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Water Resources of J & K : Judicious Utilization and Management for Irrigated Agriculture

BY

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WATER RESOURCES OF J & K :
JUDICIOUS UTILIZATION AND MANAGEMENT FOR IRRIGATED AGRICULTURE

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INTRODUCTION

Indian geographical land area is just a little over 2% of the geographical land area of the world. But, India possesses 7% of all the utilizable flow of all river basins of the world. The state of Jammu & Kashmir is still luckier, for the ratio of its geographical area (including area illegally occupied by Pakistan & China) to that of the country is 0.0678, whereas the corresponding ratio of the utilizable surface water is about the same (0.0668); if this illegally occupied area is excluded, the state possesses more than twice the proportion of water resources to land as that of the country.

Over the past eighty centuries or so, our forefathers have succeeded in bringing nearly 140 mha of Indian land from the natural ecosystem to agriculture. Since independence, we have added another 23 mha to the net sown area, bringing it to a spectacular 163 mha or 51% of our land. No other big country has been so fortunate in this regard. India's actual cultivated area is more than 10% of that of the whole world. The state of J&K, with its rich and diverse vegetation and livestock resources, special Horticultural and other crops, has a unique place in the agricultural map of India.

Water resources of J&K, extent of their development for the purpose of irrigation and the rate of utilization of the total potential so created up to date need a thorough review as a pre-requisite to understand the problems of water management on farmer's fields and attempt judicious management of "available " land and water resources through optimization of their use for meeting the ever increasing demand for food, fodder, timber, fuel, fruit and fibre.

This paper envisages to

a) summarize the latest information on the irrigation potential created, delivered and actually utilized as well as future prospects of further development of both surface and ground water potential in the state;

b) highlight the actual problems of irrigation water management in command areas of sub-tropical plains of Jammu region;

c) describe the recent efforts of WMRC, SKUAST towards on-farm water Management Research in selected distributory command of Tawi canal (Lift Irrigation scheme) of RTIC and the extent of success, and

d) Suggest future prospects of endeavours towards optimization of available land, water and socio-economic resources to bridge the gap between potential created and utilized as also to maximize agricultural production, productivity and profitability per unit water used, prioritising the tasks for the attention of the state government.

Water Resources and Current Utilization Pattern in J&K

Jammu & Kashmir, the Northern most state, has altitude variations from >300 m to 8400 m above msl, with the following four main agro-climatic divisions:

i) Low - altitude sub-tropical zone
ii) Mid to high - altitude intermediate zone (sub tropical- temperate transition)
iii) Mid to high - altitude Temperate zone.
iv) Cold arid zone.

The state is located almost in the middle of three climatic regimes of Asia--weak monsoon zone of Punjab, vast arid plateau of Tibet and the Eastern most limits of Mediterranean climatic region. Five broad macro-climatic zones can be differentiated as sub-tropical, valley-temperate, intermediate, dry temperate and cold arid.

Salient Features of Agricultural Land Use And Water Related Resources of J&K

a.	Geographical area (Mha) (including area illegally held by Pakistan & China)	- 22.2236
b.	Total reporting area (Mha), as per village papers (includes that maintained by Forest deptt.)	- 2.416
c.	Under Forest (Mha)	- 0.658
d.	Not available for cultivation (Mha)	- 0.583
e.	Other uncultivated land excluding fallows (Mha)	- 0.339
f.	Fallows, current follows (Mha)	- 0.103
g.	Net area sown (Mha)	- 0.734
h.	Total cropped area (Gross sown)	- 1,055,840 ha
i.	Gross area irrigated	- 429,000 ha
j.	Net area irrigated	- 305,260 ha
k.	Annual Normal Rainfall	- 1,027 mm

Inland Water Resources of Various Types :

Rivers and canals (length in Kms)	- 27,781
Reservoirs	- 7,000ha
Tanks and ponds	- 17,000ha
Oxbow lakes & derelict water	- 6,000ha

Water Resources Potential of Indus River Basin (up to border) :

Average Annual potential in the river	- 73.31 Km^3
Estimated utilizable surface water	- 46.00 Km^3
Use of surface water up to (1989-90)	- 17.34 Km^3/year

Ground water potential in J&K state :

Utilizable resource for irrigation	- 3.74 Km^3/years
Net draft (1989-90)	- 17.34 km^3/year

Ultimate irrigation potential of J&K :

Major & medium irrigation -surface water	- 2,50,00 ha
Minor irrigation - Surface water	- 4,00,00 ha
- Ground water	- 1,50,000 ha

Cropwise gross irrigated area, ha (A) and percentage of irrigated area to total area (B) under each of principal crops (1990-91) :

	Rice	Wheat	Total cereals	Total food grains	Oil seeds	Sugarcane	Cotton	All crops
A.	250,000	58,00	3,35,000	341,000	-	<500	<500	4,36,000
B.	91.2	23.3	39.3	38.1	69.1	-	-	40.9

Source-wise net & gross area irrigated during 1990-91 (ha) :

Source :	Canals	Tanks	Wells	Other	Total
Net :	2,78,580	1980	1330	16,200	2,98,090
Gross :	4,07,000	2000	2000	25,000	4,36,000

The total multi source utilization (Net area irrigated) and the canal irrigation component reached figures of 3,12,840 ha & 2,89,520 ha respectively during 1991- 1992, but came down to 3,05,260 ha and 284,340 ha respectively during 1994-95, owing to utilization of canal systems, poor maintenance, and other operational problems.

Against this backdrop, the status of development of surface water resources in the state deserve a fresh look. The irrigation potential created and utilized up to 1995-96, province-wise and sector-wise are summarized as follow :

Province/sector :	CCA(ha)	Potential created (ha) until 1995-96	Potential utilized (ha) in 1995-96
Jammu province			
Major / medium	1,16739	1,68,342	1,18,374
Minor	33,564	44,083	24,850
		+ 9,490 (T.W.I)	+ 9,490 (T.W.I.)
Kashmir province (6 districts)			
Medium	52,224	16,910	14,547
Minor		1,11,275	99,624
Leh District	11,500++	16,925	15,668
Kargil District	10,000++	10,284	10,284
Total		3,77,309	2,92,837

It is evident from the above data that major/medium irrigation sector caters predominantly to the irrigated belt in Jammu province while as minor irrigation forms the backbone of agricultural economy in the valley. In addition, per cent utilization of the potential created in Kashmir valley has been very high (86 to 89.5%); 100% in Leh and Kargil, but 55% to 70% in Jammu province.

Low altitude sub-tropical zone of the state happens to possess maximum potential for agricultural crops by virtue of its climate (round the year cropping season, thermal regime) natural bio-diversity and rich soil endowments. There are two major irrigation projects in existence in the province, both of which are in this zone - Ranbir canal (1905) on river. Chenab, the largest irrigation system in the state and the Ravi-Tawi Irrigation complex (with its third phase completed by 1991-92). In addition, there are seven more medium irrigation systems in Jammu province, existent at different phases, Salient features of there are provided in Table 1.

It is clear that except in case of Ranbir canal and Kathua canal, utilization of the potential created is poor. The newly commissioned / partially commissioned schemes (Ranjan, Rajal) could achieve higher utilization through CAD programme activities in the next few years. But, in the Ravi-Tawi canal system, overall utilization is less than 50% of the potential created (54% in case of Tawi canal and 45% in Ravi canal schemes), owing to constraints on power supply to run the lift stations, variable flow levels in river Tawi and shift in cropping patterns by farmers (paddy cultivation) on preferential basis) in absence of a sound mechanism for equitable distribution of available water which is not only jeopardizing the utilization scenario substantially but also leading to ills of non judicious irrigation in the form of more land getting water logged. Even the utilization of potential created in the minor irrigation scope in six districts of Jammu provide stands only at 56.4% (of 44083 ha).

On the whole, the extent of development of surface water resources in the state appears to be encouraging, particularly in view of the terrain conditions and other restrictions like the Indus water treaty. In order to bridge the gap between irrigation potential created and utilized, the Command Area Development framework was conceived in the form of formulation of proper approach for judicious management of water involving cropping strategies to maximize production output of the given inputs including water and to ensure better, safe and productive use of land resources. This approach should be built into the total strategy for developing irrigation projects, i.e. limitation of action for development of areas forming part of proposed command that stands commissioned should be made side by side with completion of irrigation projects. In the state of J&K, so far, the central committee on CAD has approved only one command area development projects of Jammu Division namely Ravi-Tawi command Area, but recently included Ranjan & Rajal commands also into its activities.

The main thrust of CAD activities has been on construction of water distribution channels, land levelling, land development, scheduling of water and regulation of water supply, laying of adaptive trials for demonstrating water use efficient crop patterns, conjunctive use of surface and ground water, reclaimation of water logged lands through drainage systems and anti water logging operations to ensure maximum utilization of potential created. The rise in ground water levels due to natural precipitation and canal irrigation has already led to water logged conditions in at least about 4000 ha of the Ravi-Tawi command. Thus, conjunctive use of ground water to supplement canal irrigation is

the only solution both to lower the water table of water logged patches as well as to provide irrigation to lands in tail end of command receiving far less water then its due share.

The CAD agency in Ravi Tawi command did excellent work initially in construction of distribution channels, land levelling and development. However, it has had little success in ensuring equitable distribution and water sharing through "wara bandi" or organizing disciplined utilization of irrigation water through forming water users' associations. Although some adaptive trials / demonstrations on the judicial methods of irrigation water management & scheduling are in progress, the impact has so far been peripheral and nominal. Thus Water Management Research Centre (WMRC), SKUAST, Jammu (Centre of AICRP on Water Management) initiated the On Farm Water Management Research Project (OFWMR) in a selected distributory command (D-3) on Tawi lift irrigation scheme of RTIC, in December 1994, with the following objectives:

i) To understand the irrigation system design and operational features, performance characteristics and management policy & structure.
ii) To assess the irrigated agricultural system in terms of production and productivity, resource utilization and sustainability, profitability and socio economic impact.
iii) To work out interventions for improvement of irrigation system and its management, improved and sustainable productivity and for equitable economic growth.

Problems of Irrigation Water Management in Command Area os Sub-tropical Plains of Jammu

The initial bench mark diagnostic survey and socio economic survey of the chosen distributory command aided in diagnosis of major problems of water management in the Tawi canal command. They can be summarized as follows:

a) Over drawal of water from a few outlets at the cost of others, through over sized outlets disproportionate to their commanded area (particularly in the head reaches of distributory main and two minors) (Distributory no.3 on Tawi canal receives water for 3.5 days in a week; while farmers of right & left minors and parts of main up to RD 1875 in (out of length 6 km) forming only 42% of designed CCA avail of water for about 2.5 days, the rest of farmers holding 58% of designed CCA in the remaining part of command of main receive water for only one day in a week)
b) Absence of any system for equitable distribution of available water (wara-bandi);
c) Poor maintenance/repair of field channels, absence of efforts towards cleaning and desiltation of water courses;
d) Water drawals from illegal outlets and through cutting of bunds of water courses, especially during Kharif season;
e) Variable discharge rates at the distributory head which is dependent on flow levels of river Tawi at head works of the lift system and variable power supply.

Other constraints for maximization of agricultural production in the distributory command identified during the survey are mainly the non-availability of farm inputs such as quality seeds, fertilizers and agricultural chemicals for timely agricultural operations as well as agricultural credit facilities for the small and marginal farmers who constitute almost 86% of the total. There have also been no attempts for transfer of latest farming technologies by any agency through periodic farmers training programmes. There is no coordination among the development departments (Agriculture, CAD and Irrigation) in their base minimal and isolated developmental activities. No activity of the Rural Development department is visible in the distributory command.

OFWMR Studies in the Command of Distributory No. 3 on Tawi Canal (Lift Irrigation Scheme)

Seeking practicable solutions to the main water management problems diagnosed, the following tasks, prioritized on a 10 point scale were envisaged for necessary interventions in the OFWMR studies, for the eventual optimization of "available" land, water and socio economic resources of the chosen distributory command for enhancing and sustaining its agricultural production and productivity:

i) Calibration and normalization of each outlet size commensurate with its area commanded;
ii) Establishment of water users' Association/s for effective and equitable sharing of available water, ensuring farmers participation;
iii) Design of practicable rotational system of water sharing (Wara bandi) on the basis of crop patterns followed, and mean discharge available in each minor, distributory & main;
iv) Regimentation against drawal of water through illegal outlets and seasonal cutting of water courses;
v) Yearly desiltation and repair of lined field channels;
vi) Lining of unlined field channels;
vii) Scheduling of irrigation depth and frequencies as per the irrigation requirements of individual crops and their growth stages, based on the technologies developed by WMRC;
viii) Physical characterization of soils of the entire distributory command on grid/relief basis, for attempting optimization of its land and water resources including ground water studies for exploring prospects of conjunctive use of ground and surface waters;
ix) Detailed studies of the quality of canal and ground water; and
x) Study of the nature and extent of problems of low lying areas (water logging and salinity proneness)

All these tasks have to be taken up simultaneously and with active cooperation and participation of farmers as well as relevant development departments. Action has been initiated on some of these tasks and linkages with other departments established regarding accomplishing remaining tasks. The progress is at various stages. As more than 50% of the sanctioned project period of OFWMR studies was lost in procuring the consent and administrative approval of the state government which shares the project cost with Ministry of Water Resources, there was limited time to evaluate the water

management technologies developed at WMRC (already tested in the command of an outlet in Ranbir Canal Command, Ponichak, 1990-94) all across the selected distributory command. Hence, intervention studies in the form of economic irrigation schedules in rice (7 cm depth, every eight days during non rainy period) were initiated during Kharif 1995 itself, with the active participation of 32 cooperative farmers, all across the commands of distributory main and two minors, who volunteered to experiment with the proposed demonstration trial. The results demonstrated successfully rice grain yield advantages of the order of 200 to 500 kg/ha in the intervention study plots over those of control plots receiving farmers traditional depth, frequency and mode of irrigations. More importantly, the average savings in irrigation water achieved in study plots was a substantial 600 to 750 mm in the entire season which was more than 50% of that applied by farmers. When the intervention studies were repeated on a systematic scale in 60 representative locations on selected outlets all across the distributory command during Kharif 1996, the results were similar with grain yield advantages ranging from 50 to 1000 kg/ha but irrigation water savings achieved were of smaller magnitude owing to good rainfall amount and distribution in the main crop growing season. In the light of the fact that hardly 50% of the designed CCA of the distributory command has been supplied with irrigation during the past eight Kharif seasons, the results of these studies clearly establish that judicious economic irrigation schedules, if implemented by farmers, could enable almost the entire designed CCA of the distributory command to receive equitable share of irrigation water.

Similarly, during Rabi season 1995-96, 50 adaptive trails on representative sites all across distributory command were laid to demonstrate the efficacy of border strip layout of wheat for efficient irrigation as well as drainage of excess rainstorm water during the later part of the season. There was an average yield advantage of about 400 kg/ha wheat grain in the study plots with border strip layout over that of control plots with check plot layout. However, owing to sub normal rainfall of the season (devoid of any rain storm and consequent drainage event) the advantage of border strip layout over traditional check plot layout was limited to the ease and consequent uniform distribution of CRI stage irrigation in study plots and the opportunity for efficient weed control operations. The trial during the second Rabi season (1996-97) is in progress on 62 plots of farmers' fields.

These results have served to boost the morale of scientists of WMRC and contributed to repose confidence in them to make further detailed studies on matching and reconciliating water supply with actual crop water demands in consideration of crop diversification and water application methods, and assessment of water availability at distributory levels and application of appropriate interventions for optimized performance at the distributory level. So far, only a good beginning has been made towards optimization of available resources of distributory command including water, with the willing cooperation of the receptive farmers. The existing efficiencies of the system need to be computed realistically and refined / reworked based on the experiences of intervention studies in selected outlets, before a comprehensive optimization plan for the entire distributory command is designed and tested

for a couple of years. Only then, extrapolation exercises of the viable optimization plans to other distributory commands would be possible.

Future Prospects for Collaborative Endeavours Towards Optimization of Available Land, Water and Socio Economic resources of Command Areas

On farm water management research studies would yield expected results only if all facts of implementation are complete. A research centre can not implement all the tasks envisaged without the active cooperation and active participation of various departments of state government. The current endeavours of WMRC in implementing the OFWMR are restrained because of lack of active participation / collaboration of development departments. For example, assistance of Irrigation and Flood Control department in calibration / modification of outlet sizes or repair, desiltation and maintenance of field channels by I&FC / CAD departments is vital. The research centre worked out a comprehensive strategy for phased closure of canal system (for desiltation and repair operations) in place of blanket closure for extended periods, so that a couple of life saving irrigations could be provided for cash crops in Rabi season and suggested the same to irrigation authorities in 1991; but it has not received the attention of the planners of relevant departments. WMRC team could convince the farmers of distributory command and receive their support and cooperation; but a collaborative effort from development departments is not yet on the anvil. It is about time that water management scientists are taken into confidence.

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Table 1 : Potential created/utilized under major/medium irrigation systems up to 1995-96. (I & FC Department, Jammu)

Sr No	Name of Scheme	Year commissioned	Type of scheme	Source of water	CCA (ha)	Design discharge cusec	Variation in discharge		Potential(ha)	
							Kh	Rabi	Created	Utilised(95-96)
1	Ranbir Canal (Jammu Dist)	1905	Gravity	R.Chinab	38,623	1000	-	-	67,814	65,458
2.	Pratap Canal (Jammu dist)	1961-62	-do-	-do-	9,919	500	-	-	14,879	9,225
3.	Parwai Canal (Jammu dist)	1974	-do-	-do-	2,429	175	-	-	3,644	1,681
4.	Kathua Canal (Kathua dist)	1961-62	-do-	R.Ravi	11,741	400	-	-	17,611	14,128
5.	Dudder Canal (Udhampur dist)	1971	-do-	Dudder Nallah	2,834	40	-	-	4,251	1,840
6.	Kashtigarh Canal (Doda dist)	1994-95	-do-	Dessa Nallah	1,093	25	-	-	1,640	126
7.	Ranjan Canal (Jammu dist)	1994-95	Lift Irrig. scheme	R.Chenab	2,024	120	100	40	3,036	514
8.	Rajal Canal (Rajouri dist)	1994-95	-do-	Nowshera (Mahavar Tawi)	1,721	60	60	20	2,587	406
9.	Ravi-Tawi Irrig. Complex									
9(i)	Ravi-Tawi lift Canal	1978	Lift Irri. Scheme	R.Tawi	14,170	300	-	-	12,880	6,942
9(ii)	Ravi Canal Ph.I	1982-83	Gr + LIS	R.Rav+ Q.Ujh	32,185	250	250 150 (Ujh Barrage)		12,000	
	Ravi Canal Ph.II	1984-85 /1988	-	-		200	(Lakhanpur R.S.)		15,000	
	Ravi Canal Ph.III	1992-93				500	(Basanpur Laft Sceme		13,000 - ----- 40,000	18055
	Ravi Canal Ph.IV	(Ultimate potential on Ravi Canal is 53,925 + 6761 = 60686 ha - Expected to achieve by end of IX 5 year plan.							13925	