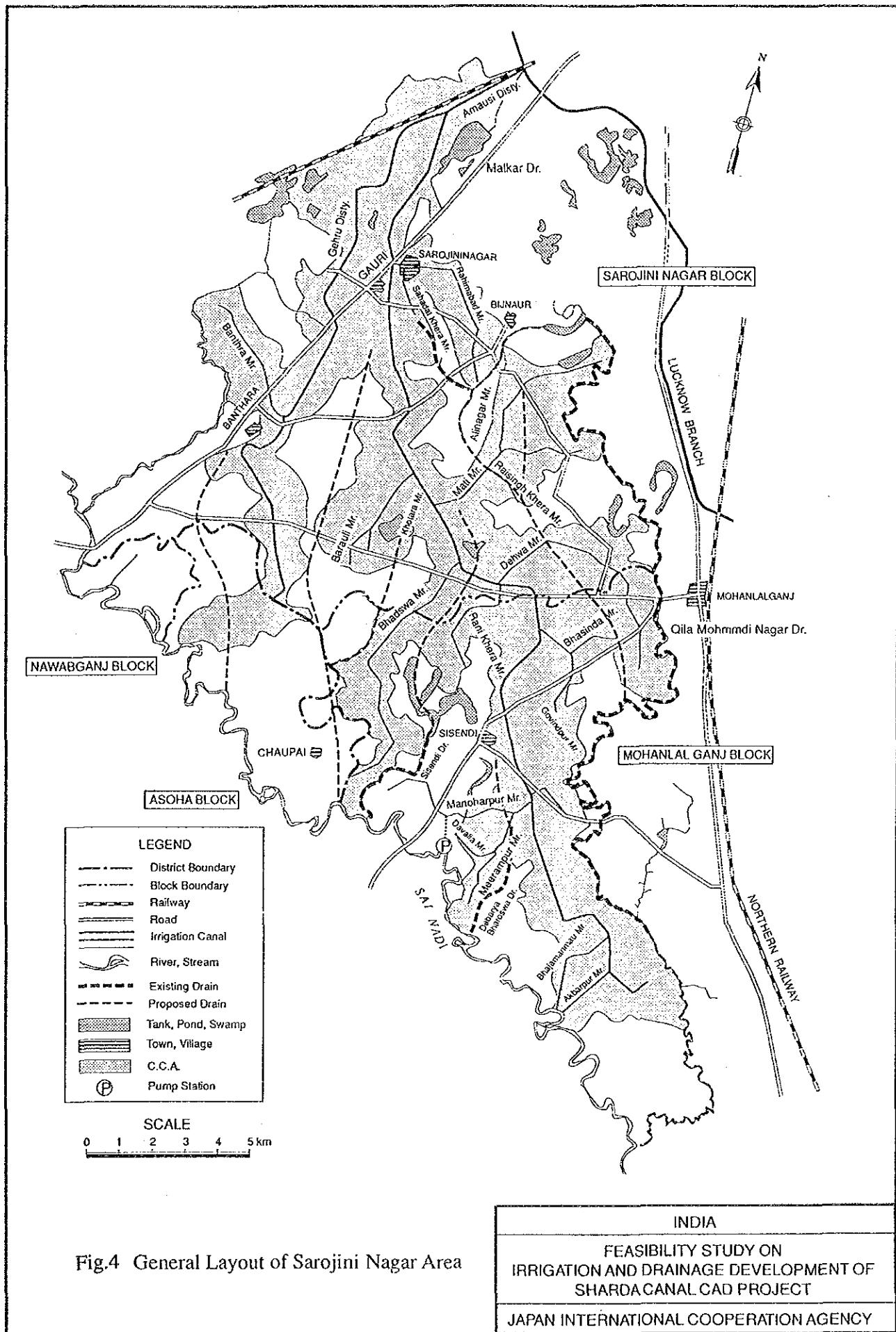


Fig.4 General Layout of Sarojini Nagar Area

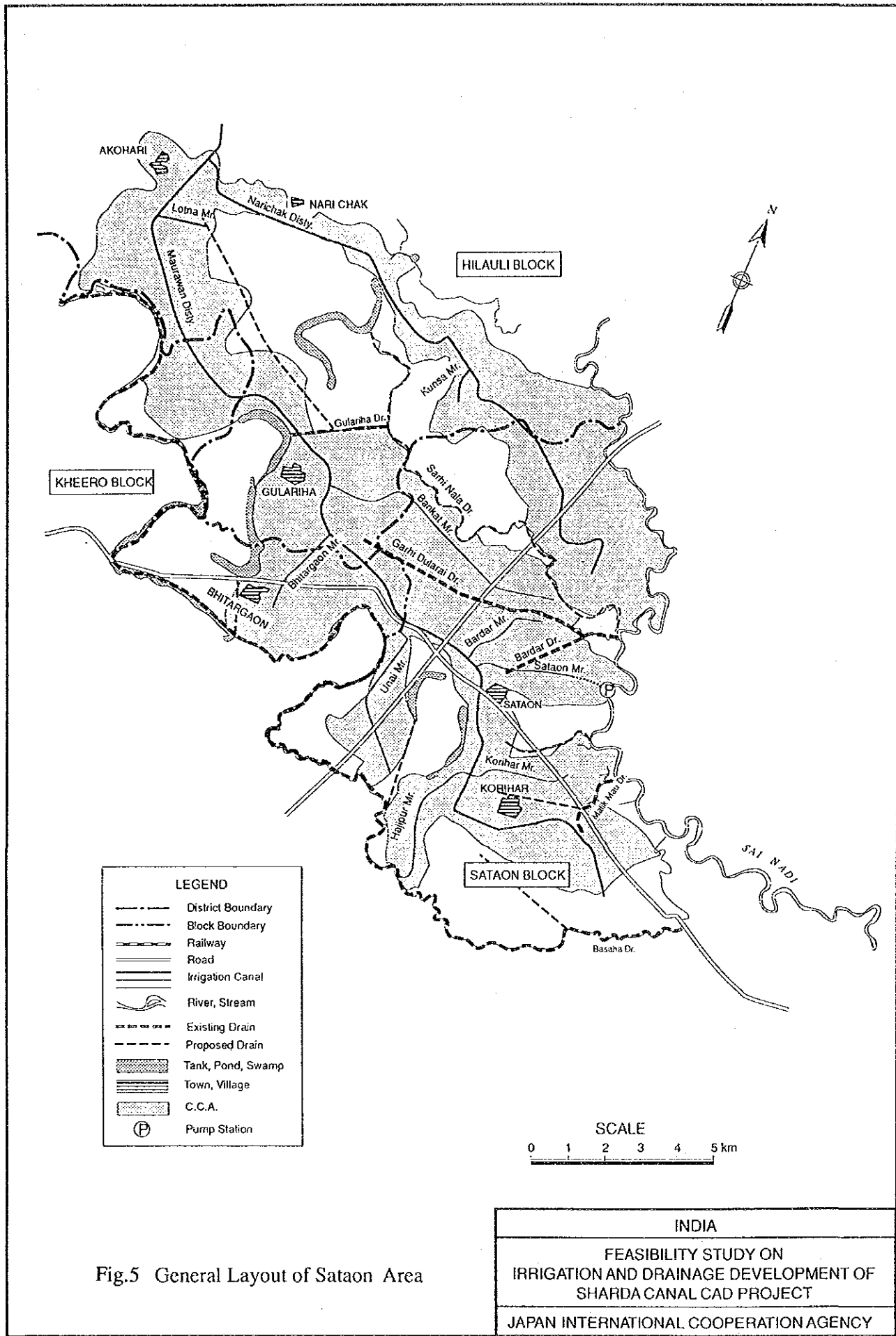


Fig.5 General Layout of Sataon Area

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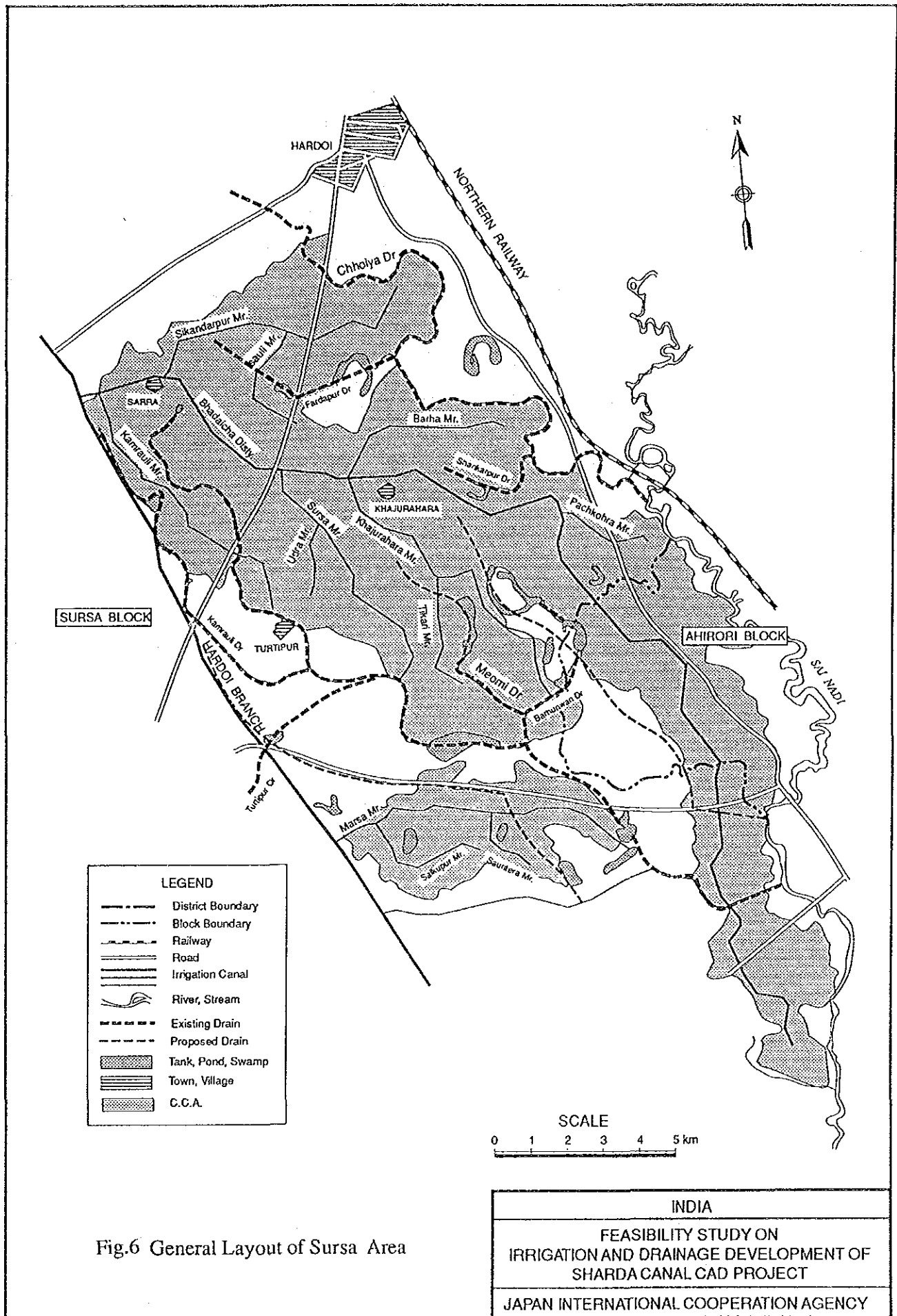


Fig.6 General Layout of Sursa Area

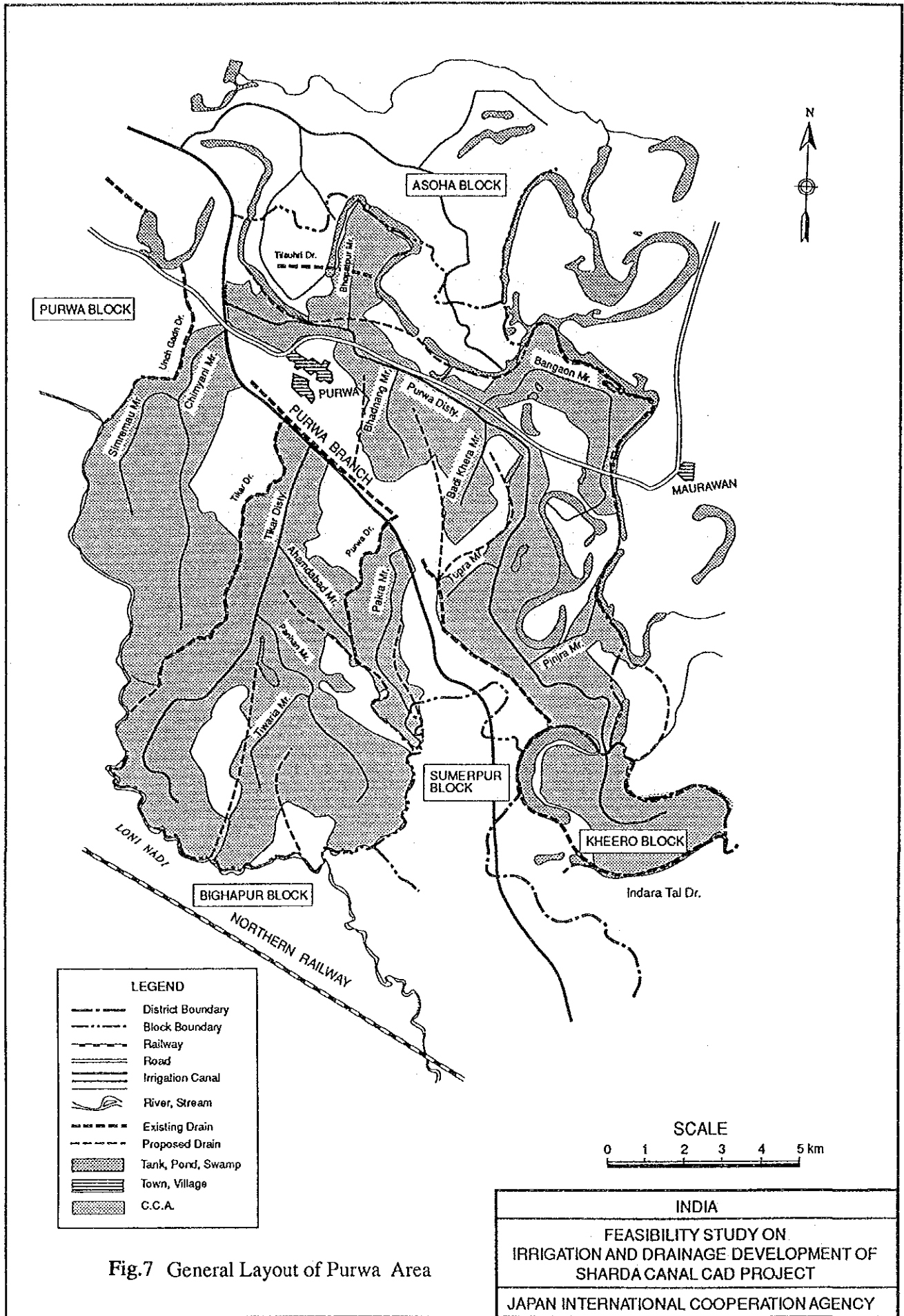
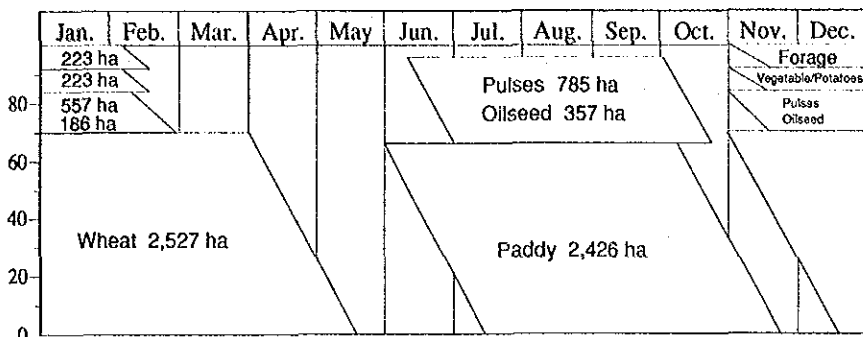


Fig.7 General Layout of Purwa Area

PROPOSED CROPPING PATTERN IN CANAL IRRIGATION AREA

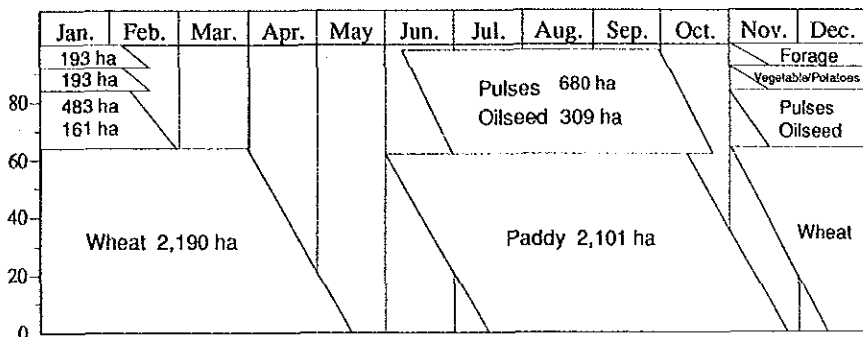
SAROJINI NAGAR

(Kharif: 3,567 ha Rabi: 3,716 ha)



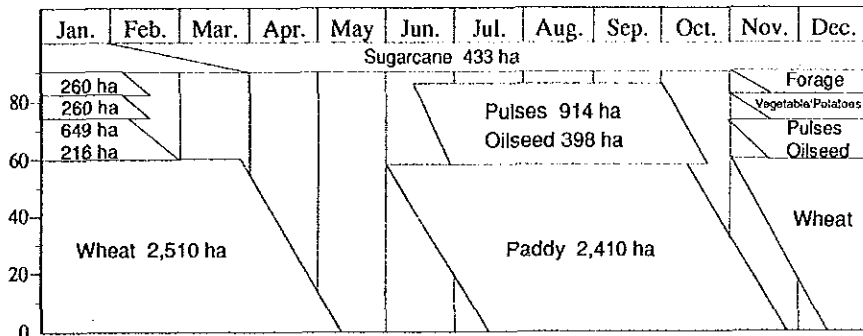
SATAON

(Kharif: 3,090 ha Rabi: 3,219 ha)



SURSA

(Kharif: 4,155 ha Rabi: 4,328 ha)



PURWA

(Kharif: 2,941 ha Rabi: 3,063 ha)

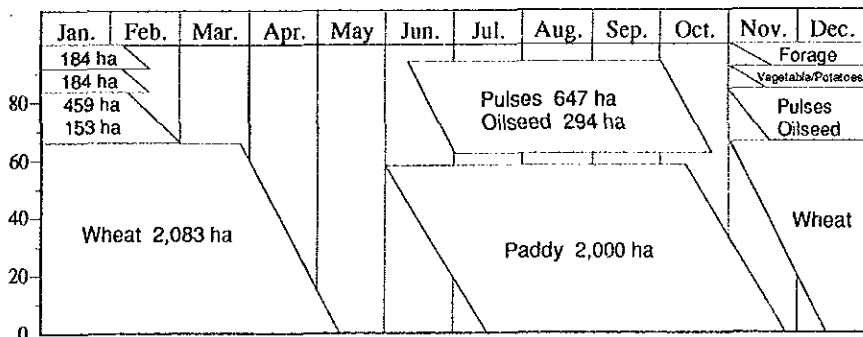


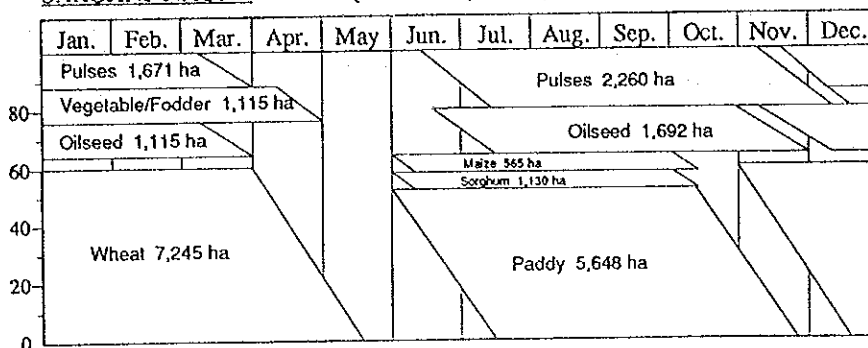
Fig. 8 Proposed Cropping Pattern (1/2)

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PROPOSED CROPPING PATTERN IN NON-CANAL IRRIGATION AREA

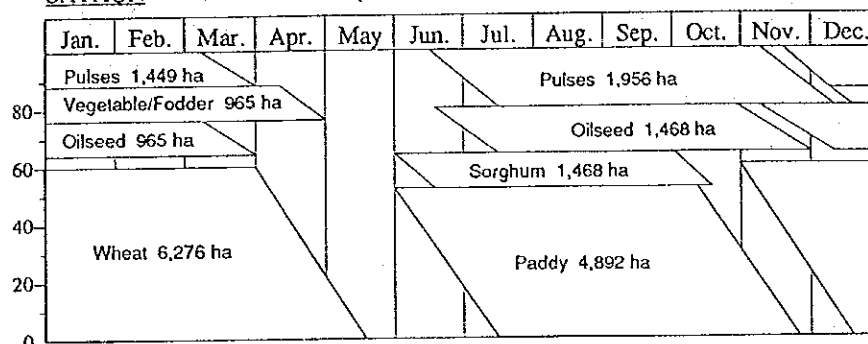
SAROJINI NAGAR

(Kharif: 11,295 ha Rabi: 11,146 ha)



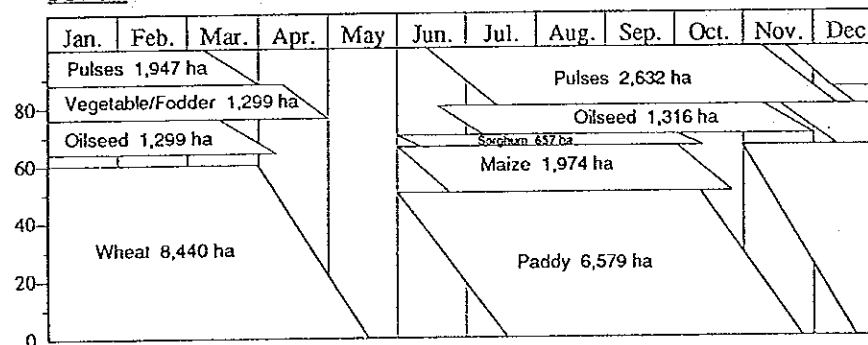
SATAON

(Kharif: 9,784 ha Rabi: 9,655 ha)



SURSA

(Kharif: 13,158 ha Rabi: 12,985 ha)



PURWA

(Kharif: 9,311 ha Rabi: 9,189 ha)

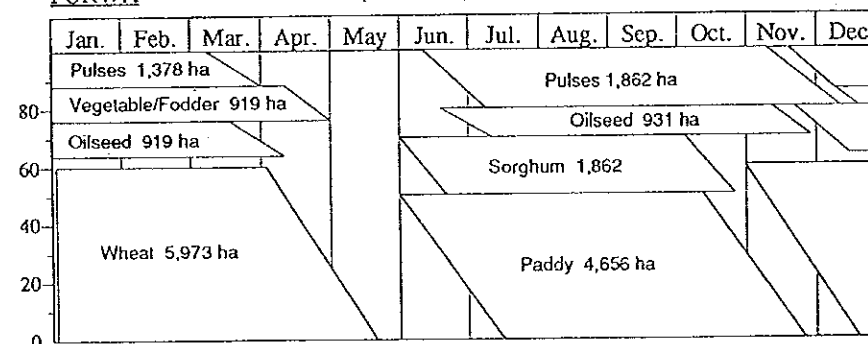


Fig.9 Proposed Cropping Patterns (2/2)

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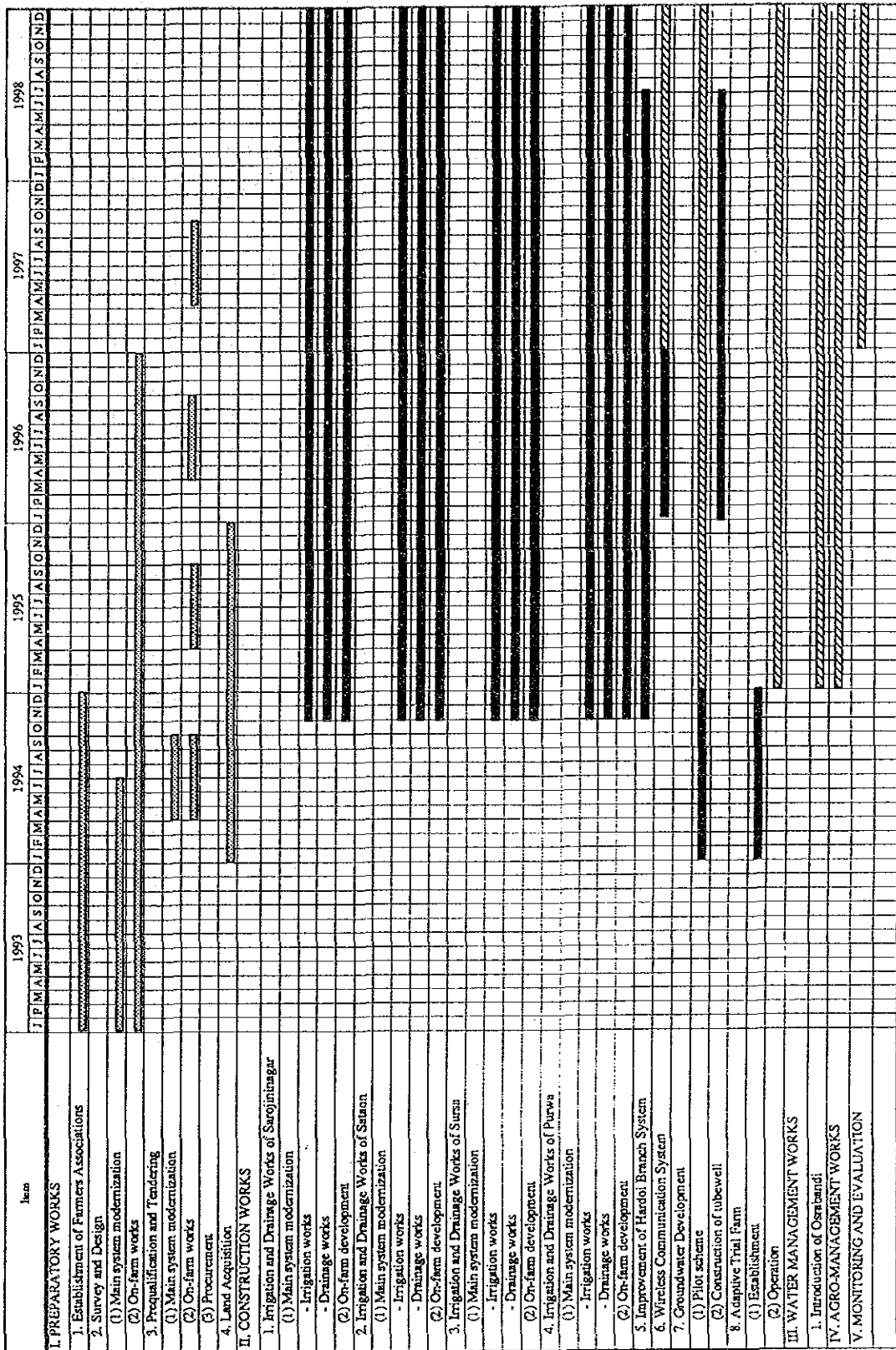


Fig.10 Project Implementation Schedule

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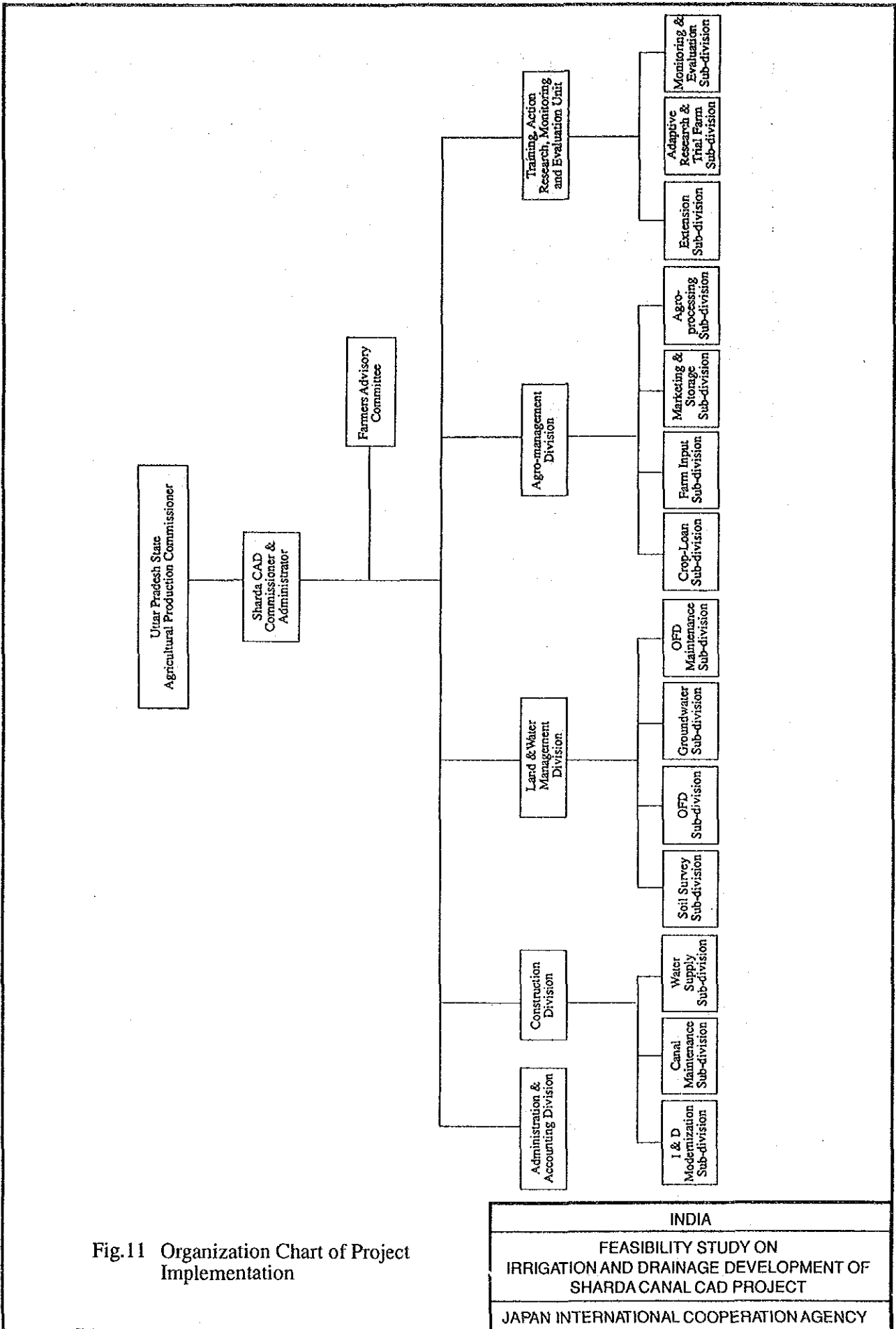


Fig.11 Organization Chart of Project Implementation

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Item	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
I. PHASE-I															
(1) 4 Representative Areas															
(a) Survey and design															
(b) Modernization of main system															
(c) On-farm development															
(d) Establishment of farmers assoc. and introduction of Osrabandi															
(e) Action research															
II. PHASE-II															
(1) Comprehensive Study for Sharda Command Area															
(2) Improvement of Hardoi Branch Canal															
(3) Construction Works															
(a) Survey and design															
(b) Construction works															
- Modernization of Hardoi Branch system															
- Renovation of on-farm works for Hardoi Branch command															
- Groundwater development															
(4) Establishment of Farmers Assoc. and Introduction of Osrabandi															
III. PHASE-III															
(1) Construction Works															
(a) Survey and design															
(b) Construction works															
- Modernization of remaining Sharda system															
- Renovation of on-farm works for remaining Sharda command															
- Groundwater development															
(2) Establishment of Farmers Assoc. and Introduction of Osrabandi															

Note : * : to be adjusted according to the progress
 ** : to be continued

Fig.12 Overall Implementation Plan

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