Does Farmer Participation in Irrigation System Management Enhance Agricultural Production?

Paper prepared for the Workshop on People's Participation in Irrigation Systems Management to Enhance Agricultural Production

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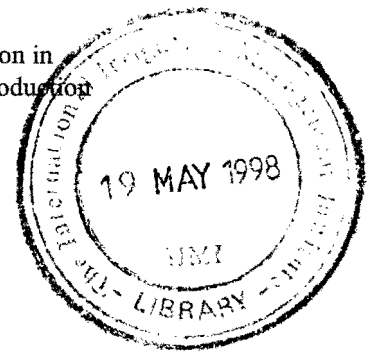

1. INTRODUCTION

The title of this workshop is "People's Participation in Irrigation Systems Management to Enhance Agricultural Production." The present paper takes the idea that "people's participation in irrigation systems management" can "enhance agricultural production" as a hypothesis. The paper elaborates the theory underlying this hypothesis and considers the evidence for it. By so doing, I hope to clarify the issues for the workshop participants.

2. THEORY

2.1 Definitions

The first step is to clarify the basic terms and concepts in the hypothesis.

Irrigation Systems Management At the most basic level, an irrigation system is a set of physical and social elements that takes water from a source, such as a river or a well, and delivers it to some other place for use in watering plants (Small and Svendsen 1992). This definition does not specify size of a system. In this paper, we consider only irrigation systems that serve more than one farmer.

Management includes many items, such as mobilizing resources, mobilizing and directing people, etc. However, the key element of management is decision making. All other elements follow from decision making. Managers are people who make decisions.

Since the primary purpose of an irrigation system is to deliver water, the core elements of irrigation system management are a) making decisions about where, when, and how much water to deliver to particular users or places, and b) implementing those decisions. The physical means of transporting water need to kept in good condition in order to successfully implement water distribution decisions. Therefore, a second major area of irrigation system management is a) deciding what, where, when, and how repairs and cleaning are to be done, b) mobilizing the needed resources to undertake these activities, and c) implementing the activities.

Participation in Irrigation Systems Management The persons directly involved in irrigation fall into two general classes:

- ***Farmers*** - persons who make use of the irrigation water to grow crops on their own land.
- ***System Managers*** - persons who are employed as managers and workers to make the irrigation system function.

These terms refer to **roles**. The actual persons taking on these roles may have other roles as well. In particular, a farmer may also be a system manager.

System managers by definition are involved in irrigation system management; farmers are not necessarily involved. The issue we are discussing is the degree of farmer participation in irrigation system management; that is, the degree to which farmers, in their roles as farmers, also take on roles as system managers.

Participation in irrigation systems management refers to taking part in any operations and maintenance activity. However, just as decision-making is the key part of management, the critical aspect of participation is taking part in decision-making, particularly decision-making about water distribution, the core irrigation systems management activity (c.f. Uphoff 1986).

The Irrigation System For discussions of system management, it is useful to view **an irrigation system** as delivering water to **farmers** rather than to crop plants. The physical means, schedules, etc., that a farmer uses to distribute water to his crop plants is the **water application system**. The water application system exists solely on a single farmer's farm, whereas the irrigation system exists outside of the farms. We are considering only the irrigation system.

From a management point of view, this distinction is important. Within the water application system, the farmer makes all the decisions on his own. His concerns are usually purely technical - namely how to make the best use of the water available. The irrigation system serves many farmers, each of whom has his own interests; decision-making for the irrigation system has a political dimension.

Irrigation Service From the point of view of a farmer, an irrigation system is of use to him only insofar as it delivers water to him in quantities and on a schedule that fits the needs of his crop plants. That is, he views the irrigation system as providing a service. From the point of view of each farmer, the ideal irrigation system is one in which the farmer can directly control the system so that he can decide the quantities and schedules and make sure that they happen.

Enhancing Agricultural Production Finally, we have to consider what we want to include within the concept of "enhancing agricultural production." In this paper, I take this term to refer to **increasing the value of irrigated agricultural production for the farmers**.

There are four ways in which the value of irrigated agricultural production can be raised. These include:

- increasing the yields of customary irrigated crops,
- increasing the area planted of customary irrigated crops,
- decreasing the cost of production of customary irrigation crops,
- switching to higher value irrigated crops.

2.2 Improving Irrigation Service

Irrigation Service as a Link The linkage between farmer participation in irrigation system management and agricultural production is not immediately evident. Irrigated agricultural production is affected by a wide variety of factors, including crop choice, soils, climate, pests, inputs, irrigation service, and others. Since it is reasonable to suppose that farmer participation in irrigation system management might affect irrigation service, irrigation service is hypothesized as the direct link between farmer participation and agricultural production.

Matching Irrigation Water Supply and Demand The basic irrigation system management problem is to match irrigation water supply and farmer demands. There are two aspects to matching supply and demand:

- System managers can attempt to deliver water to farmers to meet their needs. That is, the system managers can try to make supply match the demand.
- Farmers can adopt crops and technologies that are adapted to the water supply he expects. That is, farmers can attempt to match their demands to the supply.

Modifying Supply to Match Demand Given that the irrigation system serves multiple farmers, perhaps thousands, how can the system manager deliver water to match the demands of farmers?

The many possible approaches all fit on a continuum between two polar extremes. At one end of the continuum, system managers can make large amounts of water available at all times to every farmer. Farmers then just take water when they need it in the amount they need. This approach requires little management effort but does not make efficient use of water. At the other end of the continuum, system managers can deliver water to each farmer according to his needs at the time. This approach requires that system managers have knowledge of farmers' needs at all times, and excellent control over water delivery, including the flexibility to change delivery patterns. In this approach management intensity is high, but water delivery efficiency is high. In today's world, the increasing demand for water compels system managers to try to make efficient use of available water.

To use water efficiently, system managers need knowledge of farmers' needs for water. Ways in which system managers get information on farmers' needs include, but are not limited to:

- Negotiating with farmers as a group over seasonal plans; e.g. Sri Lanka (Brewer 1996).
- Requiring farmers to apply for water before each season; the application must identify the crop(s) to be irrigated; e.g. *shejpali* Maharashtra and Gujarat (Brewer et. al. 1998).
- Requiring system managers to estimate farmers' demand at regular intervals throughout the season; e.g. Tamil Nadu (Brewer et. al. 1997), Bihar (Raju et.al. 1994) and Mexico (van der Zaag 1992).

These approaches only approximate actual demand. Perfect knowledge of demand is impossible in any system with a large number of farmers; there are always variations in crops, planting dates, and other factors. Also, even if the system managers have a good knowledge of demand, they can only respond appropriately if the physical and management systems can deliver water as needed to satisfy the demand; therefore good control over water deliveries is also necessary.

There are systems in which both good knowledge of farmers' demands and good control over water delivery exist. In the North Poudre Valley in Colorado (Early 1990), farmers can order water when and in the quantities they want, within certain limits. This gives the system managers perfect knowledge of demand. The water is delivered within 24 hours. This ideal situation is rare. Reasons include lack of technical knowledge among farmers and system managers, lack of wealth needed to build and maintain the physical and management systems needed, and lack of water rights that define the limits within which individual farmers can order water.

Modifying Demand to Match Supply The alternative is to modify demand to match the supply. Several approaches are taken or proposed, including, among others:

- Charging high fees for water to discourage demand.
- Government or system managers' regulation of crops; e.g. localization rules in southern India (Brewer et.al. 1998: Sect. 3).

- Scheduling without regard to crop needs (supply-driven irrigation systems); e.g. *warabandi* systems in northern India (Malhotra 1982).

These approaches do not necessarily eliminate the need for the system managers to know farmers' demands since variations in crops, timing of planting, and other items can introduce different demands. Supply-driven systems attempt to eliminate the need for knowledge of farmers' demands needs. In these systems, system managers attempt to provide a reliable supply of water on the premise is that reliability of supply will enable farmers to make the best use of the irrigation water.

2.3 Farmer Participation to Improve Irrigation Service

Farmer Participation Requires Organization of Farmers Farmers want good irrigation service. There is strong evidence that when it is not good, they will take action to make it so (Brewer et.al. 1997) or will try to find other sources of water, such as installing tube wells in surface commands (e.g. see Water and Land Management Institute UP & Water Resources Development Training Center. 1992). Even if no formal channels for appropriate actions exist, there are many possible ways for farmers to influence system managers' decisions; these means include bribery, political pressure, demonstrations, and others (e.g. see Wade 1987; Brewer et.al. 1997).

We will not consider such non-formalized activities "farmer participation in irrigation system management." Here, the term "farmer participation in irrigation system management" refers to formalized organizations and procedures by which farmers take part in decision-making.

For management, the managers must be organized. System managers are organized; system management organizations may be branches of a state agency as in most government systems in India or they may take other forms. For farmers to formally participate in irrigation management, they also must be incorporated **as farmers or farmer representatives** into the system management organization. One common type of farmer organization for this purpose is the water user association that takes direct management responsibility for a part or the whole of an irrigation system,

There are many organizational forms for farmers to take part in irrigation system management. Organizational form and creating farmer organizations are the most discussed aspects of farmer participation in irrigation system management (for example, see the papers in Johnson et.al. 1995). This paper makes no attempt to discuss the issues. This large literature has made clear that, under the proper circumstances, farmers are quite capable of successfully managing farmer organizations for irrigation system management. Our interest is in the consequences of creating farmer organizations.

Organization of Farmers can Improve Irrigation Service Studies have shown that the successful organization of farmers to take part in irrigation system management has the following consequences that tend to improve irrigation service:

- Farmer organizations provide communication channels by which farmers can effectively inform system managers of their demands (e.g. IIMI/ARTI 1997). In many cases, the farmer organizations provide means by which conflicts among demands can be resolved (Vermillion 1997). Also, they provide means by which system managers can inform farmers about supply limitations and difficulties of delivery (e.g. Brewer 1996). Communication between farmers and system managers allows both to take appropriate measures to match supply to demand.

- Farmer organizations provide farmers with "voice", and sometimes direct means, to ensure that the system managers are accountable to the farmers (Paul 1994). If system managers are accountable to farmers, they will follow the water distribution decisions that match supply with demands.

- In government managed systems, farmer organizations provide a means by which resources above those provided by the government can be mobilized for maintenance and other tasks (e.g. IIMI/ARTI 1997). Extra resources can help ensure that physical system controls are adequate to implement water distribution decisions.

- Where farmer organizations take direct management responsibility for portions of large systems, the total management effort is divided among a larger number of system managers. If done properly this simplifies system managers' jobs and makes them more effective. For example, in Maharashtra we found that the Shri Datta Society in the Mula System is more effective in minor canal maintenance than is the Irrigation Department using the same resources. The difference is the added management effort that allows the Datta Society, which is concerned only with one minor canal, to use those resources precisely while the Irrigation Department engineers are concerned with many minors and cannot provide the same kind of management effort.

It is not surprising then that many studies shown that farmer participation improves irrigation service (see various entries in the references). The potential of farmer participation, if properly implemented and in the proper circumstances, to improve irrigation service is well established.

Other Consequences of Organization of Farmers Although farmer participation improves irrigation service, the primary motive for adoption of farmer participation in irrigation system management by governments and donor agencies is shifting the burden of financing irrigation system management from governments to farmers (e.g. for Indian states see Brewer et.al. 1998: Sect. 3 and App. A); see also the country papers in Geijer 1995). In many cases, this goal has been, at least in part, achieved.

Alternative Strategies to Improve Irrigation Service Increasing farmer participation in irrigation system management is not the only possible strategy for improving irrigation service.

It has been suggested that increasing the fees charged to farmers for irrigation service will allow system management organizations to invest in additional capital and personnel to improve service. Because this approach does not improve communication between system managers and farmers, it does not solve the problem of matching supply and demand.

Supply-driven irrigation system management is also promoted as an alternative. The goal of supply-driven management is to provide a reliable water supply to farmers. It is assumed that once the farmers are sure of their water supply, they can adapt crops and technologies to that water supply. The supply-driven approach is felt to be appropriate where water is short and where management resources are small. Supply-driven irrigation management relieves system managers of the need for information on farmers' needs. Some irrigation specialists thus argue that a supply-driven system has no need for farmer participation (e.g. see Haryana in Brewer et.al. 1998: App. A). However, to ensure reliable delivery, a supply-driven system may have high maintenance requirements.

2.4 Irrigation Service and Agricultural Production

Farmer participation can and generally does improve irrigation service. For the most part, it is taken for granted that improving irrigation service will enhance agricultural production. Here we consider the theory underlying this idea. We consider the evidence in the next section.

Improved irrigation service should enhance irrigated agricultural production for the following reasons:

- Water shortages caused by poor irrigation service harm crop production.
- Security of irrigation water supply may lead farmers to make greater investments in other inputs, thus leading to higher production.
- Security of water supply may lead farmers to adopt higher value crops sensitive to water stress, thus improving the value of agricultural production.
- Improved irrigation service from large systems may result in less dependence on private wells or on bribes and other actions to get water, thus reducing costs of production.

2.5 Evidence for Enhanced Agricultural Production

While there are a very large number of studies showing that increased farmer participation generally improves irrigation service, the number of studies linking irrigation service brought about by farmer participation and agricultural production is much smaller. For example, only 14 of 25 case studies presented at the large 1994 IIMI conference on irrigation management discussed increases in production or productivity (Vermillion 1997:19). Similarly, virtually none of the country reports in a 1995 FAO volume on irrigation management transfer report on agricultural impacts (Geijer 1995). One reason for this relative neglect is that agricultural production depends upon a large number of factors, not irrigation only, and thus is harder to assess than are other indicators.

We will consider three studies that have looked at a number of cases:

- ***A Study of Impacts of Irrigation Management Transfer***

  Vermillion (1997) considered impacts of irrigation management transfer in a number of studies from around the world. He shows that in most cases, the studies reported improvements in irrigation service; although he also finds counter examples.

  Table 1 (Vermillion 1997: 21) shows the findings on agricultural production impacts from 17 studies. The following points can be seen in the table:

  - Fourteen of the 17 studies report increases in agricultural production or in profitability.
  - The scale of the increases varies greatly.

  While this sample suggests that improved farmer participation is likely to lead to improvements in production of existing irrigated crops, primarily due to increases in the areas under irrigation, it also makes clear that there is a large variability in impacts.

- ***A Study of the Sri Lankan Participatory Management Program***

  A two-year IWMI study of Sri Lanka's program for increasing farmer participation (IIMI/ARTI 1997) looked in detail at 33 cases and surveyed 176 farmer organizations in 42 irrigation schemes. This study found clear evidence that farmer participation improved irrigation service and did so despite decreased government resources for irrigation management. However, the findings on agricultural production were:

  - While there were numerous anecdotes of increases in area cultivated or cropping intensity, statistically the increases were insignificant.
  - There was no evidence for increases in yields of paddy, the dominant crop.
  - There were no significant decreases in costs of production and there were reported increases.
  - Reported shifts in crops could be traced primarily to market forces rather than to changes in irrigation service.

However, lack of improvements in agricultural production may be a result of worsening market conditions for paddy farmers in Sri Lanka. From 1985 to 1995, government policies kept rice prices stable while allowing input prices to rise dramatically, thus squeezing the farmers. This suggests that agricultural production may improve when policy conditions change.

Table 1: **Reported Impacts of Irrigation Management Transfer on Agricultural and Economic Productivity**

Study, County, Type of Irrigation	Agricultural Productivity	Economic Productivity
Wijayaratna and Vermillion 1994, Philippines, SI	Increases in cropping intensity.	NA
Svendsen 1992, Philippines, SI, LI	Rice yields increased by 4% to 4 t/ha in both wet and dry seasons.*	NA
Nguyen & Luong 1994, Vietnam, LI	Cropping intensity increased from 170% to 250%. 14% increase in area cropped. Yield increased 13%.	Annual incremental benefits increased by US$193/ha or by $182/ha net of increased O&M cost.
Johnson, et al 1995, China, SI	Grain yields increased modestly.	Cases of increase and decrease in net income.
IIMI & BAU 1996, Bangladesh, LI	Slight increase in cropping intensities. Mixed results for yields.	Small farmers (<1 ha) becoming a growing share of pump owners and of expanding irrigated area (58% to 63%, 1989-94).
Mishra & Molden 1996, Nepal, SI	Rice yields increased from 2.2 t/ha to 3.4 t/ha. Wheat yields increased from 1.6 t/ha to 2.4 t/ha.	NA
Kloezen 1996, Sri Lanka, SI	Cropping intensities increased from 138% to 200%.	Gross annual value of output between US$944/ha and $1,136/ha after IMT.
Pant 1994, India, LI	Cropping intensity increased from 143% to 162%. Yields increased 10%.	NA
Kalro & Naik 1995, India, SI, LI	Increases in cropping intensities and crop diversification. No change in yields.	NA
Azziz 1994, Egypt, SI	10-16% increase in main crop yields.	Increase in farm incomes by US$60/ha.
Samad & Dingle 1995, Sudan, LI	High yields per unit of water in parastatal schemes (17 kg/100m^3) vs turned-over schemes (11 kg/100 m^3).	Gross margin 3 times higher in parastatal than in turned-over schemes. Productivity of land and water higher in parastatal than in turned-over schemes.
Maurya 1993, Musa 1994, Nigeria, SI	Increase in dry-season cropped area by 80%.	NA
Wester, During, & Oorthuizen 1995, Senegal, LI	Cropping intensity rising and falling in different locations	Cost of irrigated rice production increased 78%.
Vermillion & Garces-Restrepo 1996, Colombia, SI, LI	Rice yields of 6.5 t/ha sustained after IMT. Cultivated land continued to expand. More crop diversification.	Net farm income rose 23%. Economic return to irrigation was US$11-12/100 m^3 water. Gross value of output increased 400%, 1983-91.
Johnson 1996, Mexico, SI	No change in cropping intensity or yields.	Annual economic returns (US$1,500-1,900/ha) remained same or declined.
Svendsen & Vermillion 1994, USA, SI	Shift to less water-intensive crops but more due to changing water application technology and markets.	Average farm incomes rose 15% due to reduction in water cost.

Source: Vermillion 1997: Table 4, p 21

* Adjusted for differences in nitrogen fertilizer use and rainfall.

SI = surface irrigation, LI = lift irrigation, NA = not available

- ***A Study of the Status of Management Transfer in India***

An IIMA/IWMI study in India looked at 21 farmer organizations created for purposes of irrigation system management in Gujarat, Maharashtra, and Tamil Nadu (Brewer et.al. 1998).

These included 13 cases from major and medium government managed systems, three farmer managed lift irrigation systems, and five farmer managed small tanks. The lift and small tank cases are not considered here.

All except one of the 13 farmer organization cases in major and medium government managed systems showed improvements in irrigation service. However, only eight showed some form of enhanced agricultural production, mostly increased production because of increases in area irrigated. Of these, however, four were able to increase the area irrigated largely because the farmer organizations received increased supplies of water from the system managers. If we discount these cases because giving increased supplies of water to all farmer organizations is not possible, then only about a third showed enhanced agricultural production.

These cases show that organized farmers are capable of taking advantage of changed irrigation conditions to enhance agricultural production, but they suggest that such a consequence is not inevitable.

2.6 Conclusions

Overall, then, the evidence suggests that while farmer participation usually leads to improved irrigation service, improved irrigation service does not necessarily lead to short run enhancements in agricultural production. This is because changes in agricultural production are influenced by a large number of factors in addition to irrigation service; unless other conditions are right, no enhancement will occur.

At the moment, the evidence is still not fully satisfactory, in part because so few studies of farmer participation have attempted to measure the agricultural production impacts. All evidence that we have refers to the short run only, during which other factors may dominate irrigation service.

Therefore, I suggest the following. Improvements in irrigation service imply greater reliability in water delivery over a potentially long period because of better operations and improved maintenance. Thus farmer participation may stabilize irrigation service. Over the long run, stabilized irrigation service may allow farmers to improve long run average production. At the moment, however, there is no relevant evidence.

3. LESSONS

The evidence suggests the following points:

- Improving farmer participation in irrigation system management is highly likely to lead to improved irrigation service and may well lead to reducing government irrigation management costs and to making the systems more sustainable.

- Improving irrigation service through improving farmer participation or in some other way creates opportunities for enhancement of agricultural production. However, agricultural production may not change in the short run unless other conditions are suitable.

- Improving irrigation service may stabilize production and enhance production over the long run.

The key conclusion is that farmer participation only creates conditions conducive to enhancement of agricultural production. It is merely a starting point; agencies concerned with development of irrigated agriculture have to look beyond farmer participation.

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