CHAPTER - X

IRRIGATION

Haryana, a small State of Union of India, is situated in North-West of the country with a geographical area of 4.4. million hectares and culturable area of 3.9 million hectares. It in North is bounded by Shiwalik range of mountains and in the East by the River Yamuna. Aravali range running South of Delhi and Desert of Rajasthan form the boundary on the South-West side. In North-West, the Ghaggar River forms part of the boundary with Punjab. State lies between the basins of the Indus and the Ganges (between the Rivers Ghaggar and Yamuna) and is located in the Northern plain between Longitude 74 degree to 78 degree East and Latitude 27 degree to 31 degree North. The elevation of the State varies from 400 metres in the North to 210 metres on Rohtak- Hisar axis; 210 metres in South Narnaul, 100 metres in the South-West out fall point of River Yamuna and 190 metres in South West out fall point in the River Ghaggar. Area break up for River basins in Haryana Territory is given in Table-1.

Table-1

Sr.No.	Basin	Sub Baisn	Area (Sq. KMs)
1	Ganga	Yamuna	16330
2.	Indus	Ghaggar	27882
		Total	**44212**

Agriculture is the major sector utilizing about 85% of the present water supplies. The government accords the top most priority to irrigation and drainage and about 25% of its planned outlays and actual budget are dedicated to these sectors. Consequently, about 75% of the state's arable lands are served by irrigation canals. However, the irrigation intensity is only about 70%, reflecting on the limited availability of water supplies for the system. The reason for the low intensity of irrigation can also be attributed to the considerable loss of water in the distribution system and water application losses at the field level, particularly in Western light soil areas where the percolation loss is extremely high.

The state is reaching its limits of agricultural expansion and irrigation potential and scope for further development of irrigation for agriculture is very limited unless corrective measures are taken to conserve water by increasing water

use efficiencies at tertiary canal and field levels. Moreover, it would be difficult to maintain even the present level of agriculture production, unless steps are taken to rectify the adverse effects of long term irrigation in certain areas. Side by side, the problems of water logging and salinity in irrigated areas are increasingly evident. The state has also to face frequent floods and inundation, highlighting the problems of inadequate drainage. These issues need to be addressed on a comprehensive scale.

SOILS AND LAND RAIN FALL

The soils of Haryana State based on agro climatic conditions can be classified into five zones namely Desert soils, Sierozem soils, Arid Brown soils, Tropical Arid Brown soils and Reddish Chestnut soils depending upon rainfall.

The following describes the rainfall conditions of the state.

Table-II

Sr.No.	District	Average annual Rainfall (in mm)
1.	AMBALA	988.0
2	YAMUNANAGAR	907.8
3	KURUKSHETRA	581.8
4	KAITHAL	585.0
5	KARNAL	695.8
6	PANIPAT	626.5
7	SONIPAT	567.0
8	ROHTAK	474.4
9	FARIDABAD	564.3
10	GURGAON	577.8
11	REWARI	471.6

12	MAHENDRAGARH	518.3
13	BHIWANI	425.1
14	JIND	565.3
15	HISAR	396.5
16	SIRSA	325.3
17	FATEHABAD	396.5
18	JHAJJAR	474.4
19	PANCHKULA	1112.0

Now for optimum utilization of rainwater, rain harvesting is considered very essential.

HYDROGEOLOGY.

The sediments primarily consists of clay, silt, fine sand, medium sand, coarse sand, gravel and boulders. The kankar concretions are also found as secondary sediments. The maximum alluvium thickness is more than 3000m and the thickness decreases from North to South and also Westwards. In the western part of the state aeolian deposits overlie the alluvium. In the Northern part of the state in the districts Ambala, Yamunanagar, Kurukshetra and Karnal, the percentage of sand is higher than that of silt and clay. The aquifers with fresh water extend along the Ghaggar and Yamuna rivers. In Southern part, clay and silt form the major part of the alluvium. The sand content decreases and the quality of the ground water changes to marginal and saline water. The aquifers particularly in saline areas are mostly thin and extend over a short distance restricting the ground water flow. The characteristics of aquifer sediments show lateral as well as vertical variations.

TRENDS OF GROUND WATER LEVEL

Trends of ground water level indicate average behaviour of water levels for a particular season. Pre-monsoon water level trends indicate general behaviour of water levels. Post monsoon trend indicate recharge component of ground water at the end of monsoon. If the post monsoon period trends are declining, this indicate that the area is denied of adequate natural recharge.

Therefore the scope of artificial recharge to ground water by artificial method is indicated by the long term level trends of post monsoon period.

The latest status of ground water quality is also discussed in the following table.

District wise statement showing ground water quality (June 2003)

Area in Hect Quality in Mohms

Sr. No	Name of District	Area.	Out crop Area	Fresh (0-2000)	Sub Marginal (2000-4000)	Magi. (4000-6000)	Saline 6000
1.	Ambala	159585	300	158885	400	-	-
2.	Bhiwani	487072	4661	103395	219269	96552	63105
3.	Faridabad	210500	8846	80271	71699	30171	19513
.4.	Fatehabad	249110	-	169797	58412	14635	6266
5.	Gurgaon	274960	17689	139433	58130	33160	26548
6	Hisar	386052	-	101709	172711	81877	29755
7.	Jind	273600	-	62205	152515	42105	16775
8.	Kurukeshtra	168253	-	168253	-	-	-
9.	Kaithal	228406	-	210938	12656	2650	2362
10.	Karnal	247112	-	235519	7853	3740	-
11.	Manendergarh	193947	4646	63237	96163	22186	7715
12.	Panchkula	78915	35300	43615	-	-	-
13.	Panipat	124988	-	106209	17765	1014	-
14.	Rewari	155900	2308	35116	86029	23508	8939
15.	Sirsa	427600	-	54439	176520	106118	90523
116.	Sonipat	226053	-	65584	78967	47682	33820
17.	Jhajjar	186770	-	14214	46866	46128	79562
18.	Rohtak	166777	-	17561	64956	48218	36042
19.	Yamunanagar	175600	15300	160300	-	-	-
	Total	4421200	89050	1990680	1320711	599744	421015
%age of total area		100	2	45	30	14	9

HISTORY OF PUBLIC WORKS DEPARTMENT (IRRIGATION)

A properly organised department for carrying out public works was formed originally in the Punjab in 1849 by Captain Napier. R.A. (Later Field Marshal Lord Napier of Magdala) and the successful administration of this body led to the creation of regular Public Works Departments in all the provinces under the control of the Central Government. The Military Board, however, continued to remain in control of all military works until 1854, when all engineering works in the Punjab, civil, military or public, were placed under one department with Colonel Napier as the Chief Engineer. The canal branch was at the same time put under a " Director of Canals".

At that time, the staff of engineers was drawn from Royal Engineers and other sources including Thomson Civil Engineering College at Roorkee which had been founded in 1847, primarily with the object of imparting civil engineering education to European and Indian Officers and subordinates, to train them for employment on the Ganges Canal which was then under construction.

The designation " Director of Canals" was changed to " Chief Engineer of Irrigation Works" in September, 1854. The general branch (Building and Roads) and Irrigation were separated in 1868; the senior Chief Engineer used to be Secretary to the Local Government and the Junior was a Joint Secretary. In September, 1892, the Government of India agreed to Chief Engineers of both the branches being designated as Secretaries for their respective branches.

In 1893, in accordance with the recommendations of the Aitchison Commission on the Indian Public Services, the Provincial Service was created for the more extensive employment of Indians from the engineering colleges in India. By 1895, the Public Works Department had become a purely Civil Department and was responsible only for civil works including irrigation. Soon after this, with the development of Local Self Government, certain classes of public works were entrusted, to an extent varying in different provinces, to the control of district boards and municipalities.

Active drainage investigation was considered necessary for the first time in 1918, when a Drainage Board was formed in the province. Subsequently in 1926 this was divided into-

(i) the Urban Sanitary Board, and

(ii) the Rural Sanitary Board.

The former was placed under the control of Director of Public Health, whereas the Rural Sanitary Board, which dealt with areas outside the irrigation limits, was under the control of Chief Engineer, Buildings and Roads Branch. A drainage division was constituted in the Upper Bari Doab Canal Circle in 1920 and this developed into the post of a Drainage Engineer. In 1925 a Water-logging Enquiry Committee was constituted to advise government, and at the same time the post of Superintending Engineer, Water Logging Investigation, was formed in the Irrigation Branch. In 1928, the functions of the Rural Sanitary Board were taken over by the Irrigation Branch though the scope of the work still related to areas outside irrigation limits. The Water-logging Enquiry Committee was also replaced by the Water-logging Board to deal with the water-logging problems within the irrigation areas.

Thus in 1930, there were three posts for the drainage works in the Irrigation Branch:-

(a) Drainage Engineer,

(b) Superintending Engineer, Water Logging Investigation,

(c) Superintending Engineer, Rural Sanitary and Improvement Board.

By about the end of 1944, irrigation in the combined Punjab came to be better organized than in any other state in India. The government insisted upon highly accurate distribution and also on continued and detailed check of the revenue side. Investigations and experiments were always proceeding and modifications and improvements became an ever present feature of the activities of every irrigation officer. This responsibility of 20 highly organized circles (including the Irrigation Research Institute) and other activities of the department, proved too much for the three Chief Engineers and a fourth post of a Chief Engineer and Secretary to Government, Punjab, was sanctioned with effect from 1st January, 1945, and yet another from 2nd December, 1946, for the Thal Project.

A post of Deputy Secretary was also sanctioned from 1st March, 1946, to relieve Secretary, Central, of the routine work to enable him to pay more attention to the organization of the mechanical side of the department.

At the time of partition of the Punjab (15th August, 1947), the canal system in the province comprised the following permanent and temporary circles:-

PERMANENT

1. Western Jumna Canal Circle.
2. Sirhind Canal Circle.
3. Upper Bari Doab Canal Circle.
4. Lower Bari Doab Canal Circle.
5. Lower Chenab Canal West Circle.
6. Lower Chenab Canal East Circle.
7. Upper Chenab Canal Circle.
8. Upper Jhelum Canal Circle.
9. Lower Jhelum Canal Circle.
10. Ferozepore Canals Circle.
11. Nili Bar Circle.
12. Mailsi Canal Circle.
13. Haveli Canals Circle.
14. Derajat Circle and
15. Drainage Circle.

TEMPORARY

1. Projects Circle- for carrying out surveys and designs of Post-War Projects.
2. Thal Circle- for execution of the Thal Project.
3. Mechanical Circle – to administer excavating and pumping machinery, tube-wells, Moghulpura, Workshops, etc.
4. Northern Drainage Circle- for the construction of drains in the Chaj Doab.
5. **Bhakra Civil Circle** *for the execution of*
6. **Nangal Circle** *Bhakra-Nangal Projects*
7. **Bhakra Mechanical Circle**

The highly developed and organized Research Institute at Lahore having been left in Pakistan, a new one was set up at Amritsar immediately after the

partition as important investigations demanded immediate attention to facilitate finalizing the designs in connection with Bhakra-Nangal Project and the construction work thereon. The work on the Project being comparatively of novel and intricate nature, relatively more investigations and experiments were needed to help evolving economical and satisfactory designs. Accordingly the work of the Institute came to be expanded gradually.

The work in this circle became excessively heavy on account of number of projects and schemes taken in hand and it became difficult to deal with them expeditiously. To augment canal irrigation, tubewell investigations were also started in all the districts of Ambala Civil Division and the Delhi State. This circle was, therefore, reorganized and split into two circles (Western Jumna Canal East Circle and Western Jumna Canal West Circle) with effect from 1st October, 1948.

On account of increased activity on the construction of the Bhakra-Nangal Project, Harike Project, and other projects, it became necessary to abolish the post of Deputy Secretary and create an Administration unit on 24th November, 1952, for dealing with the construction of Bhakra Dam and important works under the control of General Manager, Bhakra Dam.

A Board called Bhakra Control Board consisting of the representatives of the Government of India and the three States of Punjab, PEPSU, and Rajasthan with the Governor of Punjab in his personal capacity as Chairman, and the Consulting Engineer to the Government of India as Vice Chairman was constituted, in September, 1950, to take over-all charge of technical and financial aspects relating to the construction of Bhakra-Nangal Project.

The Bhakra Nangal & Beas Projects were in the joint collaboration of erstwhile states of Punjab and Rajasthan. On reorganisation of the erstwhile state of Punjab on November 1, 1966, Bhakra Management Board was constituted under section 79 of the Punjab reorganisation Act, 1966 for the administration, maintenance and operation of Bhakra Nangal Project w.e.f. 1.10.1967.The Beas Project works, on completion, were transferred to Bhakra Management Board and it was renamed as Bhakra Beas Management Board (BBMB) w.e.f. 15.5.1976. The Bhakra Beas Management Board consists of a whole time Chairman, two whole time Members (appointed by the Government of India) and one representative each from the states of Punjab, Haryana,Rajasthan and Himachal Pradesh besides two representatives from Government of India (One each from Ministry of Power and Ministry of Water Resources). The functions of Bhakra

Beas Management Board are to regulate the supply of Sutlej, Ravi and Beas waters to the States of Punjab, Haryana, Rajasthan, Delhi and Jammu & Kashmir and to distribute power from Bhakra Nangal and Beas Projects to the states of Punjab, Haryana, Rajasthan, Himachal Pradesh and Chandigarh.

At the time of reorganisation of Punjab state in 1966, Haryana Irrigation Department was carved out of Punjab Irrigation Department with the following eight circles.

1. WJC (Western Yamuna Canal) Circle, Rohtak
2. EJC (Eastern Yamuna Canal) Circle, Rohtak
3. Ambala Bhakra Canal Circle, Kaithal
4. Hisar Bhakra Canal Circle, Hisar
5. WJC (East) Feeder/Gurgaon Canal Circle, Delhi
6. Planning Circle Chandigarh
7. Central Design Office Circle Chandigarh
8. Project and Design Circle, Chandigarh

Since irrigation activities accelerated in the state a number of circles were added during 1970s. Viz.

1. Five circles looking after operation and maintainance of canal network.
2. Four circles looking after drainage network in the state .
3. Seven circles for project, construction activity
4. Six circles for modernisation(lining work) of canal.
5. Two circles for design activities.
6. One circle each for project preperation activities, procurement and disposal aspects.
7. Two circles in Head Office for planning and water resources activities.
8. Two circles at Kurukshetra and Hisar for research and development activities.

In the year 1994 a new project with word bank aid viz Haryana Water Resources and Consolidation Project was sanctioned for further development and

strengthening of irrigation activities. The department was further reorganised on the following pattern :-

- Fourteen circles for water services activities including canal/drainage network.
- Thirteen circles for construction activities.
- Two Central design offices for design work.
- Two Circles namely Project Circle and Project & Design Circle for project preperation.
- Two vigilance and quality assurance circles.
- One circle for procurement and disposal related matters.
- Two circles at the headquarters.

After the completion of water resources and consolidation projects, restructuring of department was again undertaken during the year 2003 and finally the following circles are functioning in the department.

- Fifteen water services circles
- Six construction circles.
- Two vigilance circles
- Three Superintending Engineers at the headquarters for planning, design and water resources activities.
- One circle each for procurement , disposal and project activities.

Haryana Irrigation Department is primarily responsible for Operation and maintenance of canal and drainage net work besides looking after Planning, design and construction of various water resource projects. Haryana State Minor Irrigation Tubewell Corporation (HSMITC) and Command Area Development Authority (CADA) provide support to the department. After the formation of HSMITC in 1970 the work of installation of deep tubewells, both for direct irrigation and augmentation tubewells was considerably accelerated so as to fully

utilise the groundwater potential. The activities of HSMITC were further expanded in 1973-74 for lining of water courses avoiding water percolation. In 1974-75 HSMITC further took up the work of manufacturing and repairing high capacity lift irrigation pumps and gates, hoisting and gearing for canals, barrages, drains and for other hydro electric projects through its mechanical work shop located at Karnal. The government closed HSMITC in June, 2002 its functioning merged into Irrigation Department.

Command Area Development Authority started functioning in Haryana during the year 1974 under Centrally Sponsored Scheme on sharing basis (between the State and the Centre) to diminish the gap between Irrigation potential created and irrigation potential utilized on selected canal commands in the state under Command Area Development Programme (CADP) . Organisation are as follows:-

1. Construction of field channels.
2. Survey, planning & designing of OFD works.
3. Reclamation of waterlogged area through bio-drainage.
4. Correction of system deficiencies above outlet up to distributaries of 150 cusecs capacity.
5. Construction of field, intermediate and link drains.
6. Adaptive trials/demonstrations, action research.
7. Training to farmers and staff.
8. Institutional support to Water Users Associations.
9. Monitoring and evaluation.

In 1983, Haryana Government constituted a State Irrigation Advisory Committee to advise the department on general policy matter and specific programmes so that the targets set from time to time are given a realistic approach. The constitution of the committee is set forth as below:-

OFFICIAL MEMBERS

1.	Irrigation & Power Minister	Chairman
2.	Agriculture Minister	Member

3.	Minister of State Irrigation & Power	Member
4.	Secretary, Irrigation & Power	Member
5.	Engineer-in-Chief,Irrigation Deptt.,Haryana	Member

NON OFFICIAL OFFICIALS

Suitable persons are appointed from time to time by the government to assist and participate in various proceedings of the committee so that the voice of the stake holders can be considered in policy formation and other issues of the department. The terms and conditions of the committee are:-

1. The function of the committee will be to advise the Minister –in-Charge on general policy matters and specific programmes. The meetings will also afford a forum for ventilating public grievances relating to the department concerned. In respect of any matter intended to be raised at a meeting of the committee notice should be given to the Administrative Secretary concerned at least fifteen days before the date of the said meeting.
2. The committee will meet once every month under the Chairmanship of the Minister in Charge and in his absence the Agriculture Minister and in the absence of both of them the State Minister concerned will chair. In case none of them is present one of the non -official members present at the meeting will preside over it as may mutually agreed upon by the members present.
3. The headquarters of the committee will be at Chandigarh.
4. Three members present at least one of whom is a non-official member shall form a quorum for a meeting.
5. The term of the committee will be two years but the government by express order, may extend the period or dissolve and reconstitute the committee at an early date.
6. The members of the committee will draw T.A/D.A as per instructions contained in Haryana Government U.O letter No. 670-Pol(4) 72,dated the 4th April, 1972 and letter No. 10/16/80-Poll(4) dated 12th December, 1980.

Realizing the importance of research, water management and training activities, the government has upgraded and converted the erstwhile " Haryana Irrigation Research and Training Institute (HIRTI)" working at Kurukshetra since

March 1985 into an autonomous organization as "Haryana Irrigation Research and Management Institute (HIRMI)" with effect from May 1,1998.

HIRMI is an autonomous body registered under the Society Act, 1860 on 1.1.96 and notified vide Government of Haryana (Irrigation Deptt.) notification No.16/105/95-1(IW) dated 30.4.98 with Governing body and Managing Committee drawn from the Government, Haryana Irrigation Department, Command Area Development Authority, Science and Technology Department, Haryana Agricultural University and Central Soil Salinity Research Institute. The Commissioner & Secretary to Government Haryana in the department of Irrigation is the Chairperson of the Managing Committee of HIRMI. A Principal Director, Deputy Director (Research), Deputy Director (Training) alongwith other allied staff are working in this institute.

Haryana Irrigation Department in the state is an historical department dealing in state water resources management. The primary objective of department is to provide better irrigation facilities to the farmers of State including water for drinking, pond filling & Industrial purposes, operation and maintenance of network of canals and drains and river protection works, floods and drought management, planning, design and construction of various project works within the State of Haryana. In addition certain works/ schemes of other states are being executed as a deposit work in view of overall development of the country.

The broad objectives of the Haryana Irrigation Department are as under:-

a) Equitable and judicious allocation of water, with emphasis on poor and disadvantaged people.

b) Conservation of precious water resources and its optimum utilization.

c) Reforms and improvement in water resources management to include farmers participation and decentralization of management.

d) Planning for water resources development on the concept of basin or sub-basin as a unit, treating surface and ground waters as unitary resource to meet the demands of various sectors.

e) Integrated planning of water resources sector with components such as drainage, flood management, water conservation techniques etc.

f) Environmental, social, economic and financial sustainability of development plans for water resources.

g) Full recovery of operational and maintenane costs from the users.

h) Installation of sound and efficient communication system, Financial Management System (FMS) and Management Information System (MIS).

i) Substantive legal framework for water resources planning.

j) Promotion of training and research facility on water resource sector.

The following facilities are being provided by Haryana Irrigation Department to the public of State:-

i) To supply raw water for irrigation purposes to farmers located in the state.

ii) To supply raw water to various works of Public Health/ Haryana Urban Development Authority for drinking purposes and other domestic use.

iii) To supply raw water for pond filling to various villages for drinking purpose of live stock.

iv) To supply raw water to various industries for Industrial development of state.

v) To supply raw water to Thermal Power Plants for assistance in generation of electricity in the state.

vi) Upkeep of river training works on various rivers and their tributaries passing through the State of Haryana.

vii) To fight with flood furry for saving of lives and property.

viii) To arrange and maintain water resources through interstate agreements.

ix) To deliver authorized canal supply to the partner states through the canals network of Haryana.

x) To train the farmers through Water Users Associations (WUA).

xi) To act as nodal department in water resources matters

Since water is a sacred and free gift of God, man has to manage its utilization gainfully for the betterment of the mankind. According to current estimates, the potential annual available surface water in Haryana is about 13.82 MAF. The internal surface water resources of the state are comparatively meager and therefore, the availability of surface water is dependent upon a number of factors such as State's share based on inter-state agreement, rainfall in the catchment areas, water level in Bhakra Reservoir, etc.

The estimated annual groundwater reserve is about 9.10 MAF, which has been substantially exploited and the ground water conditions of the state are also not very encouraging. Two-third of the area is underlain with brackish water with rising water table and inadequate natural drainage. Mostly, salinity increases with depth, but there are also areas in which saline groundwater is reportedly underlain by water of lesser salinity, most likely as a result of the surface saline source. The state is seriously concerned about the long-term availability of groundwater, which can not be relied upon unless the unabated exploitation of this resource and its contamination by various pollution sources are checked.

MAJOR RIVERS

YAMUNA RIVER

Yamuna Basin (excluding Chambal Sub Basin) extends over an area of 226755 Sq. KM and lies between the Himalayas in the North and Vindhyas in the South.

The Yamuna river rises in the Tehri Garhwal district of Uttar Pradesh from the Yamnotri glacier near Bandarpunch at an elevation of about 6,320m at North latitude 30degree 58 ′ and East longitude 78 degree 27'. The Rishiganga a tributary of the Yamuna rises 3 Km. further North-West and joins the Yamnotri stream on its right bank near Banas while two other streams, the Unta and the Hanumanganga rising from the Jakhal glacier and the Chhaian Barmark glacier respectively to the South of Bandarpunch meet the main stream on its left bank. Further South-West the Yamuna receives several tributaries from the lesser Himalayan ranges and ridges. After crossing Shiwalik ranges upstream of Dak Pathar, two more tributaries viz. Malawi and Tons join the river Yamuna.

The Tons, the largest Himalayan tributary of the Yamuna, rises from the North-Eastern slope of Bandarpunch at an elevation of 3,900 m. at North latitude 31 degree 13' and East longitude 78 degree 26' and flowing in a valley North-West of the Yamuna, meets it below Kalsi on the South-West fringe of the Mussorie range. At the confluence of the two rivers, the Tons carries almost twice the volume of waters as the Yamuna and is considered as the principal source of that river. Other important tributaries, Ashan, Bata and Giri further join the Yamuna draining areas in Himachal Pradesh.

The combined stream of the Yamuna and the Tons then forces its way through the Shiwalik range of hills and joined by other tributaries debouches into the plains of Uttar Pradesh in the Saharanpur district. When the river emerges from the hills, its waters have already been tapped for irrigation at the Tajewala head works(now replaced by Hathnikund Barrage constructed in year 2002) from where two important canals, namely, the Western Yamuna and the Eastern Yamuna, take off to irrigate vast areas in Haryana and Uttar Pradesh. From Faizabad, the river flows for a distance of 104 Km., in a South-Westerly direction and receives the Maskara stream on its left bank. Near Bidauli in the Muzaffarnagar district (Uttar Pradesh) it turns due South for a distance of 128 Km., to reach Delhi. The Agra Canal takes off from the river at Delhi from the Okhla head-works to irrigate areas in Uttar Pradesh. The Gurgaon Canal, takes

off from the Agra Canal to irrigate lands in Haryana and Rajasthan. Beyond Delhi, the Yamuna continues to flow South as far as Mathura, a distance of 203 Km. The Hindon river joins the Yamuna on its left bank at Dankaur. River Yamuna flows for a total length of 1376 km. up to its confluence with Ganga at Allahabad.

RIVER GHAGGAR

River Ghaggar falls in Indus Basin. The Indus Basin extends over an area of about 1,165,500 Sq. Km. The basin covers area in China (Tibet), India, Afghanistan and Pakistan. In India the basin lies in the States of J&K, H.P., Punjab and parts of Haryana and Rajasthan besides UT of Chandigarh. Drainage basin area of Haryana State is 27882 Sq.Km.

The river Ghaggar has its source near Dagshai a small hill station at an elevation of 1,927 m. (77 degree 3′ East longitude, 30 degree 50′ north latitude) in the Shimla district of Himachal Pradesh. The river flows in a generally South-Westerly direction practically throughout its length. It enters the State of Haryana near Kalka about 10Km. from its source. Continuing to flow in the same direction, the river criss-crosses the boundary line between Punjab and Haryana at a number of places. The Patialawali Nallah joins it at two different places on its right bank before it receives, through the Saraswati, the combined waters of its three important left bank tributaries viz. The Tangri, the Markanda and the Saraswati, near village Shatrana, about 148 km. from its source. From here on, the direction of flow of the river is more Westerly than Southerly. From about 8 km. down stream of this confluence the river crosses the Bhakra Main Line Canal and about 28 km. further lower down, the river crosses the Ghaggar Branch of the Bhakra system. Continuing to flow about 107 km. more in a generally South-Westerly direction, the river is tapped at Ottu head works (weir) where two canals, one Northern and the other Southern take off for irrigating the nearby areas. The river goes a little beyond Hanumangarh town in Rajasthan. Thereafter, the river disappears in the sand dunes of the Rajasthan desert. The river has a total length of about 291 km. and its drainage area, though difficult to assess precisely, can roughly be placed around 1,309 sq. km. up to the Ottu Weir.

Discharge data is available for the Ghaggar at Gumthala for the years 1956 onwards; for the Tangri at Narwana Branch crossing for the years 1959-60 and 1964 to 1968; for the Markanda at Narwana Branch crossing (the Jalbera regulator) for the years 1959-60 and 1963-68, and 1954-69 and 1963-67, respectively; for the Saraswati at the Narwana Branch crossing for the years 1963

to 1966. The Chautang is a flashy torrent and its flood waters have been diverted to the river Yamuna at four points to remove drainage congestion. The total runoff of the Ghaggar river system is estimated to be about 2,159m. cu. m.

MARKANDA RIVER

Ghaggar basin has three major tributaries i.e. the Ghaggar, the Tangri and the Markanda. The Markanda Nadi emerges from foothills of Shiwalik in Himachal Pradesh near Nahan. It enters into Haryana at Kala Amb. The other rivulets which falls in the Markanda river are the Roon Nadi, the Laha Nadi, the Begna Nadi and the Sadaura Nadi before it joins the Tangri Nadi. The Markanda river is flashy in nature and brings down sudden floods which in turn inundates large area and causes considerable damage to crops and property in the districts of Ambala and Kurukshetra. However it remains practically dry during the remaining part of the year. The Markanda river joins the Ghaggar in Kaithal district in Guhla Sub Division.

TANGRI NADI.

The Tangri Nadi emerges from the foothills of Shiwalik in Morni hills in Panchkula district. The other rivulets which joins The Tangri Nadi are The Baliali Nadi and the Mattanwali Nadi. The Tangri Nadi is flashy in nature and brings down sudden floods which in turn inundates large areas and causes considerable damage to crops and property in the districts of Panchkula and Ambala. However during the remaining part of the year it remains practically dry. The Tangri Nadi Joins the Markanda river near village Budhmour (Distt. Patiala) before Markanda outfalls in the river Ghaggar.

SARASWATI NADI.

The Saraswati, a tributary of the Ghaggar, is visible at one place and invisible at another. It is named after a Hindu goddess. Brahma was enamoured of her, and she dived underground to save her chastity. The Saraswati alternately appears at the surface and flows in a subterranean course as if in fear of the pursuing Brahma.

The Saraswati Nadi is believed to have its origin in the vicinity of ADHBADRI down hill of Shiwalik Ranges. The site conditions show that the water after trickling down the mountains traverses its course in a length of one kilometer or so before it joins The Somb Nadi near village Katghar. Further also the perusal of the record reveals that the Saraswati Nadi/ Saraswati Creaks have

been in existence, in the vicinity of Gopal Mochan and Bilaspur towns, between the Chautang Nallah and the Somb Nadi and it is shown to have joined the Chautang Nallah near village Nagla Jagir. This Chautang Nallah already stands canalized outfalling into WJC at RD 138300. This portion of the Saraswati Nadi has become redundant as its catchment area is taken care of both by the Chautang Nallah and Somb Nadi.

In addition the Saraswati Nadi is also confirmed to have been in existence starting from up-stream of Thana Chapper which after traversing a course of 93.5 km. and passing on its way in the proximity of Mustfabad, Babain, Pipli, Kurukshetra and Thanesar towns ultmiately finds its way through Bibipur Lake via syphon at RD 36.951 km. of SYL and RD.282 of Narwana Branch. Thereafter the Saraswati Drain off-takes from Bibipur Lake through a Head Regulator which after traversing a course of 133000 ft. of length and passing in the vicinity of Pehowa on its way ultimately falls into river the Para and further into the Ghaggar river in Punjab State. It is also pointed out that a stretch of the Saraswati Nadi Creek is also shown to be in existence as per record in an approximate length of 10 kms., on left side of the Saraswati Drain to which it joins near Pehowa town.

The Saraswati Nadi is not discernible at most of the places. It is because the cultivators have filled up the Saraswati Nadi up to the level of their adjoining fields thereby bringing the area belonging to the Saraswati Nadi under their own cultivation. Thus the free flow of the flood water of the area which would have been channelized in the Saraswati Nadi stands blocked at most of the places in its entire length up to Ambala-Delhi G.T. Road near Pipli town resulting into inundation of the whole of the area with a sheet of water all-around even during a brief spell of 4-5 hours of rain. The area remains inundated for 4 to 5 days even with this brief spell of rain.

RIVERS ENTERING HARYANA FROM THE STATE OF RAJASTHAN.

SAHIBI.

The Sahibi river after flowing in Rajasthan for 157 km enters Haryana in Rewari district near Jarthal. The State of Rajasthan has irrigation projects with total live storage of 90M metric cubes in the catchment area of the Sahibi river. H.I.D. has also constructed Massani Barrage across the Sahibi river on the border with Rajasthan for irrigation and flood control. The Massani Barrage was constructed in the year 1985-86 and the records show that no water has flown down stream of Massani Barrage, even without gates in position. This makes it

evidently clear that there is no water available, at reasonable dependability, for utilisation in Haryana from the catchment area in Rajasthan. Moreover, Rajasthan may create more storage in the catchment reducing the inflows further. Beyond the border the catchment area of the Sahibi river in Haryana is about 1,800 sq km and the runoff generated from this area in normal years is absorbed in the plains and natural depressions in the catchment area. In the years of high rainfall it has a well defined course up to Pataudi Railway Station and thereafter water spreads into branches till it outfalls into the Outfall Drain No. 8 (connecting Bhindawas Lake and Najafgarh Lake) and flows to Najafgarh Lake through regulators in Dhansa Bund. Afterwards water flows into Yamuna river through Najafgarh Drain. There is no possibility of creating any storage, in Haryana, because of flat plain area. Since the Sahibi river ultimately flows into the Yamuna river through the Najafgarh Drain and has already been considered for apportionment of Yamuna water, no separate development plan in addition to that for the Yamuna waters is considered necessary for it.

KRISHNAWATI AND DOHAN

The River Krishnawati enters Haryana in Mahendragarh district where its water is absorbed in sand dunes. The River Dohan originates in Sikar district of Rajasthan and usually disappears in sand dunes in Churu district of Rajasthan and its water rarely reaches Haryana. Both these rivers have flows only during monsoon months. These are ephemeral streams and do not have flows at reasonable dependability level for planning their utilization.

Whatever discharge data are available, indicate that the water available is not even adequate for raising any Kharif crop during monsoon season and in non-monsoon season there is no flow. Further, the water of these rivers received in Haryana during monsoon period is absorbed in the spread of the river recharging the groundwater in Mahendragarh district and does not flow out of the State. The availability of water in these rivers is likely to reduce with increasing demand and storage works in Rajasthan.

IV. EXISTING CANAL SYSTEM

About 2.926 Mha, which is about 75% of the total culturable area in the State, is provided with surface canal irrigation by the following canal systems.

- Bhakra Canal System covering a CCA of 1.189 Mha in the North-Western and Western parts of Haryana.
- Western Yamuna Canal System covering a CCA of 1.084 Mha in the North-Eastern and central parts of Haryana.
- Gurgaon Canal and Agra Canal Systems covering a CCA of 0.131 Mha and 0.061 Mha respectively in the South-Eastern part of Haryana.
- Lift Canals covering a CCA of 0.460 Mha in the South Western part of Haryana bordering Rajasthan.

A dense network of canals spreads over the entire state except some parts of Yamunanagar, Ambala, Panchkula, Kurukshetra and Gurgaon districts.

The Bhakra Canal (BC) System

Haryana's share in the Sutlej and Ravi-Beas water is delivered through Bhakra Dam. The above water is delivered from Punjab to Haryana at two contact points viz RD 390 of Bhakra Main Line (BML) and RD 160 of Narwana Branch. The designed capacity of BML at RD 390 is 191.79 m /sec (6,774 cusecs). The water delivered at this point is utilised for irrigation in Bhakra Main Branch, Fatehabad Branch and Barwala Branch. The designed capacity of Narwana Branch at the contact point at RD 160 is 113.87 m /sec (4,022 cusecs). The water delivered at this point is utilised for irrigation in Narwana Branch and Sirsa Branch. The water meant for Western Yamuna Canal System, Lift Canals, Gurgaon Canal and Delhi drinking water supply during non-monsoon periods is passed on to the Western Yamuna Canal System through the NBK Link.

The Western Yamuna Canal (WYC) system.

The share of Haryana in Yamuna waters is drawn at Hathni Kund Barrage (HKB) by the WJC line channel. The H.K.B., is operated and maintained by Haryana State. At present there is no storage dam on rivers Yamuna or its tributaries, due to which the supplies fluctuate. The range of

fluctuation observed is between 20,000 metricubes/ sec during monsoon to about 30 metricubes /sec in the non-monsoon period.

Haryana's share in river Yamuna at HKB is diverted into WJC & then through Main Line Upper, which has a carrying capacity of 453 metric cubes /sec (16,000 cusecs) and length of 20,533 m (67,347 ft.) WYC Main Line Upper at its tail out falls into Dadupur pond upstream of Pathrala Dam, from where the water is picked up by WYC Main Line Lower, which has a carrying capacity of 382 metric cubles/sec (13,500 cusecs) and length of 58,216 m (190,950 ft.) Main line Lower feeds Augmentation Canal and WYC system including lift canals. The lift canals viz Jui, Sewani, Loharu and JLN utilise waters of river the Yamuna during monsoon and Haryana's share of Ravi-Beas waters during non-monsoon when availability of water in river the Yamuna declines.

Gurgaon and Agra Canal system

The regeneration in river the Yamuna between HKB and Okhla Headworks near Delhi, including spills from HKB, are diverted into Agra Canal off-take on the right side of Okhla Head works. The Okhla Head works and Agra Canal System are operated and maintained by UP State. Sixteen channels off-taking directly from Agra Canal serve about 61,034 ha (150,755 acres) area of Haryana State in Faridabad district. Gurgaon Canal System off-taking at Km 4.3 of Agra Canal utilises the Yamuna waters during monsoon. During non-monsoon season when water in river the Yamuna is inadequate, it utilises Haryana's share of Ravi-Beas waters.

The deliveries from the Bhakra to the Yamuna System during non-monsoon periods are passed on to the WYC System through NBK link. The water meant for Gurgaon Canal is routed through Delhi Branch and released into river Yamuna through Najafgarh Drain. This water is picked up at Okhla Headworks by Agra Canal and delivered to Gurgaon Canal System.

The total length of canals in Haryana is about 12,290 km, out of which main canals and branches are 2,277 km and distributaries and minors are 10,013 km. Lined portions of main canals and branches generally consist of double tile lining 130 mm (5.25 ″) thick. For distributaries and minors the lining consists of single brick lining 95 mm thick. The smaller channels are also unlined.

DISTRIBUTION OF AVAILABLE WATER RESOURCES

The available supply from surface sources is used in Haryana through Canals Network. For the purpose of distribution, the whole state has been divided into two command systems.

i) W.J.C. System

ii) Bhakra System

The WJC system includes Lift canal system, Gurgaon Canal and Channels of Agra canal system serving Haryana area. WJC system caters to gravity as well as lift canal network. Bhakra canal network is a gravity canal system.

ROTATIONAL PROGRAMME OF WJC SYSTEM

The requirement of Haryana from surface source is about 32 million acre feet MAF where as availability is around 9.70 MAF (10 year Avg.) since the demand is quite large as compared to the average availability so the canal system is run in rotation. The channels of WJC system including the channels of Narwana Branch and Sirsa Branch have been clubbed into four groups namely Anta group, Butana group, Sunder & Bhalaut group of eight days rotation each and with total rotation period of 32 days. The channels of Gurgaon canal and Agra canal serving Haryana area has been clubbed into four groups (A,B,C,D) of eight days rotation each and with a total rotation period of 32 days. In extreme shortage the number of rotational groups are raised to five of eight days each with total rotation period of 40 days.

ROTATIONAL PROGRAMME OF BHAKRA SYSTEM

The channels of Bharka canal system have been put into two sub systems i.e. Tail BML System and BML Barwala Link Sirsa Branch System. These systems have 3 groups of 8 days rotation each with a total rotation period of 24 days. The above grouping is changed depending upon the actual availability of surface water during Rabi and Kharif seasons. No. of groups are increased if the availability is less than the requirement of first P.O. group of channels and the deamnd of 1st. P.O. groups of channels are not fully met with. The present arrangement of rotational grouping and requirements/authorization of each group are given in the following table .

ROTATIONAL PROGRAMME OF YAMUNA AND BHAKRA SYSTEM FOR RABI 2004-05

W.J.C.SYSTEM INCLUDING CHANNELS OF NARWANA, SIRSA BRANCH SYSTEM FROM 26-10-04 TO 19-04-05 .

Sr. No.	P.O.	Name of group	Authorisation	Total
1.	BLT + SRS	BHALAUT + SIRSA	4076 + 1528	= 5604
2.	SDR + HAB	SUNDER + HABRI	4000 + 1419	= 5419
3.	BTA + TSK	BUTANA + THASKA	5499 + 226	= 5625
4.	ANT + NGL	ANT + NAGGAL L.S	5125 + 106	= 5231

TAIL B.M.L.SYSTEM (BMB+FTB) FROM 26-10-04 TO 19-04-05.

Sr. No.	P.O.	Name of group	Authorisation	Total
	BMB		FTB	
1.	B.A.C.	GROUP-A	1500 + 696	= 2196
2.		GROUP-B	1083 + 1153	= 2236
3.		GROUP-C	1089 + 1121	= 2210

B.M.L.BARWALA LINK – SIRSA BRANCH SYSTEM FROM 26-10-04 TO 19-04-05 .

Sr. No.	P.O.	Name of group	Authorisation
1.	B.A.C.	GROUP-A	828 Cs.
2.		GROUP-B	911 Cs.
3.		GROUP-C	863 Cs.

GURGAON CANAL SYSTEM AND AGRA CANAL SYSTEM FROM 16-10-04 TO 19-04-054.

Sr. No.	P.O.	Name of group	Authorisation
	GGN Canal Feeder,Agra Canal		Serving Haryana area.
1.	C	GROUP-A	339 Cs + 236 = 575 Cs.
2.	B	GROUP-B	310 Cs.+ 231 = 541 Cs.
3.	A	GROUP-C	311 Cs.+ 229 = 540 Cs.
4.	D	GROUP-D	332 cs.+ 213 = 545 Cs.

INTERCONNECTION OF THE BHAKRA AND YAMAUNA COMMAND

Since the availability from the Yamuna is varying toa great extent, so during lean period, supplies are supplemented from Bhakra system through NBK Link and SYL canal at Budhera Complex. During monsoon period ample supplies are available in Yamuna and the same are being used in Yamuna as well as in Bhakra Command area i..e. Bhakra Command is supplemented by running the Sirsa Branch (Head at Indri) to maximum extent. A new link Bhakra Sewani Link has been made functional for transfer of Bharka supplies to the Sewani Canal system via BML-Barwala Link, Barwala Branch, Balsamand sub Branch. With this arrangement 300 Cs. supplies are delivered to Sewani Canal system for 8 days in a total rotational period of 24 days.

DETAILS OF SYSTEM CHANNELS

3.1.3 YAMUNA COMMAND SYSTEM

Yamuna Command system including Lift canal system receive supplies from river the Yamuna at HKB/Tajewala Headwork and available supplies are carried through WJC Link channels, MLU, MLL etc. The available supplies are distributed at Munak Complex (near Karnal) and at Khubru (near Sonipat). The main canal offtaking from Munak Complex are Hansi Branch, Parallel Delhi Branch, Gohana distributary, Goli distributory. The main canal off-taking at Khubru are /Delhi Sub Branch, Delhi carrier channel (old Delhi branch now made

functional), Bhalaut sub branch, JLN feeder, Bhainswal distributary. Dobeta distributary.

The lift areas are being served throug JLN canal, Mahendragarh canal and Loharu feeder/canal, which off takes from JLN feeder. Sewani Lift area receive supplies from Petwar distributary New Sewani feeder, old Bhakra Link, Jui feeder and Nigana feeder serving jui and Nigana lift areas receives supplies from Hansi Branch through Butana and Sunder Sub Branch.

3.1.4 BHAKRA COMMAND SYSTEM

This system receives supplies from tail of BML at Tohana. The main channels off-taking at this points are BMB and Fatehabad branchs. Recently a new channel Sidhmukh Nohar feeder has been constructed for carrying Rajasthan share. The other main channels serving Bhakra area are Barwala branch, Sirsa branch from RD.89 to RD.342. The share of Rajasthan is delivered through Kishangarh Sub Branch, Sidhmukh feeder, Nohar feeder and Baruwali distributary. Area served for Punjab falls on BMB and Narwana Branch. Recently 3 new distributary. (Nimla Minor, Kalwana Minor, Nathore branch) have been constructed. These off-takes from I.G. feeder and serve the area of Sirsa district.

The details of channels of various Commands are given below :

Major Channels of W.J.C.System :

1. WJC Link Canal.
2. MLU, M.L.L.Canal.
3. W.J.C.and its off-takes.
4. Augmentation Canal.
5. NBK Link Channel.
6. SYL Canal
7. Habri Sub Branch.
8. Munak Canal.
9. Hansi Branch and its off-takes.

10. Butana branch & its off-takes.
11. Sunder Sub Branch & its off-takes.
12. Bhiwani Sub Branch.
13. Dadri Feeder.
14. Mithathal Feeder.
15. Parallel Delhi Branch &its off-takes.
16. Bhalaut Sub Branch & its off-takes.
17. Jhajjar Sub Branch.
18. Gurgaon Feeder/Canal and its off-takes.
19. Agra Canal & its off-takes serving Haryana area.

Bhakra System :

1. Bhakra Main Line & its off-takes.
2. Bhakra Main Branch & its off-takes.
3. Fatehabad Branch & its off-takes.
4. Ratia Branch & its off-takes.
5. Rori Branch & its off-takes.
6. B.M.L. Barwala Link Channel.
7. Barwala Branch.
8. Sidhmukh Nohar Feeder.
9. Sidhmukh Feeder.
10. Kishangarh Link Channel.
11. Nohar Feeder.
12. Narwana Branch.

13. Saraswati Feeder.
14. Hisar Major Distributory & its off-takes.
15. Sirsa Branch & its off-takes.
16. Pabra Sub Branch & its off-takes.
17. Balsamand Sub Branch & its off-takes.

Lift Canal System :

1. J.L.N.Canal.
2. J.L.N.Canal & its off-takes.
3. Sahalawas Lift Channel.
4. Mohendragarh canal&its off-takes.
5. Satnali Feeder.
6. Narnaul Branch.
7. Loharu Canal&its off-takes.
8. Jui Feeder.
9. Jui Canal & its off-takes.
10. Nigana Canal & its off-takes.
11. New sewani feeder.
12. Sewani Canal & its off-takes.

HISTORY OF CANAL IRRIGATION

Water is a sacred and free gift of God and man has to manage its utilisation gainfully for the betterment of mankind. There were no canals in the older times. Agriculture then was very limited and wholly dependent upon the rainfall. Later on, the cultivators started irrigation on the land adjacent to rivers and streams by lifting water through crude methods. The socio- economic and agricultural requirements generated new demands on irrigation system. In order to provide assured means of irrigation, planned construction of canals took shape by and large Western Yamuna Canal which takes-off from the River Yamuna was probably the first major irrigation work initially constructed by Feroze Shah Tuglak in year 1351. It was remodelled by Akbar in year 1568 and was extended in year 1626 during the reign of Shahjahan. The canal was reconstructed in a reasonably serviceable form by British during 1817-1823. The Eastern Yamuna Canal, taking off the Yamuna River, about the same place as the Western Yamuna Canal, was constructed in 1823-1829 and opened in 1830. Originally, the Western Yamuna Canal and the Eastern Yamuna Canal were both in what was then known as North Western Provinces. In 1864, the Western Yamuna Canal and the area it served were transferred to the Punjab; the Eastern Yamuna Canal remained in the North Western Provinces, which was later named the United Provinces of Agra and Oudh (U.P) and, since independence, Uttar Pradesh. The Western Yamuna Canal is now in Haryana.

Another canal taking off the Yamuna lower down near Delhi, the Agra canal, was opened in 1874. It was built by Uttar Pradesh without any reference to Punjab and the Western Yamuna Canal has always had priority over the Agra Canal on the flow in the Yamuna. Then came Upper Ganga Canal in 1851, after which the Upper Bari Doab Canal, Sirhind Canal, Lower Chenab Canal and lower Jehlam Canal etc. were constructed. Punjab was pioneer in this field but unfortunately our best irrigation system and the most fertile lands were left in Pakistan after the partition of the country in 1947.

The area of East Punjab falling in India was highly deficient in Irrigation. Punjab Irrigation Department initiated construction of Bhakra Dam, Pandoh Dam and Pong Dam and interlinks for the transfer of Ravi waters at Madhopur headworks into Beas River and link channels at Pandoh Dam for the transfer of water from Beas to Sutluj. Bhakra Dam was dedicated to the nation in October, 1963 but the Bhakra Nangal Canal network was completed in 1954 which is presently carrying Sutlej and Beas waters to the State of Haryana.

BHAKRA NANGAL PROJECT.

The Bhakra Nangal scheme has been on the anvil since 1908, and its execution was signed by Ch. Chhotu Ram in 1945 and work started thereafter on the eve of India's partition and independence. The Partition holocaust led to the sudden uprooting of millions of people from their hearths and homes, and practically the entire Hindu- Sikh population migrated to India. They needed land for cultivation, power for setting up industries and opportunities to restart their livelihoods. The Bhakra-Nangal Project was considered to provide the answer to all these needs, but its execution soon got enmeshed with the dispute between Pakistan and India on the Indus waters.

The Indus waters Treaty (IWT) that became effective from April 1960 resolved the water- related disputes between India and Pakistan. Under this Treaty, the waters of the ' Eastern Rivers' namely, the Ravi, the Beas and the Sutlej were awarded for the use of India. The IWT stipulated that during a ' transition period' ending March, 1970 (extendable up to 1973), India " shall limit its withdrawals" for agricultural use, limit abstractions for storages (including at Bhakra) and make deliveries to Pakistan from the ' Eastern Rivers' in the specified manner. The Bhakra- Nangal Project aims at utilization of the waters of the Sutlej River allocated to India.

The Bhakra Nangal Project head works are located in the (undivided) State of Punjab in India. There are two integral parts of the Project, namely, the Bhakra dam and the Nangal dam. The former compromises a storage dam at Bhakra across the Sutlej and two powerhouses. The latter is a barrage across the same river at Nangal, enabling the diversion of water into the Nangal Hydel Channel, which also feeds the new irrigation canal system at its tail. This project was the most vital river valley development scheme commissioned in the early years of the Indian Republic.

The Bhakra Nangal Project comprises two essential parts, as noted earlier- the Nangal Barrage and connected canal systems, and the Bhakra dam and powerhouses. It will be convenient to recall briefly the Project features too in terms of these two major components

The Bhakra dam is a straight gravity concrete dam across the river Sutlej. The maximum height over the deepest foundation level is 225.5m (740ft) while the height over mean river bed level is 213.6m (700 ft) The length of the dam at its crest is 518.16m (1700 ft.) The full reservoir level was finally kept at 515.11 m (1680 ft.) The gross storage capacity is 9.62 BCM. (7.80 MAF) and the effective

storage 7.19 BCM (5.83 MAF). The water spread of the reservoir is 168.35 Sq. Km (65 sq. miles)

There are two powerhouses. The Right Bank powerhouse originally had an installed capacity of 660 MW and the left Bank Powerhouse 450 MW. These were later uprated to 710 MW and 540 MW, respectively.

The construction commenced in 1948 and was completed in 1963. The Prime Minister Pt. Jawahar Lal Nehru dedicated the Bhakra dam to the nation in October 1963.

Pt. Jawahar Lal Nehru while performing the inaugural ceremony of the Left Bank Power House on 10th Dec., 1961, in his inspiring speech said that:

" In his opinion water and electricity were of much greater value than ever gold itself, because a country which had electricity and water, could buy as much as gold as it liked"

13000 workers, 300 engineers and 30 foreign experts grappled with Nature in a resolute bid to subdue its mighty forces and harnessing them for the benefits of mankind. Bhakra Dam, which is a concrete reality today, was completed in all respects in 1963 except grouting of the deep curtain. The Right Bank Power House was completed in 1969.

Finally came the moment which emotionally united everyone- from a labourer at the site to the then Prime Minister of the country. On 22nd October, 1963, the mighty Bhakra Dam was dedicated to the nation by Pt. Jawahar Lal Nehru who described it:-

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

The work on the dam was done departmentally i.e. through the Government agency without engaging contractors. This mode of construction provided great flexibility in adjusting the designs, construction techniques and programme to suit changing needs in the field and the foundation conditions from time to time. The economy, efficiency and speed of execution of the construction work had amply justified the wisdom of the decision taken.

The total cost of the Bhakra Nangal Project was Rs. 245.28 crore.

The Nangal dam was planned to be constructed by dividing the working area into two halves by enclosing the left half with a coffer dam. After this portion was concreted upto upstream floor level, the river was diverted over the completed portion. The work was then started on the right side by enclosing it by a coffer dam.

The excavation of foundation was restarted (after the partition disturbances) in January 1948, using dumpers and manual labour. In April 1948, the concreting commenced and the left half was completed by March 1949. The whole river was diverted to the left side before September 1949. Excavation on the right side commenced in November 1949. The foundation concreting on the right side was over by June 1950. By February, 1951 the crest of bays 13 to 26 was raised to final levels. The construction of the road bridge was over by the end of 1951. On 22 August, 1951 within a few days of the completion of work in the left half, the Nangal dam safely passed a record flood of 310,000 cuses (8778 cusecs).

About 13 Km (8 miles) downstream of the Bhakra dam site, the Sutlej river emerges out of the Shiwalik hills at Nangal, to enter the plains of Punjab. The barrage is built at this point. It is a 291 m (955 ft) long concrete structure. It is 27.7 , (91 ft.) high and has a small storage of 25 million cum (20,000 acre ft.), equivalent to just one day's supply in the hydel canal and to take care of the diurnal variations of releases from the dam upstream.

The Nangal Hydel channel takes off from the Left Bank of the Sutlej, just upstream of the Nangal dam. It carries a discharge, beyond the silt ejectors, of 354 cumec (12,500 cusec) and serves as the feeder for the Bhakra canal system below Ropar and to generate power at the power stations at Ganguwal and Kotla at the 19th and 30th km respectively, from the head of the channel. The canal is 64 km (30 miles) long and is fully lined with cement concrete and tiles throughout its length . It runs along broken country and is crossed by as many as 58 hill torrents.

The Bhakra canal system comprises the following:

(i) The newly constructed Bhakra canal, fed by the Nangal Hydel channel at Ropar.

(ii) Remodelling of the Ropar headworks and enlarging the capacity of Sirhind Canal by over 99 cumec (3500 cusec), and

(iii) The new Bist- Doab canal taking off on the right bank of the Sutlej at Ropar, with a head discharge of 39.6 cumec (1400 cusec).

The irrigation system comprises some 1110 km of main and branch canals and 3379 km of distributary channels. The whole system utilizes a discharge of 510 cumec (18,000 cusec)

Work on the barrage was completed by 1952. Even though construction of the canal system was completed only in 1954, partial irrigation commenced from 1952 itself. The total area benefited was 4 million ha., (10 million acres) out of which the new area covered was 2.4 million ha. (six million acres).

The Ganguwal and Kotla power houses have installed capacities of 77.65 MW each. They commenced operation in 1955 and 1956, respectively.

The Beas Project Unit-I & II (Pandoh Dam and Pong Dam) were taken up to harness and utilize the water of river Beas at a time when the Bhakra dam project was nearing completion. The Beas Sutlej link (diverting Beas waters to Sutlej), in conjunction with the existing Madhopur Beas Link (linking river Ravi with Beas) and amaniacting from river Ravi has provided a link network for the three rivers of the region thereby providing the flexibility of operation which is very efficient for the optimum utilization of river supplies. Thus at a time when the Beas catchment is wetter than the Sutlej catchment, the BSL along with MB link enable more equitable distribution of river supplies.

SHARE OF WATER OF HARYANA STATE UNDER DIFFERENT INTER-STATE AGREEMENTS

SHARE OF WATER IN RIVER SUTLEJ

After independence, the beneficiaries of Sutlej water were the state of Punjab, erstwhile Pepsu (Patiala & East Punjab States Union), and Rajasthan. On November 1, 1956 Pepsu merged with Punjab State and formal agreement on Bhakra Nangal Project was concluded between the Punjab and Rajasthan Governments on January 30, 1959 which also set out in detail the extent of area served by the project in each state. On November 1, 1966 the Punjab State was reorganised creating Haryana State besides Punjab as per the Punjab Reorganisation Act, 1966. The total availability of water from river Sutlej on the basis of flow series at Bhakra dam site from 1921-60 on a 50% dependability level was estimated at 17.28 BCM (14.00 MAF) which was distributed as under:

State		Inter-State Water Shares	
		(BCM)	(MAF)
Haryana	-	5.427	4.40
Punjab	-	10.053	8.15
Rajasthan	-	1.801	1.46
Total	-	17.281	14.01

SHARE OF WATER IN RIVERS RAVI AND BEAS

As per 1981 agreement based on flow series 1921-60 at Madhopur Headworks across river Ravi and Mandi Plain across river Beas, the availability of surplus water after satisfying the pre-partition uses was placed at an annual mean of 21.18 BCM (17.17 MAF) which was allocated as under:-

State	**Inter-State Water Shares**	
	(BCM)	(MAF)
Punjab	5.205	4.22
Haryana	4.317	3.50
Rajasthan	10.60	8.60
Delhi	0.247	0.20
J & K	0.80	0.65
Total	**21.179**	**17.17**

Actual shares would be prorata based depending on availability of water. The matter was subsequently referred to Ravi-Beas Tribunal (also known as Eradi Tribunal) which was constituted under Section 14 of Inter-State Water Dispute Act 1956 vide notification dated April 2, 1986. Eradi Tribunal vide its report dated January 30, 1987 placed the total availability of surplus Ravi Beas Water at 22.548 BCM (18.28 MAF) which includes 1.369 BCM (1.11 MAF) additional supplies found to be utilisable out of 5.69 BCM (4.613 MAF) available below the rim stations i.e. between Madhopur and Ravi syphon on Pakistan Border and Mandi Plain and Ferozpur Head works which could be lifted through pumps. The State-wise distribution for 22.548 BCM) (18.28 MAF) was given as under :-

State	Inter-State Water Shares	
	(BCM)	(MAF)
Punjab	6.167	5.00
Haryana	4.724	3.83
Rajasthan	10.608	8.60
Delhi	0.247	0.20
J & K	0.802	0.65
Total	**22.548**	**18.28**

The award of Eradi Tribunal is yet to be gazetted by Government of India after inviting and hearing objections of the basin states under Section 5(3) of the Inter-State Water Dispute Act. However, Haryana is presently getting only about 2.28 BCM (1.85 MAF) of Ravi water annually because of system constraint.

INTEGRATION OF SUTLEJ AND RAVI BEAS WATER.

The above water shares are delivered to Haryana State through a network linking various rivers and canals. Ravi, Beas and Sutlej water shares are delivered to Haryana through the Bhakra Main Canal. For this purpose, the transfer of water from river Ravi to river Beas is effected through Madhopur-Beas link which was constructed in 1954 with a discharge capacity of 283.13 cumecs (10,000 cusecs). A storage dam known as Ranjit Sagar Dam, with live storage capacity of 2.34 BCM (1.90 MAF), is already constructed on river Ravi near village Thein, U/s of Madhopur Headworks. The water diverted from river Ravi to river Beas is utilised downstream at Harike Headworks and Ferozpur Headworks to supplement the supplies in Sirhind feeder, Rajasthan feeder, Eastern Canal and Bikaner canal which mostly serves the areas of Rajasthan and Punjab. The Madhopur- Beas link joins Beas river downstream of Pong Dam, having live storage of 7.29 BCM (5.91 MAF), which feeds the system downstream. U/s of Pong dam there is a diversion structure on river Beas at Pandoh, linking Beas River to Sutlej through Beas- Sutlej link channel with a capacity of 254.85 cumecs (9,000 cusecs). The storage dam/ reservoir at Bhakra has a live storage capacity of 7.19 BCM (5.83 MAF)

SHARE OF WATER IN THE RIVER YAMUNA

Prior to the memoranda of under standing of 12.5.1994, the runoff of the river reaching Tajewala head works was utilised by Haryana and UP States as per the 1954 agreement (effective from 1950), described as below:

DRAFT AGREEMENT BETWEEN THE PUNJAB & UTTAR PRADESH GOVERNMENTS REGARDING DISTRIBUTION OF THE SUPPLIES OF RIVER YAMUNA AT TAJEWALA, BETWEEN WESTERN JUMNA CANAL, EASTERN JUMNA CANAL & APPORTIONMENT OF EXPENDITURE ON TAJEWALA HEAD WORKS & RELATED WORKS

This agreement made on the 12th day of March 1954 between the Governor of Uttar Pradesh on the one part and the Governor of Punjab on the other part, witnesses as follows :-

1. In supersession of all previous orders and agreements on the above noted subject, the supplies of the river Yamuna at Tajewala and the expenditure on Tajewala Headworks and connected training works will be governed by this agreement, which will come into force from 1st April, 1950.

2. In the event of the river discharge being less than the total indent of the two canals i.e. Western Yamuna Canal and Eastern Yamuna Canal the supplies available at Tajewala will be distributed in accordance with the table given below:

Total River discharge at Tajewala cusecs. = X	Supplies to which WYC will be entitled in cusecs.	Supply to which EYC will be entitled in cusecs.	Remarks
Upto 5890	2/3 X-47	1/3 X plus 47	WYC takes excess
From 5890 to 8790	X – 2010	2010	
From 8790 to 9280	6780	X-6780	EYC takes excess
From 9280 to 10900	X – 2500	2500	WYC takes excess

When the total river discharge is in excess of 10900 cusecs the Punjab and the UP will have the right to utilise the excess over 10900 cusecs in the ratio of 2:1.

3. The shingle Excluder at Tajewala and silt extractor at Dadupur will not be run, until the indent of Eastern Yamuna Canal has been met in full.

4. The supplies will be metered at the meters situated at RD 1000 on the Eastern Yamuna Canal and RD 7000 post of regulation beldar of Western Yamuna Canal.

5. The meters referred to in clause 4 above will be calibrated and discharge table framed, which will form the basis of regulation between the two canals. Any changes in the discharge tables found necessary will be made after joint discharge observations by officers of the Punjab and UP not below the rank of Sub Divisional Officers, if any party does not respond to the request of the other party for a joint discharge observation within a week, a change in the discharge table will be made provisionally on the basis of the discharge observed by either party till a joint discharge is observed.

6. If part supply of Western Jamuna Canal is taken through Diversion channel or through Rafting channel, the same will be metered and its discharge included in working out the total discharge of Western Jamuna Canal.

7. If for any reasons the Punjab fails to meet the share of Eastern Jamuna Canal to the limit of its indent in any one week, the deficit will be made good in the following weeks.

8. The officers of either Government will have free access to all the works, plans estimates, reports and other records pertaining to the Headworks training works and gauging sites on the two canals.

MAINTENANCE OF TAJEWALA HEADWORKS

9. The maintenance of Tajewala headworks and related training works will be the responsibility of the Punjab Government.

10. The Punjab Government will initiate all proposals for proper maintenance of the head works and training works and improvement of the same, and will carry out all works without reference to the Uttar Pradesh Government except in case of works charged to capital, the estimated cost of which exceeds

Rs. 50,000 for each individual work. Such works shall be carried out with the concurrence of Chief Engineer ,Uttar Pradesh.

APPORTIONMENT OF EXPENDITURE

11. The total actual expenditure on all works and establishment relating to Tajewala Headworks and training works in any financial year (Ist April to 31st March) will be apportioned between the Punjab and UP in the ratio of total discharge in cusec days run in two canals during the year in question. The discharge escaped back into river through the silt extractor at Dadupur will be deducted from the total discharge of Western Yamuna Canal vide clauses 4 & 6 above in arriving at the figures of net supply for Western Yamuna Canal for purpose of clause 2 above.Debit will be raised by the Punjab Government against the Uttar Pradesh for the latter's share of the expenses soon after the close of the financial year and adjustment will be made in the March supplementary accounts for the year as far as possible.

12. The works expenditure will include expenditure on all clauses of works whether chargeable to Revenue or Capital.

13. Cost of establishment referred to in clause 11 above will be worked out at 27 ½ % of the works expenditure on the Tajewala Headworks and training works, in any financial year (Ist April to 31st March).

In case of capital works, in which specific provision exists in the estimate for establishment charges on the usual percentage basis, expenditure actually booked on works will be counted as works expenditure and establishment charges will be accounted for under establishment.

14. The word "headworks" wherever used in this agreement shall include the weir, the under sluices, and the Regulators and the terms "Training works" shall include all works upstream of the Head works, and the works downstream upto one mile at either end along the river.

General

15. The Government of Uttar Pradesh will have the right to terminate this agreement and to make alternative agreements before obtaining their share after giving three years notice to the Punjab Government. If not terminated earlier, this agreement will be binding on both the Governments for period of 50 years from 1st April, 1950 after which it may be renewed.

16. The Chief Engineers of the two Governments will meet every year as soon after the flood season as convenient and discuss problems of common interest.

17. IN WITNESS WHEREOF The Chief Engineer, Uttar Pradesh Public Works Department, Irrigation Branch, for and on behalf of the Governor of Uttar Pradesh and the Chief Engineer and Secretary to Government, Punjab PWD, Irrigation, Branch for and on behalf of the Governor of Punjab, have signed this deed.

(Sd.)
S. L. MALHOTRA,
Chief Engineer and Secretary
to Punjab Government, PWD
Irrigation for and on behalf of the
Governor of Punjab

(Sd.)
Chief Engineer Uttar Pradesh, PWD,
Irrigation Branch, for & on behalf of the
Governor of Uttar Pradesh

In the Memorandum of Understanding (MOU) signed on 12.5.1994 between Uttar Pradesh, Haryana, Rajasthan, Himachal Pradesh and National Capital Territory (NCT) of Delhi regarding allocation of surface water, the 75% dependable natural virgin flow in the river Yamuna up to Okhla has been assessed at 11.70 BCM. Mean year availability has been assessed as 13.00 BCM, which is considered for allocation of shares. The Inter-state shares of various co-basin states viz. Haryana, Uttar Pradesh (UP), Rajasthan, Himachal Pradesh (HP) and NCT of Delhi is as under:-

State Allocation of water shares on mean year availability

(BCM)	
Haryana	5.730
Uttar Pradesh	4.032
Rajasthan	1.119
Himachal Pradesh	0.378
Delhi	0.724
Total	**11.983**

Copy of the agreement dated 12.05.94 is reproduced as:

MEMORANDUM OF UNDERSTANDING BETWEEN UTTAR PRADESH, HARYANA, RAJASTHAN, HIMACHAL PRADESH AND NATIONAL CAPITAL TERRITORY OF DELHI REGARDING ALLOCATION OF SURFACE FLOW OF THE YAMUNA.

1. WHEREAS the 75% dependable notional virgin flow in the Yamuna river upto Okhla has been assessed as 11.70 Billion Cubic Metres (BCM) and the mean year availability has been assessed as 13.00 BCM.

2. AND WHEREAS the water was being utilised by the Basin states ex-Tajewala and ex-Okhla for meeting the irrigation and drinking water needs without any specific allocation.

3. AND WHEREAS a demand has been made by some basin states on this account and the need for a specified allocation of the utilisable water resources of the river Yamuna has been felt for a long time.

4. AND WHEREAS to maximise the utilisation of the surface flow of the river Yamuna a number of storage projects have been identified.

5. AND WHEREAS the states have agreed that a minimum flow in proportion of completion of upstream storages going upto 10 cumec shall be maintained downstream of Tajewala & downstream of Okhla Headworks throughout the year from ecological considerations, as upstream storages are built up progressively in a phased manner

6. AND WHEREAS it has been assessed that a quantum of 0.68 BCM may not be utilisable due to flood spills.

7. NOW THEREFORE, considering their irrigation and consumptive drinking water requirements, the Basin states agree on the following allocation of the utilisable water resources of river Yamuna assessed on mean year availability:

1.	Haryana	5.730 BCM
2.	Uttar Pradesh	4.032 BCM
3.	Rajasthan	1.119 BCM
4.	Himachal Pradesh	0.378 BCM
5.	Delhi	0.724 BCM

subject to the following :

i) Pending construction of the storages in the upper reaches of the river, there shall be an interim seasonal allocation of the annual utilizable flow of river Yamuna as follows :-

STATES SEASONAL ALLOCATION OF THE YAMUNA WATERS (BCM)

State	July-October	November February	March-June	Annual
Haryana	4.107	0.686	0.937	5.730
Uttar Pradesh	3.216	0.343	0.473	4.032
Rajasthan	0.963	0.070	0.086	1.119
Himachal Pradesh	0.190	0.108	0.080	0.378
Delhi	0.580	0.068	0.076	0.724
Total	**9.056**	**1.275**	**1.652**	**11.983**

Provided that the interim seasonal allocations will be distributed on ten daily basis.

Provided further that the said interim seasonal allocations shall get progressively modified, as storages are constructed, to the final annual allocations as indicated in para 7 above.

ii) Separate agreement will be executed in respect of each identified storage within the framework of overall allocation made under this agreement.

iii) The allocation of available flows amongst the beneficiary states will be regulated by the Upper Yamuna River Board within the over all framework of this agreement.

Provided that in a year when the availability is more than the assessed quantity , the surplus availability will be distributed amongst the states in proportion to their allocations.

Provided also that in a year when the availability is less than the assessed quantity, first the drinking water allocation of Delhi will be met and the balance will be distributed amongst Haryana, UP, Rajasthan, and HP in proportion to their allocations.

8. This agreement may be reviewed after the year 2025, if any of the basin states so demand.

9. We place on record and gratefully acknowledge the assistance and advice given by the Union Minister of Water Resources in arriving at this expeditious and amicable settlement.

New Delhi, the 12th May, 1994

Sd/- Chief Minister Uttar Pradesh	Sd/ Chief Minister Haryana	Sd/- Chief Minister Rajasthan
Sd/- Chief Minister Himachal Pradesh	Sd/- Chief Minister Delhi	Sd/- Minister (Water Resources)

In the presence of :-

Apart from allocation within states it is stipulated that a minimum of 10 cumecs of water will be maintained as minimum flow in the Yamuna D/s Tajewala and Okhla accounting for 0.325 BCM annually. It is also estimated that 0.680 BCM of flood water may not be utilisable as a result of unavoidable spills. These together with the shares (11.983 + 0.325 + 0.680) accounts for a mean year availability of 13.00 BCM.

DRAINS AND ESCAPES.

During the monsoon season and other irrigation periods, whenever the WY C command does not require water or in cases when canal system can not safely carry the flows, the water is passed through canal ' escapes'. Similarly there are many drains in the command of WYC, which have catchment of their own. These drains generally flow during monsoon season. The water from escapes and drains ultimately outfall in river Yamuna.

The Diversion Drain No. 8, Drain No. 8, Ujjina drain, Gaunchi drain, flow Downstream of Pathrala/Dadupur Headworks constitute such main system. Dhanaura escape, Munak escape and Indri escape contribute flows to river Yamuna.

BIBIPUR AND OTHER LAKES

There are number of lakes in the state but utilisation of any significance is reported so far only from Bibipur Lake. This lake situated near Pehowa in Kurukshetra district, was constructed to store water of river Saraswati for Irrigation. Water is fed into Saraswati distributory system during monsoon season. The system is further connected to Bhakra Canals through Saraswati Feeder, taking off from Narwana Branch. A regulator is also provided on river Markanda (a tributary of river Ghaggar) at Jalbera to feed Bibipur Lake, in time of need, through Kanthala supply channel. Excess water of lake is drained off through Saraswati drain. Other lakes viz Kotla, Chandena, Bhindawas Ottu, Masani, Khaparwas, can also be developed for gainful storages. Besides Kameda and Raoli bunds can also be utilised for storing surplus available water in rainy season.

WATER AVAILABILITY TO HARYANA FROM SARDA-YAMUNA LINK

Initially, this proposal was thought as Ganga-Yamuna Link. But this proposal was not found feasible. National Water Development Agency, which is the Planning organisation of Government of India in water resources sector to study the feasibility of Inter- basin links for conveyance of surplus water to deficit regions have a proposal of Sarda- Yamuna Link. As per this proposal, which is only at pre-feasibility stage, it is foreseen that by efficient operation of Poornagiri reservoir on Sarda river (a tributary in Ganga basin), it is possible to convey surplus water during the monsoon season to the water starved and drought prone areas of Haryana and Rajasthan States.

UTILISATION OF THE GHAGGAR WATER

Most of the flows in the river Ghaggar occur during monsoon season and very insignificant non monsoon flows are there. A number of storage schemes in Shiwalik area including Ghaggar Dam , Khetipurali and Bhud dams have been identified. The total storages including thus created by very small check dams proposed by Haryana Agriculture Department and used by some lift schemes is about 480 Cubic metres. Presently some of the Ghaggar water is being utilized at village Ottu by constructing a weir and for taking a number of channels in

monsoon period. Besides the Ghaggar dam proposed near village Gumthala across the river Ghaggar at a point of D/S of confluence of river Kaushalya and river Jhajra(both are tributaries of the river Ghaggar) could not be considered a viable project by the Government because of its rehabilitation and resettlement problems as abadi of 13 villages were found affected. Further shifting of 8 Km. of road and 11 Km Ambala- Kalka Railway line was also involved. Thus smaller dam was considered more viable and the project scheme for constructing such medium height dam near village Dewanwala across the river Ghaggar only has been prepared and is under the consideration of the Government of Haryana as the scheme is still at the pre-feasibility stage.

About 6.5% of the total area of Haryana State lies in Shiwalik hills and foot hills contributing mostly to the Ghaggar and the Yamuna river basins and only a small part contribute to Sutlej basin. Haryana Agriculture Department, Soil Conservation Department and Forest Department have taken up construction of a number of small check dams in Candi Area of Shiwalik hills range under various programmes for envisaged benefits of ground water recharge, storage of rain water during monsoon for irrigation during Rabi season and reduction in soil erosion.

As explained earlier Haryana has no independent surface water sources and receives its share through interstate rivers i.e. the Yamuna, the Sutlej, the Ravi and the Beas. The supplies from the river Yamuna are received at Hathni Kund Barrage while the supplies (share) of Haryana in the Sutlej, the Ravi and the Beas is drawn from Bhakra Dam Reservoir at Nangal. There is no storage on Yamuna in Haryana and thus the availability is very inconsistent and vary to a great extent. During the lean period some times the inflows at HKB/Tajewala gets reduced to such an extent that even bare minimum requirement of drinking water supplies fall deficit. The supply at Okhla is also very inconsistent and limited, which hardly meets the requirements of Gurgaon canal system. Further the quality of water available in the Yamuna at Okhla is not good and practically unfit for use unless it is mixed with fresh water. The share of Haryana in the Sutlej, the Ravi and the Beas rivers is being drawn from Bhakra reservoir and Nagal Dam, and is carried to Haryana through N.H.C., B.M.L. and Narwana Branch. SYL canal is yet to be completed in Punjab portion. B.B.M.B. is assessing distributing and monitoring supplies on monthly basis as per share of the partner states through monthly technical committee meeting. Haryana receives its share at two contact points i.e. RD.160 of Narwana Branch (near Kapoori village in Patiala district) and RD.390 of BML near Ghagha Mandi).

SYL CANAL

Under the Indus Water Treaty of 1960, the waters of the three rivers, the Sutlej, the Beas and the Ravi became available for the unrestricted use by India after 31st March 1970. India paid 62.06 million pounds Sterling (then equivalent to Rs. 110.00 crore) to Pakistan as cost of replacement works to feed the canal system in Pakistan from the Western rivers which were previously served by the Eastern rivers. At the time of signing of the Indus Water Treaty, the waters of the Sutlej were already distributed and planned to be utilized by Bhakra Nangal multipurpose Project, and the surplus flows of the rivers Ravi and Beas, over and above the pre-partition use, had been allocated by an agreement in 1955 between the concerned states as to the following effect , based on the flow series of 1921-45 :

Punjab	7.20 MAF (including 1.30 MAF for Pepsu)
Rajasthan	8.00 MAF
J&K	0.65 MAF
Total	**15.85 MAF**

Distribution, of surplus Ravi-Beas waters in different areas of state of Punjab became an issue of concern and in 1965, the Government of the erstwhile state of Punjab constituted two committees known as Development Committee and Food Committee which interalia looked into the distribution of river waters in the State of Punjab. While the Food Committee recommended allocation of 4.56 MAF, the Development Committee recommended that bulk of surplus Ravi-Beas waters of out of 7.20 MAF should be allocated to areas comprising present Haryana, then a part of Punjab State. The composite State of Punjab was re-organized in 1966 into the areas forming Haryana and the territory under the linguistic Punjabi Suba, presently Punjab.

Haryana State, as a successor State of erstwhile State of Punjab and being a part of Indus Basin had a share in Ravi Beas waters. Consequent to Re-organization Act, 1966, 3.5 MAF of Ravi-Beas waters were allocated to Haryana by the order of Government of India dated 24.03.1976. Haryana proposed to bring most of its share of the Ravi Beas waters to the deficit the Yamuna command/Lift Command more particularly Western and Southern Haryana. SYL Canal had already been envisaged and proposed in 1968 to bring the surplus Ravi Beas water to Haryana. This Canal is to irrigate about 3 lach hectares of additional land and

produce 8 lakh tonnes of additional food grains worth more than Rs.1000 crore annually.

Haryana started construction of its portion of SYL Canal (91kms) in 1976 and completed the same by 1980. Haryana requested Punjab to simultaneously take up the construction of Punjab portion of the canal (121 Kms). The State of Punjab accepted Rs.1.00 Crore from Haryana in the year 1976 for this project and notified acquisition of land on 20.2.1977. Another Rs. 1.00 Crore was deposited by Haryana with Punjab in March 1979. However, Punjab did not start construction of the Canal. Haryana filed Suit No.1 of 1979 in the Hon'ble Supreme Court praying that State of Punjab be directed to start and complete the portion of SYL canal in Punjab areas. State of Punjab filed a counter Suit No.2 of 1979 in the Hon'ble Supreme Court challenging the Government of India's order of 24.03.1976 and the vires of Section 78 of the Punjab Re-organization Act 1966. On 31.12.1981, after extensive deliberations a tripartite agreement was entered into amongst Haryana, Punjab and Rajasthan states signed by the respective Chief Ministers in the presence of the Prime Minister of India, which postulated unconditional withdrawal of the suits by Haryana and Punjab and expeditious completion of the SYL Canal by Punjab in its territory. The SYL Canal in the Punjab territory was to be completed within a maximum period of two years from the date of the agreement i.e. by or before 31.12.1983. The allocation of Haryana in the Ravi Beas Waters was retained at 3.5 MAF in the 1981 agreement, and that of Punjab was increased to 4.22 MAF on the basis of 1921-60 flow series, subject to pro-rata changes based on actual flows. Pursuant to this agreement of 31.12.1981 both Punjab and Haryana withdrew Suits No.1 and 2 of 1979 from the Supreme Court on 12.2.1982.

Punjab finally commenced construction of the SYL Canal in the year 1982. The Government of Punjab issued a White Paper on 23rd April 1982 appreciating the December 1981 agreement on Ravi Beas Waters. On 24.7.1985, the Punjab Settlement was signed between the then Prime Minister of India and Late Sant Harchand Singh Longowal in the presence of other senior Akali Leaders. Paragraphs 9.1 and 9.2 of the said Settlement dealt with the question of sharing of river waters which was referred to the Ravi & Beas Tribunal. Para 9.3 of the settlement recorded that the construction of SYL canal would continue and would be completed by 15.08.1986.

Consequently, Section 14 was inserted in the Inter State Water Disputes Act, 1956 and the matters postulated by Clauses 9.1 and 9.2 of the Punjab Settlement were referred to the Ravi & Beas Waters Tribunal. (This act is re-named as The Inter-State River Water Disputes Act, 1956). On the other hand,

construction of the SYL canal continued in Punjab territory and by the time the Tribunal rendered its order/report on 30.01.1987, Punjab had completed about 55% of the SYL Canal in its territory. Ravi & Beas Waters Tribunal in its report on 31th January 1987 allocated 3.83 MAF of surplus Ravi Beas waters to Haryana under para 9.2 of the settlement. The allocation of Punjab was increased to 5.00 MAF based on 1921-60 flow series, with pro-rata adjustment based on actual flows. The report of the tribunal is awaiting gazette notification by Government of India.

In July 1990, when the work of SYL Canal stood completed to the extent of about 90%, the State of Punjab stopped work. When all efforts by Haryana failed to persuade the State of Punjab to resume the work, Haryana requested Union of India to hand over the balance work of the SYL canal to some central agency. Government of India in a meeting on 20.02.1991, attended by States of Punjab and Haryana and chaired by the Hon'ble Prime Minister, decided to hand over the remaining work of the Punjab portion of SYL canal to Border Roads Organization. However, this decision remained un-implemented. When State of Punjab in 1995 took a view that they will not restart the work on canal, Haryana filed Suit No.6 of 1996 under Article 131 of the Constitution in the Hon'ble Supreme Court for enforcing the agreement of 1981 and Para 9.3 of the Punjab Settlement.

The Hon'ble Supreme Court rendered its judgment in Suit no. 6 of 1996 on 15.01.2002 and decreed the suit in favour of the State of Haryana. The Supreme Court while upholding Haryana's contention directed as follows:-

> "We, therefore, by way of mandatory injunction, direct the defendant State of Punjab to continue the digging of Sutlej Yamuna Link Canal, portion of which has not been completed as yet and make the canal functional within one year from today. We also direct the Government of India defendant No. 2 to discharge its constitutional obligation in implementation of the aforesaid direction in relation to the digging of canal and if within a period of one year the SYL Canal is not completed by the defendant State of Punjab, then the Union Government should get it done through its own agencies as expeditiously as possible, so that the amount already spent and that would yet to be spent, will not be wasted and the plaintiff State of Haryana would be able to draw the full quantity of water that has already been allotted to its share."

Inspite of vigorous and sustained efforts on the part of the State of Haryana to have the State of Punjab implement the directions of the Hon'ble Supreme Court and to have the Union of India discharge its constitutional

obligations in this regard, no tangible steps were taken by the State of Punjab and Union of India. In these circumstances the State of Haryana was again constrained to approach the Hon'ble Supreme Court of India on 20th November 2002, praying Hon'ble Court to issue appropriate directions particularly to the Union of India to discharge its constitutional obligation of ensuring that State of Punjab continues, completes and make functional by Jan.14, 2003, the incomplete portion of the SYL Canal in the territory of Punjab. The Hon'ble Court issued notices to the Government of Punjab and Govt. of India on 16th December 2002.

On the expiry of one year period as given to State of Punjab for completion of SYLCanal, a meeting of representatives of political parties of Haryana was held on 14.1.2003 under the Chairmanship of Chief Minister, Haryana. In this meeting a Resolution was unanimously adopted in which Government of India was requested to complete the Punjab portion of SYL Canal through its own agency (ies) as per directions of Hon'ble Supreme Court of India dated 15.1.2002. In this meeting Chief Minister, Haryana was also authorised to take any further suitable action in the state's interest.

Chief Minister, Haryana also led a delegation of representatives of political parties of Haryana to meet the Prime Minister of India on 14.1.2003 itself and requested him to get the SYL Canal completed through any central agency (ies) immediately. A D. O. letter dated 14.1.2003 was also written and handed over by Chief Minister, Haryana to Prime Minister of India on this issue alongwith the resolution that had been adopted at the all – party meet.

In this connection, Union Cabinet Secretary held a meeting with Chief Secretaries of Punjab and Haryana on 24th January 2003. In this meeting Haryana requested Government of India to take up the construction work of remaining portion of SYL canal in Punjab and complete it and make it functional within a period of less than one year.

Apprehending that State of Punjab may not comply with the directions of Hon'ble Supreme Court to complete the Punjab portion of SYL Canal by January 14, 2003, State of Haryana had filed an inter-locutory application in the Hon'ble Supreme Court on November 20, 2002 with the prayer to issue appropriate directions particularly to the Union of India to discharge its constitutional obligation of ensuring that the State of Punjab continues, completes and makes functional by January 14, 2003 the incomplete portion of SYL Punjab in the territory of Punjab. Consequent to hearing in this matter on 28.7.2003 in the

Hon'ble Supreme Court and in view of the fact that time limit of one year given to State of Punjab for completion of the Canal had expired, Haryana submitted an amended application (I.A. No.4) on 13.8.2003 requesting the Hon'ble Supreme Court to direct Union of India to nominate Border Roads Organization to take up the remaining work of SYL Canal. It was also requested that the Central Water Commission should be nominated to provide technical guidance to Border Roads Organization. Union of India in its counter affidavit of 9.9.2003 indicated its willingness to comply with the order of the Hon'ble Supreme Court. It also submitted an action plan for completing the canal, including completing the formalities involved, within a period of two years and seven months. The action plan was based on the report of the inspection by Central Water Commission Team, of the Punjab portion of SYL Canal, carried out on 9th October 2002. The report had also indicated an approximate requirement of Rs. 250 crore for repairs and for completing the remaining works. It also sought direction to State of Punjab to cooperate in this regard.

Punjab State filed its reply on 5.1.2004 and Haryana State filed its rejoinder on 15.1.2004. Punjab opposed Haryana's application on the ground of suit No.1 of 2003 filed by State of Punjab and its application filed under Section (3) of Interstate River Waters Dispute Act of 1956 with the Union of India regarding constitution of a new Tribunal.

In suit no. 1 of 2003 filed by Punjab on 13.1.2003 it was prayed that Punjab be discharged of the obligation to construct SYL Canal imposed by the mandatory injunction decreed by the Apex Court in its Judgment of 15.1.2002 in Suit No. 6 of 1996, as in view of changed circumstances the decree was no longer executable. Haryana filed an application in the Hon'ble Supreme Court of India on 16.9.2003 for rejection of Punjab Suit No. 1 of 2003 at the threshold . This application was numbered as I.A No. 1–2 of 2003. In an attempt to thwart Haryana's I.A.No. 1-2 of 2003, Punjab filed a Writ Petition No. 30 of 2004 seeking a declaration that Order XXIII, Rule 6 (a) of the Supreme Court Rules, 1966 was ultra vires of the Constitution and alternatively could not be invoked in suits under Article 131 of the Constitution of India.

All pending matters in the Supreme Court were consolidated and heard at great length on 10.2.2004 and 11.2.2004 when I.A No. 4 in Haryana's Suit no. 6 of 1996 and other connected matters such as Writ Petition of Bhartiya Kisan Union (Punjab) filed on February 26, 2002, Writ Petition No. 30 of State of

Punjab, I.A.No. 1 & 2 in suit No. 1 of 2003 of the State of Punjab, were listed for hearing. The Hon'ble Supreme Court rejected the Writ Petition of the BKU on 10.2.2004 itself on the ground of locus standi. On 10.2.2004 the Hon'ble Court also did not entertain Punjab's Civil Writ Petition No. 30 of 2004 . After dismissing the aforesaid two Writ Petitions , the Hon'ble Supreme Court commenced hearing in I.A. No. 1 & 2 in Punjab Suit No. 1 of 2003 and Haryana's I.A. No. 4 in Haryana's disposed off Suit No. 6 of 1996. The hearings continued on 11.2.2004 when Judgment was kept reserved.

The Hon'ble Supreme Court rendered its Judgment on 4.6.2004 in both I.A. No. 1-2 of 2003 in Punjab's Suit No.1 of 2003 filed by Haryana as also I.A. No. 4 filed by Haryana in Haryana's Suit No. 6 of 1996. In so far as I.A. No. 1 – 2 was concerned, the Hon'ble Court allowed this application of Haryana and dismissed Punjab's Suit No. 1 of 2003 with costs. In so far as Haryana's I.A. No. 4 in Suit No. 6 is concerned the Hon'ble court allowed the application with directions, as under:-

1) The Union of India is to mobilize a Central agency to take control of the canal works from Punjab within a month.

2) Punjab must hand over the works to the Central agency within two weeks thereafter.

3) An empowered Committee should be set up to co-ordinate and facilitate the early implementation of the decree within four weeks. Representatives of the States of Haryana and Punjab should be included in such committee.

4) The construction of the remaining portion of the canal including the survey, preparation of detailed estimates and other preparatory works such as repair, desilting, clearance of vegetation etc. are to be executed and completed by the Central Agency within such time as the High Powered Committee will determine.

5) The Central and the Punjab Governments should provide adequate security for the staff of the Central Agency.

Complying with the directions at Serial No.1 and 3, Union Ministry of Water Resources (Indus Wing), on July 1, 2004, nominated CPWD as the Central

Agency to undertake the canal work and also constituted an Empowered Committee under the Chairmanship of Chairman, CWC, comprising Irrigation Secretaries of both Punjab and Haryana, Joint Secretaries of Union Ministry of Home Affairs and Water Resources and Commissioner/ Policy and Planning, Union Ministry of Water Resources as members. As per directions of the Hon'ble Supreme Court mentioned at Sr. No.2, State of Punjab was to hand over the works to Central Agency within 2 weeks of nomination of the Central Agency and, therefore, State of Punjab was expected to hand over the work to Central Agency by 15th July 2004. However, on 12.7.2004 Punjab Assembly passed Punjab Termination of Agreements Act 2004 annulling all Inter-State agreements signed by the State of Punjab relating to sharing of Ravi and Beas waters. In view of the passing of the said Act Punjab took a stand that it was absolved of all liabilities in respect of Ravi –Beas Waters and construction of SYL Canal under the previous agreements, judgments or awards. There was resentment against this Act both in Haryana and Rajasthan. Prime Minister of India invited Chief Ministers of Punjab, H.P. Haryana and Rajasthan to have meetings with him on this issue. Chief Ministers met the Prime Minister one by one. State of Haryana impressed upon the Government of India that Punjab Act of 12.7.2004 was un-constitutional and, therefore, Punjab be advised to act upon the Hon'ble Supreme Court's judgment. Government of India also filed an application in the Hon'ble Supreme Court on 15.7.2004 to place on record the subsequent facts and developments after passing the orders of 4.6.2004 to seek further direction. The application is yet awaiting an hearing. Finally, Government of India on 22.7.2004 sought opinion of the Hon'ble Supreme Court through a Presidential reference under Section 143 of the Constitution with terms of reference as under :-

i) Whether the Punjab Termination of Agreements Act 2004 & the provisions themself are in accordance with the provisions of the Constitution of India.

ii) Whether the Punjab Termination of Agreements Act 2004 and the provisions thereof are in accordance with the provisions of Section 14 of the Inter-State Water Disputes Act 1956, Section 78 of the Punjab Re-organization Act, 1966 and the Notification dated 24th March 1976 issued there under"

iii) "Whether the State of Punjab has validly terminated the agreement dated 31.12.1981 and all other agreements relating to the Ravi Beas Waters and is discharged from its obligation under said agreement(s).

iv) Whether in view of the provisions of the Act, the State of Punjab is discharged from its obligations flowing from the judgment and decree dated 15.1.2002 and Judgment and order dated 4.6.2004 of the Supreme Court of India"

In the meantime State of Punjab had filed a review petition on 2.7.2004 which was heard and rejected by the Hon'ble Supreme Court on 18.8.2004. All the concerned Stat es have filed their submissions. It has been contended by all that Punjab's Act is beyond jurisdiction and legally not sustainable. Haryana has made a detailed submission on facts and law and contended that Punjab's Act is a coloured and incompetent legislation.The matter was last heard on February 28,2005 when taking note that all states have filed their submissions, it was ordered to list the case for final hearing. It is excepted that case maycome up for final hearing after summer vacations, sometime in July, 2005.

DRAINAGE NETWORK IN HARYANA

Haryana is a small State situated in North West part of India. Total area of the State is 4.4 million hectares, of which about 3.9 million hectares is arable.

Topographically, from drainage point of view the entire state is covered under two basins, namely the Yamuna Sub Basin of the Ganga Basin and the Ghaggar Sub Basin of the Indus Basin. WJC Main Branch up to Munak and then Hansi Branch, Butana Branch, Sunder Sub Branch & Jui Feeder divide the two drainage basins up to Bhiwani. The Yamuna Sub basin comprises of part of Yamunanagar distrtict, Karnal, Panipat, Sonipat, Rohtak, Jhajjar, Rewari, Gurgaon, Faridabad district and it covers about 37% area of the State(16330 Sq. KMs.) This drains into the River Yamuna. The remaining 63% area (27882 Sq. KMs.) comprising of districts Panchkula, Ambala, part of Yamunanagar, Kurukshetra, Kaithal, Jind, Mohinderagarh, Bhiwani, Hisar, Fatehabad and Sirsa has country slope toward river Ghaggar and is known as the Ghaggar Sub Basin. Increasing urbanization in Delhi and encroachments in river bed in Delhi Territory creates drainage problem in case of heavy down pour. To improve the situation in Delhi and to provide relief in Haryana, diversion drains cutting across the valley line were constructed in the northern portion of this catchment namely the Chautang diversion, Main Drain No. II and diversion drain No. 8 to out-fall in to the River Yamuna North of Delhi and Ujina diversion drain was constructed to out-fall into river Yamuna in Haryana territory to avoid drainage congestion fromKhaluka Regulator through Rajasthan . Due to the construction of storages on rivers like the Sahibi, the Dohan, the Krishnawati, the Landoha Nallah coming from Aravalli Hills of Rajasthan now flooding in Rewari, Mahenderagarh, Jhajjar and Mewat has reduced considerably. Problem arises only when there is heavy downpour and there occurr breaches in the Bunds in Rajasthan.

Important drains of the Yamuna Sub Basin area are the Chautang - Rakshi Dhanaura Escape, Nissing Drain, Indri Drain, Main Drain No. 2, Nai Nallah Drain, Diversion Drain No. 8, Drain No. 8, Out-fall Drain No. 8, Najafgarh Drain, Chhapra Drain, Meham-Lakhanmajra Drain, KCB Drain, Supplementary Drain, Nuh Drain, Ujjina drain, Ujjina diversion Drain, Gaunchi Main Drain etc.

The River Ghaggar enters Haryana state in district Panchkula from the foot hills of Shiwalik and flows in North-West direction through Haryana, Punjab and then to Rajasthan. The River Tangri out falls in the river Markanda and the Markanda join the Ghaggar River in Kaithal district. Ghaggar river and

its tributaries create serious problems on their way through districts Ambala, Kurukshetra, Kaithal, Fatehabad and Sirsa. The Ghaggar river drains into desert area of Rajasthan. Important drains of the Ghaggar Sub Basin are Ganda Nallah, SYL Parallel Drain, Saraswati Drain, Kaithal drain, Amin drain, Pundri Drain No. 1, Pundri Drain No. 2, Kasan Drain, Kalwa-Kinana Drain, Padana Drain, Hansi Drain, Rori-Ghaggar Drain, Rangoi Kharif Channel cum Drain , Rangoi Nallah, Rangoi Diversion.

A new project of Bas Hisar-Ghaggar drain is under implementation. This will provide relief to the area of Hisar, Fatehabad and Sirsa districts.

At present total length of drains are about 4660 Kms. Main drains and their out-fall are as under:-

Sr. No.	Name of Drain	Capacity	Out-fall
1	2	3	4
YAMUNA BASIN			
1.	Main Drain No. 2	6325 Cs.	River Yamuna
2.	Nai Nallah Drain	2241 Cs.	Drain No. 8
3.	Diversion Drain No. 8	7320 Cs.	River Yamuna
4.	West Jua Drain	500 Cs.	Mangeshpur drain
5.	Drain No. 8	1537 Cs.	Out-fall into Bhindawas lake/ drain
6.	Out-fall drain No. 8	4000 Cs.	Dhansa out-fall drain
7.	KCB Drain	692 Cs.	Mangeshpur drain
8.	Chandeni drain	425 Cs.	Nuh drain
9.	Nuh drain	1362 Cs.	Ujina drain
10.	Ujina drain	2200 Cs.	Ujina Diversion drain
11.	Ujina Diversion drain	2200 Cs.	Gaunchi Main drain
12.	Gaunchi Main drain	6655 Cs.	River Yamuna
GHAGGAR BASIN			
13.	Saraswati drain	16660 Cs.	River Para a Try.,of River Ghaggar
14.	Kaithal Drain	4268 Cs.	River Ghaggar
15.	Amin Drain	2250 Cs.	82000/L Kaithal Drain
16.	Assand Drain	268 Cs.	111271/R Hansi Branch.
17.	Pundri Drain No:1	285 Cs.	18000/L Shudkan Disty.
18.	Pundri Drain No:2	495 Cs.	278850/L Sirsa Branch.
19.	Kagsan Drain	335 Cs.	73260/L Pundri Drain No:2
20.	Rangoi Diversion Drain	4000 Cs.	River Ghaggar.

Brief history of floods in the State

a) Year 1976-77

Haryana experienced very heavy floods during the year 1976 & 1977. The South-Western parts of Haryana experienced 'One in 50 / 100 years' flood both in 1976 & 1977. The Northern part of Haryana experienced heavy floods during 1976, except Kaithal area which experienced heavy flooding during 1977.

b) Year 1978

The floods during this year were direct result of heavy rainfall in the state, as well as in the catchment areas of the River Yamuna in Himachal Pradesh and U.P. (now Uttranchal). The discharge in the River Yamuna was more than 7,00,000 Cs. on 3.9.1978. High flood was also experienced in the districts of Karnal, Sonipat , Faridabad and adjoining areas of Delhi were badly affected. The districts of Ambala and Gurgaon were also affected by floods.

c) Year 1983

Where as the floods in year 1978 were caused by the rivers and nadis on account of heavy rainfall in their catchment areas which lies out side the state, floods in 1983 were caused by excessive and intensive rainfall within the state. This caused flooding in the districts of Rohtak, Sonipat, Jind , Gurgaon, Hisar, Bhiwani, Faridabad, Kurukshetra and Sirsa.

The Rohtak district was worst affected when Drain No. 8 was not able to carry requisite discharge from Gohana areas for a number of days, which also resulted in worst situation in entire Gohana Sub Division. The situation in Rohtak town was also grim as 3-4 ft. water remained standing in large parts of the town, besides causing damage to infrastructure. Since, Delhi administration had not completed the out-fall drains in their areas, the flood water submerged fields in Bahadurgarh-Jhajjar belt.

d) Year 1988

There was heavy rainfall during August 1988 which affected 615 villages in Ambala, Kurukshetra, Karnal, Jind, Hisar, Faridabad, Sonipat and Sirsa districts. The heavy rainfall in the catchment areas of Himachal Pradesh resulted in very heavy discharge in the river Ghaggar which was 80398 Cs. on 8.8. 1988 at Panchkula - Barwala Road crossing. This much discharge was recorded only after the year 1973.

After the heavy rains of July & August, there were also incessant rains through out the state from 22.9.1988 to 26.9.1988 which caused flash floods again in Ambala, Karnal, Kurukshetra, Jind, Sonipat, Hisar, Sirsa and Faridabad districts. Flood protection works were badly damaged as a result heavy damage occurred to infrastructure, leading to loss to crop property and loss of human lives and cattle.

e) Year 1993

There was continuous heavy rainfall for 76 hours from 9th July onwards which resulted in flooding of all the rivers and drains etc. The total rainfall from 9th July to 12th July and again from 22nd July to 23rd July was of the order of more than 50% of the average annual rainfall in just 5 days. Heavy rainfall was also experienced in Punjab areas and as a result of this, thick sheet flow of water entered in Haryana through SYL Canal inundating a large number of villages. Besides damage to cropped areas, human and cattle lives were also lost and property devastated.

f) Year 1995

Floods during the year 1995 were unprecedented. The average rainfall was between 200 to 250 mm between 2.9.1995 to 4.9.1995. Prior to this heavy rains were also received from 26.8.1995 to 30.8.1995, which caused floods. Such floods were never seen in the last 100 years. All districts of Haryana were affected except Mahinderagarh. All the urban and rural areas were under 2 to 5 ft. flood water and the water remained stagnant for many days in Jind, Hisar, Rohtak and Bhiwani districts due to non-availability of natural drainage system and flood water had to be pumped out.

All drains and canals over flowed and were not able to drain out the flood water. Road net work , public health installations including water works, electric installations etc. were submerged and badly damaged. During the floods of year 1995 it was found that the main cause of flooding in Gohana, Rohtak and Bhiwani areas was non-existence of natural drainage system. More over, the canals and drains were mostly rendered incapable of carrying the flood water to their designed capacity due to non-desilting / deweeding during the last many years. Further due to urbanization, new colonies and slums sprang up in low lying areas of the cities, which obstructed the flow of water and caused flooding.

The statement showing maximum discharge observed of various rivers in the state is enclosed for a perusal of the discharges received during the different years of river the Yamuna and the Ghaggar & its tributaries.

STATEMENT SHOWING MAXIMUM DISCHARGE OBSERVED AT VARIOUS SITES

(Discharge in Cusecs)

Year	YAMUNA RIVER	GHAGGAR RIVER					MARKANDA River	TANGRI River
	U/S TAJEWALA	4-A Panchkula	Guhla Cheeka	Khanauri	Chandpur	D/S Ottu	JHANSA	JANSUI
1978	7,09,000 on 3.9.78	NA	NA	19,100	16,705	34,461	90,000	28,500
1983	2,70,000	22,435 on 8.8.83	38,700 on 29.8.83	27,000 on 1.9.83	11,719 on 3.9.83	24,588 on 6.9.83	90,000	30,699 on 3.7.83
1984	82,000 on 5.9.84	23,655 on 15.7.84	**65,000 on 17.7.84**	9,700 on 10.7.84	3,535 on 11.7.84	5,764 on 12.7.84	36,624 on 17.9.84	23,000 on 18.7.84
1985	3,05,530 on 10.10.85	17,306 on 20.8.85	25,950 on 7.8.85	6,800 on 27.7.85	8,640 on 8.8.85	9,563 on 11.8.85	49,000 on 21.8.85	23,500 on 25.7.85
1986	1,09,313 on 11.8.86	9,208 on 27.7.86	23,100 on 14.8.86	8,800 on 29.7.86	3,528 on 4.8.86	5,764 on 5.8.86	32,120 on 26.7.86	19,557 on 18.6.86
1987	66,161 on 23.8.87	2,374 on 26.7.87	Leakage	Leakage	Leakage	Leakage	14,510 on 31.8.87	Leakage
1988	5,75,522 on 25.9.88	**80,398 on 8.8.88**	54,000 on 25.7.88	**60,000 on 6.8.88**	**35,000 on 6.8.88**	34,157 on 10.8.88	78,500 on 1.8.88	70,000 on 24.7.88
1989	3,50,000 on 28.8.89	34,576 on 20.8.89	42,342 on 28.8.89	18,900 on 30.8.89	15,160 on 3.9.89	10,472 on 6.9.89	49,500 on 28.8.89	28,785 on 28.8.89
1990	1,46,704 on 13.8.90	46,250 on 10.7.90	45,403 on 30.7.90	18,900 on 30.8.90	15,160 on 3.9.90	10,472 on 6.9.90	49,500 on 20.8.90	28,785 on 28.8.90
1991	68,214 on 8.8.91	41,124 on 10.8.91	NA	6,800 on 12.8.91	3,150 on 12.8.91	1,440 on 13.8.91	20,000 on 7.9.91	Leakage
1992	1,85,015 on 10.9.92	**81,388 on 27.8.92**	NA	1,025 on 28.7.92	1,140 on 28.7.92	1,205 on 30.7.92	52,570 on 28.8.92	30,720 on 28.892
1993	1,28,000 on 12.7.93	15,890 on 22.7.93	**65,000 on 14.7.93**	27,000 on 13.7.93	20,800 on 15.7.93	**41,963 on 19.7.93**	28,530 on 25.9.93	21,320 on 13.7.93
1994	1,49,968 on 20.7.94	33,462 on 5.9.94	55,150 on 21.7.94	14,900 on 23.7.94	17,800 on 26.7.94	30,600 on 30.7.94	64,000 on 31.7.94	24,034 on 20.7.94
1995	5,36,338 on 5.9.95	**1,40,000 on 14.8.95**	**64,375 on 6.9.95**	17,350 on 9.9.95	22,830 on 11.9.95	39,863 on 11.9.95	82,000 on 6.9.95	43,106 on 5.9.95
1996	2,77,803 on 31.8.96	53,289 on 8.9.96	51,773 on 11.9.96	16,875 on 14.9.96	12,950 on 16.9.96	3,655 on 10.9.96	67,000 on 9.9.96	23,034 on 9.9.96
1997	3,98,849 on 3.8.97	32,785 on 3.8.97	54,349 on 4.8.97	16,750 on 7.8.97	12,650 on 10.8.97	6,426 on 8.8.97	65,5000 on 3.8.97	33,747 on 3.8.97
1998	5,41,000 on 16.10.98	24,614 on 10.7.98	46,968 on 12.7.98	18,100 on 15.7.98	14,500 on 19.7.98	11,424 on 21.7.98	54,050 on 13.7.98	38,219 on 11.7.98

1999	2,55,168 on 21.7.99	61,730 on 21.7.99	47,907 on 23.7.99	17,650 on 24.7.99	12,100 on 24.7.99	6,664 on 27.7.99	83,313 on 1.8.99	33,747 on 21.7.99
2000	2,78,951 on 17.7.2000	**83,684 on 17.7.2000**	56,998 on 20.7.2000	17,500 on 21.7.2000	15,000 on 27.7.2000	18,735on 29.7.2000	68,500 on 19.7.2000	41,380 on 19.7.2000
2001	2,57,481 on 14.8.01	**82,625 on 14.8.01**	53,695 on 19.7.01	18,000 on 17.8.01	13,700 on 24.7.01	9,380 on 29.7.01	70,000 on 15.8.01	39,362 on 17.7.01
2002	3,11,174 on 14.8.02	17,862 on 14.8.02	45,096 on 16.8.02	14,900 on 17.8.02	9,850 on 17.8.02	5,850 on 16.9.02	59,000 on 14.8.02	26,890 on 15.7.02
2003	86,411 on 5.7.03	10,818 on 31.7.03 & 3.9.03	46,029 on 5.9.03	14,650 on 5.9.03	10,500 on 7.9.03	6,000 8.9.03	52,570 on 5.9.03	11,298 on 4.9.03
2004	81,929 on 18.8.04	**83,684 on 3.8.04**	**61,730 on 7.8.04**	**17,500 on 7.8.04**	**17,000 on 11.8.04**	**20,700 on 13.8.04**	25,010 on 17.8.04	47,818 on 3.8.04

In addition to protection of vast area of state by network of small drains which fall into bigger drains, the districts of Yamunanagar, Kaithal, Panipat, Sonipat, Faridabad etc. are also affected by the continuous erosion in the monsoon season by the river Yamuna and the Ghaggar & its tributaries and a large tract of land has already been eroded away by the river. As a preventive measures, a battery of stone studs and stone spurs have been installed all along the river banks to minimize erosion as a short term measure.

Short term measures

Generally after flood season, all flood affected areas are inspected and schemes are prepared on the basis of experience of floods for short term and long term measures in consultation with respective Deputy Commissioners and Irrigation Department. Schemes so recommended are discussed in the districts level Committees headed by respective Deputy Commissioners and finally considered by State Level Committee under the chairmanship of Engineer-In-Chief, Irrigation Department for its recommendations to State Advisory Committee. The Haryana State Flood Control Board under the chairmanship of Hon'ble Chief Minister, Haryana holds an annual meeting around the month of December / January for the floods schemes recommended by State Advisory Committee under the chairmanship of Financial Commissioner & Principal Secretary, Revenue Department.

On approval of the schemes by the Flood Control Board, the priority schemes of each district are taken up for execution in proportion to the availability of funds. Efforts are being made to complete these schemes before the next rainy season so as to derive maximum benefits in the monsoon season.

The priorities of the schemes are fixed in consultation with respective Deputy Commissioner for short term and long term measures.

Long term measures

Floods being annual features in Haryana ,the state prepared a master-plan after the flood 1977 costing about Rs. 150 crore and executed most of them for long-term mitigation measures of flood. The following schemes were part of the master-plan:-

* Construction of Ujina Diversion Drain for Gurgaon and Faridabad districts.
* Construction of KCB Drain for Rohtak district.
* Construction of Link Drains.
* Construction of Ring Bunds around villages.
* Construction of River Embankments and river protection works along the river Yamuna.
* Remodeling of Drain No. 8, Diversion Drain No. 8, Main Drain No. 2 etc.
* Construction of Storages along canals and natural storages at Bhindawas, Bibipur, Massani Barrage on River Sahibi, Ottu lake, Kotla lake etc.

Another master-plan for drainage costing Rs. 2278 Crore has been prepared in 1998 by High Level Expert Committee under the chairmanship of Vice Chancellor, Hisar Agriculture University. The details of projects and estimated cost are given below :-

Sr. No.	**Project**	**Cost (Rs. in Crore)**
1.	Surface drainage	1231
2.	Horizontal sub surface drainage	257
3.	Vertical tube-well drainage	43
4.	Conjunctive use tube-wells	250
5.	Bio-drainage	385
6.	Repair of canal water courses , water supply tanks	44
7.	Road raising and cross drainage	68
	Total Cost	**2278**

The following major schemes under the Master Plan have been envisaged :-

* Development of a surface gravity drainage network for the Ghaggar Basin in Kaithal, Jind, Hisar, Fatehabad and Sirsa districts
* Construction of Meham Lakhan Majra drain for Rohtak district.
* Construction of Darba the Ghaggar Drain for Sirsa district.
* Construction of Kalwa Kinana Drain for Jind district.
* Construction of Numerous small link drains.

The mobilization of such a huge amount is a crucial factor for its successful implementation. In view of constraint of funds work has been taken in phases. Kalwa Kinana link drain and construction of numerous small link drains have been completed under state funds. Construction of Meham Lakhan Majra Drain has been completed under NABARD.

In order to prevent flood water being pumped out into near by canals where water is used for irrigation and drinking purposes, a comprehensive gravity drainage scheme namely Hisar-Ghaggar drain at a cost of Rs. 770 crore has been prepared under S.No.1 above. The drain will carry flood water of districts Kaithal, Jind, Hisar, Fatehabad and Sirsa to the river Ghaggar near Ottu. A partial project (out of total project) Hisar-Ghaggar drain scheme has been prepared to take up the work in stages with the assistance of NABARD funding at a cost of Rs. 188 crore which is under implementation at present. The partial project consists of small drainage schemes such as Hisar-Ghaggar Multi purpose channel RD 0-3,60,000, Bass & Hansi Multi purpose Channel, Rangoi Kharif Channel, Dharaudi and Sunderpura drains etc.

Flood Management

Before onset of rainy season, all big and small drains are de-weeded and cleared of all obstructions. Comprehensive inspection of all the drains and bunds are carried out both by the Deputy Commissioners and office of Irrigation Department. The vertical pumps installed on the permanent pump houses are overhauled for efficient functioning. Both Electrical and Diesel Mobile Pumps spread all over the districts are repaired for proper use. De-watering if required, is carried out promptly in consultation with Deputy Commissioners. Flood preparedness measures like EC bags, ballies etc. are procured and stored at the

strategic locations in the district. Field de-watering is carried out after 15 September so that agricultural area that have been water logged are cleared for sowing of Rabi crop. On setting of monsoon, Flood Control Rooms are set up at district head quarter to monitor flood situation in the State w.e.f. 1st July. Police Wireless Sets are also installed at vulnerable sites for issue of timely warning. All relief measures are carried out under the supervision of Civil Authorities (Revenue Department). As per the past experience the floods have been occurring in the month of September when there used to be concentrated and high rain fall causing heavy floods.

DEVELOPMENT OF IRRIGATION PROJECTS

Although the state of Haryana has been carved out of composite Punjab, yet Haryana areas have always remain chronically short of water resources as there is no river passing exclusively through the state. The two main sources of watersupply for irrigation in the state are the rivers Sutlej and Yamuna. The water in Western Jamuna Canal (WJC) carrying the Yamuna waters to the state could get reduced to as low as 1800 Cs. during winter and hence to meet the Rabi crop requirements in the State Augmentation of canal supplies is therefore a matter of paramount importance for agricultural development. The tirade of the situation is further aggravated with groundwater not being utilizable all over in the state. Hence all out efforts were required to undertake a number of water resource project for improvement in this sector by Haryana Irrigation Department. The following main projects were undertaken by the department in the state to augment the water resources.

1. GURGAON CANAL PROJECT.

Gurgaon Canal Project was conceived in the year 1954 and work on the project was taken up during 1960-61. Substantive completion of work was undertaken in 1965 at an estimated cost of Rs. 7.89 Crore (2/66 price index). The project was framed to irrigate Southern part of Haryana & border area of Rajasthan State. The main features of the project were remodelling of existing Agra Canal System to cater 2240 Cs. The gross area of project is 144929 hectares. The area benefited comprises of Faridabad & Gurgaon districts and border area of Rajasthan State. The length of main canals is 89.89 KMs & length of offtaking channels, at present is 415.20 KMs (38 No. channels). This project was framed keeping in view the utilisation of Haryana's share from the Ravi-Beas & the Yamuna River i.e. 1740 cs. & for Rajasthan share of 500Cs. at the head of Gurgaon Canal feeder offtaking from mile 4 furlong 3 of Agra Canal.

2. AUGMENTATION CANAL PROJECT

Whereas the Yamuna groundwater basin is rich in sweet water, yet to augment the water supply in WJC system, a number of deep tubewells were installed in yester years along the canal for pumping water into the canal. Later, it was decided to combine the augmentation of canal supplies with saving of absorption losses by constructing a lined canal i.e. augmentation canal from Jagadhri town to Munak. In other words, during the Rabi season the available water supply in WJC canal was to be diverted into the Augmentation canal which

was also to receive water from the augmentation tubewells and carrying savings of seepage losses to water starved areas. The construction of Augmentation canal project was undertaken in November, 1971 at an estimated cost of Rs. 12.69 Crores and the canal was commissioned in January,1973.

3. LIFT IRRIGATION SCHEMES

The South-West area of the state where the canalwater through gravity could not flow and thus could not irrigate the land through out the ages, the lift canal system was necessary due to higher ground level elevations. The area constitute drought prone high and arid lands, a number of following lift irrigation systems were constructed wherein water is lifted in stages with the help of vertical pumps installed in large number in various pump houses located on the alignment of the canal from lower to higher tibba levels. The schemes constructed and operated in 1970 provide drinking and irrigation water to the parched areas falling under the districts of Mahenderagarh, Rewari, Bhiwani, Hisar,Gurgaon, Rohtak and Jhajjar. The following schemes have been constructed under this programme:

a) Jui Irrigation Scheme:

This scheme provides irrigation to gross area of 41647 hectares of CCA in Bhiwani district. There are seven pump houses constructed under this scheme in order to lift water to an height of 129ft. in stages to provide canal water by gravity flow to the adverse slopping areas. The estimated cost of the scheme involving 242 KMs of channel length was Rs. 7.3 Crores at the initial stage.The project was started in the year 1969-70 and was completed in the year 1971-72.

b) *Loharu Lift Irrigation Scheme:*

The successful results of Jui Lift Irrigation scheme led to revise another scheme i.e. Loharu Lift Irrigation Scheme for an initial estimated cost of Rs. 49.1 crore to bring vast track of un-irrigated area of South Western part of Bhiwani District in Loharu areas. The scheme involves a total lift of 215.32ft to irrigate 121586 hectares of CCA.

c) *Sewani Lift Irrigation Scheme:*

To provide Irrigation to undulating and arid areas of Bhiwani and Hisar district, the scheme was approved by the government initially at an estimated cost of Rs.27.52 Crore to irrigate CCA of 72100 hectares to lift water for 102ft.

through 21 pump houses. The scheme was started in the year 1971-72 and was completed in the year 1978-79.

d) JLN Lift Irrigation Scheme:

The scheme was approved initially for an outlay of Rs. 164.97 Crores to irrigate the most undulating and parched/arid area of Southern part of Haryana bordering Rajasthan and districts of Mahenderagarh , Rewari and Jhajjar . The scheme provides a total lift of 464.04ft to command CCA of 265220 hactares through 94 pump houses.

4. Haryana Irrigation-I Project (Credit 843-IN)

This project was taken up during August 1978 with the assistance of the World Bank.The main objective of the project was to improve and modify the existing irrigation facilities by taking measures to prevent water seepage losses in the canal network for better, efficient and equitable distribution of water among users. This project also had other components such as improvement of rural roads, improvement in market facility and clean drinking water for rural areas, which were taken up by other departments.

The project cost was of Rs. 1909 million but actual expenditure was Rs. 1938 million. Besides achieving financial targets, physical targets were also achieved and as a matter of fact the major component of canal lining exceeded the targets.

5. Haryana Irrigation-II Project (Credit 1319-IN)

Haryana Irrigation-II Project (credit 1319-IN) estimated to cost Rs. 2703 million was taken up in March 1983 and was designed to give impetus to the development of irrigation infrastructure already taken up in Phase-I project. This project had several components such as Canal Modernization, Sprinkler Irrigation, Research and Development, Village Water Supply, Village Access Roads, Modernization of Watercourse and AugmentationTubewells.

6. National Water Management Programme:

In view of the achievement of the department in Haryana Irrigation-I & II Projects, the World Bank, Government of Haryana & Government of India conceived the concept of Haryana Resources Consolidation Project. But as it would have taken three years in project formulation and actually taking up, the

World Bank agreed to finance the on-going activities i.e. canal lining, watercourse lining and institutional strengthening for this period of three years as a sub-project of National Water Management Programme.The project cost was Rs. 1742.6 million with provision Rs. 1026 million for canal lining. Rs. 632 million for watercourse lining and Rs. 84.6 million for institutuional strengtherning.

7. Haryana Water resources Consolidation Project (HWRCP).

This project was made affective from June 24,1994 with the finnancial aid of World Bank. The total outlay for the project at the time of agreement was Rs.1858 Crore (for works Rs. 1362 crore and Rs., 496 crore, for establishment expenditure). The project activities continued upto December 31, 2001. The broad objectives of the project were to manage the total available water resources efficientlly and economically to improve equitable distribution of water amongst the stake holders by rehabilitation/modernization of the existing canals & Drainage system so that the department could emerge self-sustaining. The components of the project were:-

1. Rehabilitation of Canal & Drainage net-work.
2. Modernization including construction of HKB.
3. Operation & Maintenance (O&M) of Canal & Drainage net-works.
4. Institutional Support activities.
5. Rehabilitation/Modernization/Operation & Maintenance of Water Courses.
6. Strengthening & Intensification of Agricultural activities.

MODERNISATION OF CANALS PRIOR TO HWRCP

The programme of modernisation of existing canals in Haryana started with the taking up of the World Bank assisted ' Modernisatin of Existing Canals' (MOEC) Phase I Project in 1978. The objective was to improve and modify the existing irrigation facilities by taking measures to prevent seepage losses in the canal system up to farm gates and to ensure equitable water distribution amongst the users. Under this project Rs. 1,938 million were spent on modernisation of 159 channels with a length of 2,913 km and lining area of 24.62 M square metres (265 M square metres) during August, 1978 to February, 1983. Phase II Project was taken up, in continuation, from 01.03.1983 which also included canal modernisation as one of its components. The expenditure on the project was of the order of Rs. 3,840 million and the project finally closed on 31.03.1992.

Lining of 370 channels with a length of 3,800 km and lining area of 23.88 M square metre (257 M square metre) was carried out under this project. Evaluation studies confirmed that the objectives set out in these projects were more or less realised. More area was brought under irrigation, there was a steep drop in the number of cuts and breaches and the travel time of water from head to tail of channels was reduced resulting in enhanced availability of water at the tails of channels. Also the water logged area along the channels was reclaimed to a large extent. As formulation and launching of HWRCP was to take about two years, the World Bank agreed to finance the three important ongoing activities under National Water Management Project (NWMP) viz. lining of channels, lining of water courses and institutional strengthening. The project estimate for improvement of the existing irrigation system in Haryana costing Rs. 1,742.6 million to cover the above activities for a period of 3 years was therefore prepared as a sub-project of NWMP of the Government of India. The expenditure on this project ending June, 1993 was Rs. 576.8 million. This was terminated with the sanction of HWRCP with World Bank financing, as these activities were covered under this project.

Modernisation of canals under phase I and II and NWMP was confined to the Bhakra Canal and Western Yamuna Canal tracts. It was proposed to continue the work in these systems and also to extend it to Gurgaon canal system under the World Bank assisted HWRCP.

Apart from lining of channels, the old structures were proposed to be remodeled/ reconstructed and the means of regulation and communication were to be modernised so as to improve the operational efficiency of the canal system. The following items of work in addition to lining of canals were proposed to be carried out under modernisation of canals component under HWRCP.

- Remodelling of masonary canal structures i.e. falls, regulators etc.
- Strengthening / replacement of bridges.
- Adjustment of outlets.
- Construction of meter flumes and cattle ghats.
- Gates and gearing where necessary.

Provision for remodelling of structures had been made in the project estimate at 11% of the cost of lining the canals on the basis of NWMP.

63 channels with unlined area of 9.06 M square metres (97.53 M square metres) and lined area of 7.43 Mm2 (80 M square metres) were proposed to be lined/ modernised under HWRCP, out of which 5 channels with unlined area of 2.34 M square metres (25.17 M square metres) and lined area of 1.95 M square metres (20.95 M square metres) fell in sweet water zone. In the sweet water zone only side lining of the channels had been proposed so that the recharge of ground water in the sweet water belt was not affected. It is felt that no useful purpose is served by lining of the channels only on sides in the sweet water zone unless it is required for safety of the canals banks in filling reaches. Lining of channels both in bed and sides is, however, necessary in high water table/ saline areas to check rise of water table due to seepage from canals.

History of Lining of Water Courses.

Erstwhile HSMITC took up the programme of lining of water courses in the year 1973-74 with the assistance of Agriculture Rural Development Corporation(ARDC) (now NABARD). Subsequently the programme was continued under World bank assisted MOEC(Modernisation of Existing Canals) Phase I from the year 1978 and under the Phase II of the same project from the year 1983. The Phase II of MOEC ended on 31.3.1992, and thereafter the work was continued under NWMP (National Water Management Programme), under World Bank assisted project from the year 1988, for executing the work of lining the water courses and this activity is continuing both in HSMITC as well as CADA. Lining of 7,552 water courses were completed up to the end of March, 1999, out of total 11,456 water courses of the canal system considered feasible for lining. Water courses with discharge less than 0.5 cusecs or without proper outlets and where land consolidation was considered feasible for lining.

As per experiments conducted by Haryana Irrigation Department, seepage losses are high in unlined water courses and vary from 15-29% in normal soil to 30-40% in sandy soils. In well maintained lined watercourses, seepage losses are reduced. According to soil conditions, on an average, water saved by lining has been assessed as 25% and 12% in BC and WYC system water courses respectively. Watercourses located in areas having saline/marginal groundwater only are selected for lining under HWRCP to reduce seepage losses and check the rise of ground water table. Lining of water courses in sweet groundwater areas should not be done unless the seepage losses are excessively high due to soil and geological conditions.

FARMERS ROLE IN CONSTRUCTION AND MAINTENANCE OF WATER COURSES .

When the work of lining of watercourses was taken up in 1973, recoveries including interest charges, on account of actual construction were being made from the beneficiaries in installments and the loans were repaid to the concerned banks by the HSMITC. Subsequently in 1979, the State Government waived off the recoveries in respect of beneficiaries having land holdings upto 2.5 acres and reduced the recoveries from remaining beneficiaries to the extent of 50%. In 1986, the matter was further reviewed by the State Government and all the recoveries in respect of lining of watercourses irrespective of their holdings were waived off. Since 1986, the activity of lining of watercourses is continuing under the state funds for which necessary provision is being made in the state budget.

When the lining activity was started in 1973, maintenance of all the constructed watercourses was being arranged by HSMITC and the recoveries in respect of expenditure incurred were being raised and realized from the beneficiaries. After the charges for construction of watercourses were waived off completely in 1986, no charges are being raised and realized in respect of maintenance of watercourses also.

Farmers are associated in the supervision of the construction work of lining of water courses, under HWRCP. This will ensure that the work carried out is of good quality and to the entire satisfaction of the farmers. Earlier maintenance of lined watercourses was being done by HSMITC by utilising the funds made available by the State Government under its Non-Plan budget head. Unskilled labour for normal maintenance of watercourses is provided by the beneficiaries. For execution of repair works skilled labour and material was provided by HSMITC and balance unskilled labour was provided by the beneficiaries. The maintenance of the lined water courses in due course is proposed to be handed over to the beneficiaries through " Share Holder Maintenance Committees", proposed to be formed for each water course. These committees weresupposed to be associated to identify the repair works to be done, keep a regular check on the consumption of material, supervise day to day works and ensure that voluntary labour was provided for maintenance of water courses. The beneficiary farmers of tail reaches were envisaged to be particularly included in the committees to ensure equitable distribution of water. Each shareholder was

also to be responsible to maintain proper earthwork on the lined water course passing through his field and ensure that another field channel very close to and parallel to the lined water course is not constructed as it might damage the lined water course.

Besides Command Area Development Authority (CADA) established in 1974 in Haryana under a Centrally Sponsored Scheme to bridge the gap between Irrigation potential created and Irrigation potential. Since its inception 2981 No. of watercourses have been lined in various commands upto March 2004. Since the lining of watercourses, as a policy decision has been associated with formation of Water Users Association (WUAs), the formation of WUAs has also been accelerated side by side. Erstwhile HSMITC could make efforts to get 2084 Water Users Association formed/registered By December, 2001 whereas CADA has got formed/registered 1530 Water Users Associations by March 2004) under societies Act,1860. Consequent to registration of WUAs, the lined watercourses once constructed/rehabilitated are being turn over to the farmers for maintenance.

SYSTEMWISE PROGRESS ENDING 31.3.2001 FOR LINING OF WATER COURSES BY HSMITC.

	WJC	Bhakra	Jui	Sewani	Loharu	Gurgaon	Total
Water Courses	1997	3357	197	148	57	119	5875
Course length in Kms.	279.9	470.13	27.36	19.93	5.06	17.58	819.98
Lakh feet.	8515	14344	833	607	153	537	24989

HATHNI KUND BARRAGE PROJECT

Tajewala Headworks being over 125 years old had outlived its life. Moreover, the unprecedented floods of the century in river Yamuna on September 3,1978, carrying a discharge of 7,09,239 cusecs, caused extensive damage to the Tajewala headworks and inundated vast areas of Haryana, Uttar Pradesh and Delhi.Under the circumstances, the operation of Tajewala Headworks had become very risky. Therefore, after extensive surveys over a period of years, it was considered expedient to constrtuct a new barrage/headworks as a replacement for the existing Tajewala Headworks.The historic agreement on the sharing of water of river Yamuna was signed between the basin states of Haryana, Himachal Pradesh, Uttar Pradesh, Delhi and Rajasthan on May 12,1994.

The construction of Hathnikund Barrage & its Appurtenent Works about 3 Km. upstream of Tajewala Headworks had been funded bythe World Bank. The estimated cost of project was about Rs. 220.00 crore.

The agreement for the constructiion of Hathnikund Barrage & its Appurtenant works was signed with M/S Hindustan Construction Co. Ltd. Mumbai on September 19,1996.The work was scheduled to be completed by September 23,1999. However, sustained efforts completed the project before June 30,1999 which involved earthwork 20.00 lak. Cubic metre, concreting 5.41 lakh. Cubic metres and reinforcement about 8000 metric tonnes,besides Gates & Gearing mechanism.

REPLACEMENT OF PATHRALA DAM (BARRAGE) AT DADUPUR

An important Canal Regulation cum Control Complex exists at Dadupur. The Western Jamuna Canal (main line upper, offtaking from the River Yamuna) joins the River Somb and Pathrala to create a level crossing. The hydel channel running parallel to WJC (MLU) also out falls into this pond, with a discharge of 5500 cusecs.

The various structures presently existing at Dadupur headworks are:

Sr. No.	Name of structure	Maximum Design Discharge
1.	Old Head Regulator of WJC (MLL)	8700 Cusecs
2.	New Head Regulator of WJC (MLL)	11000 cusecs
3.	Under Sluices	25000 cusecs
4.	Silt Ejector	2957 cusecs
5.	Existing Pathrala Dam	67000 cusecs.

The river discharges were regulated through Pathrala Dam (Barrage) which was in shape of a weir (over 100 years old) having 60 bays of 10.0' width with falling type wooden shutters. These wooden shutters were operated manually, were inefficient, time consuming and hazardous as there was excessive leakage of water through these gates during floods in monsoons.

It had also been experienced that uprooted trees come floating and block the waterway due to the small width of the bays (of 10').

Keeping in view these factors, the replacement of the Pathrala Dam with a modern structure (of 22 bays of 8.20 m each) with mechanical remote control regulation system had been proposed under the Haryana Water Resources Consolidation Project, funded by the World Bank. In this manner the pond level at 916.0' would also be maintained to enable feeding of the proposed Mini Powerhouse of 4.6 MW capacity at Dadupur.

The existing Pathrala Dam was proposed to be dismantled and replaced by a modern barrage with vertical lift type gates. The new Pathrala Dam (Barrage) was constructed at the same place by keeping the central line of the road bridge unchanged so that new road bridge is in alignment with the existing bridge over under sluices. The estimated cost of work was 18.50 crore.

BUDHERA COMPLEX

Budhera is a very important canal regulation cum control point. Haryana share of Bhakra Water of 3500 cs. is carried through Narwana Branch upto Budhera and about 2900 cs. of WJC is carried through Sirsa Branch off-taking from WJC MLL at Indri Head Work. Also the Ravi Beas share through SYL will be received in the pond at Budhera. The canal supplies are distributed through the NBK link, SYL Canal, Habri sub-branch and Sirsa Branch for the different districts of Haryana and also for drinking water supplies to Delhi. The Head Regulator of NBK link and SYL canal have gated regulation. Gated regulation for Habri Sub Branch has also been constructed. The regulator for Sirsa Branch was century old structure, outdated and outmoded with Kari regulation, which led to leakage, and improper regulation. Therefore, rehabilitation/replacement was provided under WRCP to carry authorised share of 2442 cs. water for Sirsa Branch at an estimated cost of 89.97 lakhs.

OTTU WEIR ON RIVER GHAGGAR

The existing Ottu Weir was constructed across river Ghaggar near village Ottu about 16 Km, from Sirsa in the year 1894. Originally, this was constructed as storage weir, but at present, it is functioning as diversion weir due to silting of upstream of the weir. The existing weir has 17 bays each 20 ft., wide and the crest of the weir is RL 639.50ft.The weir is designed for a pond level of 647.00 ft., and the design capacity of the lake at this pond level is 9118 acres ft., which has got reduced to less than 1000 acres ft.,because of siltation. There are silt flushing

ducts in the centre of each bay which were used to be operated by horizontal wooden karries, but at present the Karri System is not operational. The pond level is maintained for feeding the off-taking canals Northern Ghaggar Canal (NGC), Southern Ghaggar Canal(SGC) and Sheranwali Parallel Channel by placing vertical wooden Karries in each bay.

During the lean period, when the Ghaggar inflows are inadequate, the NGC and SGC are fed from Ottu feeder carrying Bhakra water. The Ottu feeder meets the NGC at RD 2700 ft. and to fed the SGC which is on other side of the river, a syphon barrel is there just u/s of the weir. The top level of barrel is same as the crest level of the weir i.e. 639.50ft., and this has made the silt flushing ducts ineffective leading to huge silt accumulation in the lake on the u/s side.

Against design capacity of 20000 cs., Ottu weir passed about 42000 cs. During heavy flood in the year 1993 and HFL of 651 ft., was attained on the U/S of the weir. There is a 12 ft., wide road bridge over the existing weir which had become quite inadequate and is unable to cater to the requirement of present day traffic over the bridge.

Since the existing weir is more than 100 years old structure, provision for its rehabilitation was made in the Haryana Water Resources Consolidation Project and the new weir was constructed 300 metre downstream the existing weir at an estimated cost of Rs. 32.10 crore.

NABARD WORKS

Due to scarcity of funds various states in India were facing financial crunch for the up gradation of the infrastructure available to the optimize use of available resources. Many rural infrastructure projects could not be taken up by the states and in turn resulting major loss of potential income and employment to the rural population. To overcome this difficulty the Rural Infrastructure Development Funds (RIDF) was instituted in the National Bank for Agricultural and Rural Development (NABARD) in the year 1995-96 by the then Union Finance Minister for enabling financial resources to flow for agricultural infrastructure project. Initially this fund was instituted only for on going schemes. Later on the scope of RIDF fund was widened and new schemes were also included. The rate of interest charged on such loan is also floating. Initially RIDF loan was provided by the Bank @ 13% interest which has now been reduced to 6.5% for project sanctioned up to RIDF-VII and 6% thereafter.

To avail of this opportunity Haryana Irrigation Department approached NABARD and accordingly got sanctioned 12 Projects from NABARD for financing under RIDF loan i.e. RIDF-I, RIDF-II, RIDF-III, RIDF-III (PART-II), RIDF-IV Rewari Lift Irrigation (RLI), RIDF-V (PART-I) & RIDF-V (PART-II) RIDF-VI RIDF-VII RIDF-VIII (Part-I) RIDF-VIII P-II RIDF-X for constructing 378 irrigation and 210 drainage schemes with total financial outlay of Rs. 71220.29 lakhs.

RIDF-I, RIDF-II & RIDF-III Projects have since been closed and completed. Extension to RIDF-III (Part-II) was sought for up to 31.3.2005.

RIDF-IV, Rewari Lift Irrigation also closed on 31.03.2005. Almost all the schemes in this project were completed except for some gaps and electrification of the pumps.

RIDF-V PART-I & RIDF-V PART-II sanctioned during Sepember, 1999 and March, 2000 are in the advance stages of completion out of 89 schemes 76 schemes have already been completed and work the remaining schemes is in progress. Earlier it was expected that the schemes would be completed by 31.3.2005 but now due to some revisions in the cost the remaining schemes would be completed by 31.12.2005.

RIDF-VI & VII were sanctioned during March, 2001 and September, 2001. Out of 35 schemes 26 schemes have already been completed and work on the remaining seven. schemes is in progress. Earlier it was expected that the schemes would be completed by 31.3.2005 but now due to some revisions in the cost the remaining schemes would be completed by 31.3.2006.

RIDF-VIII P-I & II were sanctioned during March, 2003. Out of 40 schemes sanctioned under these projects work on 21 schemes have already been completed and work is in progress on 12 schemes. Work has yet to be taken up in respect of 7 schemes. Preliminary works on these schemes had already been initiated but due to some disputes on the alignment or court cases the work is held up on these 7 schemes it is expected that the work on the schemes would be taken up very shortly and completed by 31.3.2006.

Total expenditure incurred upto 31.01.2005 is Rs. 41236.22 lakhs on all the projects sanctioned so far by the NABARD under RIDF loan. .

A fresh project for constructing Dadupur Nalvi Major Irrigation Project costing Rs. 167 crore have already been submitted to NABARD for sanction.

This project has been prepared for providing irrigation facilities to the area bounded by right sides of Western Jamuna Canal, Ladwa-Pipli Road and left side of Ambala Yamunanagar Railway Line and Narwana Branch Canal in the districts of Yamunanagar, Kurukshetra and Ambala which is devoid of any surface irrigation at present. This area is being irrigated through tubewells at present. With the advent of surface irrigation by private tubewells water table has been steadily going down. This area has already been declared as grey area for on account of depletion of ground water due to excessive withdrawal. Hence there is necessity for providing canal irrigation in the tract as well as to re-charge ground water level. There is sufficient availability of water in the river Yamuna during monsoon season and accordingly it has been proposed to utilize this surplus availability of water for re-charging the ground water in the project area as also to provide kharif irrigation. The project has already been apprpved by the NABARD and work on the project would be taken up. Administrative approval for the project has already been accorded by the Government.

The procedure to be followed for the projects is as under:-

1. The availability of water for irrigation purposes in Haryana is not sufficient and truly speaking water is available for irrigating only for 50% of the area. It is , therefore, important that equitable water is made available to all the irrigators and shortages are passed on to the complete state. It is most important that techniques for better water management are, therefore, exercised to achieve desired targets and to improve the overall irrigation since Haryana State is a food bowl of India.

   To achieve this it is most important that the transition losses are reduced to minimum. Therefore, on the demand of irrigators, and with the announcement of Hon'ble C.M. Haryana various schemes for better water management are investigated in the field.

2. The scheme is prepared on the plans and, if found, feasible notified for hearing under canal act for inviting objections, if any, for finalising the scheme.

3. The scheme so prepared and approved by the Divisional Canal Officer and Superintending Engineer is submitted to Chief Engineer for his consideration and approval.

4. The adjustment and availability of waters is examined alongwith the feasibility of the scheme. The scheme so approved by the Chief

Engineer is submitted to Standing Technical Committee (STC) chaired by Engineer-in-Chief having all Chief Engineers as Member, SE Project is the Member Secretary, SE/CDO and concerned Xens works are usually invited as Special invitees. The concerned SE is also invited for explaining the scheme to STC for its technical feasibility and economical viability.

5. All such schemes approved by the STC are clubbed together in the shape of a project and are submitted to Government /NABARD for administrative approval and financial approval respectively.

6. Similarly, the drainage schemes approved by the Flood Control Board under Hon'ble C.M. Haryana and for which funds are not made available under RNC 2245 are also considered for obtaining finances from NABARD.

7. While forwarding the projects to NABARD Finance Department has to give an assurance that matching budget grant and funds would be made available for which phasing is provided in the project.

8. Once the project has been submitted to NABARD (Regional Office, Chandigarh) through Finance Department. Field appraisal is taken by the NABARD authorities. Economist, Agronomist and Consultants of NABARD visit the field area for field investigation of the schemes. And after their satisfaction appraisal report is finalised and submitted to their head office for consideration by the Project Sanctioning Committee (PSC) of NABARD.

9. The project is considered by the PSC and if approved sanction letter is issued by the NABARD with their terms and conditions seeking acceptance from the state. As per the latest directions NABARD is providing 95% assistance for Irrigation projects which used to be 90% earlier. These shares include the land cost also.

10. Advance is allowed by the department @20% of the first year phasing which used to be 20% of the total financial outlay for advance planning. This payment is released to the Finance Department.

11. Interest as applicable starts immediately on issuance of the cheque. The re-payment period is also specified in the sanctioned letter, which is 7 years these days. The re-payment of the interest starts

immediately after the issue of advance but repayment of principal starts after 3 years. Haryana Government has authorised A.G. Haryana to release these payments as per the schedule provided by the NABARD and accordingly regular payments are being released.

12. The sanction of the NABARD is conveyed to the field SEs for immediate necessary action.

13. Survey works are taken up for finalisation of the alignment, preparation of land papers, preparation of estimates, calling of tenders etc. etc.

14. When preliminary works are taken up 10% additional advance is also made available by the NABARD against the project.

15. The work is taken up as per the laid down codal instructions.

16. The progress of the works is monitored regularly. Quarterly meetings of Field SEs executing NABARD works are taken by Engineer-in-Chief, Irrigation Department, Haryana, where each and every scheme is discussed in details. These Quarterly meetings are also attended by the Officers of Regional Office NABARD.

17. Quarterly or Half yearly High Powered meetings are also taken either by FC & PS Finance, Chief Secretary, Government of Haryana or some times Hon'ble C.M. Haryana.

18. The Progress report is compiled in the shape of Quarterly Progress Reports (QPRs) which is submitted to NABARD as well. **The QPRs of Haryana Irrigation Department has been applauded by the NABARD and it was circulated in a special meeting of all Regional Offices of NABARD in India convened by the Board of NABARD and it was emphasised that similar type of QPRs should be prepared by all the States.**

19. The Progress of the works is also monitored by the District Development Manager (DDM) of NABARD who are posted in each and every district of the state. They physically inspect the scheme during the currency of execution, before execution and after the completion of the scheme.

20. Regular inspections are also carried out by the Regional Office, by deputing special teams for monitoring purposes. The monitoring

team is headed by Deputy General Manager (DGM), GM accompanied with an officer and a technical consultant of the NABARD. Monitoring studies are submitted to the Government by the NABARD for comments and expediting the works. The shortcomings, if any, are also projected by the NABARD.

21. As per the latest directions of the NABARD approximately one visit is being organised every month for the monitoring of schemes in various districts by the Regional Office NABARD. It has also been decided that each and every scheme will be inspected by the NABARD. They are monitoring the maintenance part as well as formulation of WUAs of the schemes constructed with NABARD funds as well.

22. The progress report is taken monthly from the Circles and based upon the physical and financial progress reimbursement claims are submitted to NABARD under the signature of Special Secretary Finance (Nodal Officer). The advance already released is adjusted on pro rata basis in all reimbursement claim being disbursed by the NABARD.

23. Monitoring is also carried out by the Finance Department for the budget allotted expenditure incurred, reimbursement claims received and so on.

24. After the completion of a scheme it is mandatory for the department and government to submit Project Completion Reports (PCRs) for each and every scheme on the prescribed performa of NABARD. So far out of 480 completed schemes, 404 PCRs have already been submitted. The remaining PCRs are in pipeline and would be submitted very shortly.

25. Regular Workshops are also conducted by the NABARD for interaction and clarification of the points of field functionaries for preparing Project Estimate, Quarterly Progress Report, and Project Completion Report etc.

26. It is important that reimbursements are allowed by the NABARD only with the sanctioned cost of the scheme and not for the excess expenditure till the revised project estimate is sanctioned by the Government as well as NABARD.

27. Schedule for the works are formulated at the time of preparation and sanction of the project which are monitored regularly at all levels.

28. Lift irrigation system of Haryana Irrigation Department for irrigating Southern part of Haryana is very old. Due to continuous running of the pumps the efficiency of pumps have gone down considerably affecting the irrigation of the area. Therefore, number of projects for rehabilitation of pumps were also got approved from NABARD under various RIDF trenches. The work on such schemes is in progress and likely to be completed within next one year.

29. LOC is demanded on the basis of the expenditure either already incurred or proposed to be incurred during the month which is generally allotted as per the demand.

HARYANA IRRIGATION RESEARCH & MANAGEMENT INSTITUTE (HIRMI)

HIRMI envisages a number of training courses in various disciplines like Water Resources & Irrigation Management, Participatory Irrigation Management, Computer Operation System, Canal Revenue & Financial Management, Project Evaluation Review Techniques, Environmental Aspects etc. for the Engineers. This institution is also conducting training courses for Agriculture Officers and farmers of Haryana on 'Efficient Use of Irrigation Water (Water Management) Watershed Development Programme under Agriculture Intensification Programme and Integrated Command Development Area in Haryana for CADA staff. A special attention is given on PIM training course for Officers/Officials of HID/MITC/CADA. The field level training course on PIM for farmers are also being conducted at District and Village level. HIRTI the training institute of yesteryears which is now converted as HIRMI is an equivalent to WALMI's in other states.

Necessary infrastructure alongwith computer centre, hostel, auditorium, lecture theaters have already been created. HIRMI is acting as nodal agency for conducting the above training courses.

OBJECTIVES

1. Serving as a centre for training and extension education in water resources sector for in service Engineers, Agricultural officers, Water User Associations and farmers.

2. Stepping up the base for the use of information technology and computer.

3. To guide and develop beneficiaries/farmers participation in irrigation and drainage management.

4. Demonstration of following in the Research Farm

   a) Various types of equipments for efficient use of water in irrigation i.e. sprinkler, drip and micro sprinkler.

   b) Water Technology Park consisting of demonstration of various type of hydraulic structures i.e. spillways, falls, energy dissipaters and various type of discharge measurement devices.

   c) Various types of plantations for studying the feasibility of inter cropping system.

5. Adaptive and action oriented research on water resources management (surface and ground water) with focus on irrigation and drainage technologies for sustainability of irrigation and land use.

6. Collaborating with different states, national and international agencies on research management and training activities in water resources sector.

ACHIEVEMENTS OF HIRMI

TRAINING IN HIRMI

In HIRMI, eight training courses i.e. "Participatory Irrigation Management" " Project Evaluation & Review Technique" " Environmental Aspects" " Canal Revenue & Financial Management" " Computer Operation System" " Water Resources & Irrigation Management", " Water Management for Agriculture Department under AIP (Agricultural Intensification Programme) and Integrated Command Area Development in Haryana for CADA staff have been taken up and training to 19554 persons comprising of 11985 Engineers/Revenue staff/ Agriculture officers and 7569 Farmers have been imparted covering various training courses since inception of HIRMI i.e. from May 1998 to December, 2004.

TRAINING IN PIM

The special emphasis has been given to training in Participatory Irrigation Management to officers/officials from the Irrigation Department HSMITC,CADA, Agriculture Department and farmers in the HIRMI as well as in the field. Since inception of HIRMI, training to 4136 officers/officials and 5850 farmers has been given. In addition to it, two groups of 19 officers/officials and 47 farmers has also been taken to Andhra Pradesh.

(a) TRAINING TO TRAINERS

The training to trainers who will further impart training in the field to WUA's /farmers have been given to 165 officers comprising S.Es//XENs/SDOs and officers from Haryana Irrigation Department MITC (now closed) and Haryana Agriculture Department (HAD) from 15.12.2000 to 19.2.2001 and 89 officials comprising Deputy collectors/Junior Engineers/Zilladars/Revenue Officers/ officials from 20.2.2001 to 22.3.2001.

Since all the engineers and revenue staff had not yet been covered it was decided by the Irrigation Department. that training to the field staff should be imparted at the district headquarters.

Training of the staff at the district head quarters from 5.5.2001 to 16.06.2001, was imparted to field staff at Ambala, Kaithal, Fatehabad, Sirsa, Chandigarh, Hisar, Jind, Karnal, Bhiwani, Rohtak, Faridabad, Delhi and Rewari where 2942 officers/officials attended the training.

b) TRAINING TO WATER USER ASSOCIATIONS:

The training to 150 selected WUAs were imparted from 7.12.2000 to 16.3.2001 and 632 farmers of these Water User Association have been benefited from these trainings . In all, training to 5800 farmers have been imparted since inception of HIRMI.

FIELD TRAINING DURING 2002-2003

At village level the training to 3600 farmers and 358 field functionaries was imparted from 5.10.2002 to 27.1.2003 for Karnal, Kaithal, Panipat, Hisar, Sirsa, Sonipat and Jind districts.

DEPOSIT WORK:

1. PIM TRAINING TO FARMERS BY CADA:

On request of CADA, 300 farmers i.e. Presidents, Secretaries, Members of Water User associations (WUAs) were trained at HIRMI in two batches. CADA made advance payments for the courses.

2. BIO DRAINAGE SYSTEM :

The Command Area Development Authority also deposited Rs.5.75 lakh for carrying out the study on Social Marketing of Bio Drainage system. The work is under process.

OTHER ACHIEVEMENTS OF HIRMI

i) The World Bank has observed that Irrigation Department should actively participate in PIM activities. In this context interaction with trainees is being done during the training course. As recommended by World Bank, an educational trip to Andhra Pradesh was arranged for Chief Engineers, SEs, Xens,SDOs, JEs of HID/MITC and farmers of Water Users Associations. A team

of 10 engineers and 23 farmers was taken to Andhra Pradesh from 24/4/2000 to 1/5/2000 for acquainting themselves with the PIM activities. The trip was very successful and every member of the group had interaction with the concerned officers and Presidents of various WUA's of Andhra Pradesh. During the last visit of World Bank team on dated 4.5.2000 in this Institute, some farmers and engineers who visited Andhra Pradesh were called in this Institute and the World Bank team had interaction with them and members of the trip informed the World Bank team about the experience gained on PIM. Another trip of 9 engineers and 24 farmers was sent to Andhra Pradesh from 23.9.2001 to 30.9.2001. The trips to Orrisa and other states is also under consideration.

ii) National level Workshop on PIM was organized at Haryana Niwas Chandigarh on 4.12.2000 which was inaugurated by Chief Secretary, Government of Haryana and key note addressed by Adviser, Planning Commission Government of India. Workshop was attended by participants from department of Irrigation, MITC, CADA and other departments of Haryana and special invitee from other states. Experts on PIM from Andhra Pradesh, Uttar Pradesh and NPIM, New Delhi addressed the PIM workshop, besides the Commissioner Irrigation and other senior functionaries from State Government addressed the participants

iii) For further improvement in quality of training in various courses, action has been initiated to appoint Course Experts for various training courses. The Managing Committee of HIRMI has approved the names of course experts for Participatory Irrigation Management and Water Resources & Irrigation Management. The experts opinions are being incorporated.

iv) Special efforts have been made to re-orient the contents and quality of training. Consultation and discussions were held with Chief Engineers and SEs of HID regarding course materials and contents of lectures for various courses. Modification have been made accordingly.

v) Regarding upgrading quality of training, communication with speakers and interactions with trainees are being regularly done and relevant suggestions are incorporated, 15 minutes of discussions of trainees is ensured with experts.

vi) Various steps have been taken to increase and motivate adequate participation in the various training courses.

vii) Visits to Hathni Kund Barrage, Bhakra Dam and Lift Irrigation system are made and audio/ visual documentaries are shown to the trainees in the various training courses.

viii) Seminars on Participatory Irrigation Management, for farmers, and government functionaries are organized. The training camps have been held at various districts and village level such campus at Rohtak. Hathin, Fatehabad, Sirsa, Jind, Rewari, Hisar, Kaithal, Palwal, Chajjupur, Bhuna etc. was conducted.

ix) Functioning of the Institute has been streamlined and it has now become more organised

x) A panel of faculty has been prepared with the panel of experts of the subjects (from National/International reputed institutions of the country) for delivering lectures in HIRMI training courses. Process is under taken to invite them for delivering lectures.

xi) The quality of training being imparted to trainees has been appreciated by the senior officers visiting the institute from time to time

xii) Evaluation assessment:- suggestion given by the trainees are being incorporated for improvement.

xiii) One Assistant Director of HIRMI attended the three day training programme on Participatory Rural Appraisal from 25.6.2001 to 27.6.2001 at Hyderabad and one Research officer of the Institute has attended the National Level Workshop cum Seminar on Participatory Approach to Water Management from 27.9.2001 to 29.9.2001 at PUSA Institute, Water Technology Centre Delhi.

xiv) Two Assistant Directors of HIRMI attended two day training programme on Pressure Irrigation System from 22.11.2001 to 23.11.2001 at E.S.C.I. Hyderabad and one Deputy Director and one Assistant Director of HIRMI attended three day training programme on " Water Shed and Draught Management" from 12.12.2001 to 14.12.2001 at E.S.C.I. Hyderabad. Other Officers of HIRMI also attended various training courses and seminars organised by WALMIs of other states.

xv) Training to field staff of CADA on Integrated Command Area Development in Haryana has also been started.

DEVELOPMENT OF FARM AND RESEARCH ACTIVITIES

HIRMI was in possession of 48.5 acres farm land for research and demonstration activities at Jyotisar, Kurukeshtra. Out of which 31 acres 2 kanals and 11 marlas land at Jyotisar Research Farm has been demanded by the Tourism Department Haryana for setting up of "All India Institute of Tourism Management & Catering". The transfer of said land has been initiated by Water Services Division Kurukshetra with the consent of HIRMI. In this farm, following activities have been started/ initiated.

i) Sprinkler, drip and micro irrigation equipments have been installed in two acres of land for demonstration of "efficient use of water in irrigation" to trainees. Seven more sprinklers have been got transferred from Irrigation Department for installation at the Farm. One drip irrigation sytem has also been installed from M/s. Jain Irrigation System under a scheme intimated by District Horticulture Officer, Kurukshetra.

ii) Combined meeting of Officers of HID and HAD called for adequate interaction & co-ordinated training, research & management of water with cropping pattern.

iii) Various types of plantations i.e Guava, Papaya, Citrus, Roses, Haldi, Teak and Poplars have been done at the Farm in 16 acres of land.

iv) The Water Technology Park in collaboration with PUSA Agriculture National Institute with latest technology is to be setup at Farm for demonstration of hydraulic structures, various types of lining and discharge measurement devices. The process for setting up of water Technology Park has been initiated.

v) The plantation of Ber and Faizabadi Amla in 2.3 acres land at research farm Jyotisar has been sown with the help of Horticulture department.

vi) The plantation of Eucalyptus (Safeda) in 3.00 acres land at Research Farm has been planted with the consent of District Forest Officer, Social Forestry, Ambala.

vii) Guava and Citrus were auctioned and leased out for the year 2001-2002 and 2002-2003 for amounting to Rs. 18000/- & 18400/- respectively.

RESEARCH ACTIVITIES

For starting research activities in the institute, seminar type meeting was conducted which was attended by the Chief Engineers/SEs of Water Service Units. In this meeting the officers desired some useful research work on control of weed growth in drains/channels, water logging, design of outlets and demonstration of construction techniques of flared out walls below regulators, design of pumping sets, outlet for APM (Adjustable proportion module) and the optimal use of available water alongwith cropping pattern. Matter regarding tackling of problem of weed growth in canals has been discussed in the Managing Committee of the HIRMI, in which it was decided that work done by various Institutes i.e. HAU Hisar, Amritsar Research Institute, Wild Life Deparment. should be seen.

HIRMI has contacted "National Research Centre for Weed Science Jabalpur" for tackling of problems of weed growth in canals. They have suggested the remedies of weed problem. The same report has been sent to the Chief Engineers of Water Service Units of Irrigation Department for taking further necessary action.

A report for improving efficiency of pumps of lift canals and other pumps has been sent to Chief Engineer/LCU irrigation department for taking further necessary action.

Research projects in different sub soil irrigation techniques have been undertaken at research farm Jyotisar. For this work two kinds of models have been installed in the mango plants. Two models for study and research in underground irrigation has also been installed at research farm.

(i) SETTING UP OF VARIOUS LABORATORIES:-

The Managing Committee decided not to set up big laboratory but small and useful laboratories for trainees may be setup. Managing Committee has constituted a committee under the Chairmanship of Director/HIRMI comprising of members C.E/DRU, S.E. construction Circle, Karnal S.E./NABARD Circle Jhajjar, Joint Director HIRMI (Member Secy.) for examining the feasibility and technical aspects of the proposal and recommend the same to Managing Committee to set up the laboratories.

In this context, committee submitted the report and recommended to establish the soil, cement, and concrete and steel laboratories at the cost of 15.00 lakh. The Managing Committee decided to transfer the testing machine and equipments from the Irrigation Department.

The work for rehabilitation of Research laboratory building in HIRMI was completed.

(ii) SETTING UP OF MODEL ROOM CUM MUSEUM :-

The Committee of three members were constituted by Government of Haryana comprising of Director HIRMI, Chief Engineer/Co-ordination HID Chandigarh & Deputy Director HIRMI regarding setting up model room cum museum in the institute at HIRMI, Kurukshetra. The committee submitted his report along with details of cost and recommended for setting up model room cum museum. The proposal had also been approved by the Government of Haryana. Managing Committee of HIRMI decided to keep the work pending in view of tight financial position.

(iii) FURNISHING OF AUDITORIUM:-

The work of air conditioning and acoustical treatment of auditorium hall has been completed and is being used for conducting various seminars and farmers training courses.

vi) Haryana Sinchai Patrika journal for dissemination of information in the fields of irrigation and agriculture is being published for the benefits of engineers/ farmers.

v) Modern library is being set up in the Institute. For this purpose committee has been constituted and process of purchase of books has been started.

vi) HIRMI has taken the life membership of Central Board of Irrigation and Power, New Delhi under category "A". (One time subscription) as approved by the Managing Committee of HIRMI.

vii) Facility of E-mail, Internet and Fax has been introduced in the Institute

FUTURE SCENARIO

The future scenario of the Haryana Irrigation Research Management Institute is very bright with the help of funds assisted by World Bank and other agencies. The Institute has a well furnished auditorium of capacity of 200 persons,

where seminars/ workshops are being organized. The Institute also has two classrooms & concrete, soil and cement testing labs for demonstration and field testing purpose. A modern research farm in which various studies involving efficient use of water are being taken up, inter cropping is being demonstrated to engineers/farmers .

The proposed water Technology Park in the research farm will have various types of lining and discharge measurement devices which will be demonstrated to trainees. The trainees are can have access to latest technological development i.e. internet, E-mail etc. The trainees are feeling more confortable in the hostel due to various facilties including television in the hostel rooms.

With the emphasis on imparting of training to engineers and beneficiaries i.e. farmers in the participatory irrigation management there will be awareness among them regarding various benefits of PIM and they will not hesitate to adopt it and thus Haryana State will progress further.

GROUND WATER BEHAVIOUR, SALINITY AND WATER LOGGING PROBLEMS.

Complete study of water logging problem, soil salinity, their remedies especially by bio-drainage methods and co-ordinating with CADA, CSSRI, Karnal in this field has been taken up. This office is taking up collection of data in the field.

Efforts are being made to have a material testing laboratory for day to day testing of cement, concrete, aggregate for design of cement concrete mixes, foundation investigations, general characteristics of soil in the field and in the laboratory, with regard to research activities and this facility will be extended to other departments on nominal rates. Since, a few of testing equipments need to be replaced the same is in process of procurement, the laboratory will be made fully functional shortly.

IRRIGATION EFFICIENCY :

HIRMI has also proposed to take up study on latest discharge measurement techniques, seepage losses in the canal system for monitoring irrigation efficiency. For this purpose, two Water Services Divisions have been selected for model study i.e. Water Services Division, Kurukshetra and Water Services Division, Kaithal.

It is proposed to maintain close interaction with Agriculture Department regarding sub soil water monitoring in state, water recharging techniques of ground water adopted by Haryana Irrigation Department, Agriculture Department and Central Ground Water Board. To create facilities for analyzing water and other affluent for environment aspects of city waste and impact of insecticides, pesticides and fertilizer on soil and ground water, the trend of use of bio fertilizers and its impact on water management.

This office is also taking up other canal related problems which include weed problem in canals/ponds and study of seepage losses in various irrigation systems in collaboration with IPRI, Amritsar.

IN HOUSE ENVIRONMENTAL POLICY OF HARYANA IRRIGATION DEPARTMENT

Haryana though essentially an agrarian state, has shown increasing trend towards extensive urban development and industrialization. Virtually all land presently and economically viable for agriculture is under cultivation. Overall water availability is 13.82 million acre feet per year (with 90% use) which is insufficient for double or multiple cropping of all lands serviced by irrigation facilities. Demand for water for non-irrigation purposes is also expected to rise. Therefore, the endeavor of the Irrigation Department is to upgrade existing water availability, improve water efficiency, water quality, conservation and make it sustainable.

Haryana Irrigation Department, responsible for the O&M of canals and distribution is endeavoring to deal effectively with environmental or pollution control aspects relating to water resource management and other irrigation related activities. Since water is a scarce resource in the state, the future planning, management and development has to focus on a two-pronged strategy. On the one hand, efficient use and conservation of water is to be ensured and on the other hand, protection of water quality of surface and ground water resources is to be achieved. With a view to provide a directional impetus to achieve this formidable task, an in-house environmental policy has been framed. The main objectives of the policy are:-

- Creating of environmental awareness within the organization.
- Ensuring proper and equitable use of water for designated purposes.
- Keeping the water bodies free from pollution in order to maintain water quality.
- Arresting environmental degradation during irrigation developmental activities.
- Improving the efficiency of water conveyance system and drainage network.
- Monitoring the ground water over exploitation or water logging aggravations.

The main environmental issues of concern relating towater resources planning and management include :

i) Water quality protection requirements for the canal supply system; particularly to ensure suitable water to rural/urban raw water sources and for irrigation purposes;

ii) Water logging and soil salinity problems in irrigation, particularly in areas saline or marginally saline groundwater or soils;

iii) Groundwater over-use, depletion and potential for induced recharge of shallow aquifers underlying permeable zones, such as in the Yamuna river drainage system;

iv) Long- term drainage and flood mitigation infrastructure to reduce extent and direction of flooding and risks of flood damage to urban and rural communities.

v) Potentials for management options and monitoring requirements to protect water quality associated with reuse of wastewater and subsurface drainage of saline waters reuse in the water supply system.

The major initiatives shall be in the following areas:-

1. Create environmental awareness

The need of the hour is to create awareness among field functionaries in the changing scenario of the environmental degradation. A substantial change can be brought about in this respect if field units are directly involved with environmentally awakened approach.

Water Services Units can play an important role by simple measures such as, proper maintenance of drainage net work, canal net work (such as checking leakage along canals), cross drainage works and embankments. These units will have to take concrete steps to stop unauthorised pollution of all water bodies under their jurisdiction by industrial effluents/sewage, in close coordination with the local unit of Haryana State Pollution Control Board (HSPCB) and the Environment Cell of Haryana Irrigation Department. Further, Service Units will ensure proper tree plantations on various sites along the canal banks, drains embankments, canal rest houses and canal colonies.

Construction Units will prepare an environmental assessment of the project to be taken up. The negative impacts of the project should be assessed and mitigation measures, preferably preventive measures be planned before taking up the project. Stress needs to be laid on compensatory afforestation (for any loss of forest cover) and plantation of trees on otherwise barren sites.

2. Monitoring Mechanism

A State Level Environment Monitoring committee shall be constituted in order to ensure effective management of environmental safeguards in the state and review environmental aspects on various projects of major and medium irrigation and flood control works of the Haryana Irrigation Department. It would be establishing and maintaining extensive liaison and working relationship with other governmental authorities in the area of water quality monitoring and data processing and exchange network. The other authorities would be Power utilities, Public Health, HSPCB, and Departments of Forests and Fisheries.

An Environmental Cell shall be set up in the Irrigation Department. The main functions of Cell shall be as follows :-

i) Develop a core expertise in environmental planning and management to meet Haryana Irrigation Department obligations and responsibilities under national or state environmental legislation and regulations;

ii) Develop H.I.D's environmental assessment capacity for project Planning and development activities that need to be formally evaluated according to Government of India or lending agency requirements;

iii) Prepare a plan for and implement a comprehensive water quality monitoring network and data collection and processing in cooperation with other state authorities involved; mainly Haryana Public Health Department (HPHD) and HSPCB;

iv) Provide sound advice to Engineer-in-Chief, Haryana Irrigation Department on environmentally related matters.

v) Provide environmental inputs to the State Water Plan and project formulation options;

vi) Develop and apply environmental policy directives and standard Operating procedures, checklists, construction specifications

required to manage environmental issues associated with project implementation;

vii) Provide internal training to H.I.D. staff and inputs to external Programs focusing on water resource conservation and environmental awareness.

The Cell shall clear the new project and monitor the progress of implementation of environmental safeguards of the water resources projects.

Project level Environment Management Committees shall be constituted. It will hold regular meetings as per guidelines already issued and submit reports sothat environmental safeguards can be taken well in time.

3. Environmental safeguards and Clearance of new projects

All new irrigation flood control projects and sub projects costing Rs. 200 lakh or more would require clearance from environmental angle from the Environment Cell of Haryana Irrigation Department. The input parameters will be provided by the field officers and submitted along with project proposal for evaluation of the project from the environmental angle. Environment safeguards, which are required to be implemented along with the constitution of the project, will be stipulated by the Engineer-in-Chief.

4. Afforestation on irrigation works

It should be mandatory to plan afforestation on all works. Afforestation will be made a part of the estimate and sanctioned drawings. The department will issue guidelines on the subject. The job of plantation could be entrusted to the Forest Department.

5. Rationalization of water rates

There are number of water rates for different crops. The water rates are required to be rationalized, with a view to promote crops with less consumption of water. The water saving devices like spinkler/drip irrigation should be encouraged by giving concessions in water rates. The need is for its inclusion in Haryana Canal and drainage Act, 1974.

6. Amendment of Legal Provisions

A review of the Haryana Canal and Drainage Act, 1974 would be undertaken with a view to regulate discharge of effluents from industries etc. into

canals, drains and other water bodies. Penalty provisions for unauthorized discharge of effluents will be made more stringent.

7. Optimum utilization of water

Optimum utilization of water is the need of the state in view of the absence of perennial river system. All service units should be responsible for ensuring that water is not wasted at any cost. This aspect would be covered in various training packages for officials as well as users.

Proformas for the purpose of guidelines for water services units, construction units, input parameters for clearance of projects and for discharge of effluents have been devised .

The above initiatives would help the Department in establishing and maintaining a comprehensive water quality and managing the resultant database.

PROFORMA FOR MONITORING OF SOCIAL/ENVIRONMENTAL SAFEGUARDS FOR CONSTRUCTION UNITS

1. Name of work,Circle and Division.
2. Estimated cost
3. Type of work and its duration
   - i) Net work
   - ii) Modernization
   - iii) Rehabilitation
4. Brief description of work
5. Area tobenefit (in acres)
6. Villages covered (if the scheme is new)
7. Type of improvement envisaged (if rehabilitation work)
8. Whether shareholders are being involved or not?
9. Any major suggestions received from shareholders and implemented.

10. Does the machinery being used have any adverse effect on

    i. Air quality by exhaust or dust

    ii. Noise level

11. Will the work in anyway have positive or negative effect on water logging?

    i. Give baseline data i.e. state of channels, surface and groundwater,

    number of tube wells and state of water table.

    ii) Mitigation measures proposed along with cost.

    iii) Curative measures proposed along with cost.

12. Will the work involve cutting of trees and how many?

13. If yes, has the clearance been obtained from Forest Department?

14. Does the area of work fall within reserve forest?

15. If the answer is yes, specify area.

16. How much land is required for compensatory afforestation?

17. Has the work been allotted to the Forest Department after obtaining certificate that there will be no double funding for this project.

18. What are the arrangements for labour at site:-

    i. Housing

    ii. Drinking water

    iii. Sanitation

    iv. Fuel

19. Status of cross drainage works

    i. Whether this work will interfere ;with the natural drainage?

    ii. Whether provision for such cross drainage work made or not?

20. Action taken for stability of slopes.
    i. Provision for drainage of rainwater made or not ?
    ii. Tree plantation planned or not ?
21. Plans for restoration of construction site formulated or not?
22. Whether land scaping has been planned or not?

Executive Engineer In-charge of Project

MONITORING OF SOCIAL /ENVIRONMENTAL SAFEGUARDS FOR WATER SERVICES UNITS

1. Name of Division/Circle Area of Division
    i. Main canals names and length in kms.
    ii. Number of Distributory and Minors
    iii. Numbers of drains and their length in kms
    iv. Number of embankments and river protection works
    v. Regulation points
        a. Name of canal/drains and its RD.
        b. Type of regulation
        c. Whether leak proof or not
        d. If not, what method is being adopted to make it leak proof?
        e. If there is karri system, whether adequate & proper size karrie available?
        f. What alternative is used for karries ?
    vi. Number of tails
    vii. Major structure in Division.
2. Whether canals are regularly cleared of silt, weed and jalla growth?

3. Whether drains are cleared of weed, jungle growth and other obstructions before monsoon?

4. Where is silt cleared disposed?

5. Whether all the tails are being fed with AFSD? (Authorised full supply Department

6. If there is any chronic shortage on any tail and what are the measure taken to overcome the same?

7. What is the state of theft of water in general and tampering of outlets?

8. Are stringent measures being taken to control theft ?

9. Whether shareholders are being associated for issues from Sr. No. 6-9 above?

10. Is any of the irrigation channel or structure interfering with natural drainage?

11. If yes, whether proper cross drainage works have been provided for?

12. If no, please specify location, description and measures proposed .

13. Are the drains in the area capable of taking designed discharge, otherwise give details?

14. What is the state of afforestation on

	Poor	Satisfactory	Good
i.	Canal		
ii.	Drains		
iii.	Embankments		
iv.	Canal colonies		

15. Whether provision for drainage of rainwater exists on canal banks and embankments?

16. Whether any plan for planting of trees on irrigation structures/lands has been envisaged in line with environment Policy of Haryana Irrigation Department? What is the state of encroachment of land canals, drains, embankments, canal colonies and canal rest houses (a detailed note be attached along with measures taken to remove such encroachments).

17. Are there any industries discharging effluents into any water body in the area?

18. If yes, attach a list giving details thereof.

19. Whether any formal sanctions for such discharge has been granted?

20. If yes, who granted such sanction? Also attach all documents relating to such sanction.

21. If no such sanction is there and effluents are discharging pollutants into water bodies, what action has been taken? Attach documents.

22. Whether any new application for such discharge has been received or lying pending?

23. If so, the application complete with proforma for equivalent clearance be sent to Environment Cell for appraisal & evaluation as per norms/standards and decision of E.I.C.

24. Whether any sewage (treated or untreated) is being discharged into any water body in area?

25. Whether any sanction has ever been granted for such discharge? Attach documents.

26. Action taken so far in this matter may also be intimated separately.

27. A detailed index plan of the division giving all entry points of effluents and sewage be enclosed.

28. What is the state of water logging in the area? Give details thereof.

29. Whether shareholders, farmers, public and NGO's are being actively involved in various activities?

Executive Engineer Water Service Division.

PROFORMA FOR ENVIRONMENTAL CLEARANCE OF A PROJECT IN HARYANA IRRIGATION DEPARTMENT

1. Name of Project

2. District

3. Circle and Division

4. Type of Project

   i. New

   ii. Modernisation

iii. Ehabilitation

iv. Operation & Maintenance

v. Others, specify

5. Nature of Scheme

i. Canal and related works

ii. River ProtectionWorks

iii. Drains/Bunds

iv. Building Works

v. Others, specify

6. Cost of the Project

7. Socio-economic evaluation.

i. Whether the scheme has been processed under Section 17-20 of Canal and Drainage Act,1974.

ii. Area to benefit (in acres)

iii. Total no. of beneficiaries.

iv. Village to be covered.

v. Economic Status of Shareholders (in percentage)

a. Marginal landowner upto 5 acres land holdings.

b. Middle level landover 5-50 acres land holding.

c. Higher Group of landowners above 50 acres land holding.

vi. Whether people will be displaced by the project?

vii. If yes, the plan for their rehabilitation and resettlement (separate note to be attached).

viii. Status of land acquisition process.

ix. Type of land to be acquired (specify by type in acres).

x. Whether any monument of cultural heritage will be affected?

xi. Whether shareholder's view and suggestions have been taken?

xii. Whether NGO, WUA have been involved for framing of the scheme?

8. Environmental Appraisal

i. Water Environment

a. Effect of the scheme on surface water quality.

b. Effect of the scheme on ground water quality, like water table, recharging, quality and pollution.

ii. Air Environment

a. Whether there will be any effect on air quality by the machinery to be used?

b. Whether the exhaust of the machinery will adversely affect air quality?

c. What will be the fuel used and what will be its effect on air quality?

iii. Soil

a. Whether there will be any water logging in the area due to implementation of the scheme?

b. Whether there is a possibility of soil salinity in the area?

c. Whether any soil erosion is anticipated?

iv. Climate

a. Whether any wetlands will be lost due to the project?

b. Whether any forest cover is going to be converted into non-forest area?

c. If there is a soil erosion, whether any effect on climate like less transpiration is expected?

v. Forest

a. Is there any forest cover likely to be converted to non-forest area?

b. How many trees are expected to be felled for the scheme?

c. Has the clearance for such conversion been obtained from the Forest Department?

d. If the answer to the above is yes, has the plan for compensatory afforestation been included in the project and at what cost?

e. Who will execute this plan and bear the cost thereof?

f. Has the detailed plan of afforestation in the scheme been included in the project?

g. Has some expert opinion been taken for afforestation within the project area?

vi. Aqua culture

a. Is there any scope of creating wetlands for migratory birds within the project area?

b. Is there any scope of creating fish ponds?

c. Is any large-scale migration of fish expected due to the implementation of the project?

d. If answer to (c) above is yes, what measures have been planned to safeguard?

vii. Flora and Fauna

a. Will the project have any adverse effect on existing flora?

b. Will the project have any adverse affect on the fauna?

viii. Cropping Pattern

a. Whether any change in corpping pattern of the area under the project is expected?

b. Whether any proposal for education of share holders for taking optimum benefit of the project by way of cropping pattern has been mooted?

ix. Discharge of effluents/sewage

a. How many industries (category-wise) are located near the project site?

b. Has any request for discharge of effluents been received so far?

c. If so, attach all such requests?

d. Has any method to curb any unauthorized discharge of effluents been planned?

e. How may towns and cities are located near the project site, whose sewage is likely to be discharged into the canal or drain?

f. Has the concerned authority like Public Health, Municipality, HUDA etc. been consulted and any such request been received? (please attach).

g. Interference with natural drainage.

x. a. Will the project interfere with the natural drainage lines of the area ?

b. What measures have been proposed to take care of natural drainage of the area?

c. Please attach natural drainage lines map of the Project area, obstruction created by the project and measures to mitigate the same.

Executive Engineer
In-charge of the Project

PROFORMA FOR ENVIRONMENTAL CLEARANCE FOR DISCHARGE OF EFFLUENTS INTO WATER BODIES.

1. Name of Industry

2. Location

   i. Village

   ii. District

   iii. Index map.

3. Product and capacity per day.

4. Process involved in brief otherwise a separate note may be attached.

5. Consumption of water.

   i. Quality of water required per day

   ii. Source of supply

   iii. Quality of water available.

6. Solid waste

   i. Quantity likely to be produced per day

   ii. Quality anticipated

   iii. Proposed disposal site and process (A detailed note should be attached)

7. Liquid waste.

i. Quantity of effluent likely to be produced per day.

   ii Quality of effluent (expected characteristics of effluent or laboratory report of latest test be attached)

   iii. Proposed treatment plant and process thereof.

   iv. Anticipated characteristics of treated effluent or actual if already in production.

   v. Proposed disposal site of treated effluent and conveyance system.

   vi. Whether treated effluent to be discharged into water body conforms to the norms laid down in Schedule 1 & 2 of Water Pollution Act?

   vii. The data should be verified by the local unit of Haryana State Pollution Control Board.

WATER CONSERVATION MISSION, HARYANA

Haryana is deficit in the most precious natural resource i.e. water and has a maximum availability of 13.82 million acre feet (Maf). The state does not have any perennial source of surface water and has to depend upon its share in the inter-state river water allocation in the Sutlej, the Ravi, the Beas and Yamuna.The water demand, according to an estimate is about 36 Maf and more than 90% of this demand is for irrigation and the rest is for domestic, industries, drinking water, power, sanitation, fisheries, animal husbandry etc. Therefore, the state is left with a shortage of about 23 Maf. Needless to say that there is a great amount of pressure on available water on account of population increase, accelerated economic activities, improved standards of living, over-exploitation of soil and forestry resources, lack of pollution control measures, growth in industry urbanization etc.

As the availability of water is limited, the issue of conservation becomes paramount. The efforts at conservation have no contend with the problems of both, quality and quantity. As water has a great bearing upon the lives of various user groups, the response has to be multiple.

Presently, the Haryana Irrigation Department, Command Area Development Authority (CADA) are the agencies, who are directly involved in conservation of water by carrying out lining of canals, minors and water courses.

The traditional approach in water management has sofar been sectoral and fragmented. The need is to have a combined multi-sectoral management by integrating all the stakeholders involved directly or indirectly. Therefore, it is proposed to launch " Water Conservation Mission" in order to provide the enabling environment by creating a framework within which participatory, demand driven, sustainable development can be possible, which will lead to integrated Water Resources Management.

The proposed Water Conservation Mission will be headed by Hon'ble Chief Minister, Haryana with the following members :-

Ministers

1.	Agriculture	Member
2.	Public Health	Member
3.	Industries	Member

4.	Rural Development	Member
5.	Irrigation	Member
6.	Health	Member
7.	Local Government	Member
8.	Environment	Member
9.	Power	Member
10.	Fisheries	Member

Secretaries

11.	Chief Secretary	Member
12.	Vice Chancellor, CCSHAU, Hisar	Member
13.	Agriculture	Member
14.	Public Health	Member
15.	Industries	Member
16.	Rural Development	Member
17.	Irrigation	Member
18.	Health	Member
19.	Local Government	Member
20.	Environment	Member
21.	Fisheries	Member
22.	Power	Member
23.	Education	Member
24.	Animal Husbandry	Member
25.	Town & Country Planning	Member
26.	Women and Child Development	Member
27.	Building & Roads	Member

Head of the Departments

28.	E.I.C., Haryana Irrigation Department	Member
29.	E.I.C., B&R	Member
30.	Director,Agriculture	Member
31.	Director,Industries	Member
32.	Director, Rural Development	Member

33.	Director, Panchayat	Member
34.	Chief Administrator, HUDA	Member
35.	Chairman, Pollution Control Board	Member
36.	MD, MITC(If MITC is sustaining)	Member
37.	PD, HIRMI, Kurukshetra.	Member
38	Chartered Accountant , CADA	Member

Besides, the other Members (to be nominated by Chief Minister, Haryana), will be one President of Zila Parishad, two Panchayat Samiti Chairmen, two Sarpanches, two Municipal Committee Chairman, one Member each from Mewat and Shiwalik areas, two women members, representative from PHD Chamber of Commerce & Industries (Haryana Chapter), one representative from CII and two Presidents of Water Users Associations.

The Secretary, Irrigation will be the Member Secretary of this Mission. The headquarters of the Mission will be at Chandigarh.

It is also proposed to constitute an Executive Committee of the Mission, which will have the following composition:-

Principal Secretary Chief Minister	Chairman
Secretary, Agriculture	Member
Secretary, Public Health	Member
Secretary, Industries	Member
Secretary, Rural Development	Member
Secretary, Irrigation	Convener

A special cell is proposed to be created in the office of the Secretary, Irrigation to facilitate the functioning of the Executive Committee. The proposed composition of this cell will be as under:-

E.I.C., H.I.D.	Chairman
All C.Es H.I.D.	Member
MD, MITC	Members
C.E.,MITC	Member
C.A. , CADA	Member
C.E.,CADA	Member
C.E.(Coordn.)., H.I.D.	Convener

Functions:

The main functions of the Mission will be:-

1. to bring all stake holders on one platform with their vision and action.
2. to co-ordinate and harmonise roles and functions of various stake holders.
3. to approve plans for conservation of water resources and its optimum utilization.
4. to promote conjunctive use of surface and groundwater.
5. to integrate the needs of various sectors in water management.
6. to allocate periodical priorities among various water users,
7. to devise methods for effective regulation, monitoring and enforcement.
8. to advise on practices and procedures, administrative arrangements and regulations for the fair distribution and utilization of water resources by different groups of users. In case of major users such as Agriculture, Public Health departments guide efforts for change in sanitation technology, crop diversification, promotion of suitable technology of sprinkler/drip irrigation etc. for conservation,and
9. to direct carrying out studies as may be necessary for consideration of any plan/project or component thereof.

The Executive Committee will examine the " Water conservation efforts and plan" of each of the agency representing a particular user group and after dovetailing it into the overall pattern and will recommend suitable action for approval to the Mission.

The Mission will meet twice a year while the Executive Committee shall meet once every three months or whenever required.

Proposed Action Plan

The following action plan is proposed for achievements of the objectives of the Water Conservation Mission and all the concerned departments will come up with their detailed action plan.

1. **Awareness campaign**

An awareness campaign will be launched to educate all the users for the need and necessity of conservation of water. Detailed educational material will be prepared

to tell the end users ways and methods of conservation of water in all sectors. Each department will prepare and submit a programme to launch a campaign to target public at large with whom the department has direct dealings.

2. **Incentives and disincentives**

All the departments will come up with a proposal to provide incentives to the users, who resort to conservation methods and techniques. Another plan will be mooted for disincentives for non-compliance of conservation and wastage of this precious resource.

3. **Rainwater harvesting**

This is a very effective and feasible proposition of water conservation in Haryana and some departments have already initiated some steps in this direction. The actions taken up so far and proposed plan needs to be taken up at this forum.

4. **Artificial recharging**

Few schemes of artificial recharging have been taken up in isolation by Haryana Irrigation Department. This technique needs to be tailor-made for the conditions i.e. geographical, meteorological, social etc and launched statewide

5. **Afforestation**

Afforestation leads to conservation in a number of way us, particularly in catchment areas, waterlogged areas and other areas. All the departments can play a major role in launching a campaign of afforestation.

6. **Conjunctive use of water**

There is an urgent need of resorting to conjunctive use ofwater and agriculture department in coordination with all other departments dealing with farmers will prepare a detailed action plan to promote the same.

7. **Use of recycle water**

A number of STPs and ETPs have either been commissioned or are in progress. Use of recycled wastewater for irrigation of selected crop needs to be explored and expedited.

8. **Sprinkler & Drip Irrigation**

In a number of countries sprinkler & drip irrigation has been used to a large extent and these methods of irrigation save a large quantity of water. Use of these irrigation techniques at a large scale requires systematic and well-planned action plan.

9. **Better agricultural practices**

The present method of flood irrigation wastes a large quantity of irrigation water, therefore, the need is to develop and promote less water consuming techniques for irrigation.

10. **Shift in cropping pattern**

The current cycle of wheat and paddy consumes maximum irrigation water and there is a need for promotion of crops which consume less water. Agriculture department in consultation with CCS HAU, Hisar will launch a campaign for promotion of such crops.

11. **Development of new techniques**

In addition to the methods above, there is a need to develop new techniques for water conservation. The departments having research facility and human resource for the same will pool their resources for development work. CCS HAU, Hisar will help in coordination for this research work.

PARTICIPATORY IRRIGATION MANAGEMENT IN HARYANA

History of PIM

A look at the history of PIM in Haryana reveals that the original Northern India Canal & Drainage Act, 1873 now replaced with Haryana Canal & Drainage Act, 1974 provided for a clear role of farmers in operation and maintenance (O&M) of watercourses. Earlier katcha watercourses used to be maintained by farmers and they provide voluntary labour for desilting and deweeding of minors and distributaries. However, with the passage of time, the welfare state gradually took upon itself the maintenance responsibilities leading to increased O&M expenditure, slow deterioration and inefficiency in the irrigation system, under utilization of the created potential. In the year 1988, CADA started formation of Water Users Associations essentially as a pre-requisite for lining of watercourses and also with many other noble intentions. In 1994, negotiations were held with the World Bank for HWRCP with beneficiary participation and formulation of WUAs as essential objectives.

The Staff Appraisal Report (SAR) of Water Resources Consolidation Project (India) dated March 3,1994 in the project description talks of selective lining of canals and watercourses. It talks of beneficiary participation and notes the provisions of the Northern India Canal & Drainage Act-1873 for a clear role of farmers in operating and maintaining the watercourses. It also talks of promotion of turn over of maintenance to beneficiaries organized into Water Users Association by Government of Haryana. However, striking a cautious note, it adds that the approach would be progressive and voluntary and also notes that the present system of operation is working satisfactorily and may not be disturbed. Therefore, the farmers may be given the option of assuming full responsibility for maintenance of a watercourse. In 1995, the HSMITC started the formation of WUAs and in 1996, Haryana Irrigation and Management Institute, Kurukshetra registered under the Societies Act was set up for the training purposes. In 1997, Agriculture ntensification Programme was included in WRCP after its Mid Term Review during November 1997.

Guidelines for formation of Water User's Association (WUA)

The management of Irrigation System is a state subject, with little contribution from the stakeholders. Haryana has created a vast infrastructure of water conveyance system by lining of watercourses but the system is declining fast due to a number of reasons such as poor O&M,lack of funds, no involvement

of the farmers etc. The only way out to check the decline is to take up comprehensive reforms through Participatory Irrigation Management (PIM). The experience of PIM in other states in the country as well as abroad has demonstrated that PIM is a viable solution in the Irrigation sector. Haryana Irrigation Department has taken up the task of forming of WUA at outlet level at this stage and turning over the management of watercourses to this Farmer's Organization.

WUA is an association of farmers and the membership is limited to the shareholders of an outlet WUA will be a registered body, having a General Body and Managing Committee. The WUA will take over the management of watercourses and Haryana Irrigation Department will provide the necessary support in this transitional period. These guidelines are being issued to form the WUAs immediately.

The guidelines are on the following lines.

Part A- consists of the general outline of the WUA, rules, regulations, duties, functions, resources etc. and is based on the model bye-laws approved by the government.

Part B- gives the procedure for formation of the WUA

Part C- lays down the role and responsibilities of officers/officials.

Part D- gives the detailed instructions for registration of the WUA.

Part A

Area of Operation

The area of operation of a WUA will be the area served by an outlet.

Formation of WUA

The following persons of a WUA will be from the area served by an outlet.

- Allthe shareholders of an outlet as per approved warabandi under Section 55 of Haryana Canal & Drainage Act, 1974.
- Actual owner or his representative of the owner of land located within the jurisdiction of a WUA.
- Junior Engineer/Patwari of Haryana Irrigation Department as an ex- Officio member without any voting right. The other conditions for membership are

- That the person should be- (I) major, (ii) having sound mind and (iii) is not insolvent.
- In case the Managing Committee or the General Body refuses to admit and otherwise eligible person, it shall record the reasons and communicate to the person.
- Such a person can appeal to the Divisional Canal Officer within a fortnight of communication of such decision and the decision of the Divisional Canal Officer will be a binding on the society.

Aims and Objectives of Water User's Association

The main aims and objectives of the WUA shall be as under:-

- Equitable and uniform distribution of available canalwater among all Users on the basis of approved warabandi under Section 55 of the Haryana Canal & Drainage Act, 1974.
- Adquate repair & maintenance of water courses and keep it in running condition by clearance of the silt & vegetation.
- Ensure efficient and economical use of canal water.
- Agricultural extension programmes to decide type of crop for optimum utilization of available water.
- Activities for the welfare of all the users/members.
- Protection of environment and ecological balance by involving shareholders in implementation of water budget and operational plan.

Function of WUA

The WUA will have following functions in general:-

- Help prepare warabandi schedule under section 55 of Haryana Canal & drainage Act,1974 and implement the approved warabandi for each crop season.
- Prepare a plan for maintenance of irrigation system in its area at the end of a crop and carryout maintenance work as per plan.
- Regulate supply of canalwater among shareholders economically and arrange full supply discharge in the canal.

- Assist in various activities like water charges assessment (booking), raising of water charges (distribution of demand statement) and collection etc.
- Maintain a register of landowners as per the revenue record and Also keep record of tenants.
- Maintain an inventory of the irrigation system within the area of operation.
- Generate resources and maintain accounts of WUA.
- Get annual audit of the accounts done as prescribed.
- Assist in the conduct of elections to the Managing Committee.
- Settle dispute among shareholders amicably.
- Keep close liaison with the Haryana Irrigation Department for technical assistance and other necessary help.
- Conduct General Body meeting as prescribed.
- Arrange agricultural extension programs to determine the most suitable crop for the area, soil & water availability.
- Conduct water budgeting & crop budgeting with the help of Agriculture Department and Haryana Irrigation Department.

General Body

The General body of a WUA will consist of the members as detailed above. The powers and functions of the General Body will be as under-

- All the members on a given date once they exceed 50% of the beneficiaries covering 51% of outlet shall constitute the General Body of the society.
- The General Body will elect a Managing Committee by secret ballot which will perform essential functions of the WUA.
- It will ensure that representation is given to every reach of the chak.
- It may suspend or remove the elected members of the Managing Committee.
- It will have minimum two meetings in a year, one before each crop.

- The meeting can also be convened at the request of at least one third of total members.
- The meeting will be convened with a clear notice of 7 days by the manner prescribed under rules.
- It will approve the programme of the WUA for each year with a clear agenda of improving irrigation efficiency .
- The General Body will be the final authority in finalise the yearly budget & accounts, as submitted by the Managing Committee.
- It will take all major decisions for fulfilment of the objective and for betterment of the shareholders of the WUA.
- It will authorised its elected Chairman to execute MOU with the government.
- It may amend bylaws.

Managing Committee Constitution

- The Managing Committee shall consist of 7 members or as fixed by the General Body & will be duly democraticaly elected by the General Body of WUA.
- The term of members of Managing committee will be 3 years and fresh election will be held of completion of term.
- It will elect its Chairman, General Secretary, Treasurer and other functionaries as per requirement.
- If one-third members desired not to serve the as members of Managing committee, election for the same shall be held by calling the meeting of General Body.
- If less than one-third members resign the Managing committee will co-opt the members of the same area.
- If more than half members resigns fresh election for the Managing Committee shall be held.
- No person shall be eligible for election as a member of the Managing

Committee if he is :

* Paid employee for the society.
- Of unsound mind.
- Defaulter under Haryana Canal & Drainage Act,1974.
- Held any place of profit under the society/outlet society.

Duties

- It will observe all the rules laid down in the byelaws, adopted by the General Body.
- It will perform all activities to fulfill the objective of the WUA as laid Down in the adopted bye-laws.
- It will manage the entire finances of the WUA as per the adopted bye-laws.
- It will maintain true and accurate account of funds received & spent .
- It will keep a register of members correct & uptodate.
- It will summon generalbody meeting as per bye-laws.
- It will meet monthly or earlier, if required earlier to discuss the affairs of the WUAs.
- It will discuss & finalize operation & maintenance plan, action taken & action to be taken to fulfill the objectives of WUA.
- It will carry out beneficial schemes as prepared by the Central/State Government from time to time.

Funds

The WUA may raise funds for its functions from the following sources:

- Share money from the Government as notified by the Government from time to time.
- Voluntary deposits from its members .
- Contributions in emergency.
- Budget grant from the Government & other financial assistance from the Government.

- Any saving from the works undertaken by the WUA.
- Resources raised from other financing agency for undertaking any economical development activities in the area.
- Money received from any other source.

Management of funds

- All the capital investment of WUA will be in long term fix deposit, with instructions to deposit the interest in the saving account every six months.
- The WUA will deposit its operating funds in a saving account in the Post office, Cooperative Bank or Nationalize Bank.
- The saving account will be operated jointly by the treasurer and any other member, nominated by the Managing Committee.
- The Managing committee can spend Rs. 5000/- at one time subjected to a maximum of Rs. 20000/- in one year without obtaining prior formal technical/administrative sanction from the competent authority in Haryana Irrigation Department.
- Only such amount should be drawn from the saving account (Operational funds) which is required to cover running expenses for approved work. The maximum cash in hand be restricted to Rs. 1000/-.

Default in payment

If a shareholder fails to pay his share as fixed by the WUA and it remain unpaid for six months, penalty as deemed appropriate by the WUA will be imposed.

Financial year

The financial year of the WUA shall be from July to June. The accounts should be audited and placed in the Kharif General Body Meeting.

Winding up

In case the society has to be wound up,the property and funds remaining after discharge of liability shall be transferred to Haryana Irrigation Department which is already engaged in similar activities. Further, if the WUA is dissolved on the request of the General Body or Haryana Irrigation Department the funds shall be returned to the same authority from where these were collected.

Miscellaneous

- The service of the members of the Managing Committee shall be honorary capacity.
- Any person employed by the WUA shall be appointed with approval of The General Body and pay, allowances, terms of services shall be decided by the General Body & such a person shall work under the guidance of the Managing Committee of the WUAs.
- Once a year a list giving detail of the members of the Managing Committee of the WUAs shall be filled in the month of January with the Registrar of Firms and Societies Haryana.
- The movable and immovable property of the WUA shall be deemed to be vested ;in the Managing Committee of the WUA and in all proceedings of the civil & criminal may be described as the property of the WUA by its proper title.
- The society may sue or may be sued in the name of the Chairman, Secretary or Treasurer or any other member as determined by the General Body.
- In the normal course, the Secretary of the Society may sue or be sued.

Part B

Procedure for formation of a WUA

Motivations

Executive Engineer/Sub Divisional Officer, Water Services Division will conduct a meeting of all the shareholders of an outlet, after giving a due notice & persuasion for maximum attendance by the Zilladar/Canal Patwari. This meeting should be preceded by consistent efforts on the part of the Zilladar/Canal Patwari to motivate and educate shareholders about the benefits of WUA in informal meetings during their routine visits to the villages concerned. They will prepare a list of the shareholders of the water course.

On the Haryana Irrigation Department side, the Sub Divisional Officer, (W/S Haryana Irrigation Deptt., & MITC), Junior Engineer, Zilladar and Canal Patwari of the area will attend the meeting. Executive Engineer, Sub Division

Officer or (a trained person on WUA) will explain all the aspects of the WUA to the shareholders. The stress will be laid on the participatory feature of WUA, sense of ownership, self-governance, long term benefits etc. It will be brought out to the shareholders that after formation of WUA, the role of Haryana Irrigation Department will be that of a facilitator & provider rather than that of a regulatory body so far as irrigation management at outlet level is concerned. The decision making authority for all aspects of O&M of the water course will rest with the WUA. In order to accelerate the process and achieve the objective, an extensive publicity programme, duly supported by audiovisual aids should be adopted.

Elections

Once the shareholders are convinced and quorum (all the members on a given date once they exceed 50% of the beneficiaries covering 51% of outlet shall constitute the General Body) is complete, elections for Managing Committee will be held in the same meeting. Though the elections will be conducted democratically by secret ballot, efforts will be made to elect Managing Committee unanimously by consensus among all shareholders. Executive Engineer/Sub Divisional Officer/Junior Engineer will explain the model bye-laws of the WUA and the General Body will adopt bye-laws after making any amendment to suit their requirements without changing the basic structure of model bye-laws.

The members of Managing Committee will elect (I) Chairman (2) Secretary (3) Treasurer (4) Member authorise to operate the bank account of WUA. The Managing Committee shall also authorise its Chairman to sign Memorandum OF Understanding (MOU) with the government. The proceedings of the elections, adoption of bye-laws and authorization to the Chairman to sign MOU will recorded in the printed proceeding register by the elected Secretary of WUA with the help of the Canal Patwari.

Collection of share money receipts & accounts

Once the Managing Committee is in place, Junior Engineer/Canal Patwari will encourage the Managing Committee to collect share money from shareholders. He will ensure that the Managing Committee arranges the necessary instruments like receipt book, cashbook, stock register etc. for issue of receipts and maintenance of proper accounts.

Ziladar/Canal Patwari will ensure that a saving account is opened in the name of the WUA in the post office or Cooperative Bank or Nationalized Bank. This account shall be operatable by the treasurer and authorised member of the Managing Committee.

It will be the duty of the Executive Engineer to arrange a simple basic training of accounts to the treasurer of the WUA, utilizing available resources within the division such as accountant, accounts clerk etc. junior Engineer/Zilladar/CanalPatwari will ensure that proper receipts are issued and account is maintained.

Registration of WUA

After all the above actions are complete, junior engineer/canal patwari will ensure that all the papers for registration of WUA are completed and checked from Sub Divisional Officer. The job of registration shall be that of the WUA, however, necessary assistance will be made available by the Deptt.

The detailed formalities for registration of WUA are enclosed as Part D

Functioning of WUA

1. As an ex-officio member of the WUA, Canal Patwari shall attend every meeting of the WUA. Junior Engineer will provide technical guidance and will help the WUA in preparing O&M plan, preparation of estimates after due consultation with WUA.The estimate will be submitted by the Junior Engineer for technical approvals. The prevalent powers for technical sanction will be applicable in the works of WUA.

Part C

Role and Responsibilities of Executive Engineer

Since Executive Engineer Water Services is the executive head of a water service division, he will be responsible for formation of WUA and its proper functioning. He will actively work for the success of this ambitious programme and will work in the executory and advisory capacity. Some of the prime responsibility and duties of Executive Engineer will be-

- To get fully conversant with the entire procedure, functions, bye-laws detailed guidelines.
- To plan and execute a strategy, according to bye-laws and the guide-Lines for formation of WUA, with due consultation of MITC counterpart.
- To arrange the first meeting of shareholders of an outlet at a convenient to place preferably village square.
- To arrange proper notice of meeting bythe prescribed manner as laid down in Haryana Canal & Drainage Act, 1974 & hold the

concerned junior engineer/Canal Patwari responsible for maximum attendance.

- To communicate to the shareholder that concept, functions, duties, powers & benefits of WUA in the meeting. It should be impressed upon them to keep party & local politics out of WUA.
- To make efforts to hold the elections for Managing Committee in the same meeting preferably unanimous with consensus.
- To arrange basic & simple training of accounts for Managing Committee of WUA using resources from divisional establishment.
- To ensure that the process of registration of WUA is completed.
- To interact & discuss various issues with WUA members during his field visits.
- To accord/arrange technical sanction to the estimate exceeding Rs. 5000/- for the works of WUA,as submitted by the Sub Divisional officer.
- To monitor the progress of WUA work & provide guidance wherever necessary.

Role and Responsibilities of Sub Divisional Officer

Sub Divisional Officer will be competent authority on behalf of the government and he should acquaint himself fully with all the aspects of WUA. Mainly the following will be the responsibilities of the Sub divisional Officer.

- He will be responsible for all the activities of the formation of WUA and associate with his counterparts in MITC.
- Before the scheduled meeting, he will propagate and publicize to impress upon the shareholders the benefits of WUA.
- He will arrange to explain the model bye-laws to the General Body in order to facilitate adoption of the bye-laws by the General Body.
- Once a WUA has been formed, it will be the duty of Sub Divisional Officer to ensure that all formalities are completed as per the adopted bye-laws.
- It will be the responsibility of the Sub Divisional Officer to check that the paper work relating to registration of WUA is in order.

- Sub Divisional Officer will regularly interact with and educate the share-holders and Managing Committee about improvements in operation and maintenance plan, resource development and execution of works.
- All the necessary technical guidance and checking of estimates will be the responsibility of Sub Division Officer.
- Sub Divisional Officer will inspect the works of WUA, issue instructions for proper and good quality work.
- He will check the quantity of work recorded bythe Junior Engineer as per codal rules.

Role and Responsibilities of Junior Engineer

Junior Engineer in the capacity of first level field official shall have one of the most important roles in the transfer of irrigation management. He will provide technical guidance to the WUA, whenever required. His main responsibilities in this programme will be-

- To motivate shareholders for formation of WUA and explain to them the benefits of the WUA before the scheduled meeting.
- To ensure that all the papers and relevant documents required for registration of WUA are completed by WUA
- To attend the meetings of Managing Committee and General Body of the WUA as a special invitee.
- To provide necessary technical guidance to the WUA as and when required in the O&M plans and other improvement schemes planned by the WUA.
- To inspect the site of work with members of WUA to help them in decision-making by providing the necessary technical guidance.
- To prepare estimates of the works decided by the WUA in his consultation for submission and obtain technical sanction of the competent authority.
- To supervise the execution of works, provide all necessary technical guidance such as marking alignment, layout of structures, levelling work, work as per approved drawing & specifications and good quality of work.

- To ensure that the required specifications and quality of work is maintained on all these works by constant and consistent instructions.
- To assess and measure the executed work in association with the authorised member.
- To check and report the completion of all the works.

Role and Responsibilities of Zilladar

Zilladar is the revenue head of a section and works in close association with the shareholders. He should play an active role in this prestigious plan of the department. His primary duties will include –

- To assist Executive Engineer and Sub Divisional Officer in the formation and functioning of the WUA.
- To make all his efforts to motivate shareholders in the format ion of WUA by explaining its benefits.
- To ensure that the notice of meeting is conveyed properly to all the shareholders as laid down under rules.
- To oversee the preparation of list of shareholders of the chak of an outlet by the Canal Patwari in close association with revenue counterparts.
- To ensure maximum attendance of shareholders for the first meeting of the General Body of the WUA.
- To attend the first meeting of the shareholders convened to form WUA.
- To keep a check over the day today work of the CanalPatwari in attending needed for the registration of the WUA.
- To provide necessary guidance toWUA for matters relating toHaryana Canal & Drainage Act, 1974,such as warabandi, transfer of area, shifting of outlet, restoration of dismantled watercourse etc.

Role and Responsibilities of Canal Patwari

Canal Patwari will be the pivotal force in this ambitious transfer of irrigation management programme of the government He will be the ex-officio member of the WUA of a watercourse and thus asumes an important place in this

plan. Besides making all his efforts to ensure success of WUA, his main role and responsibilities will be:-

- He should get fully conversant with the guidelines for WUA, the procedure for registration, bye-laws and his responsibilities in this program.
- On issue of the notice for first meeting of the shareholders for WUA, he should ensure that the same is served to all shareholders,not only in the prescribed manner but he should also personally meet the shareholders during the notice period to persuade them for attendance and explain benefits of WUA.
- He will prepare and update the detailed list of all the shareholders of Chak of an outlet, with due consultation of record of his counterpart of revenue department. This list should contain all details of land holdings of the shareholders with other relevant details.
- On election of the Managing Committee, he will encourage the Managing Committee to collect share money from the shareholders.
- He will advise the Managing Committee to open the saving bank account of the WUA in the post office, cooperative bank or nationalized bank. The saving bank account will be operable by the treasurer and the authorized member.
- Canal Patwari shall make certain that all the papers required for the registration of the WUA as per the checklist enclosed with the guidelines.
- He will provide necessary guidance to the WUA in the matters relating to Haryana Canal & Drainage Act, 1974.
- He will help the elected secretary of the Managing Committee of the WUA in recording the proceedings of the meeting.
- Canal Patwari as a direct field functionary will interact with all the shareholders, members of Managing Committee to provide guidance and will work as an important link between the WUA and the Department.

Part D

Detailed instructions for Registration of WUA

The following documents are required for registration of a WUA with the Registrar of Firms and Society, Haryana:-

1. Memorandum of Association
2. Rules and regulations of the WUA.
3. Copy of the proceedings of meetings.
4. Registration charges receipt.

1. Memorandum of Association.

This performa will have the following particulars:-

(i)	Name of society	The name of the WUA shall be given.
(ii)	Location of the registered Office:	The location will be given.
(iii)	Area of operation:	The area of operation such as the chak area etc. or villages will be given.
(iv)	Aims & Objectives:	Here the aims and objectives as per the adopted bye-laws shall be given.
(v)	Conditions:	Here the conditions given in the procedure for registration shall be written.

(vi) Here the details of the Managing Committee members in the following Performa shall be given.

S.No:	Name/Father's name	Address	Occupation	Age	Designation

(vii) We the several persons, whose names and addresses are hereunder subscribed are desirous of being formed into an association in pursuance of this memorandum of association:

S.No:	Name	Address	Designation	Signature

All members of the Managing Committee will sign here.

Witness: I know all the above persons and they have signed in my presence.

Station Signature

Dated: Name, address and stamp.

(The witness should be the Sarpanch or an advocate but he should not be a member of the WUA)

2. Rules and regulations of the WUA.

In this performa a copy of the adopted bye-laws will be given. This copy will be attested by at least three office bearers of the Managing Committee.

3. Copy of the proceedings of meetings.

A photocopy of the proceedings from the **' printed proceeding book'** of following resolution, duly attested by the Chairman of the Managing Committee shall be submitted.

4. Copy of the proceedings of meetings.

Rs. 50/- shall be deposited in Haryana Treasury under the following heads-

(i)	Head of Account	" 1475-Other General & Economic services Other General Services-Admn. Of the Society Registration Act, 1860".
(ii)	DDO Code	859
(iii)	Sub Head	02

(iv) Sub Major Head 12

(v) Minor Head 800

The original Treasury receipt shall be attached.

Note

- Documents should be neatly typed on one kind of paper Without cutting/errors.
- Each page should be signed by an office bearer, preferably Chairman or Secretary.
- Two sets of the documents shall be attached.

(Guidelines for formation of Water User's Association Approved by government vide memo No: 7/30/95-11W dated: 10.08.2000.)

Model Bye-Laws

1. Objective

The main objects of the society shall be

(i) to distribute the available canal water equitably and uniformlyamongst all the shareholders on the basis of approved warabandi done by the Irrigation Department.

(ii) to upkeep the field channels in running condition by clearance of the silt and vegetation and also attend to repair and maintenance of field channels.

(iii) to determine crops to be sown for optimum utilization of available water.

(iv) to carry out all the required activities with the basic aim of welfare of members, shareholders and tillers in the canal command area falling under the jurisdiction of society with the sole aim of increasing agricultural production.

(v) to do all acts not specified above but which are identical or conducive to the attainment of the objective of the Society.

2. **Membership**

(A) Members of the society will consist of the following:-

(i) all the shareholders of canal water under the approved warabandi of the concerned canal system by the Irrigation Department under Section 55 of the Haryana Canal & Drainage Act,1974.

(ii) An actual owner or his authorised representative of land situated with in the area of operations of the society.

(iii) Subject to the provision of bye laws any person who is major, having sound mind and is not insolvent shall be eligible for admission as member of the society and

(iv) Junior Engineer/Canal Patwari shall be ex-officio member of the society but will not have voting right.

(B) If the Committee or the General Body refuses to admit a person who is otherwise eligible for membership, it shall record its reasons for such refusal and communicate them to the person concerned. Any person who has been refused admission shall have the right of appeal to the Division Canal Officer within a fortnight of the date of communication of refusal. The decision of Divisional Canal Officer on such appeal will be binding on the society/sub-society and the applicant.

3. **Constitution of General and Managing Body.**

(i) All members form the general body of the society.

(ii) The general body shall elect a Managing Committee.The Managing Committee may consist of 7 members elected democratically.

(iii) The general body shall also ensure representation for all reaches of the chak.

(iv) The Managing Committee will elect its Chairman and other functionaries as required.

(v) The terms of the office bearers shall be three years and thereafter fresh election will take place.

3. Funds

(A) The society may raise funds by:

(i) The amount of share capital, which shall be Rs. 250/- per hectare (CCA) Cultureable Command Area or such amount as fixed by the general body. As regards the CADA area which is being promoted by the Government of India under centrally sponsored CAD (Command Area Development) Programme, wherein one time functional grant is provided to farmers @ Rs. 500/- per hectare of which an amount of Rs. 225/- per Hectare each will be contributed by each member of water users association.

(ii) Acceptance of voluntary contribution from its members:

(iii) Raising of deposits in emergency;

(iv) Budget grants received from Government of India, State Government under the head of managing subsidy as and when offered;

(v) Financial assistance received from government and other sources;

(vi) Unused amounts or savings from subsidies offered by the government for specific purpose.

(vii) Saving from the works undertaken by the society;

(viii) Remuneration for taking up government works like collection of water charges;

(ix) Accumulation of profits;

(x) Share in water charges as fixed by the government.

(B) If the payment due on account of share capital remains unpaid for six months, his right to use the canal waters shall stand forfeited.

4. **INVESTMENT OF THE FUNDS.**

(i) The society shall deposit all its operative funds in the post office or savings bank account.

(B) all its capital investment in the long term fixed deposits which includes share capital and government contribution of any or other funds raised,

with instructions of transferring only the interest part every six months to its saving bank account and renewal of the fixed deposit on its maturity.

(ii) (a) The savings bank account (operative funds) shall be operated jointly by the treasurers anyone member out of the committee member out of the committee members authorised by the Managing Committee.

(b) They will draw only such amount as is required to cover the running expenses on items approved.

(c) Cash in hand with the treasurers will not exceed Rs. 1000/-.

5. FUNCTIONING AND MEETING OF THE BODY

(I) All the members on a given date once they exceed 50% of the beneficiaries covering 51 percent of outlet shall constitute the General Body (GB) of the society.

(ii) The General Body members of the society shall meet from time to time at twice in calendar year. A meeting of the General Body shall be convened by the Secretary of the Society, before commencement of Kharif season and commencement of Rabi season, every year.

(iii) A General Body meeting shall also be convened, if the requisition for such a meeting signed by not less than one third of the total members is received by the Managing Committee,. If it is not convened within a month, the signatories to the requisition may refer the matter to the Executive Engineer of the area. Executive Engineer will summon the General Body meting of outlet society specifying.

(iv) A clear notice of seven days for General Body meeting of outlet societyspecifying the date, place, time and agenda of the General Body shall be given tomembers.

(a) The notice shall be affixing a copy of the notice at the society's office or at some conspicuous place in the area of operation of the society;

(b) By circulation of notice book and getting signatures of members on it;

(c) By post

(d) By beat of drum;

(v) The chairman or in his absence one of the Managing Committee Member approved byother members shallpreside over the meeting of the General Body.

(vi) Every member of the General Body shall have one vote. Voting by proxy shall not be allowed. When the votes are equal, the Chairman of the General Body shall have a casting vote. Final authority of the Society shall vest in the General Body.

(vii) General Body shall have the following powers and duties:-

(a) the election of the Managing Committee members, suspension and removal of the elected members, of the Managing committee.

(b) Approval of the proceedings of the last General Body meeting And consideration of the annual report of the society, its audited balance sheet income and expenditure statement and the inspection notes, if any;

(c) approve the programme of activities of the society prepared for ensuing year;

(d) Amendment of the bye-laws;

(e) Determine the improvements to be introduced for increasing irrigation efficiency.

(f) Take all other decisions on all the matters for fulfillment of the objectives mentioned in the bye-laws.

(g) Consider any other matter, which may be brought forward in accordance with bye-laws by members to the notice of General Body.

(h) Pass the budget for the ensuing year and approval of the expenditures statement towards repairs of the previous year.

(i) Empowering the Chairman to execute the Memorandum of Undertaking with the Governor of Haryana.

7. MANAGING COMMITTEE

The Managing committee (MC) shall consist of 7 members of as fixed by the General Body. If at a later date, 1/3rd members desire not to serve as Managing Committee members, election for the same shall be held by calling for a General Body meeting to fill in the above vacancy. If less than 1/3rd members resign, then Managing Committee will coopt the member of the same area. If more than half resign fresh election for Managing Committee shall be held.

No person shall be eligible for election as a member of Managing Committee if he is:-

a) Paid employee of the society.

b) Of unsound mind.

c) Defaulter, under Haryana Canal and Drainage Act, 1974.

d) Held any place of profit under the society/outlet society.

The Managing Committee shall have the following powers and duties:-

(a) To observe the notified rules laid down bye-laws.

(b) Undertake all activities to fulfil the objectives of the society as per bye-laws.

(c) To maintain true & accurate account of all the money received and spent.

(d) To keep a register of members correct and upto date.

(e) To summon General Body meeting in accordance with the bye-laws.

(f) To observe that the members are performing their duties in a proper way.

(g) To accept or reject the resignation of the Managing Committee member and co-opt in their place fresh committee members or call for a fresh General Body for that purpose.

(h) To carry out beneficial schemes as prepared by Central/State Government from time to time.

(i) To incur expenditure upto Rs. 5000/- at one time and upto Rs. 20,000/- with in a year without obtaining formal technical/administrative sanction from the concerned department

Haryana Irrigation/HSMITC/ Command Area Development Authority once the procedure for the same is prescribed by the Government Quorum will be half of the total elected members.

The Managing Committee will meet once in a month, if needed earlier and discuss in depth affairs of the society, chiefly the operation and maintenance work and action taken to fulfil the objectives of the society.

8. FINANCIAL YEAR

The financial year of the society shall be 1st July to30th June next. The accounts should be audited and placed in the Kharif General Body.

9. WINDING UP

In case the society has to be would up, the property and funds of the society that remain after the discharge of the liabilities shall be transferred to the Haryana Irrigation Department or other Institute established for similar objectives to serve the minor of the society and will be utilized for improving the services for the operation and maintenance of the minor. Further, if the society shall be dissolved on the request of the General Body or by the Irrigation Department of Haryana, the funds and other properties of the society shall be returned to the same authority from which these were collected. In case of loss due to natural calamities, the members will not incur any liability.

10. MISCELLANEOUS

1. The services of the members of the Managing Committee shall honorary.

2. The paid manager/cashier-cum-official worker/Engineer/ Agricultural officer, as and when needed shall, however, be appointed with the approval of General Body and the pay and allowances of these employees shallbe decided by the General Body, along with the terms of service, and they have to work under the Managing Committee.

3. Once in a year in the month of January a list shall be filed with the Registrar of societies of Haryana Irrigation Department Of name, address and occupation of Managing Committee members.

4. The property, moveable and immoveable belonging to the society shall be deemed to be vested for the time being in the Managing Committee and in

all proceedings civil and criminal may be described as the property of the society by their proper title.

5. The society may sue or to be sued in the name of the Chairman, Secretary or Tresasurer or any other member as shall be determined by the General Body. In the normal course, the Secretary of the society will file a suit and on behalf of the society sue or be sued.

6. Whenever any bye-laws are dully made in accordance with rules regulations of the society, & any precautionary penalty is imposed by Managing Committee for the breach of any rule or bye-laws of the society such penalty when accrued may be recovered through Managing Committee or through any court having jurisdiction where the defaulter shall resigned or the society shall be situated as Managing Committee shall deemed suitable.

11. AMENDMENT TO BYE-LAWS AND FRAMING OF BYE-LAWS AND RULE THEREUNDER.

It shall be sufficient that the Managing Committee of the society file with the Registrar of societies any change effected in bye-laws and rules, made and approved from time to time, with a copy of the report of the proceeding of the General Meeting at which the changes in the bye laws or rules are made and approved. In the meeting of the general body and that of managing committee it will be desirable if the Sub Divisional Officer concerned attends even after transfer of operation and maintenance is effected. Junior Engineer should attend as a special invitee in all General Body and Managing Committee meetings at least for first two years. They can also request to the Managing Committee to call for urgent meting as and when they feel it necessary.

(Model bye laws for formation of Water User's Association approved by Government vide memo No. 7/30/95-IW dated: 17.11.1998.)

DRAFT MEMORANDUM OF UNDERSTANDING

Memorandum of understanding(Haryana Irrigation Department (ID) and water users Association (WUA) at watercourse RD_____of _____Minor_____Distributory_____Canal_____ _____Irigation scheme.)

1. Draft agreement to be executed between the Chairman or President on behalf of ---------- water users Association at watercourse taking off from _____ Minor _____ of _____ distributor of _____ main canal _____ of Irrigation scheme _____ Tahsil _____ District on

the one side and the Executive Engineer of Haryana Irrigation Department/Command Area Development Authority/Haryana State Minor Irrigation and Tubewell Corporation Lining Division or concerned Division of the Haryana Irrigation Department which ever is the original constructing agency/operational agency of the system on behalf of the Government of Haryana on the other side.

2. OBJECTIVE :-

The main objective of the agreement is to promote effective participation of the farmers in irrigation management so as to achieve appreciable increase in crop production through economic use of available water in the_____ Irrigation scheme and sustainable level of maintenance of the Irrigation Channels before outlets. The memorandum of understanding will provide a written agreement between the Water Users Association and the Irrigation Department on the activities, rights and responsibilities of the two organizations after the turn over of the watercourse below outlet number taking off from Minor of the _____ Irrigation scheme.

3. DEFINITIONS:-

For the purpose of the agreement the following definitions shall be understood:-

*The Water Users Association refers to the Association of farmers as defined in the bye-laws of the Water Users Association sponsored by Haryana Irrigation Department/HSMITC/CADA.

- The Haryana Irrigation Department(ID) refers to the Irrigation Department of Haryana(H.I.D).
- The Irrigation Act means the Haryana Canal & Drainage Act,1974 .
- The Chairman refers to the Chairman or President of the_____watercourse.
- The Executive Engineer refers to the Executive Engineer of Division of Irrigation Department of Haryana.
- The water course refers to the water supply channels constructed for conveyaning water from outlet _____of minor _____

distributary for the purpose of supplying Irrigation water to the individual farmer's field & shall includes all structures & linings.

4. THE RULES

The rules in respect of the water users Association & the Haryana Irrigation Deptt., will be as under:-

- Out of the total number of farmers in the command of the water courses,minimum 51% shall be the members of the Water Users Association at the signing of this Memorandum of understanding & the Water users Association shall get registered as body corporate, under Cooperative Act or as a society Act of the State.

- On turn over, the Water Users Association shall maintain the water course field channels, field drains and the structures under the jurisdiction.

- The Water Users Association shall release water at the offtake of the water course according to the operation plan.

4. RIGHTS AND RESPONSIBILITIES

A. Rights

i) Irrigation Department:

- Operation & control of the outlet of head of watercourse.

- Preparing operations & maintenance plan, roster of distributories & exercising, powers vested in cnal officers as per the Haryana Canal & Drainage Act, 1974 in respect of implementation of warabandi.

- Suggesting improvement in operations & maintenance below the outlet for efficient & equitable distribution of water to all the farmers.

- Reducing/increasing the water releases, proportionately as per the availability of water in the system.

- Levying irrigation Fees as fixed by the Government of Haryana.

ii) Water User Association

- The Water Users Association will have the ownership, jointly with the farmers, of all the works under the water course including lining & structures.
- It shall have the right to improve the water course,extend lining , and construct bridges.
- It shall exploit of ground water from the command for augmentingIrrigation, increasing irrigated areas on community basis as per rules.
- It shall have the right to request for training, deemed necessary by them so as to carry out the operation & maintenance responsibility more efficiently.
- It shall have the right for information on irrigation related aspects such as water availability schedules for water supply.
- It shall have the right for information on irrigation related aspects such as water availability schedules for water supply.
- It shall be right to levy fees, service charges to the farmers to meet maintenance & repair cost of water courses & management of the society.

B. RESPONSIBILITIES

i) Irrigation Department:-

- Providing, releasing water as per the share of water,proportional to the command under the watercourse.
- Maintaining the main canal, branch distributories and minors so as to allow designed flow at the outlet.
- Promptly informing the Water Users Association on positionof water availabilityand other irrigation related aspects.
- Providing necessary training for the Water Users Association and farmers.
- Rehabilitate damaged watercourses in case of anynatural calamity.

ii) Water User's Association:-

- Implementing operation & maintenance plan below outlets.
- Providing/supplying water equitablytoall the farmers in proportionate totheir holdings as per the warabandi schedules in vogue.
- Collecting contributions or fees from thefarmers for meeting the maintenance and repair costs of water course and management costs of the Water User's Association.
- Maintaining the watercourse including all earthwork,lining, structures so as to allow full discharge from head to tails per design.
- Maintaining accounts for the contributions, service charges collected from the farmers and getting the same audited as per the rules prescribed by the Registrar of the Co-operative Societies.

6. PROCEDURES FOR THE TURNOVER:

The HSMITC or CADA on behalf of Irrigation Department shall prepare an inventory of the works under the watercourse showing lengths of lined/unlined channels, structures, crossing, turnouts, division boxes, map showing the command, list of farmers, area which can be irrigated of each farmer and time allocated to each farmer as per warabandi schedules.

7. JOINT INSPECTION:

- The work shall be jointly inspected by the Irrigation/HSMITC/CADA and the representatives of the Water User's Association.
- The Water Use's Association identify any deficiencies , commissions substandard or incomplete works.
- The works as listed in the joint inspection shall be rectified, improved, completed by HSMITC/CADA.

8. HYDRAULIC TEST:

The Irrigation Department HSMITC/CADA shall organize hydraulic test of the watercourse to ensure and exhibit that the designed discharge can pass up to tail end and then prepare final/record plans of all the works as executed.

9. **TURNOVER**

- The Irrigation Department/HSMITC/CADA shall hand over the physical charge of the watercourse along with all the relevant record as listed.

- The Chairman and Executive Engineer shall sign the handing over/taking over at the space provided at the end of this Memorandum of Understanding.

- The Water User's Association will assume entire responsibility of operation & maintenance of the watercourse from the date of turnover.

WITNESS

1.	Signature	Signature
	Date	Date
	Name_____	for and on behalf of water
	Address_____	Users Association.
2.	Signature	Signature
	Date	Date
	Name _____	
	Address_____	
3.	Signature	Signature
	Date	Date
	Name_____	for and on behalf of the
	Address_____	Governor of Haryana.

Draft Memorandum of Understanding for formation of Water User's

Association Approved by Govt. vide memo No. 7/30/95-1W dated: 17.11.1998.

XIII Cropping Pattern and water requirement of major crops:

'Rabi' and 'Kharif' are the principle cropping seasons of the State, the former being the major one. The principle crops grown in' Rabi' are wheat, gram,

rapeseed and mustard. The main ' Kharif crops are paddy, bajra, pulses, cotton and jowar. Sugarcane is perennial crop is also sown in some of the districts.

The irrigation requirement of various crops as recommended by CCS Haryana Agricultural University, Hisar is given in the following table :-

IRRIGATION REQUIREMENT OF CROPS

Sr. No.	Crop	No. of Irrigation	Depth of Irrigation (cms)	Total Irrigation requirement ** (cms)
1	2	3	4	5
1.	Paddy	20-25	5-6	120-140***
2.	Maize	1*	8	25-30
		3	6	
3.	Pearlmillet	1*	8	15-20
		2	6	
4.	Jowar	1*	8	25-30
		3	6	
5	Cotton	1*	8	30-35
		4	6	
6.	Groundnut	1*	8	25-30
		3	6	
7.	Arhar	1*	8	25-30
		3	6	
8.	Kharif pulses Moong/ Urd/Cowpea	1*	8	15-20
		1	6	
9.	Wheat (Tall)	1*	8	25-30
		3	6	
10.	Wheat (Dwarf)	1*	6	35-40
		5	6	
11.	Barley	1*	8	20
		2	6	

12.	Gram	1*	8	15-20
		1	6	
13.	Peas	1*	8	20
		2	6	
14	Lentil	1*	8	20
		2	6	
15.	Oilseeds, Raya & Sarson	1*	8	20
		2	6	
16.	Oats	1*	8	30-35
		4	6	
17.	Barseem	1*	6	50-55
		7	5	
		3	6	
10	Sugarcane *	11-16	8-10	140-150
19.	Potato*	7-9	3-4	25-30

* Pre sowing irrigation

** It excludes rainfall which is 5-6 cms during ' rabi' and 30-40 cms during ' Kharif" season, but including pre-sowing irrigation.

*** Includes 25-30 cms extra water needed for puddling operation.

IMPACT OF AGRICULTURE PRODUCTION

The economy of Haryana has been primarily an agrarian. The State Government laid major emphasis on increasing agricultural production to meet the growing need with regard to food, oil and fibre for the population increasing at an alarming rate. Earlier our farmers had to depend upon rains and traditional method of cultivation. The situation changed drastically over the next four decades due to assured supply of water as well as the use of fertilizers, adopting of modern methods of management of agriculture were adopted tractors and combines etc. With the introduction of high yielding varieties of wheat introduced on the large scale during the year 1966-67, production of foodgrains touched new heights and production of wheat during the last two and a half decades had increased about nine times in the state. It rose from 1.06 million tone to 9.06 million its production. As regard to rice, achievement were exciting which has gone up from 0.22 million tonnes in 1966 to 2.79 million tonnes during 2003-2004 which is more than 13 times . As a result of this remarkable achievement in wheat and rice production, the size of Haryana share in central pool basket increased year after year. The yield of rice per hectare has increased from 1166 kgm/hect. in 1966-67 to about 2749 kgm/ hect 2003-2004. Similarly the yield of wheat has increased from 1425 kgm/hect in 1966-67 to 3935 kgm/hectare in 2003-04.

The total foodgrain production has steeply increased. It has risen from 2.59 million tonnes in 1966 to 13.15 million tonnes in 2003-04. Similarly there is an increase in cash crops production in the state. The production of sugarcane has risen from 0.51 million tonnes in 1966-67 to 0.93 million tonnes in 2003-04. The production of oil seeds is estimated at 0.60 million tones in 2003-04 against 92000 tonnes in 1966-67. The production of cotton is likely to be in the order of 1.40 million bales during 2003-04 as against o.30 million bales during 1966-67. Now to give further boost diversification of crops are planned. Sunflower crops are being encouraged. New crops of soyabean and rajmash have also been introduced. At present requirement of irrigation water at 62% intensity is for less than the availability and if full requirement is met the production figures would far be exceeded.

In irrigation sector the impact of a project is gauged in terms of area under irrigation, which is the main objective.It is quite pronounced in a small state like Haryana, which had little development in water sector at the time of its formation in 1966.The table below indicates that the increase in area since Haryana State came into being to the year 2000 has been phenomenal to the extent of 0.846 million hectares or 20.91 lakh acres i.e. 64.58% rise in area under crops.

During the project periods of Gurgaon Canal & Lift Irrigation Schemes and before the start of Haryana Irrigation Project-I, the increase in area has been 0.23 million hectares or 5.68 lakh acres i.e. 17.56%. On completion of three projects i.e. Haryana Irrigation Project-I, Project-II and National Water Management Project in 1993, the increase in area since 1978 was 0.448 million hectares or 11.07 lakh acres i.e. 29.09% over 1978 figures, which means this gain in area was on account of these projects. During the project period of HWRCP (1994-2000), the benefit is clearly reflected in increase in area to the tune of 0.168 million hectares or 4.15 lakh acres i.e. 8.45%.

Comparison of Area Irrigated over Major Projects.

Area in M.Ha

Year	Total Area Irrigated	Increase in Area Over Previous Year.	Percentage Increase	Increase in Area Over Year 1966	Commulative percentage increase.
Haryana State Formed 1966-67	1.31	0	0	0	0
Modernization Projects started 1977-78	1.54	0.23	17.56%	0.23	17.56%
Launch of HWRCP 1994-95	1.988	0.448	29.09%	0.678	51.76%
Latest Irrigation Figures 1999-2000	2.156	0.168	8.45%	0.846	64.58%

Area in Hectares

Year	Bhakra Command	Yamuna Command	Lift Command	Total
1966-67	791484	519336	0	1310822
1967-68	828602	542612	0	1372214
1968-69	773138	518964	0	1292102
1969-70	881703	602564	0	1484267
1970-71	830916	608407	0	1437323
1971-72	860928	832869	4336	1498133
1972-73	882987	624507	11278	1518862
1973-74	898317	707827	19806	1625950
1974-75	787655	702275	22528	1512458
1975-76	916444	749444	28260	1694148
1976-77	851050	657599	267131	1535380
1977-78	863908	648753	26942	1539603
1978-79	928111	697130	41848	1667095
1979-80	940467	692637	39988	1672672
1980-81	1030213	740640	47682	1818535
1981-82	1077801	759991	54183	1891955
1982-83	1083390	745513	35799	1864702
1983-84	1105416	758428	40606	1904450
1984-85	969245	714366	31845	1715456
1985-86	1116140	783240	46041	1945421

1986-87	1150615	804800	60653	2016068
1987-88	1084012	745446	62810	1892268
1988-89	1118655	786030	65244	1969929
1989-90	1142166	808020	84112	2034298
1990-91	1145421	789038	46835	1581324
1991-92	1182231	778054	60076	2020368
1992-93	1200737	803579	45414	2049730
1993-94	1193585	788382	50529	2026496
1994-95	1189938	746687	51674	1987699
1995-96	1209265	730295	58915	1996475
1996-97	1290150	800833	70511	2161500
1997-98	1299993	753010	47553	2160559
1998-99	1253479	787000	58919	2098578
1999-2000	1247509	8334030	70599	10158538
2000-01	1245568	824037	77336	2146941
2001-02	1205447	785874	62500	2053821

Irrigated area in hectares

Year	Bhakra Command	Yamuna Comman	Agra Canal Command	Lift Command	Total
2002-03	1226681	794717	31000	63600	2115998
2003-04	1205744	836350	30000	63000	2135094

As a result of development of irrigation in Haryana, the agriculture scenario has changed and agriculture produced has been improved.

Some relevant irrigation statistics in table A and table B and irrigation map have been given in the end of the Chapter.

Future Scenario

It is abundantly clear that the Haryana, a land locked state does not have sufficient perennial source of surface water and has to depend upon inter-state allocation as per various agreements/MOUs. Demand of water from various sectors is for more than the state resources surface/sub surface and the Haryanvis are langushing for the legitimate share of about 2 MAF of Ravi Beas water from controversial SYL Canal and about 1 MAF of the Yamuna waters due to non construction of storages across the river in state Uttranchal and U.P.The tirade of situation is further aggravated due to vagaries of nature envisaging availability of major part of rain fall in monsoon season for a limited period of hardly 90 days to 100 days in a year and that too confined to further very short durations. Thus the state is passing through a state of utmost stress and the conservation of water attains paramount importance besides there is need to create awareness among end users to realize the extent of water scarcity and resort to its conservation. This consciousness can be created through education, incentives and disincentives.

An immediate plan will be developed for consrvation of water through actions such as promotion of less water-consuming crops and a major shift in cropping pattern, conjunctive use of waters, artificial recharge of groundwater, rainwater harvesting, small storage dams in lower Shivalik areas to store rainwater during rainy season etc.

The state has done substantial development in this sector during previous five-year plans. In order to realise maximum benefits from investments in irrigation sector, efficient management,scientifically economical use and conservation of water is essential. The qualitative improvement in management of existing resources is required and following actions need to be taken.

- Improvement in conveyance management so as to have optimum use of precious irrigation water.
- Judicious lining of canal network to reduce seepage losses.
- Control and check of unauthorised irrigation.
- Appropriate use of cropping pattern suitable for the area & also depending upon availabilityof various imputs.

- Equitable distribution of canal water amongst stakeholders included in one outlet/command/different areas.
- Adoption of improved irrigation and agriculture practices with emphasis on optimum use of irrigation water.
- Involvement of shareholders in this sector by making use of the forum of Water Users Associations.
- Crop diversification for maximum return per unit of water.

In the foregoing backdrop the state is trying to take up the activities of top most agenda like recharging of groundwater, rain water harvesting, conjuctive use of water and recycling of the water. The state has already made a start in this direction by taking up the following notable projects :

- Extention of Dadupur Nalvi Project physically catering to the sweet water belt of Eastern Haryana falling in the districts of Yanunanagar, Kurukshetra & Ambala, serving Kharif Irrigation in about 15000 hectares, falling in a cross area of 75000 hectares, which remained devoid of canal Irrigation in the past.
- Artificial recharging to groundwater & rain water harvesting project in Sweet water zone by constructing recharge shafts.
- Conjuctive use of saline and canal water in WJC command .
- Modernisation/Rehabilitation of canal net-work through AIBP(Accelerated Irrigation Benefit Program).
- Improving irrigation in canal commands through NABARD aided projects. Besides constructing schemes for flood control, protection and Management.

The state has taken an advantage for long term measures/visions as guided by the National Water Policy of 1987 (amended in the year 2002) and the State Water Policy has been drafted keeping in view its own priorities, physical conditions and limitations. The future scenario is being planned as per the following objectives in different areas.

Groundwater Management

An extensive study and analysis of groundwater data is essential. Actual estimates of total groundwater recharge and availability will be used for short term planning & consequently updated frequently. The rainfall-recharge relationships could be evaluated for small representative basins/areas and not necessarily for the whole state, since it involves more accurate monitoring & assessments.

The state has three organizations namely the Central Ground Water Board (CGWB), and the Ground Water Cell (GWC) and Irrigation Department which are involved in the hydro-geological data collection, mainly the groundwater levels and the groundwater sampling for chemical analyses. The need is to have a close coordination among these three units to avoid duplication of efforts and to share data and plan a unified front for groundwater management.

The monitoring of quality of groundwater would be taken up by these organizations on top priority. In order to check the drastically depleting groundwater level in sweet water zones, these organizations shall form a common front to come up with practical & sustainable solutions. Legislative action required for effective implementation of such measures will also be jointly drafted by these organizations.

Drought Management:

The state has areas, which are prone to drought, as these areas depend upon rain and in case of failure of rain, the drought conditions do arise.The vulnerability of this area needs to be reduced by measures such as, soil-moisture conservation, rainwater harvesting, artificial recharge, groundwter development etc.

In case of drought years,the surface water as well as groundwter availability is bound to reduce. But in such years, limited over-exploitation of groundwater can be allowed, as it would be compensated in good years when groundwater recharge would be higher.Conjunctive use of surface and ground waters will enable reduction of water deficits in drought years.

Rainwater harvesting will play a significant role in drought prone areas.The drinking water and cooking needs can be easily met with through

traditional rainwater harvesting techniques.An action plan will be developed for a mass movement for water harvesting.

Thus, the drought management would be based on the following principles:-

- Prepare & implement action plan to develop a mass movement for rainwater harvesting.
- Assess the stored water availability to anticipate drought condition.
- Prepare cropping pattern & crop areas based on assessed water availability.
- Educate people to ensure judicious and conjunctiveuse of water.
- Encourage farmers to have fodder crops in adequate areas for sustaining the livestock population .
- Reserve water for drinking purposes in surface water storage and arrange for its transportation to areas where the groundwater quality is expected to be unfit for drinking.

Environmental sustainabilityof development of water resources:

Environmental allocation ofwater has been given the top priority, as it is essential for ecological balance and to retain sustainability of rivers and all life form, which is dependent upon it.

Development of water resources will be planned in such a way that the development plans are environment friendly. This can be ensured through a sound environmental & social institutional infrastruture in water sector.The environmental issues and impact of a water resource project on environment would be identified and preventive as well as mitigative measures planned before hand in the shape of an Environment Management Plan. The state has alreadyadopted an in-house environmental policy for Haryana Irrigation Department, which will be strictly enforced to avoid environmental degradation.

Drinking Water:

Drinking water for humans and animals also ranks at the top after environmnetal allocation. It will be ensured that all urban and rural drinking water

supply schemes are given priority over all other uses. Similarly, ponds for animals will also get the same priority.

Flood control, protection & management:

Flood control and management can be divided into four, mutually non-exclusive, main categories of structural as well as non-structural measures that may all be implemented in a river basin. The four main categories referred to above may be summarized as follows:

- Flood Protection Works on the river itself, aimed at containing flood flows (up to a certain frequency) within the river course.These works, of a 'structural' nature, comprise construction of structures, or works on the river itself.

- Flood mitigation works in the catchment.These works aim at reducing flood peaks by small storage dams, maintaining (or increasing) rainfall retention & reducing erosion in the catchment through soil conservation methods.

- Damage reduction works in the flood plain.Works under this categoryinclude drainage systems, flood zoning, land-use restrictions, flood proofing: and

- Flood warning, evacuation & emergency relief. As a result, there is a need for a masterplan for a comprehensive flood control, protection and management, instead of isolated efforts for various pockets.

Drainage & Problems of Water Logging and Salinity

Haryana is faced by high & rising groundwater levels and salinity.The situation raises grave concern about the future of Haryana's arable lands whose productive potential is jeopardized by water logging and salinity.

Rise in groundwater levels can be attributed to factors such as infiltration of excess rainfall & of accumulated surface runoff, deep percolation losses from irrigation & seepage losses from conveyance canals.These are prevalent in other parts of the world also but do not necessarily result in water logging and salinity. Haryana has peculiar geological constraints, particularly in the central part of the state, where the inflow exceeds outflow resulting in rise in water table.

Therefore, it is essential to have long-term plan to tackle the problems of water logging & salinity by horizontal & vertical drainage techniques. In a 'closed basin' environment, such as Haryana's depressed bowl-shaped area, salinity of groundwater willinevitably continue to increase in the long run and exceed the tolerance limits of currently grown crops. A radical switch to salt-tolerant crops may not be viable in the foreseable future and therefore a sustainable solution for the long term requires the removal of salts in one form or another before the quality of irrigation water reaches the upper tolerable salinity limit.This would be achieved by continuing research and piloting efforts and better water mainagement practices.

Participatory Irrigation management (PIM).

Haryana has launched PIM programme at watercourse i.e. below outlet level statewide.This programme is being coordinated by Agriculture Department & Haryana Irrigation Research & Management Institute (HIRMI), invariably depends upon theextent of participation of stakeholders will help in meeting of withthis objective substantially. Therefore, this programme will be closely monitored and if the response to the present launch is encouraging, it will be further enlarged to cover minors for turning over the management.

Rehabilitation & Resetlement & other Social issues.

The water resources sector has extensive effect on social life and its projects have a number of social issues such as land acquisition, rehabilitation & resettlement, participation, stakeholders, poor & disadvantaged groups, backward classes, scheduled classes, landless etc., which need proper planning and remedial measures in case of adverse effect of the project.

Rehabilitation and resettlement of a water resources project is a crucial aspect as the project may have impact on human lives, settlements, occupations, economic and other aspects.The national policy on Rehabilitation and Resettlement of Project displaced and project affected persons will be strictly followed.

Management Information System (MIS)

There is an urgent need to create a well-developed, unified database and management information system for the water resources sector, which can be

easily accessible by toplanners and users. A database has been created under the State Water Plan by collecting enormous information from various sources regarding availability, demand and uses of water, meteorology and hydro-geology etc. This database will be regularly updated and enlarged to cover other related aspects/fields. A study for modernization of Communication System and establishment of a sound Management Information System is the need of the hour, work on which has been initiated under the Haryana WRCP, will be integrated and further developed and strengthened to cover all stakeholder agencies.

Sustainability of water resources sector:

In order to make the water sector self-sustainable, water rates to make the charges adequate to cover the cost of operation & maintenance of the system will be rationalized. Moreover, the water rates will be such as to convey the scarcity value of the resources and to foster the motivation for its economical use. Incentives for use of water-saving devices such as sprinkler irrigation & drip irrigation will be provided in the structure of rates.

Ecological health and recreation:

All water resources projects will give due regard to the ecological health and other needs for which adequate provision will be made on priority basis. The quality of water, its protection against pollution and its sfeguard will be the key concern. The Environmental policy, adopted by Government of Haryana will be a key instrument in this regard.

Mini-hydel Projects

The state has a shortfall in power sector while there is considerable scope for hydel power generation on main canals. This feasibilitywill be further explored and the potential shall be exploited.

Private sector participation

Feasibility of participation of private sector in various aspects of water resources planning, development, management for diverse use needs tobe explored.This will help in some innovative ideas, generation of financialresources,

introduction of corporate management for efficiency in this sector. Simultaneously, Haryana will also examine the prospects of corporatization of water srvices on the jurisdictionaland/or functional considerations, while the role of the government agencies (like H.I.D.) will primarily be limited to planning, regulation, allocation and inter-state matters.

Institutional Strengthening:

Haryana Irrigation Department is traditionally a department of civil engineering, with a focus on construction activities.This aspect has been completed and there is little scope for the growth in this sector.The time has come for a change in focus from that of regulatory and controlling body to a facilitator and service provider.Therefore, institutional strengthening totake cater to issues such as social, environment, agriculture, agronomic, economics etc.,should be taken up . this will be achieved by exploring the feasibility of sharing of human resources withother departments. Integration of certain specialist jobs into water resources department shallbe explored and a comprehensive plan on this issue will be framed.

Research & training:

The research & training are an integral part of an organization and there is a tremendous amount of shift in focus on water sector world over. Haryana Irrigation Department has an independent institute i.e. Haryana Irrigation Research & Management Institute (HIRMI), which is currentlycatering to the training needs of this sector.The institution of HIRMI will be strengthened with research work and study of latest techniques in the field of irrigation. Effort will be made to have training programmes on every aspect of water sector.

Conclusion:

Haryana Irrigation Department is striding in accordance with the laid down policies for not only providing food for the country's population but also for ensuring their prosperity.

Table – A
Net Area under Irrigation in Haryana

(000 Hectares)

District	Net area irrigated						
	Government canals	Tanks	Wells	Tubewells	Other sources	Total	Percentage to net area sown
2	3	4	5	6	7	8	9
1966-67	991	4	289	-	9	1,293	37.8
1970-71	952	1	574	-	5	1,532	43.0
1975-76	1,036	1	31	682	4	1,754	48.4
1980-81	1,161	(a)	26	941	6	2,134	59.2
1985-86	1,191	1	10	1,042	4	2,248	62.2
1990-91	1,337	1	(a)	1,248	14	2,600	72.7
1995-96	1,375	1	(a)	1,352	32	2,760	77.0
1998-99	1,433	1	(a)	1,395	13	2,842	78.3
1999-00	1,441	1	(a)	1,432	14	2,888	81.3
2000-01*	1,476	1	(a)	1,467	14	2,958	83.9
Ambala	14	1	-	97	1	113	90.4
Panchkula	-	-	(a)	13	2	15	45.5
Yamunanagar	3	-	-	106	-	109	87.2
Kurukshetra	27	-	-	122	-	149	99.3
Kaithal	99	-	-	86	11	196	99.5
Karnal	70	-	-	117	-	187	98.9
Panipat	28	-	-	64	-	92	98.9
Sonipat	83	-	-	92	-	175	100.0
Rohtak	101	-	(a)	25	-	126	89.4
Jhajjar	71	-	-	49	-	120	82.2
Faridabad	25	-	-	97	-	122	76.3
Gurgaon	16	-	-	64	-	80	42.6
Rewari	2	-	-	100	-	102	82.9
Mahendragarh	3	-	-	117	-	120	78.4
Bhiwani	135	-	-	85	-	220	55.0
Jind	133	-	-	103	-	236	94.4
Hisar	244	-	-	9	-	253	86.9
Fatehabad	136	-	-	74	-	210	96.3
Sirsa	286	-	-	47	-	333	90.2

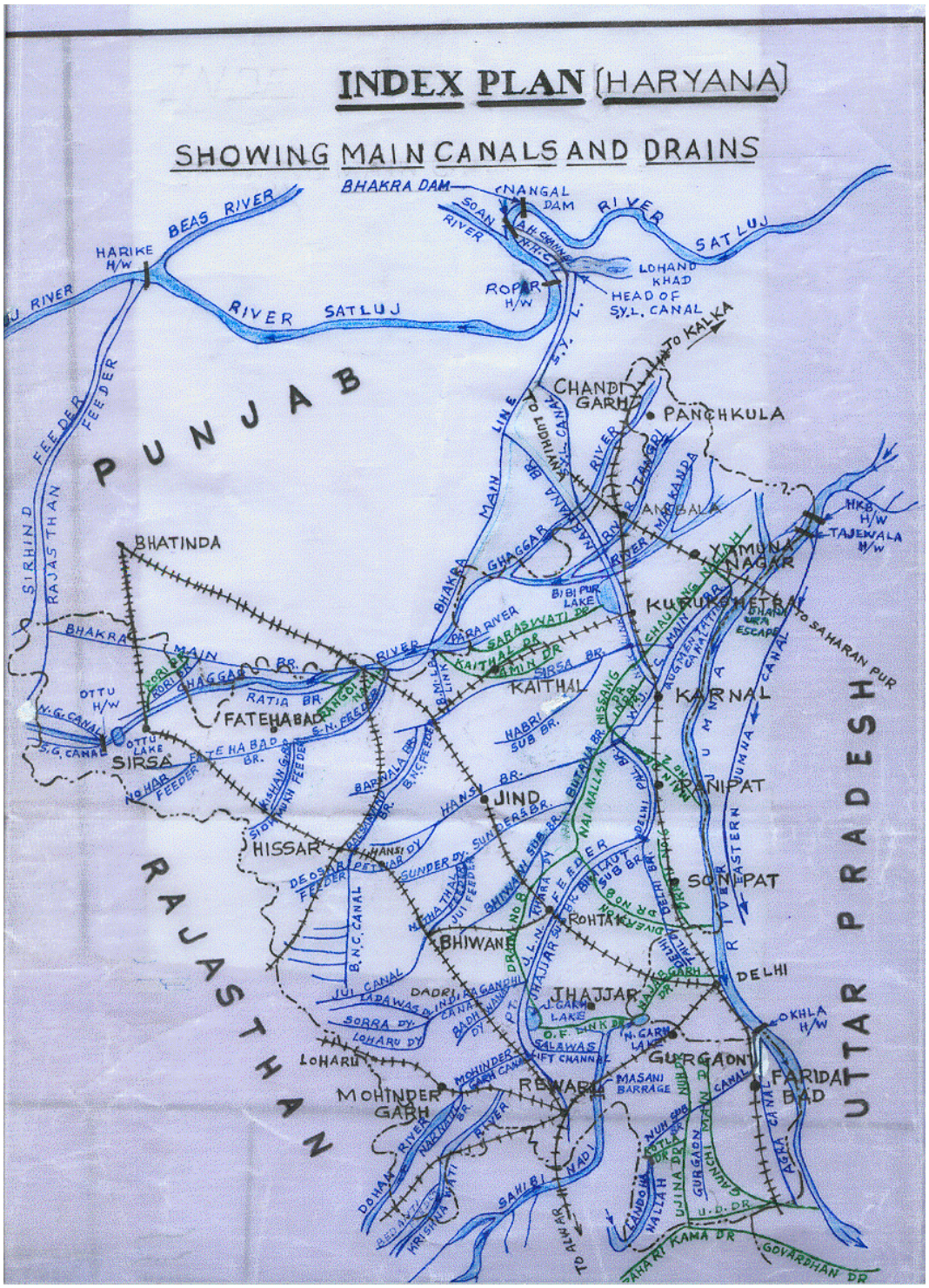
(a) Means less than 500 hecates. *Provisional

Table – B

Gross Area Irrigated and Gross Cropped Area by Districts in Haryana during 2000-01

(000 Hectares

District	Gross Irrigated Area	Percentage to Sate Total	Percentage of Gross Area Irrigated to Total Cropped Area	Irrigation Intensiry (Gross Irrigated Area X 100-Net Irrigated Area)
1	2	3	4	5
Ambala	176	3.4	88.0	155.8
Panchkula	18	0.3	46.2	120.0
Yamunanagar	171	3.3	89.5	156.0
Kurukshetra	262	5.0	100.0	175.8
Kaithal	361	6.9	99.4	184.2
Karnal	377	7.2	99.5	201.6
Panipat	195	3.7	99.5	212.0
Sonipat	277	5.3	97.9	158.3
Rohtak	182	3.5	84.7	144.4
Jhajjar	186	3.6	80.9	155.0
Faridabad	227	4.3	85.7	186.1
Gurgaon	192	3.7	64.0	240.0
Rewari	142	2.7	75.1	139.2
Mahendragarh	147	2.8	55.1	122.5
Bhiwani	377	7.2	55.0	171.4
Jind	433	8.3	93.5	183.5
Hisar	509	9.8	92.2	201.2
Fatehabad	400	7.7	98.0	190.5
Sirsa	591	11.3	94.3	177.5
Total	5,223	100.0	85.4	176.6


INDEX PLAN (HARYANA)
SHOWING MAIN CANALS AND DRAINS
BHAKRA DAM
NANGAL DAM
BEAS RIVER
SOAN RIVER
RIVER SATLUJ
HARIKE H/W
ROPAR H/W
LOHAND KHAD
HEAD OF S.Y.L. CANAL
S.Y.L.
TO KALKA
CHANDI GARH
PANCHKULA
PUNJAB
SIRHIND FEEDER
RAJASTHAN FEEDER
MAIN LINE
TO LUDHIANA
AMBALA
YAMUNA NAGAR
HKB H/W
TAJEWALA H/W
BHATINDA
BHAKRA MAIN
GHAGGAR BR.
BHAKRA RIVER
SARASWATI DR
KAITHAL BR.
KAITHAL
KURUKSHETRA
TO SAHARAN PUR
KARNAL
OTTU H/W
N.G. CANAL
FATEHABAD
RATIA BR.
S.N. FEEDER
S.G. CANAL
SIRSA
OTTU LAKE
FATEHABAD BR.
NOHAR FEEDER
HABRI SUB BR.
PANIPAT
JIND
HISSAR
HANSI BR.
SUNDER BR.
DEOSAR FEEDER
PETWAR DY.
SONIPAT
ROHTAK
BHIWANI
B.N.C. CANAL
JUI CANAL
DADRI
INDIRA GANDHI CANAL
JHAJJAR
DELHI
OKHLA H/W
LOHARU
SORRA DY.
LOHARU DY.
GURGAON
FARIDABAD
MOHINDER GARH
REWARI
MASANI BARRAGE
RIVER NARNAUL
DOHAN
SAHIBI NADI
TO ALWAR
GOVARDHAN DR
UTTAR PRADESH
RAJASTHAN