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RAPPORTEUR'S REPORT ON IRRIGATION AND WATER MANAGEMENT

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Twenty-one papers have been accepted for discussion at the Conference relating to the topic of irrigation and water management under the sub-theme of Science and Technology Policy. The papers are grouped under eight headings, namely, (1) Field application of irrigation, (2) Field channel lining, (3) Tank irrigation maintenance and viability, (4) Spatial inequity, (5) Management via crop pattern changes, (6) Scientific research in water management, (7) Project level studies and (8) Miscellany. The concluding part of the report identifies select issues for discussion.

With the singular exception of one paper that describes the problem of watershed management, the paper-writers have dealt with the irrigation question with a fairly strong empirical thrust. However, not all papers explore the management aspect of irrigation. This is understandable because irrigation/water management has yet not come, unlike high-yielding variety (HYV) technology, in the mainstream of agricultural economics. Much of the research in this area is being currently conducted by professionals in soil physics, agronomists, agricultural and civil engineers. Anyway, subjectwise categorisation of the papers may be broadly viewed as follows.

About half a dozen papers explore the subject of altering crop pattern through more efficient allocation of available irrigation resource at farm or reservoir level. Two papers investigate in depth the economics of water management below the canal outlet—one dealing with the issue of lining earthen field channels, and the other with drip and furrow methods of applying water to the plants. Two scholars analyse the distribution of canal water in the head, middle and tail-end areas of the command. Techno-economic aspects of tank irrigation are discussed in depth and detail by two authors. Scientific research in on-farm water management is a subject of sharp comment and criticism in one paper. Experiences, including beneficiaries' views/opinions, in two major irrigation projects are described in two papers. Problems of irrigating black cotton soils of low impermeability are described in two papers.

Important propositions, or conclusions, emerging from the papers that may be critically appraised at the Conference session for their universality at least for the different regions of the Indian sub-continent, may be listed here before going into paperwise highlights.

(*i*) Drip method of field irrigation substantially raises vegetable crop yield over the furrow method but the gains do not appear commensurate with higher costs.

(*ii*) Lining of earthen field channels adds to crop output with a favourable benefit-cost (B-C) ratio.

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(*iii*) Crop sequences that are waterwise and incomewise superior to sugarcane are available for highly water-scarce regions like the Deccan plateau where cultivation of sugarcane absorbs a large chunk of irrigation water.

(*iv*) Development of conjunctive use of canal and well water mitigates waterlogging tendency in canal commands.

(*v*) Tank irrigation is a viable proposition.

(*vi*) Canal and tank maintenance suffers because of inadequate funding for this purpose.

(*vii*) Tail-end farmers receive much less canal water supply than their counterparts in the upper portions of a canal command, thereby creating a spatial hiatus in benefits from public investment.

(*viii*) Research work in water management (*i.e.*, on optimum irrigation requirements for crops) needs to be conducted under the more realistic condition of water availability being much less than the required level.

(*ix*) Linear programming exercises indicate considerable room for raising productivity of irrigation water in water-scarce regions by altering existing crop patterns.

DISCUSSION OF PAPERS

1. Field Application of Irrigation

D. P. Katria *et al.*'s paper is based on the first author's Ph.D. work on tomato crop. The experimental yield impact of switching over from furrow to the drip method, keeping every thing (including volume of irrigation) the same, is found to be very substantial but not commensurate with the incremental cost of water application (the investment for the drip system amounts to Rs. 30,000/ha. as compared to Rs. 12,000/ha. for the furrow method). Since tomato yield is observed to be adversely affected by larger dose of irrigation, the comparative result needs to be reappraised through trials in which the volume of irrigation in the drip case is deliberately kept much less than in the other case. After all, part of the motivation in switching in irrigation application techniques is to effect saving in irrigation water, so as to extend irrigation to a larger proportion of a land holding in a water-scarce region.

2. Field Channel Lining

B. S. Panghal *et al.* compare the performance of farms served by lined and unlined field channels in Rohtak district (Haryana). Investment in lining improves the intensity of cropping, fertiliser intensity and crop pattern, thereby enhancing farm income more than the cost (Rs. 258/ha.) of lining. The estimated B-C ratio of 1.35 appears to be from a private angle. The social benefit-cost analysis of investment in lining needs to be worked out keeping in mind (*a*) government subsidy to farmers on lining investment, (*b*) reduction in waterlogging due to reduced seepage and (*c*) diminution in groundwater recharge in tracts experiencing decline in the water table.

3. Tank Irrigation Maintenance and Viability

System tanks of Tamil Nadu, which are fed partly by rainfall run-off and partly by canal water, are studied by M. Sivanantham and S. Varadarajan. The

siltation is occurring at a rapid rate, leading to about 3 per cent depreciation in tank capacity every year. No wonder, tanks are depending more and more on canal water (3.5 fillings done during 1984-85) to meet the irrigation needs of farmers. Feeder channel as also tank structure is poorly maintained by the Public Works Department (PWD), partly because of poor funding. The PWD allocation for maintenance is on the basis of Rs. 10 to Rs. 20 per acre as against the needed Rs. 40 to Rs. 50 per acre. The inadequate funding is clearly due to nominal water tariff (Rs. 5 to Rs. 8 per irrigated acre), a fact affirmed in Dinesh K. Marothia's paper also.

The functioning of the tanks suffers because of an inherent conflict of interest between command area farmers and foreshore area farmers on the catchment side—some of the latter category farmers are encroachers on tank bed land, interested in minimising the storage level of the tank. The authors feel that a water *manyam* be appointed by each beneficiary village to take charge of the tank maintenance and its operation. While they favour the defraying of his wages from revenue proceeds from fish auction, social forestry, farmer levies in cash and kind, the farmers expressed themselves in favour of government support for this purpose. This brings us to the question of income benefits accruing to tank beneficiaries, an issue examined by Marothia.

Leaving aside the maintenance problems, Marothia's in-depth study of tanks in the eastern rice bowl of Madhya Pradesh is otherwise quite reassuring. Though his data reveal that the benefits from tank irrigation exceed even the resource cost estimate of Rs. 243 to Rs. 259 per irrigated hectare, one suspects that the cost estimate, based as it is on historical records of tank construction maintained by the PWD, is much less than the investment needed in 1984-85, the year to which on-farm income benefits pertain.

4. Spatial Inequity: Top-end versus Tail-end

S. K. Datta *et al.* have studied, besides public tubewell irrigation in West Bengal, the working of the canal system in the Sone Command (Bihar). They find that the farmers in the lower reaches do not show as good performance in the matter of crop yield and water utilisation as their counterparts in the upper reaches. For example, for wheat and *kharif* paddy (HYV) the comparative yield picture duirng 1984-85 was as follows:

Location (Sone Command, Bihar)	Wheat (kg./acre)	Paddy (kg./acre)
Canal head reaches ..	993	1,243
Canal lower reaches ..	615	954

The authors do not cite, unlike Rajkishor Panda, any direct evidence to link the spatial difference in crop productivity to water distribution problems. That the tail-end farmers receive much less water is pointed out by C. J. Joseph who looked at the working of a section of the Periyar Valley Project (Kerala). On this vital matter, Panda offers a very definitive account based on his research work in deltaic Orissa. For the *rabi* season, paddy dominates the crop pattern, though its domi-

nance tends to diminish as one moves down the canal system. How better access to irrigation influences crop pattern choice is more poignantly brought out by looking at the relative shares of lightly irrigated crops like pulses and groundnut vis-a-vis heavily (or more frequently) irrigated crops like paddy, potatoes and vegetables. Variations in the relative shares of the two categories of crops within the canal command during 1984-85 (*rabi* season) were as follows:

Location (Bamnal minor canal, Orissa)	Per cent share in area of	
	Lightly irrigated crops	Heavily irrigated crops
Head reach	10	85
Middle reach	15	83
Tail-end	36	62

Paradoxically, crop yields do not diminish steadily as one goes down the canal length despite a reduction in the number of waterings actually done by the farmers. In the matter of lightly irrigated crops the tail reach farmers exhibit the best yield performance. And in the case of heavily irrigated crops the best performance comes from the middle reach farmers, though the head reach farmers certainly realise better yields than the tail-end farmers. Panda's evidence about over-irrigation in the head reaches is noteworthy, notwithstanding that one would like to know more about his norms about optimum irrigation for various crops—these norms are a bit variable across the farmer categories and over the canal reaches.

5. Management via Crop Pattern Changes

B. W. Ashturkar's paper deals with the crop sequences that can compete with sugarcane. The importance of this question stems from the fact that sugarcane utilises excessively large amount of irrigation resource in peninsular India (including Gujarat). From the social viewpoint of water resource management it has been known for quite some time that rising cultivation of sugarcane in Maharashtra is not a desirable development. The critical issue has been whether such crop sequences can be found as would be comparable to sugarcane in private income generation but utilise much less of irrigation resource. It is here that Ashturkar has made a signal contribution by identifying several crop sequences that can be an alternative to sugarcane within the private calculus of the Maharashtra farmer. It would be useful to probe into the data base and other assumptions of this paper—more so because in the following paper by T. G. Satpute and K. D. Rajmane the acreage allocation to sugarcane improves under optimum cropping pattern for Jaykwadi project in Maharashtra.

The results of linear programming analysis reveal that even at the existing level of technology of farming there is more scope for growing *kharif* jowar, cotton, safflower, sunflower and sugarcane, though the increase would be at the expense of summer groundnut, wheat, pulses, etc., but with ten per cent less use of 0.9 million ha.m. available for irrigation. If the beneficiaries were to successfully adopt improved

technology, the crop pattern shifts radically in favour of cotton (44 per cent), *kharif* jowar (25 per cent), sugarcane (16 per cent)—summer groundnut almost retains its existing share (10 per cent) but all other oilseeds, pulses, etc., disappear. Though considerable economy (18 per cent) occurs in irrigation water use, the social desirability of allocating about 45 per cent of the water resource to sugarcane alone is open to question.

V. K. Sharma's optimising exercise for Dhora reservoir in Nainital Tarai (Uttar Pradesh) point to the need for greater allocation to sugarcane crop instead of paddy-wheat sequence as one moves from the head reach to the tail-end of the command area. It is not clear whether in the optimal crop pattern the per cent share of sugarcane in the whole command would be more than the existing one, as the author recommends a steep reduction in the share of sugarcane in the head reaches. If it does rise, we have an answer to the question: who would produce sugarcane for meeting the growing demand for sugar if Maharashtra farmers are forced to curtail sugarcane cultivation within canal commands in the wake of eight-monthly proposed running of the canal system?

In three more papers the scope for improving the crop pattern has been explored with the help of linear programming (LP) technique. And sugarcane is not considered a feasible activity in these papers, two of which pertain to arid regions, and the third one (by S. P. Saraswat) to the sub-montane Himalayan area of Himachal Pradesh. For the small Jai Samand reservoir in Rajasthan, R. C. Verma and Harish Kumar Banga suggest a more even scheduling in a year, whereby wheat acreage rises sharply (to about 2500 ha. in a command area of 3000 ha.) at the expense of pulses and oilseeds. Is the change in the crop output-mix a socially good outcome? O. P. Chhikara and I. J. Singh go to the extreme by imposing an upper area constraint on oilseeds in their LP exercise for Hisar in Haryana, because they fear too much use of scarce resources (other than water) by rapeseed "due to its higher net income". This raises the vital question about the imposition/relaxation of constraints in LP exercises, and the issue of interpreting results as mainly due to better water management.

6. *Scientific Research in Water Management*

On the basis of his research studies on the management of irrigation reservoirs in the Nainital Tarai region, on the one hand, and his knowledge of scientific research undertaken by the water management experts in the Pantnagar Agricultural University, on the other, Sharma offers some critical remarks and some suggestions for improving water management in India. He raises doubts about the relevance of research in water management that is conducted under conditions radically different from those under which the Indian farmer is working. He rightly pleads for experimental research based on the realistic situation of water shortage instead of full availability of this, or other resources.

7. *Project Level Studies*

Papers by S. D. Suryawanshi and Joseph offer project level results/observations. Suryawanshi's analysis is about the Mula project (Maharashtra). From a purely administrative viewpoint the Mula project appears to be well managed as the far-

mer's grievances were confined to a small proportion and without bearing any in verse relation to farm size. To what extent satisfaction with public irrigation is linked with the farmers' good access to private means of irrigation, *viz.*, wells, needs examination. Thanks to well irrigation, the problem of waterlogging is minimal: only 19 farmers reported waterlogging which accounted for just two per cent of the total area of the 250 sample farmers.

Joseph apprises us of his findings on the working of the Periyar Valley Irrigation Project, a diversion work in Kerala. While the maintenance of the barrage is found to be good, this cannot be said about the canal channels which were found to be both silted and infested with aquatic weeds. Naturally, the farmer-beneficiaries were not satisfied with the maintenance of canal channels, and this they mainly ascribed to lack of funds—the annual maintenance estimate is about Rs. 4,800 per km. of a distributary and Rs. 7,200 per km. of main canal. The farmers were not hopeful of the water users' associations in maintaining field channels because of the political climate in the State.

8. Miscellany

K. A. Varghese and B. L. Sharma compare farm parameters of irrigated farming with those of unirrigated farming in the arid Ganganagar district (Rajasthan) served by the Bhakra Canal system. Though canal irrigation is highly income-augmenting, yet the authors do not appear to favour enhancement in the low water rates being charged by the government. Interestingly, inter-farm disparity in income is found to be less in the canal irrigated villages than in the unirrigated villages.

V. N. Singh *et al.*'s paper is based on a Ph.D. work by the first author, conducted within the Chambal Command area of Madhya Pradesh. It is mainly a comparison of irrigated versus unirrigated farming. Some of the unirrigated farms reported having acquired access to lift irrigation (groundwater or surface water?) at the second time of enquiry. Hence, the authors report some lessening of income and wealth disparity between the canal irrigated and the non-canal irrigated farmers in 1984-85 as against 1980-81.

V. K. Madalia pleads for a separate extension agency that should concentrate on water management at the field level. H. S. Sandhu and Balbir Kumar mainly describe the components of the Kandi Watershed Project that is being implemented in the sub-montane region of Punjab, but without offering any critical appreciation, or evaluation report, of the programme.

That irrigation can be a curse is well known in the history of mankind as canal irrigation renders fertile soils uncultivable through the twin process of waterlogging-cum-soil salinity. A. G. Pujari deals with this problem in the case of clayey soils of poor permeability within the command of the Ujjani Right Bank Canal of the Bhima project in Western Maharashtra. Such problem tracts have been reported from other irrigation projects in the Deccan plateau, Madhya Pradesh, etc., where deep black soils are found. Though the paper gives a number of technical details, it does not record the extent of damage in the command area. Reducing the irrigation delta by growing lightly irrigated crops instead of heavily irrigated crops is recommended by the author. Otherwise, unconventional methods of irrigation (sprinklers, drippers, etc.) in which water application rate is equalised to the con-

sumptive water needs of the plants should be used. K. B. Phadke, on the other hand, does not favour irrigation of deep soil lands in the river valleys of the Deccan. He favours irrigation to medium soils situated away from the main rivers.

Anandamoy Sen has investigated the working of five river lift schemes in Birbhum district of West Bengal. He finds that the revenue from irrigation water does not cover even the maintenance cost of the schemes. The performance was low, partly because of energy shortages and partly because of reduced flow in the river during summer (this is attributed to non-release of water from a barrage serving a canal system).

SELECT ISSUES FOR DISCUSSION

Though several of the issues are interlinked, yet it would help if the discussion at the Conference is organised around the following points one at a time.

1. Extensive versus intensive irrigation policy for canal commands given our endowment of land and water resources;
2. Desirable irrigated crop pattern/crop sequences for water-scarce and water-abundant regions separately, and the price and the non-price instruments needed for this purpose so as to move irrigators towards them;
3. Water management below the final canal outlet;
4. Water management above the canal outlet;
5. Direct and indirect instruments of groundwater regulation in respect of (*a*) well spacings and (*b*) preventing permanent decline in water table and Statewise experiences thereof;
6. Extent and nature of unutilised irrigation potential created in both high rainfall and low rainfall regions;
7. Under-pricing of (*i*) public irrigation and (*ii*) electricity for waterlifting, along with its consequences for water management;
8. Agronomical research in water management at crop level and the hurdles in diffusing it among farmers;
9. Anti-waterlogging measures and experiences;
10. Inter-State, as also intra-State, water squabbles: should water be declared a national resource to be managed by the Centre only?