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RAPPORTEUR'S REPORT
ON
SOCIO-ECONOMIC IMPACT OF IRRIGATION PROJECTS

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At the time of inviting research papers, the contributors were requested to cover, *inter alia,* the following themes connected with the the socio-economic impact of irrigation projects:

1. Planning, execution and management of irrigation projects;
2. Benefits of irrigation in terms of increase in productivity of specific crops, changes in the cropping pattern, technological change, employment, etc.;
3. Impact on income distribution;
4. Magnitude of social costs — salinity, waterlogging, etc.;
5. Experience of group action in water management and water use;
6. Strategies for increasing efficiency of irrigation systems (for farmers, investors and credit agencies) and making them more equitable; and
7. Proposals for more rational social regulation of groundwater use and irrigation.

Of the 30 papers accepted for discussion at the Conference, only one (P.K. Joshi and A.K. Agnihotri) dealt with the adverse effects (social costs) of canal irrigation. Others made only a casual reference to the unfavourable impact of irrigation. Two of the papers dealt with the impact of irrigation on income distribution (A.K. Giri and G. Mallik; and I. Bhavani Devi and S. Seetharaman). H. Chandrashekar *et al.* in their paper on the effects of well irrigation also devoted a section to the favourable impact of such irrigation on the small and marginal farmers' income, but this was attributed to the change in the definition of small farmers.

One of the papers (Ashok K. Mitra) dealt at length with the planning, execution and management of an irrigation project (Mula project located in a drought-prone area of Maharashtra), while another (Chandrashekar *et al.*) dealt with the planning of well irrigation in Karnataka.

On the experience of group action in water management and water use, there was no paper as such. Giri and Mallik, however, made a reference to the effect of group action (action of Beneficiary Committees) on the pattern of land utilization in two deep tubewell areas — one under the direct administration of the block and another under the direct control of Command Area Development Committee.

As many as five papers dealt with the efficiency of irrigation systems on a comparative basis (Jawahar Thakur and Praduman Kumar; D. R. Kalita and M. Rajbangshi; C. J. Joseph; M. R. Patel and S. B. Singh; and A. K. Ray). Reference was also made to the problem of efficiency of irrigation projects in the papers of Arun S. Patel and Haribhai F. Patel; D. S. Sidhu *et al.*; and Damodar Tripathy.

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Concrete proposals for social regulation of either groundwater use *or* surface irrigation, were not properly spelt out in any paper. Even where some suggestions were put forward, they were based purely on economic criteria related to increase in crop income. There was no indication of the advantage of using surface irrigation in conjunction with groundwater.

About a score of papers focused attention on the impact of irrigation on productivity, cropping pattern, input use, income and employment. The derivative effects of irrigation dealing with the impact on trade, industry, health and education, transport and communication, consumption and saving, banking and credit, marketing, processing, storage and warehousing, institutional development, etc., did not receive the attention which they deserved. Social, cultural and potential repercussions of irrigation expansion were almost neglected by all the authors.

With the background of the papers discussed above, it may be worthwhile to spell out the issues on which attention was focused by the authors of various papers accepted for discussion and issues which require further discussion and deliberation at the Conference. For the sake of convenience these issues may be considered under the following heads:

I. Concepts and definitions;
II. Methodological devices for evaluating the impact of irrigation projects;
III. Criteria for assessing efficiency and equity of an irrigation system;
IV. Need for rational control over the use of irrigation water between different crops/seasons/farms of different sizes, etc.;
V. Adverse effects of canal irrigation; and
VI. The general issues.

I

CONCEPTS AND DEFINITIONS

One of the issues to which attention has been focused in recent years relates to the increasing gap between 'the irrigation potential created' and its 'actual utilization'. Under-utilization of irrigation water leads to lower benefits and consequently higher costs in terms of the benefits generated. Mitra attributes this to the way the potential created is defined and the manner of reporting 'utilization' by the irrigation department. The potential is assumed to have been 'created' even when the works below the outlet (field channels, drains, land levelling, etc.) are incomplete. Similarly, 'utilization' given by the project authorities is based on the applications received from the irrigators and not on the basis of actual area irrigated. This leads to over-estimation of both 'the potential created' and its 'actual utilization'. He therefore suggests that the 'potential created' and the 'potential utilized' should be redefined so as to reflect realistically the gap between the two. The issues to be considered in this context are:

(i) Should the area not available for irrigation due to inadequate or faulty on-farm development (OFD) works (field channels, drains, land levelling, etc.)

be included in the 'potential created' or excluded from the scope ?

(ii) Should the area lost due to waterlogging, salinity and alkalinity be subtracted from the irrigable command area to get the 'potential created' or not ?

(iii) Should the figures of annual utilization given by the project authorities/ irrigation department be rejected in favour of the figures supplied by the Revenue Department/Bureau of Economics and Statistics, in order to estimate the actual area irrigated ?

(iv) Should irrigation potential/utilization statistics reflect only the productivity of water use in terms of cropping pattern, cropping intensity, physical yields, or should they also reflect the periodicity, reliability, regularity and adequacy of supplies of irrigation water and its distribution ?

(v) Should not vagueness in the concepts of 'irrigated area' which does not take account of the quantitative, temporal and spatial aspects of irrigation be cleared ?

(vi) Does not 'Cropping Intensity' need revision and elaboration with reference to short duration, long duration and perennial crops raised in the irrigated area, in the backdrop of the advocacy of multiple cropping ?

Another conceptual confusion relates to the definition of 'small' farmers in assessing the impact of irrigation on income distribution. Chandrashekar *et al.* point out the dubious manner in which the erstwhile landlords distributed their lands among their kith and kin to gain eligibility for State Land Development Bank loans as 'small' farmers. With the increase in income per hectare and a certain rise in land value, the old criterion of 'area of holding' is no longer relevant for deciding whether a farmer is 'small' or not. In this context, the issues which merit serious consideration of the participants are:

(i) What other criteria should be adopted for defining a 'small' farmer ?

(ii) Could output or income be a satisfactory basis for classifying farmers into different categories for the purpose of evaluating the impact of irrigation on income inequality ?

(iii) Could there be an uniform basis for classification of farmers under different groups in all project areas ?

Yet another area where conceptual clarity is needed relates to the definition of 'costs' and 'benefits' of irrigation.

(i) Should costs of construction initially incurred on older projects be revised upwards in the light of present day prices of materials, equipment and human labour ?

(ii) Should the costs incurred on works below the command outlet be included or left apart ?

(iii) Should interest on the capital invested during the gestation period be considered as an item of fixed cost ? If so, at what rate ?

(iv) Should the costs of establishing Command Area Development Authorities (CADAs) be treated as an operational and maintenance expenditure ? In the absence of their inclusion, costs are bound to be on the lower estimate, and the

benefit-cost (B-C) ratio is likely to be over-estimated.

Similarly, what benefits should be included for assessing the impact of irrigation ?

(i) Should only *direct benefits* accruing to agriculturists from higher productivity and changed cropping pattern be considered in this context, or should *indirect benefits* be also taken into consideration ?

(ii) What *indirect benefits* are to be included and how are they to be quantified and evaluated ?

These are the pertinent questions on which clarity, rigour and consistency are required, if comparisons of efficiency of different irrigation systems are to be effectively established. Exclusions of *indirect benefits* is bound to lead to under-estimation of B-C ratios. Low costs of older projects are bound to give a misleading view of their efficiency vis-a-vis new projects completed at very high costs, if the *replacement costs* are not taken into account.

Some of the other parameters which call for precise specification, conceptual clarity and consistency as raised by Mitra and several other scholars are:

(i) What should be the rate of interest for capitalisation during the entire period of construction of a project including the prolongation of its gestation period due to one reason or the other ?

(ii) What should be the economic life of the irrigation project — whether the long drawn out gestation period should be taken into account while determining the economic life of a project ?

(iii) Should the interest be capitalised until the project is completed and full irrigation potential is developed ?

(iv) Should the cost of the project be computed only after the realisation of its full irrigation potential and considering only the remaining life of the project (the estimated economic life of the project minus the protracted gestation period) ? In such cases, the B-C ratio may even turn out to be less than the stipulated/recommended level.

II

METHODOLOGICAL DEVICES FOR IMPACT EVALUATION OF IRRIGATION PROJECTS

For an economic evaluation of irrigation projects, two different approaches have been adopted in several papers. One method is to assess the position in regard to productivity, cropping pattern, input use, income, employment, etc., *'before'* the installation of the project and then to compare it with the position prevailing *'after'* the project comes to fruition stage: *BA Approach* (Tripathy; R. S. Misra and S. K. Gupta; S. B. Dangat and R. K. Rahane; Leelambike Puttanna and K. Hema; and V. B. Jugale). Another approach is to consider the position on farms *'without'* irrigation facility and compare the same with the position observed on farms *'with'* such facility: *WW approach*

(Tripathy; M.R. Alshi and V.D. Galgalikar; Kalita and Rajbangshi; C. Arputharaj and R. Rajagopalan; and S. Adinarayana.) The former approach obviously requires reliable data for a series of years. The latter approach requires cross-section data for a comparatively shorter period. Tripathy has shown his preference for the second approach (WW) on the ground that it takes care of the interactive aspects of various other programmes operating simultaneously with the irrigation programme, influencing the benefits of irrigation, and eliminating the possibility of over-estimation in pure yield effect observed under BA approach. His emphasis, however, is on the impact of OFD works on productivity defined in terms of physical output of a crop per hectare during a specific season.

Could the results of the two approaches be reconciled and brought into harmony ? Or is there any other alternative to segregate the effects of irrigation proper from the effects of other programmes like OFD works, HYVs of crops, tractorisation, extension, credit and the like ?

Thakur and Kumar address themselves to this problem and suggest a model for decomposition of total changes in crop production due to irrigation system into its constituent causal forces. According to them, output growth resulting from an irrigation system takes place in two stages: first, increase due to irrigation itself without additional resources; second, increase due to additional input utilization. The model developed seeks to capture the effects of both the stages. The first stage measures the contribution of better management of water (in terms of assured, timely and adequate water supply), while the second stage estimates the contribution of changes in the levels of inputs. In a similar way, P. L. Sankhayan and Inder Pal Singh have used restricted profit function for measuring the relative economic efficiency of the three systems of irrigation, namely, canal, canal+lift, and lift irrigation.

Sidhu *et al.* seek to compare alternative systems of irrigation in terms of flexibility and reliability of water supply. Farms using canal as source of irrigation are compared with farms using tubewells to demonstrate the benefits of water supply flexibility, while diesel *or* electric operated farms are compared with diesel *and* electric alternatives to show the benefits of reliability of water supply.

Another important approach followed to assess the effect of irrigation is the functional analysis. With the help of multiple regression equation, Patel and Patel; Sib Ranjan Misra; Alshi and Galgalikar; Chandrashekar *et al.*; and Adinarayana have estimated the marginal value productivities on the irrigated and unirrigated farms, while D. V. Singh and S. P. Saraswat; and Ray employed normative approach through linear programming models.

In view of the multiple approaches (BA and WW) and the variety of methods followed for evaluating the impact of irrigation, the questions that arise are:

(i) Can there be a comprehensive model to show the total impact of various programmes associated with irrigation and break it down into its constituent sources ?

(ii) How much, for example, of the change in output is due to irrigation, cropping pattern, cropping intensity, use of HYVs of crops, tractorisation, fertilizer (N.P.K.) usage and use of human or bullock labour ?

III

CRITERIA FOR ASSESSMENT OF EFFICIENCY AND EQUITY OF AN IRRIGATION SYSTEM

Efficiency of an irrigation project depends on several factors, namely, rate of utilization of the potential created, rate of increase in productivity of various crops, rate of return on investment, regularity, certainty and adequacy of water supply, extent of seepage and evaporation, availability of water in the lower reaches of the outlet, inter-departmental co-operation and co-ordination, proper maintenance of drains and field channels, proper designing and location of storage reservoirs, training of farmers in the use of water and other associated inputs, proper allocation of water between different seasons, regions and crops, etc. Some of these factors are of a technical nature and need the help of engineers and hydraulic experts, apart from agro-economists and administrators. The task of evaluation becomes more complicated when non-economic considerations enter into the decision-making process, that is, political pressures, corrupt practices due to vested interests, differences in policy objectives, *viz.,* maximization of output, minimization of cost per unit of output, employment expansion, equitable distribution of water between farms of different sizes located at different reaches, freedom of operation for the farmers, inter-sectoral balance and development of backward areas. Sometimes, considerations of self-sufficiency, particularly in matters of foodstuffs and essential raw materials, may outweigh other criteria like high B-C ratio, low pay-back period, net present worth, internal rate of return, marginal value productivity, etc. Then, again efficiency criteria from the view-point of the farmers may differ from those applicable to the investors or credit institutions. They may also differ between short and long periods, and between sectional and national interests.

In view of the complexity of the problem, suitable concepts and methods for economic evaluation and evaluation of overall performance in terms of the goals set for an irrigation project need to be defined and developed. There must be a certain measure of consensus among irrigation experts in regard to the goals which they seek to achieve. Traditional approaches based on production and profit functions or on marginal value productivities, leading to undue emphasis on the attainment of high B-C ratios, must be modified to yield precedence to other wider national objectives. It is for the participants to hammer out such consensus. The issues to be discussed in this context would appear to be:

(i) Should the B-C ratio be taken as a reliable guide for economic policy in an economy plagued by unemployment and under-employment and confronted by food shortages and scarcity of essential raw materials with the correspond-

ing difficulties involved in the import of the same at reasonable prices due to limited foreign exchange ?

(ii) Should the efficiency of a privately operated irrigation system (tubewells, for example) be judged on the same lines as the efficiency of a public project (for example, canals)? If not, in what respects should performance appraisal of a public irrigation project differ from that of a private source of irrigation ?

(iii) How can the rate of utilization of the irrigation potential created be increased and sustained ?

In the ultimate analysis, the questions of efficiency are linked up with effects of irrigation (both favourable and unfavourable, direct and indirect, tangible and intangible, short-term and long-term) and the costs involved (both installation costs and operational costs and perhaps also costs of OFD works). As pointed out earlier, these terms need clear-cut definition even if the evaluation is to be done purely in economic terms.

For evaluating the impact of irrigation in terms of equitable distribution of water between different size-groups of farmers, in different reaches of the command area, the scope of adopting discriminatory irrigation policies (in regard to the supply of water and the rates charged for the same) in favour of small and marginal farmers may be explored. A re-definition of small and marginal farmers may be attempted in this context.

So far, attempts have been made for evaluating the efficiency of surface irrigation independently of groundwater use. In view of the inter-connection between the two systems of irrigation, the new direction of research must focus on the conjunctive use of water—both surface and underground. In the wider sense, an integrated policy of scientific management of water should meet the requirements of not only of crop production, but also of industry, human and livestock consumption, flood control, hydropower, electric generation, recreation and navigation. Such studies have been attempted abroad and may be taken up for further analysis of efficiency of water use in an integrated fashion.

IV

CONTROL OVER THE USE OF IRRIGATION WATER

The question of control over the use of irrigation water between different crops/seasons/regions/farms is connected with the issues of efficiency and equity briefly examined above. One view is that irrigation authorities should confine themselves to the supply of water at economical rates and leave its use to be determined by the farmers themselves. This freedom, it is assumed, will ensure allocation of water in an optimal manner. It may, however, run counter to the needs of the national economy and the priorities of planning accepted by the nation. It may also generate income inequality due to unequal resources at the command of different farmers. Farmers may not know the actual cropping pattern which would ensure maximum returns per acre of net sown area (per unit of water, per unit of area, per unit of time)

in a given situation, specially in the initial stages of irrigation expansion. They may not be aware of the quantity and timing of water use and may thus need deliberate direction from outside. Invidious distinctions may emerge between different users located in different reaches of the canal outlet, or in different parts of the project area. In view of these considerations many projects specify the crops for which irrigation water will be made available and also the number of irrigations which will be allowed to the farmers. Other projects do not have such restrictions on the use of water. The pros and cons of this controversy may be examined and the conditions under which and the extent to which rigid control may be enforced, need be analysed and adopted as a guide for policy. Penalties for violation of the accepted cropping pattern and/or unauthorised use of water by the farmers may also be considered in this context, to ensure justice to the tail-enders and the growers of less profitable crops like wheat, jowar and bajra in the place of sugarcane or cotton.

V

ADVERSE EFFECTS OF CANAL IRRIGATION

Joshi and Agnihotri have highlighted the adverse consequences of canal irrigation in terms of area lost due to waterlogging and salinity-alkalinity problems, and the consequential loss of output, income and employment. Their analysis is based on the experience of eleven projects and needs further appraisal in the light of experience gained in other projects. Even if the disaster and doom forecast by the authors does not appear to be imminent, it would be worthwhile to take their findings as a point of departure for further studies on the impact of canal irrigation. In this context, the issues to be examined are:

(i) Should the negative aspects of irrigation like waterlogging, salinity and alkalinity of soils and other environmental hazards be also taken into account on the side of costs ?

(ii) What remedial measures are needed to arrest the further deterioration of land on account of unsuitable water management practices ?

(iii) Does the conjunctive use of groundwater need active encouragement in order to lower the water table and conserve the non-renewable land resources ?

(iv) Should the reclamation of waterlogged, saline and alkaline lands be subsidised ?

VI

THE GENERAL ISSUES

No other infrastructural investment holds out such high promise for improving the productive base of the rural economy in India as does the investment in irrigation. It is paradoxical that returns from our irrigation projects have been so low as to have become a large operating financial deficit. A candid

and comprehensive appraisal of our strategies towards the development of irrigation resources is important and imperative. Certain fundamental questions arising in this context are:

(i) Where should be the overall investment thrust in irrigation ?

(ii) How can our irrigation investment be made more productive and fruitful ?

(iii) How should the unduly long gestation periods and slippages in the construction and completion of irrigation projects which lead to unnecessary cost escalations and result in drastically altered cost profiles which upset the entire *ex ante* evaluation be avoided ?

(iv) What should be the trade-off between investments above and below the irrigation outlet ?

(v) Is there a need for a fresh look on priorities in irrigation investment ?

(vi) What financial, organizational and administrative restructuring can be considered ?

(vii) What measures are necessary to make our projects more egalitarian and equity-oriented ?

(viii) Could modernization of old irrigation investments yield high pay-off ?

(ix) What kind of legislative backing is required for achieving a better articulated and more integrated national water policy resulting in a rational social regulation of groundwater use and irrigation ?

(x) What should be the rationale for the fixation of water rates for irrigation ?