TOWARDS BETTER UTILIZATION OF WATER RESOURCES OF INDIA: AN ASSESSMENT OF INSTITUTIONAL AND ORGANIZATIONAL REFORMS IN SURFACE IRRIGATION PROJECTS

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Introduction

Surface irrigation dominates the Indian irrigation system. The total surface waters in the country have been estimated to be around 180 million hectare metres, out of which about 60 million hectare metres have been assessed to be usable. The groundwater resources for irrigation have been calculated to be 26 million hectare metres. Together, they would enable 113 million hectares to be irrigated. Up to March 1980, which marks the end of the Fifth Five-Year Plan, 57 million hectares of irrigation potential had been developed. Nearly 30 million hectares fall under surface irrigation and the remaining is covered by groundwater use. It is planned to add another 13 million hectares during the Sixth Five-Year Plan (1980-85), half of which will be under surface irrigation.

While a major part of the developed groundwater potential is in the hands of the private sector, surface irrigation is entirely owned and managed by the public sector. The private sector exploitation of groundwater resources has been found to be more efficient than the State owned and operated tubewells (Mellor and Moorti). Since the public sector deals only with a small part of groundwater resources, the costs imposed on society are less, both in absolute and relative terms.

In the case of surface irrigation, evaluation studies have brought out their poor performance in terms of utilization of the created potential and realization of projected cropping patterns. Organizational and management deficiencies have been found to be the causes behind this poor performance. Some far-reaching reforms are under way, the evaluation of which is the subject of this paper. The paper is divided into two sections. The first section offers a brief review of the recent research findings and indicates the areas for reforms; the second section evaluates some of the reform measures undertaken so far.

Areas for Reforms

Investment in surface irrigation projects has been undertaken with the objectives of providing much needed protective cover crops during the uncertain monsoon season and offering multiple cropping and crop diversification possibilities in the winter and hot weather. These two basic objectives, if realized, would enable Indian peasants to stabilize their incomes. Further, they would also help to break the poverty barrier among the small and marginal farmers and landless agricultural labour by providing opportunities for greater labour absorption in irrigation agriculture and generating higher wage earnings in the rural sector.

Irrigation departments in the states were preoccupied with operation of the main system, consisting of the central works and the distribution network of canal branches and distributaries up to the government outlet of one cusec capacity. The resulting situation was that the farmers in the area commanded by each outlet, ranging from 20 hectares to 40 hectares, were left to themselves to undertake critical on-farm development (OFD) works such as field channels for taking water to individual farms, field drains for removing excess water, and precision land levelling and land shaping to enable water to reach all parts of the field evenly. The OFD works required substantial engineering skills and a favourable atmosphere for collective action since most of the works are community oriented. Leaving them to the individual initiatives of the farmers did not yield any useful results. Therefore, in the mid-1970s, the Government of India (GOI) suggested that the state governments set up an agency known as a Command Area Development Authority (CADA) for each major irrigation project irrigating more than 10,000 hectares, primarily to undertake the construction of OFD works on behalf of the farmers with a view to raise the level of water use efficiency. The model formulated by the GOI envisaged setting up a CADA with a full time administrator of a high rank equal to that of a Commissioner having the powers of heads of operating departments such as irrigation, agriculture and cooperation. The idea behind this was that the senior level officer would have sufficient influence and control over the personnel working in the command area of the project so that coordination among various department personnel could be effected more easily, even if they are not placed under him directly (Jayaraman and Clyma).

The CADA was also to have a separate allocation of funds for OFD works independent of the budgets of the constituent departments. Each authority was to have a separate board of representatives of both official and nonofficial interests for supervising and reviewing the programme. The authority was given the responsibility for developing the command area, operating the irrigation system, promoting the cropping patterns, strengthening extension, training farmers, demonstrating improved practices, ensuring the flow of credit, supplying inputs such as seeds and fertilizers, and developing roads and market facilities.

We now have six years of experience of CADAs in different states. What looked to be highly promising has materialized into disappointment. The results assessed in terms of gross area irrigated, productivity per hectare, or desired changes in cropping patterns have been found to be far below expectations. The reasons are obvious. A high degree of coordinated action did not materialize under a loose administrative structure of several departments having different goals and modes of operation, despite their common denominator of working in the sphere of irrigated agriculture. What was seriously lacking was a single unified cadre of management personnel operating under one authority. In the absence of such a cadre, the CADA settled for speeding up infrastructure construction below the outlet. But attention to the hardware components was not alone sufficient since the software elements (namely managerial inputs) were critically important. The latter includes delivery of water at the farm level and settlement of conflicts among the farmers (Levine).

While maintenance of the main system is left to the irrigation engineers who operate the system, the delivery of water at the farm level has been found to be "no man's land." The engineers tend to think that they are concerned with rotating the canals and distributories to ensure the required discharge at the government outlet, and that they are not responsible for distribution of water and its use at the farm level. The agricultural staff who are engaged in the command area development, in charge of either on-farm development works (such as field channels and field drains) or extension, feel that their roles are limited to their respective functions and do not cover water delivery at the farm level (Elman). The resultant picture is familiar. Farmers below the outlet resort to undisciplined irrigation methods with those at head-reaches usurping most of the supplies at the cost of the tail-enders. Added to this, in the faction ridden rural societies, the weaker sections belong to low castes, and the small farmers are denied their legitimate irrigation supplies by the farmers of upper castes and of large sized holdings.

An evaluation of the Mahi-Kadana Irrigation Project (the cultivable command area of 224,000 hectares) in Gujarat State reveals some interesting findings (Jayaraman, 1979). Though cropping intensity went up over an 11-year period, the changes in the cropping pattern were not significant. Crop diversification involves switching from coarse food grains normally grown under uncertain monsoon conditions to fine and high yielding varieties under assured irrigation, and from food grains to cash crops such as sugarcane and groundnuts. An analysis of growth during 1968/69 to 1977/78 shows that output recorded an overall growth rate of 124 percent out of which area accounted for 58 percentage points and yield 45 percentage points. Cropping pattern contributed only 5 percentage points.

Cropping patterns are determined mostly by certain critical variables. Foremost among them are: (1) profitability of cultivation signified by the relative ratio of the price of the crop under cultivation to the price of competing and substitutable crops (P_t) lagged by one year; (2) risks associated with uncertainties in quantities and timeliness of irrigation supplies represented by the standard deviation in area irrigated by canals during the preceding three years (σI); (3) risks associated with variation in rainfall represented by standard deviation in rainfall during the preceeding three years (σR); (4) risks associated with variations in yields (σY); (5) expenditures on extension at constant prices (E_t); and (6) credit per hectare at constant prices (C_t). Assuming a linear relationship between the area in hectares under paddy (A_t) and these independent variables, with pearl millet as a competing crop during the monsoon season, a regression equation was fitted. The results are as follows:

$$A_t = \underset{(1.29)}{14290.270} + \underset{(0.52)}{2173.259}\, P_{t-1} - \underset{(-1.32)}{24.715}\, \sigma R - \underset{(-2.52)}{0.046}\, \sigma I - \underset{(-0.66)}{0.821}\, \sigma Y$$

$$+ \underset{(5.62)}{0.193}\, E_t^* + \underset{(2.82)}{44.475}\, C_t^*$$

Figures in parentheses denote "t" values.
Adjusted $R^2 = 0.664$, Degrees of Freedom: 4
*Denotes significance at 0.05 level.

Uncertainties in irrigation have a significantly negative influence on area, though other significant variables, namely extension and credit, positively affect area. In the case of inputs, fertilizers and labour use are significantly adversely affected by risks associated with fluctuations in irrigation (Jayaraman, 1981a). The same situation is responsible for the farmers' unwillingness to come together to voluntarily maintain the OFD works constructed on their behalf at their cost, not to speak of discharging complex functions of water distribution by turns and of solving disputes among themselves. Lack of faith in irrigation supplies has been singled out as the cause of the absence of farmers' participation.

The foregoing discussion indicates the urgent need for setting up project management objectives to achieve the desired breakthrough in agricultural production and rural transformation of (a) predictable delivery of water at the farm level; (b) productive water use through supply of credit and inputs; (c) equity of delivery of water to all farmers; (d) conservation of the environment through appropriate crop advice and drainage measures; and (e) cost effectiveness and a productive return on investment (Lowdermilk).

Once the objectives are clear, it is obvious that the reforms will be in the areas of organization and management, such as evolving a unified professional management cadre, training personnel in the short run, improving the delivery irrigation system at the farm level, and systematic monitoring and evaluation. Institutional reforms would include the hitherto neglected participation of farmers in the scheduling of water distribution below the outlet, and resolution of conflicts. The next section reviews the steps undertaken in this regard.

An Assessment of Current Reforms

In the Indian irrigation bureaucracy, the construction and design (CD) wing is generally considered more prestigious than the operation and maintenance (OM) wing for various reasons, chief among them the so-called independence and insularity of the CD wing from the public and politicians, the monotonous nature of OM activities, and the recognized superiority of the personnel working in the CD. For these reasons, those in the OM try to switch over to CD at the earliest opportunity, never allowing themselves sufficient time for specialization. The first steps towards professionalization would therefore be to encourage an atmosphere of self-esteem among the personnel concerned, and to create an appropriate institutional and staffing structure. This might be best achieved by creating a separate department and a water management cadre. Such a separate department in each state would create sufficient promotional opportunitites for career advancement in the cadre and the seniormost member of the cadre would head the department (Jayaraman, 1982).

Each irrigation project under the department would be headed by a manager assisted by an agronomist, extension specialist, OFD engineer, irrigation engineer, and economist, all belonging to the same cadre of water management. Similarly, all along the line, the deputy managers and assistant managers would be assisted by similar teams of officers.

Formation of such a cadre would take time. But, in the short run, the OM personnel and agricultural and extension personnel working at various levels in the irrigation projects would become members of the cadre. Specialized programmes will be needed to bridge gaps in knowledge and skills. Apart from this, there should be interdisciplinary training sessions of different duration for members of the cadre of different seniority so that they can function as a team in an interdisciplinary setting (Jayaraman, 1981b).

Realizing these needs, a high level committee composed of Indian National Government and state officials is examining ways of forming such a specialized cadre. Two state governments (Gujarat and Maharashtra) have also set up Water Management Training Centres, with technical and financial assistance from the World Bank, to strengthen individual discipline skills in water management and to conduct interdisciplinary training programmes.

Building up a professional cadre should, it is hoped, ensure the realization of the ultimate objective of predictable and controllable delivery of water at the farm level. Here all the disciplines come into play. The agronomists have to work out the water requirements of the crops and the intervals at which they have to be delivered, based upon the soil characteristics. The engineers have to prepare the rotational schedules of water at the farm level, regardless of ownership status (such as small or marginal farmer, caste and location) at the outlets on a given distributary and all along the line above, such as minors and branches. The extension specialists have to spread the message of disciplined water delivery by rota and convince the farmers that such rotational water supply (RWS) is in their interests. They have also to promote the idea that farmers take up the responsibility of observing RWS schedules themselves once they are laid down.

Experiments of RWS on a limited scale have been exceptionally successful. They have proved that an interdisciplinary approach could ensure predictable delivery at farm level and hence create faith in irrigation supplies. Further, RWS assures equity of access to water for the weaker sections of the farming community, such as small and marginal farmers, low castes, and tailenders. Assured supply through RWS, apart from resulting in economic gains though increased per hectare yield, dramatically showed farmers' willingness for voluntary maintenance of the OFD works. As their rotas were fixed, the farmers were keen to keep their field channels in good condition so as to ensure maximum efficiency of conveyance of water. Though no formal associations have come into being, the farmers felt that they could informally function more effectively among themselves to undertake the minimum responsibilities of regulation of the rota and collective maintenance of OFD works (Jayaraman, 1981c).

It is apparent that the RWS experiment has to be extended to cover all the command areas in the country as it helps to achieve many of the objectives at once, including the prevention of overirrigation and hence conservation of soil. Effective monitoring and evaluation of the project are also required. Because of the current fragmented implementation approach, monitoring and evaluation studies need also to be discipline oriented rather than interdisciplinary.

It is visualized that the training centre in each state would prepare interdisciplinary teams under their training programmes and such teams could also function as monitoring cells. The cell would function under the manager of each project and report to him directly. It could undertake studies of randomly selected outlets under a minor official or areas under certain distributaries along the same lines as diagnostic analysis conducted by Colorado State University (CSU) Water Management Synthesis Project (Clyma). Special training programmes in diagnostic analyses were undertaken by the CSU in 1981 and their enormous success has prompted the Indian National Government to repeat the programme in the next few years.

In addition to the assessment of performance of projects in terms of their objectives, the monitoring and evaluation cell would also study conditions relating to waterlogging, salinity, soil erosion, groundwater deterioration, soil fertility reduction, health hazards enhancement, and other environmental concerns. Such cells are being contemplated in many states as trained men with interdisciplinary skills are available.

It should be mentioned here that the levels of administrative efficiency and absorption of new ideas vary from state to state within the country. Accordingly, the speed of implementation of reforms cannot be expected to be uniform among the states. But one thing is clear. There has been an acute awareness of the need for improvements in organization and management of the irrigation projects all over the country which augurs well for national agricultural development.

Note

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OPENER'S REMARKS—Roley R. Piggot

Forests

My major point of puzzlement with this paper is that, while the authors mention various impediments to the implementation of measures for site protection early in their paper, they seem to ignore these later in the paper. I have some questions resulting directly from these observations. First, to what extent are the impediments (that have been observed generally) a problem in the Dominican Republic case? A more general question is whether the benefits from these schemes might be sufficiently obvious that research resources would be better spent on analyzing ways for overcoming the institutional impedients to site protection. It seems to me that, where an analysis yields an internal rate of return of 50 percent, then perhaps the profitability of the project would have been obvious without detailed calculations. I wonder whether there are competing projects with internal rates of return in the neighbourhood of 50 percent?

I would be curious to know whether the rate of adoption is a central issue in this analysis. What guarantees are there that farmers are going to adopt the practices described in the paper? Will there be some incentive provided by the government? If so, is it likely to differ according to farm size? If there are likely to be differences in adoption rates among farm classes, what causes these differences? Incidentally, the authors refer to "small" and "medium size" farms. Is there a "large" sized farm relevant to this analysis?

The authors note that taxes and subsidies are treated as transfer payments. My understanding is that this is now considered to be a little dangerous because real resources are utilized in tax avoidance and in maximizing one's share of subsidy payments. In other words, the existence of taxes and subsidies not only results in transfers, but they create incentives which result in resource utilization, and this needs to be considered as a real cost to society. I wonder whether the authors would agree with this as a general proposition and whether they think it is relevant in the case of the project they consider.

Turning to the equity question, it is noted that "small" farmers' incomes will increase relative to "medium" farmers' incomes. Can the authors provide us with an intuitive explanation for this? If small farmers are slower adopters than medium farmers, presumably the project would do little for equity, at least in the short run. My reason for emphasizing the rate of adoption issue is that there is some empirical evidence that points to an inverse relationship between farm size and risk aversion, and rate of adoption might well be inversely related to the degree of risk averision.

Water Resources

It seems to me that this paper contains several value judgments, and I am not prepared to debate these. Rather I will make three brief comments on the areas for reform reported in the paper.

It is apparent that the author believes risk aversion to be important. However, according to his specifications, farmers are not risk averse with respect to price. This strikes me as odd.

The author has specified three different sources of risk and measured them by the standard deviation. I find it extremely difficult to believe that farmers can juggle the standard deviations of these variables in making decisions on area to plant to paddy.

I wonder how much pretesting was undertaken in answering the equation reported in the paper? The author reports formal hypotheses tests, but I find these less than credible, given my suspicion that a substantial amount of pretesting was not undertaken.

Let me say that I dislike launching attacks on another author's choices in model specification, but it did strike me as particularly important to do so in this case.

OPENER'S REMARKS—Wayne C. Thomas

Water Resources

Before the 1970s, the government provided water within surface irrigation projects and farmers were responsible for on-farm development and use. Administrative changes, instituted during the 1970s, continued government control of water delivery and added command area development authorities to control on-farm development. The major reason for this change was to increase water use efficiency.

The outcome of these administrative changes is that little has changed. Several government agencies were allowed to administer parts of the irrigation project separately and no coordinating agency was created. This led to poor implementation of the programme.

What occurred was a classic case of externality. Even with reformed administrative structures, farmers closer to the canal headgate captured the water resource and those farther away got little. The author, unfortunately, did not pursue this economic argument.

A major problem was the regression model which was used to indicate that irrigation uncertainties had significant negative influence on the dependent variable--the area under paddy. In fact, the only independent variables significant at 5 percent level were positively influencing extension and credit. The regression model had only 4 degrees of freedom. The main criticism is that the quantitative model does not enhance the author's descriptive analysis.

RAPPORTEUR'S REPORT—Bruce L. Greenshields

Forests

Total forest resources bear little relation to satisfying urban fuel wood needs, due to transportation costs. In Malawi, e.g., there has been a massive expansion in forest reserves, but nothing done in populated areas to provide fuel. Why has the issue of fuel wood availability suddenly and recently emerged on a worldwide basis? Do the authors offer anything new on how to put a dollar value on not losing soil?

The content of the paper is not related to the title. Forests are going into nonagricultural use. There is too little detail on why the particular land use pattern was chosen. In agroforestry, the number of variations is infinite, especially if architecture of canopy, minimum tillage, and physical forms of cover are considered.

The arguments are not well quantified. The extent of costs or benefits from certain practices is not substantiated. Reforestation projects can be a real cost to small farmers.

Forest dwellers in India complicate the forest policy issue. Because they must give up their land, there is a large scale deforestation to survive.

Water Resources

The major fault is that water use has not been efficient in the canal system, due to final delivery systems being left to the farmers, and minimum allocation of water between plots within a system. While administrative structures have been changed, are there incentive systems to reward qualified managers of the irrigation systems and water management in general?

Optimum allocation of water among crops is a problem, as well as allocation among plots. Yields of competing crops should be in the equation as well as the relative prices.

Participants in the discussion included D. G. R. Belshaw, Alfredo Cadenas (Session Chairman), S. H. Deshpande, Ian Livingstone, C. Ramalingam, D. S. Tyasi, C. L. F. van der Meer, Donald D. Waite, and Ian Wills.