



IRRIGATION MANAGEMENT NETWORK

FARMER PARTICIPATION IN PLANNING,
IMPLEMENTATION AND OPERATION OF SMALL-SCALE
IRRIGATION PROJECTS

Ian Smout

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1 INTRODUCTION

1.1 Purpose and Scope

The aim of this paper is to recommend practical methods of executing small-scale irrigation projects through farmer participation. The key points are summarised in Table 1 (centrefold). These are discussed and expanded in the paper.

The paper is an attempt to integrate my consultancy experience as an engineer in Asia, published accounts of experience elsewhere and discussions with colleagues (for example in the UK working group on small-scale irrigation). The main ideas were formulated during work on tubewell irrigation in Indonesia in the mid 1980s and more recently on hill irrigation in Bhutan. (Details of this work may be found in Smout, 1986 on the Madura Groundwater Irrigation Project and van Bentum et al, 1989 on the Chirang Hill Irrigation Project.) These projects are used as examples in the paper and their characteristics provide the focus of the discussion: both projects are implemented by government agencies and consist of numerous discrete irrigation schemes; on each scheme there are many households and a water user association (WUA) provides a structure for participation.

After introductory material on small-scale irrigation projects and participation, the recommendations for each stage of a project are discussed in rough chronological order in sections 2 to 5, starting with overall project organisation and then dealing with the preparation, implementation and operation of a particular scheme.

1.2 Small-scale Irrigation Projects

Small-scale irrigation has been defined (Carter, 1989) as:

irrigation, usually on small plots, in which farmers have the major controlling influence, and using a level of technology which the farmers can effectively operate and maintain.

The concept of small-scale irrigation thus combines small size with farmer management. It covers a wide range of complexity from the small garden of a single household, to canal and tubewell systems which serve 50 farmers or more. It includes both 'traditional' irrigation schemes built from indigenous technology and new developments with external assistance.

Traditional schemes present numerous success stories of small-scale irrigation. Farmers have been constructing and operating these schemes successfully for centuries all over the world. In most African countries for example (except for Egypt and Sudan), the area of farmer-managed irrigation is much greater than the area of formal irrigation (FAO, 1987). Most traditional irrigation schemes have small command areas, but there are also some large schemes of several thousand hectares, for example the Chhatis Mauja in Nepal, a 150 year old system which irrigates 3000 ha. This is run by the farmers through a three tier representative structure, with rules and methods which have been developed for maintenance, detection and punishment of infringements, and allocation and distribution of water (Chambers, 1988; the scheme has also been studied by IIMI). This scheme illustrates farmers' capability over the range of irrigation management tasks and shows that farmer management is possible even on large schemes. However there are also farmer-managed irrigation schemes of various sizes in Nepal and elsewhere which seem to have failed or under-achieved from poor management, for example inadequate maintenance. Examples can be found in applications to government for the renovation of these schemes.

Farmer-managed irrigation has been neglected in the past, and small-scale irrigation in particular may still be under-estimated in government statistics, but both its existing contribution and its potential to improve agricultural production are now much better recognised.

As well as this greater recognition, governments and aid agencies are now attempting to promote and improve small-scale, farmer-managed irrigation through development projects, perhaps because of the high cost and disappointing performance of some recent large, formally-managed irrigation projects. This interest in developing small-scale irrigation has

resulted in the involvement of professional staff, from government, non-governmental organisations (NGOs) and consultants, in the planning and implementation of small-scale irrigation, instead of these being carried out by the farmers alone. On some projects this process has excluded farmers' participation, but this loses the benefits of small-scale irrigation and is unnecessary. Practical ways are described below for professional staff to work with farmers effectively to produce farmer-managed irrigation schemes.

Small-scale irrigation projects cover both the improvement of traditional irrigation schemes and new developments to introduce small-scale irrigation on land which is not currently irrigated. Each project is assumed in this paper to include a number of individual irrigation schemes.

The main aim of these projects is to improve farmers' production where water shortage is a major constraint, by investments in irrigation infrastructure which improve water availability at the field. In general these projects work with the existing landholdings and structure of power. However in some cases small-scale irrigation is used to bring new land under cultivation, which can then be allocated to village families. Small-scale irrigation may also be directed to benefit disadvantaged groups, for example the programmes of various non-governmental organisations in Bangladesh, to provide landless groups with a tubewell or low lift pump so that they can sell irrigation water to farmers with land (Palmer-Jones and Mandel, 1987).

1.3 Participation

McPherson and McGarry (1987) define participation as the inclusion of the intended beneficiaries in the solving of their own problems. They describe the benefits of participation as:

- lower costs;
- a greater likelihood of user acceptance of the technology;
- appropriate and socially accepted designs;
- user care and maintenance of the facilities;
- the assumption by the users of part if not all of the responsibility for operations and maintenance.

These are strong arguments for a participative approach to small-scale irrigation projects, especially as the crucial long term operation and maintenance tasks will normally have to be carried out by the community for cost and logistical reasons. Participation of farmers in the earlier

stages of the project then helps to ensure that they will be able to carry out these tasks successfully. However a flexible approach is needed to achieve this, and after reviewing user participation in water and sanitation projects, McPherson and McGarry (1987) reach the following conclusions:

The degree of participation is really not the central issue. Ideally users should be involved in every phase of a project but this is sometimes not feasible for a variety of reasons. What is vital is that the participation should be an agreeable and beneficial experience for the users so that when the facilities are constructed they have a sense of pride in their ownership of them, are pleased with what they have accomplished and have learned how to care for the system.

Similarly for small-scale irrigation schemes, participation is not a fixed procedure to be followed strictly like a blueprint, but a general approach of joint work between the farmers and the agency. Forms of participation will therefore vary between projects and even between schemes on the same project.

Although valuable lessons can be learnt from experience on other community development projects such as water supply, participation in small-scale irrigation projects may be more complicated and difficult. Particular problems arise because farmers with larger landholdings will normally benefit much more than others from the scheme. This is one of the limitations of irrigation projects on existing landholdings compared to settlement projects with equal sized plots (though in practice settlement projects have often had difficulty providing reasonable benefits for the settlers and maintaining equity between top-enders and tail-enders and between early settlers and late settlers).

2 PROJECT ORGANISATION

2.1 Implementing Agency

Ideally the same agency should be responsible for the irrigation engineering and the development of farmer participation, so as to ensure that the participation feeds back into the engineering decisions. A key step in the Philippines seems to have been the combination of these functions in the National Irrigation Administration (Bagadion, 1989). This requires that the agency has the necessary expertise and commitment to farmer participation, which may be new to government irrigation agencies. NGOs however are often particularly well suited to implement small-scale irrigation projects because of their general grassroots approach (Carter, 1989).

For projects which work with the existing social structure, local technical staff are well able to implement a policy of participative development, given on-the-job training and support. However it is important that staff have a positive attitude towards participation. Problems are likely to arise if there is a wide difference in the relative status of project staff and farmers, in which case staff are unlikely to encourage effective participation unless they are really pushed by their superiors.

It is easier for a project to follow a participatory approach if this is the accepted policy of the agency. If participation is being introduced for the first time, it is important that the senior staff in the agency understand and support the participative approach. It would be unrealistic to expect junior staff to introduce a participatory approach without institutional support, or to pursue radical social objectives.

If there are difficulties adopting a fully participative approach, it may be possible to start with limited consultation, and use this as a learning process which leads to greater participation.

Important factors on the hill irrigation project in Bhutan have been:

- the government policy that farmers have to provide the unskilled labour required for rehabilitation work;
- the consensus on the participative approach among the project staff, project manager, technical staff and consultant;
- the rapport which has developed between the technical staff and the local farmers, particularly the village heads and the leaders of the water user associations (WUAs).

2.2 Choice

One way in which a project can approach participation is to provide the farmers with choices between different technical options. This process depends on decision-making by a group (except where each individual has an irrigation source, for example, a small pump project) on matters which affect individual farmers in different ways. It may be difficult to get agreement, and decisions may change erratically in some circumstances, but this problem applies to all forms of participation. Skilful project staff can lead the group towards firm decisions, with assistance from local leaders.

At its most fundamental, this approach entails explaining and demonstrating clearly what the project can offer, under what conditions (covering contributions of money or labour, responsibility for operation and maintenance, etc), and giving the farmer group the choice whether to apply for a scheme or not.

Some projects may be able to offer a choice of the type/size of development, possibly like a 'shopping list'. For example, a groundwater project might be able to offer choices between a shallow tubewell and a deep tubewell, a short-life and a long-life screen, a diesel and an electric motorised pump, and between a simple discharge box and a full distribution system with canals and structures. Farmers' choices on these will clearly depend on the conditions attached to each, such as costs, and these must be fully explained.

Other projects offer just one type of development and choice may be limited. For example, the Indonesian groundwater project used deep tubewells with diesel powered pumps, and standard canal and structure designs. The layout of the command area and canals and structures was the only area of choice in the design. (Nevertheless, as discussed below, the choice of this layout is extremely important to the farmers.) The Bhutan project covered rehabilitation of gravity canal systems within a budget limit, and the main choices here were the priority lengths of canal for rehabilitation, and the works to be constructed.

2.3 Replication

It is usually desirable for a small-scale irrigation project to cover a number of schemes, so that the total area which benefits is sufficient to justify the start up costs of outside assistance. Ideally the schemes are all close together, and of a similar type so that the same approach can be used on each. It is necessary to plan for this expansion and replication from the beginning, and develop the institutions which will carry it out. Four elements seem to be important:

- developing with the local staff, simple standard procedures and designs which are suitable for the project and acceptable to the farmers. This may take some time, discussions and trials, before a satisfactory package can be finalised;
- training local staff to carry out these procedures;

- allowing flexibility for local modification and bargaining with the beneficiaries where necessary;
- establishing good relations with the local communities, an understanding of the project's aims and activities, and a good reputation, so that there is a demand for schemes.

2.4 Project Timescale

It commonly takes some years to establish the project as described above and build up to a high rate of implementation. Each individual scheme may also have a long preparatory and design period, with a series of meetings, during which the farmers' understanding and decisions firm up. It is necessary to allow for this time in the overall project programme. The standard five year project term is often too short for the stages of establishment, build up and replication, and does not allow a project to achieve its full potential benefits.

Small-scale irrigation is little different in this to other types of participative projects for the construction of small works. Working on irrigation in Bhutan, the most valuable guide I found to organisation of a participative project was the account by Glennie (1983) of the development of an organisation to undertake participative rural water supply in Malawi. He describes the two year pilot phase and six year consolidation phase of the programme before it reached full development. Glennie emphasises that the rate of expansion was controlled at the level at which staff could be trained and the work properly supervised.

3 PREPARATION

3.1 Mobilisation and Leadership

3.1.1 Approach and Communications Methods

Communication and mobilisation are recurring activities, which arise at various times during the development of a scheme. Information about the project may be spread through the local administration and meetings with village leaders or directly in the villages themselves.

Early requirements are to spread information about the scope of the project and to raise the farmers' awareness and interest. These often involve the introduction of new ideas which are outside the farmers'

understanding and experience, covering both the potential of irrigation and its limitations in the local situation. Development staff have the difficult task of devising a suitable way to communicate these ideas.

A practical, field-based and participative approach seems to be appropriate, and agricultural extension can provide some useful guidance for this, with its emphasis on simple messages and use of demonstration sites. My preferred approach is to get work started wherever there is interest from the farmers and local leadership, to learn from the initial schemes and thereby develop suitable standard procedures, and then to use the most successful of these schemes as demonstration sites to focus discussion on the project's approach with farmers from elsewhere. The key is to get started, and then to develop a successful package which is demonstrable and replicable.

In another paper in this set, Millican (1990) describes different ways of communicating with farmers groups through discussion, including the use of stories. These techniques are interesting both for mobilisation and for subsequent discussions with farmers as the scheme progresses. Health education workers also have considerable experience in community mobilisation, and Laver (1986) provides a valuable example of communication methods adopted at the different phases of a project for low cost sanitation in Zimbabwe. I found these useful for tubewell irrigation development in Indonesia. The methods include meetings with key leaders, group discussions, visits to demonstration sites, and use of various types of visual aid. Visual aids made for the Indonesian project comprised posters and videos to put over the project's messages in an attractive way, and we also used an existing film. Both the videos and the film were built around a story. In all cases the main purpose of the visual aids was to arouse interest, and the message itself was stressed verbally as clearly as possible, for example by a summary at the end of the video. Conveying messages through the pictures themselves is complex, requiring greater skills to prevent misunderstandings.

Some innovative training techniques have also been developed for health education, including song, dance, drama and role-play (Werner and Bower, 1982). These techniques have been tried for agricultural extension in a limited way, including, for example, the use of puppets in Nigeria and Bhutan, and they could also be used to generate interest in small-scale irrigation.

3.1.2 Institutions

In some countries (notably the Philippines), specialist Community Organisers have been posted to the villages for several months to facilitate the process of mobilisation. In principle they may be able to by-pass the existing power structure and encourage democratic participation, including the involvement of people who are often not consulted such as women and the poor. In practice however their success may depend on support from the large landowners. The Community Organiser may remain in the village throughout the preparation and implementation stages of the scheme. (Illo, 1989, gives an interesting case study.) This is an exciting approach, which could be a means of introducing real social change, but it requires substantial resources of educated personnel who are prepared to work in the villages. It may generally be easier for NGOs to work in this way than for government agencies.

Government agencies in other countries rely more on their usual technical and administrative staff, working through the existing social and administrative structure to mobilise farmer participation. This approach can also require a significant commitment of time for meetings, etc. In a cohesive community with good leadership and trust in the government staff, the approach can work well, but in other circumstances local divisions and powerful individuals can cause major problems, possibly resulting in the failure of the scheme.

These local forces can be seen as built-in hazards of farmer-managed irrigation. Three possible unifying forces are discussed below:

- the project staff;
- the local government structure;
- the group of beneficiaries organised in a water user association (WUA).

Project technical and administrative staff can carry out similar work to Community Organisers (but in a more limited way) provided they are well supported by their agency and can call in assistance from senior staff when problems arise. On-the-job training is needed initially. With continuity, staff can develop good relations with the farmers over the project period, which is very important for implementing the scheme.

Local government representatives and officials can provide leadership, endorsement of the project, and assistance in resolving the frequent misunderstandings and disagreements which arise among the farmers and

between them and the agency. It is important that the local administration also respects the farmers' right to make decisions about the scheme.

A WUA can offer some countervailing power to any divisive forces in the community. The WUA is an organisation of the beneficiaries of the scheme, which holds meetings and co-ordinates farmers' activities such as operation and maintenance. Ideally it is run like a cooperative, with responsible elected officers, and written records of decisions made in the meetings and of WUA accounts. One of the important aims of the project staff should be to develop a strong and effective WUA (see sections 4.1 and 4.4).

In practice, local elites are often powerful and may have a strong influence over the WUA, but the structure of the WUA provides some constraints. As the consultants on a deep tubewell project in Bangladesh point out (MacDonald and Hunting, 1987):

[The WUA] involves the placement of existing power groups within a framework of procedures and control and the development of their accountability within this framework...The clear advantage of this approach is that it makes use of scarce resources of management and leadership in villages.

Leadership is crucial, to overcome the inertia and wariness in the community, and persuade the farmers to work together for a sustained period before receiving the benefits which result from small-scale irrigation. This leadership may be developed by a Community Organiser, or it may come from a respected community leader or entrepreneur. Sometimes it can also be provided by a charismatic leader, such as the Aga Khan in parts of Pakistan.

3.2 Application for Development

It is important that the initiative for the scheme comes from the beneficiaries, and it is not imposed from outside. One way to do this is to start the development process with an application for a scheme. On the Bhutan project, villagers who want improvements to their canal must submit an application, in which they provide details of the farmers and their irrigated landholding areas on the canal, request improvement works, say how much unpaid labour they can provide each month, and commit themselves to maintain the works in future. This application must be signed by all the beneficiaries, so it encourages them to meet and discuss the project. The application can also be a valuable bargaining tool later,

as the villagers (or the agency) can be reminded of the commitments they made, to provide labour etc.

3.3 Meetings Between Project Staff and Farmers

Project staff should try to establish a community consensus about the scheme at an early stage, and this requires that they clearly explain the proposals, the timetable, and the farmers' obligations if the scheme goes ahead. Similarly, farmers can be encouraged to explain their difficulties, for example over working on the scheme at certain times, or problems with land or water rights. It is important to determine whether there is real interest in the scheme, or if it is just being pushed by one or two powerful individuals without community support.

In initial meetings, farmers can advise project staff about the existing problems which need attention, and their priorities. It is important for the project staff to identify the constraints on the existing cropping, and how these may be overcome. On the project to improve existing canals in Bhutan, a 'problem area' approach was adopted, whereby work was concentrated on the problem sections of the canal which limited its overall conveyance capacity. The value of the materials and skilled labour to be used on each canal was limited to \$450 per hectare in 1986, which was the average cost used at appraisal of the project. The per hectare cost limit is one of the few feasibility criteria available to a development agency in small-scale irrigation (see for instance Ansari, 1989); it requires the agency to make reasonably accurate estimates of cost before committing itself to undertake a scheme.

The problem area approach need not be applied only to the physical irrigation infrastructure. The constraints may lie elsewhere, possibly with the management (requiring work to strengthen the WUA), or agricultural services, or markets. In these cases, it is unlikely that farmers will be interested in working on irrigation development until these problems are solved.

In these early meetings, the command area boundary can be a major issue, and discussions need to be held with the farmers to decide the location of the boundaries of the command area, which farmers' land is to be included, and which excluded. Considerable change may be involved: Martens (1939) describes a project in Nepal where the farmers persuaded the engineers to increase the command area by 70% over the initial proposal.

**KEY POINTS FOR FARMER PARTICIPATION IN SMALL-SCALE
IRRIGATION PROJECTS**

KEY POINT	EXPLANATION	POSSIBLE DIFFICULTY IF NOT DONE
PROJECT ORGANISATION		
Agency covers both engineering and participation	To enable dialogue between the farmers and the engineer	Confusion and inter-agency disputes
Senior agency and project staff support the policy of farmer participation	Agreement within the agency is necessary to provide consistent approach	Staff will tend to neglect participation as though it is unimportant
Procedures and designs are standardised	This makes it easier to understand the options and to reach agreements. Also necessary for replication	Extra time needed for design and for construction supervision. Wasteful mistakes. Slow progress.
Staff are trained in project procedures, etc (including newly appointed staff)	Participative procedures are likely to be new to many staff	Staff fail to implement the procedures as intended
Agency agrees basic project concept and division of responsibilities with local administrative leaders	The project should be consistent with other local programmes. The local administration can assist in resolving disagreements and disputes with the farmers	Disagreements with the local administration can cause disruption and confuse the farmers
Demonstration sites are set up and used for farmer visits	These provide a physical example of the project concept which farmers can see and understand	Farmers are likely to be uncertain about the project concept and its value
Project programme includes reasonable time allowance for start up and gradual expansion	Time is necessary to develop viable procedures and designs and train staff and implement maximum number of schemes	Project progress will be below target and emphasis on output may reduce standards
SCHEME DEVELOPMENT		
Staff hold open meetings in village to discuss project, including project scope; land and water rights; villagers obligations to contribute cash, labour, land, etc; responsibilities for operation and maintenance; timetable.	It is essential to clarify these issues before going ahead with the scheme	Farmers will be reluctant to participate and disputes may arise later about issues which were not explained in advance

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Farmers groups submits application for assistance with irrigation development	The application requires prior discussion among the farmers and represents a commitment to the scheme	Agency may go ahead with a scheme which farmers do not want
Water user association is set up	Provides a structure for participation	Difficult for agency to liaise with farmers and get firm decisions
Staff hold discussions on site on preliminary design	Need to agree command area, canal layout, position of outlets, etc	Disagreements with farmers during construction and possible damage to works later
Technical staff retain responsibility for technical decisions	The training and experience of technical staff must be used to develop appropriate designs for farmers' needs	Waste of resources in unsuitable or short-lived works
Farmers contribute unskilled construction labour	This gives the farmers a direct involvement in the scheme and trains them for operation and maintenance	Farmers consider the scheme belongs to the agency
Farmers elect construction committee or leader to organise their construction labour	The difficult tasks of organising farmers' labour are best done by their own representative	Poor labour turnout and poor work performance. Waste of agency staff time
Project has separate base force of skilled and unskilled labour	The project labour force can then work independently of the farmers on complex tasks	Delays and inefficient use of skilled project labour
WUA is formalised and opens a bank account	The responsibilities of WUA officers are specified and procedures are standardised	Erratic WUA performance and unaccountable officers
Agency trains WUA officers	The officers' tasks are unfamiliar and need to be explained and demonstrated	Inactive officers
Scheme is handed over to WUA after commissioning and WUA is then responsible for operation and maintenance	The responsibilities of the WUA and the agency must be stated very clearly	Delays in hand over can cause confusion about the farmers' responsibilities
Agency monitors condition and performance of scheme	The role of the agency is to check and support the work of the WUA, not direct it	Preventive maintenance might be neglected or a weak WUA could become inactive

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It is important to remember that the command area defines the group of people who will have to cooperate in the eventual operation and maintenance of the scheme, and the existing social relationships in rural communities are very relevant to this. As an example, in southern Bhutan there are numerous small, parallel canals, each constructed by a small group of about 5 to 10 families. In some cases, the canal crosses another canal to feed a lower command area. However, attempts to persuade the farmers to combine two traditional schemes into one improved scheme have failed, even where this has been a condition for providing government assistance. The farmers insisted that each canal should continue to serve the same group of beneficiaries as in the past, and they would not consider combining small command areas so that they would be served by one improved supply canal.

In the Indonesian tubewell project, the farmers' main concern was that the command area should all be in one village, to prevent the administrative problems which arose if two villages were involved. It may be noted that the project staff accepted the farmers' point but they could not comply with it without farmer participation; the relevant information was not shown on the maps.

These are examples of the general issue of land and water rights, and if these are not clear, farmers may be reluctant to participate. This happened on a small village scheme in Tanzania which was constructed to irrigate a particular area of uncultivated land, but it was unclear which villagers would eventually farm the land. An example of the importance of water rights comes from discussion with Indonesian engineers in East Java, who are reluctant to construct new diversion structures in the hill areas, because of the consequences for downstream users.

Following approval of the scheme, an agreement to implement it can be made between the farmers and the agency. It is important to include all relevant obligations: Martens (1989) reports that farmers on a project in Nepal objected to the introduction of a water charge because it had not been mentioned in the project agreement they had made with the agency. Similarly, if the farmers have to contribute the land required for canals, etc, without compensation, this should also be included.

4 IMPLEMENTATION

4.1 Water User Association

In order to create a structure for participation, a water user association (WUA) is usually set up on each scheme, with all the beneficiary farmers as members. The WUA is in principle independent of the agency and government, and responsible to its members. However it is usually set up with assistance from the agency and constituted according to standard agency regulations.

The appropriate time for setting up the WUA will depend on local issues, and in some circumstances this may be at the time that the scheme is commissioned. However there are strong advantages in starting the WUA at an earlier stage to assist with participation in design and construction.

It can then hold open meetings to discuss the scheme and elect committees to liaise with the survey and design teams, etc.

It is important that the WUA is orientated towards involving farmers in the immediate practical tasks, with flexibility to develop as the scheme progresses and the necessary tasks change, until eventually it takes on its long term operation and maintenance role. This facilitates participation, strengthens the WUA organisation, and encourages the recognition of capable individuals and their value as WUA officers. To some extent this may counter-balance the local power structure. Illo (1989) provides an interesting case study of this approach from the Philippines.

At the planning stage of a small-scale irrigation scheme in Nepal, the beneficiary group is identified, which can elect a construction committee, and later become a WUA. The committee has to raise a certain proportion of the estimated cost of the scheme, and deposit the cash in a construction committee account. The system has been described in a recent Irrigation Management Network paper (Ansari, 1989).

Another approach is to sell irrigation facilities to the farmers. For example, deep tubewells in Bangladesh are sold to village cooperatives at a subsidised rate, through a credit system. A weakness of the Bangladesh system is that the cooperative may be dominated by a few local families, and exclude many water users from membership, which limits its effectiveness as a WUA.

An issue which has arisen in Indonesia and Bangladesh is whether water user associations should be based on irrigation units (to facilitate irrigation

management), or administrative units (to liaise better with the local government structure). In many situations this problem can be avoided at the planning stage, by choosing the command area to fit the administrative boundaries, for instance by designing each scheme to serve land in one village only. This may well be what the villagers themselves want. As far as accountability is concerned, it is my view that the WUA should be primarily responsible to its members, rather than the village leader.

Another important issue is the degree of formalisation which is appropriate for the WUA. At the early stages of a project when farmers are probably hesitant about participating, the WUA may best be fairly loosely structured for the immediate tasks, and may be based on a previous informal organisation. When trust has been established and procedures have been developed, there are advantages in formalising the responsibilities of the WUA officers and opening a WUA bank account. This formalisation could involve a legal framework to give the WUA rights such as the following (GDC, 1989):

- the right to make contracts;
- the right to bring legal action against defaulting suppliers;
- the ability to obtain credit;
- rights of ownership of the irrigation canals and equipment.

4.2 Design

Irrigation design is not a direct deductive process which generates a unique solution. Particularly in the design of the general concept and the canal layout, the engineer attempts to satisfy various objectives (e.g. close fit with the farming system, low capital cost, high efficiency, simple operation and maintenance), and considers various possible solutions before developing the design which seems most suitable. The chosen design is therefore not the only one nor necessarily the 'best' possible, and the experienced designer is well aware that another engineer would probably develop a different solution. It is important to remember this when designing works which directly serve farmers, such as small-scale irrigation schemes and tertiary canal systems on large schemes, because the engineer may not be able to take account of all the local factors in selecting a suitable design. For example, the unseen landholding boundaries of social groups and individual farmers are often as important as the topography.

Vermillion (1989) has described the alterations which farmers made to engineers' designs on a project in Indonesia, including destroying works

after construction. These alterations arose from the better local knowledge of the farmers, and because some of their criteria differed from those of the engineers. Elsewhere, engineers observe that farmers have modified structures and canals because they misunderstood the designs, or because minorities have tried to get unfair shares of water. Many of these changes (and waste of resources) could be avoided by involving the farmers at key points in the design process, to enable the designer to take account of their objectives, and to explain important aims and constraints (e.g. water availability).

Discussion is required between project staff and the farmers on the works to be carried out, before the designs are prepared in detail and finalised for construction. Particularly sensitive issues are the alignment of canals (which will govern who loses land, and who has best access to the water), and the position of outlets. These issues include various possible sources of conflict, and a representative committee (of the WUA) can help to overcome problems. It is wise to involve as many farmers as possible; the issues can best be discussed by walking the canal line with the farmers, and trying to reach agreement on site. Some negotiation may be needed, with compromises from both sides, but it is important that the project staff retain responsibility for technical decisions, and for example do not agree to increase the size of a canal unjustifiably or to construct an unsuitable structure.

On the Indonesian tubewell project, discussions about operation and maintenance were held with WUA officers after commissioning of the first tubewells. These discussions brought up various questions and criticisms about the original designs, including the boundaries of the command area and the positions of outlets on some schemes. As a result, a more participative approach was adopted at the design stage of future schemes, to settle these issues at the right time. Design staff spent more time in the field and there was an increase in the total time required to design each scheme, but the results seemed more satisfactory.

In the participatory approach adopted in the Philippines the Community Organiser encourages the farmers to discuss the plans with technical staff. Bagadion and Korten (1985) provide a detailed description of this. They report that an important technical effect of the participatory approach was to improve the designs of the tertiary canal networks (similar costs, much less damage and greater utilisation by the farmers).

It is important to use standard designs for the irrigation canals and structures, to simplify both design and construction as far as possible, making it easier for the farmers to understand the works and build them

correctly with minimum supervision, and also facilitating replication of the works on other schemes. Somewhat different design criteria may be needed for small-scale irrigation than for larger schemes, for example to take account of fluctuations of water availability or limited hours of operation per day. The standard designs need to be based on suitable materials and construction methods, so that villagers will be able to carry out the necessary maintenance later.

Usually the project design will aim for durability, but in some circumstances the farmers may be satisfied with works which have a relatively short life, provided that they work well until then and can be replaced relatively easily; motorised pumps are an example. In some situations, the easiest way to promote small-scale irrigation may be to make a suitable pump readily available for farmers to purchase, with credit if necessary. The pump may be powered by diesel, petrol, animal or human power. Lambert and Faulkner (1989) describe various simple pumps.

4.3 Construction

Small-scale irrigation projects commonly involve farmers in construction of the scheme. This has two advantages:

- they are more likely to regard the works as their own, after working on them, rather than as belonging to the agency;
- they have a direct interest in the quality of the works.

In addition they may contribute to the capital cost of the works, by providing unpaid labour (as on rehabilitation projects in Bhutan), or cash (as on tubewell projects in Bangladesh), or a mixture of cash and labour (as in the Philippines and Nepal). Farmers' contributions may be made in equal amounts per household, or according to their irrigated landholding which appears fairer.

Sometimes it may seem that the implementing agency's main interest in community participation is to reduce costs by using unpaid labour. However, farmers may only provide the labour if they approve of its purpose, in which case they get an effective veto on the works constructed. For example, on the hill irrigation project in Bhutan, there was considerable discussion with the farmers about some of the proposed works, especially at the early stages of the project, and even at later stages little progress could be made on improvements to earth channels beyond

clearing weed and reshaping. This experience shows the importance of starting construction with those works which give an immediate benefit, for example the headworks or a particular problem area. Success here demonstrates the value of the project and encourages farmers to participate in other works.

If the farmers work as labourers on the project, the agency is also obliged to use unsophisticated construction techniques and materials, and train the villagers in using these, all of which make for slow construction, but strengthen the farmers capability for operation and maintenance later. Some farmers may show sufficient skill and interest to be taken on to the project payroll, to work as masons or supervisors, after training if necessary. Clearly this also raises the WUA's maintenance resources.

Because of their limited construction skills farmers can only do some parts of the works. Indeed if they could do all of it, why have they not done this previously? Therefore outside skills and materials need to be employed for complex tasks, such as concrete or masonry work.

An effective way to organise the construction seems to be for the project to provide skilled labour and materials, and for the beneficiaries to provide the unskilled labour. This approach is widely used in other small development works, e.g. community water supply. As a direct labour method of working, it obliges the project staff to carry out all the technical work, including organisation of materials, equipment and labour as well as setting line and level and quality control.

A major problem with using unpaid farmers for direct labour construction is that labour management can be very difficult in these circumstances, because farmers have many other demands on their time; farming, domestic, social and other development projects. In some situations, families may try to meet their obligations to provide labour by sending children to do the work, rather than adults. In general, unpaid labour tends to arrive late, leave early, take long holidays at times of festivals and funerals, and generally be much less productive than paid labour on contract work. For example, O'Brien (1987) reports that an effective working day of only three hours could be expected from self-help labour on a project in Tanzania. In addition, farmers may only be available for work for part of the year.

It is essential to make an elected construction committee or leader responsible for labour management, including resolving these problems. Nevertheless, delays and slow progress can be anticipated. It is in the

project's interest to agree in advance with the farmers the days when work is to be carried out, and then to insist that they keep to this.

It is also advisable to use a base force of employed labour to support the skilled labourers and technicians and ensure that their time is not wasted because of the unreliability of the farmers' labour.

Another approach tried on the Bhutan project was firstly to give the WUA its own independent tasks, such as collecting a volume of stone or clearing a length of canal, and secondly to delay the work of the project's masons until the WUA's task was complete. However, it proved very difficult to persuade the farmers to work on their own, and so these ideas had to be dropped. They might be worth trying elsewhere.

On some projects a contractor is used with the aims of reducing the involvement of agency staff in construction management and increasing the rate of construction, at the cost of paying the contractor and hired labour. In practice the agency still has to provide technical supervision, and it is difficult to require a contractor to recruit labour from the local farmers. Also the quality of small-scale works built by a contractor often seems to be poor. To try to reduce such problems on the Indonesian tubewell project a preconstruction meeting is now held to introduce the contractor to the farmers. Issues discussed include construction quality and recruitment of labour.

In small-scale irrigation, as elsewhere, good engineering is still necessary for success and durability. Where permanent works are being constructed, it is important to use good quality materials, proper construction practices, and accurate setting out (e.g. levels of offtakes). Both the concept and the methods of long-life construction may be new to the farmers, so clear explanations and close supervision are needed to train them in good working practices. Examples are the compaction of earth banks, and the cleaning of sand and stone before use in concrete or masonry.

4.4 Training the Officers of the Water User Association

During the implementation stage of the scheme, the main activities of the WUA are holding meetings, liaison with project staff, and labour management. An effective leader is required for these, with the necessary motivation and personal skills, and some specific tasks may also be done by committees (e.g. assisting the survey team, or arranging rights of way for canals).

At the operation stage, an established WUA will normally have a leader, a secretary, a treasurer, a water guard, and possibly leaders of sub-sections (e.g. blocks based on the area served by a particular offtake and/or the area irrigated as a unit in the irrigation schedule), and a pump operator. These officers will all have fairly defined duties, which will probably be new to them, but which are important for the sustained operation and maintenance of the scheme. Therefore each of these officers needs to be trained in their specific responsibilities and tasks, so that they understand these and are able to carry them out. Particularly important are:

- the WUA leader to call regular open meetings of all the farmers;
- the secretary to record all WUA decisions in an official register;
- the treasurer to record all income and expenditure in an official register or cash book;
- the water guard to be responsible for maintenance of the scheme (organising others as necessary).

The ideal time for this training is probably immediately before the scheme is handed over to the WUA. An example of a particular programme for training WUA officers in Indonesia is described by Smout (1986).

4.5 Commissioning and Handover of the Scheme to the Water User Association

The commissioning and handover of a scheme is an important event, which should be formally recognised. Even if the farmers have retained control of the scheme during development, handover still represents the end of agency-assisted construction and the beginning of farmer-managed operation. This is a good time for involvement of senior local figures, to formally open the scheme, and at the same time give it their approval and stress the farmers' responsibilities for future operation and maintenance.

It is recommended that the project provides the WUA and local government with basic information about the scheme at this point, for instance a layout map and a record of the structures which have been built (and details of the tubewell and pumpset if applicable). Without a deliberate effort to do this, the information has become irretrievable after a few years on some schemes.

It may also be appropriate to provide some tools and materials to the WUA for maintenance work, if these are difficult to purchase locally.

5 OPERATION AND MAINTENANCE

5.1 Operation and maintenance by the Water User Association

As Moore (1988) has pointed out for small irrigation tanks in Sri Lanka, the operation of small-scale irrigation systems is often too complicated hydraulically to be governed efficiently by outside rules, and intervention is unlikely to bring improvements. Another example is provided by the tubewell irrigation systems in Bangladesh, where attempts to introduce systematic rotation based on day blocks have been largely ignored by farmers.

Maintenance however is not complicated. It consists of various tasks which need to be carried out in time to ensure that the irrigation scheme remains in working order. The main problem is that these tasks and their importance are not always immediately apparent to farmers, who may therefore neglect preventive maintenance on improved small-scale irrigation schemes, as tends to happen on other types of community development schemes. A strong effort is needed by project staff to overcome this, firstly by explaining the tasks, secondly by training someone to be responsible for ensuring that the tasks are carried out, and thirdly by checking from time to time that the scheme is being maintained properly.

Maintenance activities typically include the following:

- minor day-to-day reshaping and cleaning of canals and structures, to prevent blockages and leakage developing into more serious problems. These can be carried out by the water guard or farmers;
- repairs to canals and structures before each season as necessary, usually carried out by all the WUA members working together. Some materials may need to be purchased, such as cement and paint (for water control gates);
- regular servicing of pumpsets or other equipment;
- emergency repairs following breakdown or damage.

These activities require diligence from the water guard, and the mobilisation of labour by the WUA. The requirement for funds varies

with the type of scheme, from simple gravity schemes which may occasionally need a bag of cement, to tubewell schemes which need funds on a daily basis for operation, with additional requirements from time-to-time for repairs.

Farmers are understandably reluctant to part with their money and suspicious about what will happen to it, so if funds are not needed regularly, it seems unnecessary for the WUA to collect fees until the need arises or the WUA has built up trust among the farmers. However, if funds are needed frequently it is important that the project introduces systematic procedures for the WUA to follow, covering for example:

- agreeing a budget and water charge;
- collecting and keeping funds (normally in a WUA bank account);
- recording receipts and expenditures (e.g. in an official cash book);
- accounting for these publicly (e.g. by reading them out in the WUA meeting).

If farmers are satisfied about security of funds and the financial procedures, the WUA can aim to collect sufficient funds on a regular basis to build up a reserve for emergency maintenance.

5.2 Groupings of WUAs

Once they are well established, the WUAs on different schemes can form a grouping to discuss common problems (e.g. obtaining materials for maintenance), and provide mutual assistance (e.g. labour or even a loan at the time of a major problem). This grouping could also act as a representative body for liaising with government.

5.3 Monitoring and Extension by Agency Staff

Even though the scheme is being operated and maintained by the WUA, some continued development agency activity may be advisable to safeguard the investment and maximise the benefits from it. The following types of activity seem to be appropriate:

- inspection of the scheme from time-to-time to check that it is being maintained properly;

- collection of monitoring data such as irrigated areas and crops, water charges, WUA funds, pump operation records (running hours, fuel etc);
- extension work on irrigated agriculture, including water management.

It may be possible for all of these to be carried out by agricultural extension staff, provided they have been involved in the project and receive some training on maintenance requirements. Much of this work would involve reminding and persuading farmers to carry out simple preventive maintenance tasks, but if difficult problems arise they should be able to call in engineering staff.

6 CONCLUSIONS

Small-scale irrigation schemes vary in size and complexity, and suitable forms of joint working between farmers and development agency will also vary. However participation is possible even on relatively large schemes (e.g. the 3000 ha Chhatis Mauja), and technically complex schemes (e.g. deep tubewells with motorised pumps). Indeed only the farmers will normally have the local knowledge and motivation needed to manage the complex social and hydrological factors which often govern the success of small-scale irrigation schemes.

Development agencies commonly hand over the operation and maintenance of small-scale irrigation schemes to the farmers, but joint work is also needed at earlier stages to ensure that the design is suitable, and that the farmers have the skills and motivation to maintain the scheme. This should usually be done through the formal framework of a water user association.

This participation needs to be integrated into the various stages of the project in a way that is acceptable to the farmers. Practical methods of doing this are summarised in Table 1. They require flexibility by the agency. Firstly, it is necessary to learn from experience on the initial schemes, and adapt the project designs and approach accordingly. Secondly, the consequence of sharing power is that the agency may have to accept that local variations and forms of participation can be agreed by bargaining and compromise between the farmers and the project staff.

The attitude of project staff to farmers is very important. The agency can assist by training project staff in the participative approach and methods,

and ensuring that their supervisors and senior staff are supportive, particularly when work is delayed by disagreements and farmers' changes of mind.

A serious problem from the point of view of the development agency is that participation places high demands on the time of both technical staff and skilled labour. It is therefore a longer process than conventional design and construction. As a result project lifespans may have to be increased to optimise the benefits from the project.

Participation is difficult, but if done properly from the outset it results in a better designed and sustainable scheme. The key is for the agency to commit itself to making participation work.

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