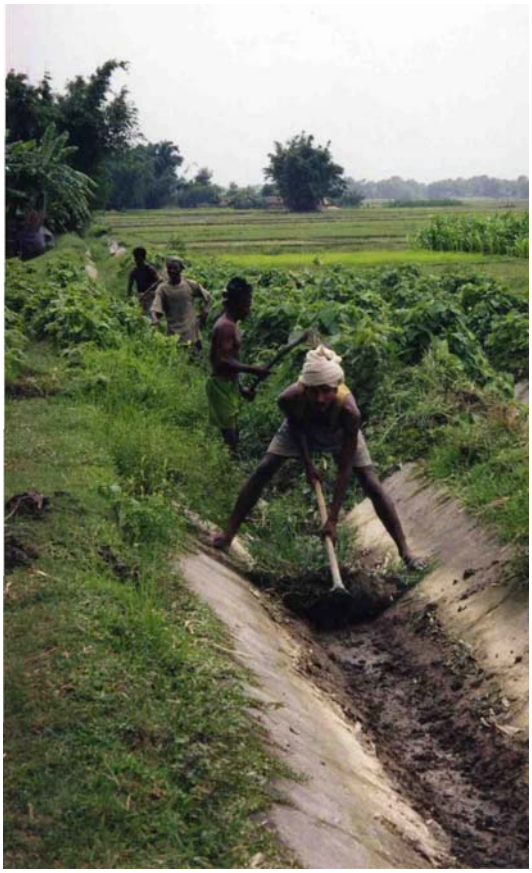
DFID Department for International Development

Equity, Irrigation and Poverty

Guidelines for Sustainable Water Management

Summary Report



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Equity Irrigation and Poverty: how to distribute water to the poor

Summary Report

1 Introduction: objectives of study

It is now widely recognised that irrigation has many direct and indirect impacts on the livelihoods of the poor, and that it is important for poverty reduction (Hussein, 2005, Lipton 2003, Smith 2004). However, the direct impact is severely reduced by poor management of water distribution at a local level. Even within small areas some farmers can get an adequate supply of water while others have insufficient water and may even be forced to abandon their crops.

One approach now widely adopted for solving this problem is to transfer responsibility for management at a local level to the users, often referred to as Participatory Irrigation Management (PIM). Associations of water users (WUAs) responsible for management within areas of around one to two thousand hectares are established, are provided with a reliable supply of water from a strengthened system for managing the main canals, and are then expected to manage the canals and the water within that area. This process of privatisation has been much studied (Vermillion, 1997, Samad & Vermillion, 1999). Although it requires extensive reforms at all levels in the water sector (Samad, 2005), there is still an assumption that once WUAs are set up they will be able to manage water well (Johnson, 2001). This assumption appears to be unjustified, and there are technical and institutional reasons (including social and power relations) why distribution of water remains inequitable.

We recognise as a starting point that land in many countries is not shared fairly, but in our study we do not address either issues of land reform or the separation of water rights from land rights[1]. We believe that water is often even more inequitably distributed than land. If water were distributed proportionately to the crop needs for area farmed, then poor farmers would be able to make better use of their land. In this study we looked at cases where land distribution is very inequitable (most of Nepal and India) and others where land ownership is relatively uniform (Kyrgyzstan and to a lesser extent some parts of Nepal). In both cases we believe that water could be distributed more fairly and that this would reduce poverty

In this project we investigated how WUAs share water at local level, evaluated what impact this has on the livelihoods of the poor, and then helped the WUAs to improve distribution of water amongst their members[2]. We also reflected on the process of establishing WUAs and embedding them in the community: one of the early findings of this study was that despite considerable efforts to date, many WUAs are not well connected with the communities they represent. We therefore linked this study to a parallel project[3] in Nepal to strengthen WUAs and embed them in their community.

[1] Separation of land and water rights is seen by some as a way of strengthening the livelihoods of the poor (Hussein, 2005), who have little land, but in Sri Lanka there is concern that it will have the opposite effect and result in a loss of water rights by the poor (Samad, 2005). The complexity of this issue has also been discussed for India by Chambers (1988).

[2] We worked directly with the water users, as well as with WUA committee members and staff. We helped them to identify ways that water users could work with the WUA to bring about an improvement. As we will describe below, the improvements involved both institutional and procedural changes.

[3] DFID KaR R8023: Guidelines for Good Governance

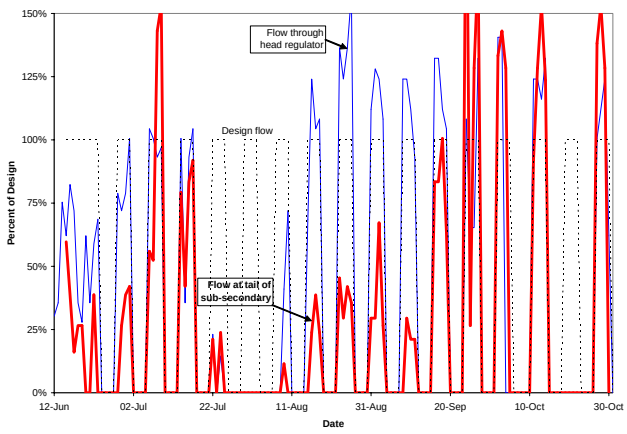
This was an action research project, implemented in India (Andhra Pradesh – AP)[4], the Kyrgyz Republic and Nepal, with supporting information collected from China. Its aim was to identify methods for improving water distribution, to test these techniques on two projects, and then to draw up guidelines for wider application.

2 Role and performance of Water Users' Associations

In the most commonly adopted PIM model, water users' associations (WUAs) are made responsible for management of the lower parts of the system, whilst the government generally retains responsibility for the main canals (sometimes with some involvement by the WUA, as in Nepal). It is expected that WUAs will be able to collect water charges and other resources; arrange maintenance of canals; share water equitably amongst their members; resolve conflicts; and coordinate with the government or main system managers. In return the government assists in formation and capacity building of the WUA and undertakes to deliver a reliable supply to the WUA (for which the main system management should be paid a fee). The details of these responsibilities vary, and are described in Chapter 5. Many WUAs have had a beneficial impact (Samad, 2005) but few have had the impact that has been hoped for and few have been able to make as much progress with equitable water distribution as had been expected. As we discuss in Chapter 5, the WUAs in our study sites are local organisations which are rarely as democratic as anticipated - they tend to be dominated by local elites who continue to attend to their own access to water while neglecting most of their other responsibilities.

Whilst our focus was on improving water distribution, it became apparent through these case studies that there was a more fundamental deficiency in most WUAs, in that they are not 'embedded' in the community[5] – they are not understood, not trusted, and cannot make or enforce rules. Their roles and responsibilities may be ambiguously defined, not clearly understood or not fully agreed with by either the executive members or the water users. Finally they lack key technical skills to manage water effectively.

Box 1: Canal flows as a percentage of design at head and tail of WUA



The consequence of this is an unfair distribution of water, with the inequity increasing down the system (we examine the concepts of equity in more detail in chapters 2 and 7, but it is generally acknowledged that each farmer is entitled to a share of water proportionate to the area of his land). An example of unfair distribution is illustrated in Box 1, which shows the flows at the head (in blue) and tail (in red) of one WUA at Sunsari Morang Irrigation Project (SMIP, in Nepal) in 2002, before the

[4] There was exceptionally poor rainfall in northern AP during the study period. This meant that there was no irrigation possible in the study area, which is in the Sri Ram Sagar Project, and precluded much of the work originally envisaged under this study.

[5] The way the WUAs have been established – generally externally promoted and with insufficient consideration for the local social and political context, or for the livelihood assets and strategies of different categories of water users – has contributed to this failure to be 'embedded'.

start of the study. This distribution is expressed as a percentage of design flow: little water reaches the end of the system until very late on in the season, when there is little need for water. There are weak procedures for sharing water – mostly decided by individual farmers rather than through consensus. The WUA is hardly engaged in solving this problem and gives greater emphasis to other tasks, such as lobbying the main system management to promote particular interests related to contracts or water delivery as requested by influential individuals. Farmers recognise that access to water is unfair, but they regard this as inevitable and essentially a problem to be solved by others. This causes local disputes and conflicts: these may not be overtly expressed but they contribute to a background of ill-feeling. This has far-reaching impacts, for example by feeding into more fundamental conflicts such as the 'maoist' insurgency in Nepal. This underlines the wider social and political importance of improving irrigation management.

This background and our methods for investigating and improving the situation in our selected study sites are described in Chapters 1 to 4 of this report.

3 Development history of WUAs and its consequences

There is a common pattern to the development of WUAs in the study areas: they have all been established within the wider context of government legal and institutional reform of the water sector, and they all have centrally standardised constitutions which define their entitlements and obligations. There are, however, variations between the countries and they have developed from two different backgrounds: one approach built on experience with community management of small-scale irrigation[6] (Nepal and India); and the other followed on from privatisation of state or collective farms (Kyrgyzstan). WUAs in Kyrgyzstan fill a void created by the collapse of collective agriculture, and are thus less threatening than those in India and Nepal which take over some responsibilities from existing government departments.

In the 'community model', groups of farmers who are traditionally smallholders are encouraged to form a legally registered association to work together to manage the irrigation system which serves the group[7]. In the latter, WUAs have taken over responsibility for management of the on-farm canals from the state farm[8]. The WUAs are required to deliver water to individual farmers who were previously (in many cases) workers on the state farm. In Kyrgyzstan, WUA managers are likely to be technically skilled and to have had the same water management role under the previous system, but in Nepal and India the WUA committee members tend to be village leaders with little technical expertise or interest.

Within these two strands there are many local variations, and it is important to note that the history of land and water development, as well as of social and power relations, does have a profound impact on the nature and performance of irrigation management organisations. Variations occur within as well as between countries: Khageri Irrigation System (KIS, in Nepal) was developed from forest and settled by smallholders in the 1960s; whereas SMIP (also in Nepal) was developed by relatively rich people who were granted extensive land rights by the central government. They employed local people to

[6] Traditional community management groups are rarely democratic and often rely on strong autocratic leadership (see for example Pradhan, et al. 2001 and Mosse 2004 who describe the situation in Nepal and Tamil Nadu, India): such arrangements are often effective but not necessarily equitable. Modern WUAs are set up to be more democratic and egalitarian, but Pradhan sees this as a reason for their poor performance: he believes that such 'western' concepts are not accepted by the community

[7] They may previously have worked together on an informal basis for community management of natural resources, but they are unlikely to have had a corporate identity for water management. Now they are encouraged, as a matter of government policy, to form a users' association.

[8] Some of this took place spontaneously after the collapse of state farms after independence from the Soviet Union. But it subsequently became a matter of government policy, supported by external donors including the World Bank.

clear and cultivate land on a share-cropping basis - a system which was changed by land reforms in the 1960s but which has left a profound legacy in the form of a highly stratified social environment, with strong patron-client relations.

Irrigation management in India is more centralised than in Nepal, and the reforms were promoted by central government[9] – initially driven by the need to save money. Land distribution is even more polarised than in Nepal, but the system of WUAs now promoted has much in common with the community-based approach adopted in Nepal. In both cases, social relations are strongly influenced by concepts of caste and untouchability. China by contrast has more in common with Kyrgyzstan, but increasingly favours contract models of management, giving financial incentives to managers – at least in those systems we visited in Ningxia.

Box 2: WUAs in Kyrgyzstan

Obi Haet has a 7-member WUA council, elected by a representative assembly of the farmers (1 representative per 20 ha) for a 3 year term. Day to day management is provided by a separate WUA directorate, who are paid from the irrigation service fee (ISF). The assembly approves by-laws and has power to penalise those who break the rules. In practice the *ayil okmotu* (local government) or *aksakals* (village elders) are most involved in dispute resolution. The WUA manages a contract for bulk supply with the *raivodkhoz* (irrigation agency) and pays a bulk volumetric charge for this. *Mirabs* (ditchriders) are the main agents of communication between the WUA and the users. Fee collection is good, but this has created some opportunities for dubious practices – a few people reported "*it is the elites who get water easily, those who have enough money… simple people do not get water this easily*". Nevertheless, as we report later, this WUA is more active and water is more equitably distributed here than in other study areas. The *mirab* is both active and highly respected, and the Director plays a key role.

We describe the structure, obligations and entitlements, and rules of the WUAs in the study areas in some detail in Chapter 6. Despite the local differences, there is a remarkable similarity in the way they are set up – perhaps reflecting the ubiquitous influence of donors and the relatively small number of people involved in advising on irrigation reforms. Certain characteristics are particularly relevant here:

- WUAs have been introduced in a top-down manner, generally as part of a project which has included a substantial construction component; and
- Institutional development activities have focused on the formation of organisations and on developing administrative and technical competence. Insufficient effort has gone into addressing social and power relationships or on strengthening the ability to design and enforce rules which will be accepted by water users. Both are needed for sustainable management, whatever form the WUA takes.

These weaknesses mean that the WUAs have had difficulties in meeting their obligations (as laid down in their constitutions and by-laws), and their performance has been dependent on the motivation, dedication and ability of the leader[10]. Actual water distribution is determined more by the relations between individual users and the WUA executives than by overall performance of the WUA as an institution[11].

[9] In our case study, by the government of the state of Andhra Pradesh, with strong encouragement from the World Bank.

[10] Kolavalli & Brewer (1999) also confirm the crucial role of strong and motivated leadership in a national review of WUAs in India, and Shah et al. (2004) describe the benefits from giving WUA managers in China strong financial incentives

[11] Here we refer to the WUA *institution* not only as an organisation, but as a set of rules and relationships. Our understanding of the word 'institution' is discussed in Chapter 2.

4 Existing systems and performance of water distribution

Water rights are often politically contentious, and entitlements to water are not rigorously defined in any of the study sites. In our sites, farmers assume that they are entitled to as much water as their crop requires and that the system should be able to supply this – they have little appreciation of the costs or constraints of achieving this. There is little concept of pre-season planning of either crops or water (with the exception of imposing some restrictions on the areas of rice[12]). Farmers see planning to be a theoretical exercise unrelated to actual distribution of water.

Nevertheless, the main system managers need some sort of plan for managing the main system. At SMIP (Nepal) the canal supplying the WUA is operated on a rotational basis with a constant discharge – but the duration of rotations may be adjusted to suit availability of water. There are inevitable variations due to rainfall, sediment, or river flows. These can be compensated for by farmers if there are sound communications from the project office to the WUAs and users.

While a reliable bulk supply to the WUA is a pre-requisite for effective water management within its command area, it is equally important that the timing of this should be predictable. We demonstrated in this study that the total volume used can be reduced if farmers know when water will arrive. We found poor communications to be a crucial weakness in all study areas during this study. In SMIP rotations are decided by the project office with little consultation, and poor communication, with the users. Although still weak, performance was much better in WUAs which had relatively good communications with the supply agency: at KIS (Nepal) a proportional share (but not the absolute quantity) between branch canals is fixed and this agreement is well-known and adhered to; and in Kyrgyzstan the contract between WUA and supply agency is (in effect) based on the previous years' actual supply.

The physical layout is another important constraint to the management system, although knowledge and understanding of the layout by water users is equally important. There was a major rehabilitation at SMIP which enabled a logical and coherent management system and should have made it easy to operate[13]. However, the strong design advantage of the system was undermined by a lack of awareness by the end users of how it was supposed to be operated. They did not understand it and disrupted it, rather than attempt to work within it. In the other sites, which were not so extensively restored, there are more mismatches between infrastructure and management – for example, in all other cases there were a large number of small outlets with few control structures on the canal, as can be seen on this photograph of a branch canal and outlet in Kyrgyzstan. Equitable water distribution under these conditions demands skills and management resources which the WUAs we studied did not have. These are constraints that the WUA must be able to address: it is

[12] There are strict and well-enforced limits in Kyrgyzstan, but crop restrictions which were recently introduced in the study area in AP are largely ignored

[13] This was designed according to the principles of "structured irrigation" (Albinson & Perry, 2002) which is intended to make operation simple and delivery of water proportionate to land area.

unrealistic for users to expect all physical problems to be resolved before a WUA takes responsibility, and water management systems need to be developed to accommodate the limitations of the infrastructure[14].

Box 3: WUA and village boundaries at SMIP

T5 serves two main villages: Sattarejhora and Hattimuda. Residents, who are mostly Yadavs (traditionally a livestock-owning caste), of Sattarejhora farm land in T5-1 and T5-2 as well as in three watercourses of T6. These are all within the same registered WUA (Sitaganj), but in 5 separate subordinate water users' groups. Hattimuda is mainly inhabited by Sahs, a separate ethnic group, and they farm land both in T5-3 and T5-4 (Sitaganj WUA), and in Shankarpur WUC. Coordination within these villages is much easier than between them, making it difficult to manage water effectively at tertiary canal level (T5). Interestingly, however, disputes between communities are said to be easier to solve than those within the same village.

Finally, the mismatch between physical layout and organisational boundaries can be a difficulty. WUA boundaries and membership do not always conform to logical hydrological units. In SMIP individual water users often operated land in a number of locations, under the jurisdiction of more than one WUA. Villages are located on high ground between canals, and cultivate land on either side of the village – it is therefore normal for WUAs to cut across rather than coincide with social boundaries. In Kyrgyzstan there are many points of transfer of management with little scope for measurement and control at these points. This makes it difficult to design hydrologically rational WUAs. However, the WUAs in Kyrgyzstan are more active than at SMIP and are better able to recognise and cope with this constraint.

Actual distribution of water at field level in the study area is managed on one of the following bases:

- *Warabandi*: a fixed time per unit area each week, regardless of crops and regardless of flow in the outlet.
- Defined order: each farmer takes water in turn for as long as they need it – the frequency of irrigation is thus related to the availability of water, but depth is according to need. This may be predetermined (eg from head to tail of an outlet as in Nepal) or negotiated between individual farmers (as in Kyrgyzstan).
- On demand – with an indenting system between farmers and ditch riders.
- *Ad hoc* – farmers take water as and when they need it, closing other outlets, cutting canal banks, or doing whatever they consider necessary to capture sufficient water.

In practice a combination of several methods is used, with different systems in different outlets or at different times.

Observations during this study showed that there is increasing inequity down the system. At SMIP virtually no water reached the tail of the WUA, except at times of heavy rainfall when it was not required and was rejected by upstream farmers. Land distribution is also inequitable, with poor farmers more likely to have land at the tail. However, well-off farmers who have land at the tail of the system are able to capture a relatively good

Table S.1: Access to water at Khageri (Nepal)

Location	Percentage time fields are dry		
	Poor farmers	Medium farmers	Well-off farmers
Average of all plots			
Head	7%	8%	8%
Middle	10%	12%	14%
Tail	24%	23%	4%
Worst plot			
Head	19%	15%	10%
Middle	61%	14%	14%
Tail	30%	39%	4%

[14] Indeed there is a strong case to be made for delaying such improvements until the WUA is well-established, so that they can plan the improvements they want. At the same time, if there is no hope of improvement in the physical condition of the system water users may simply see no point in investing effort, and resources, in the WUA. We selected schemes for this study where the physical condition did not fundamentally constrain the ability of the WUA to manage water.

supply. At KIS the worst plots managed by poor farmers were dry for 60% of the time, as compared to 14% of the time for the rich farmers' worst plots (Table S.1).

Inequity is less pronounced in Kyrgyzstan than in Nepal since the overall water supply is quite generous, tail-end lands can compensate by drainage reuse or illicit access to other canals, and a standard area of land has recently been distributed to each person. Access to water here is more related to relations between farmers and the WUA, than to location or well-being.

In SRSP (AP, India) poor farmers were also concentrated at the tail of the study area, but as in Kyrgyzstan, access was compensated for, to some extent, by drainage flows as well as by direct pumping from the canals. Still, relatively better off farmers were in a better position to use these options than the poor.

Existing systems for water management are described in Chapter 7, and the resulting water distribution is analysed in Chapter 8.

5 Livelihoods and water management

The assets and livelihood strategies of different well-being groups have an important influence on water distribution. Access to resources other than water is highly polarised in our study sites: indeed access to land in Nepal and India is a proxy for wealth. Poor farmers have less land, in worse locations, and under less secure tenancy conditions. They are also less likely to own tractors or livestock for ploughing, and are more dependent on hiring equipment from others. As we have noted earlier, land distribution is more equal in Kyrgyzstan.

While irrigated agriculture is a critical component of rural livelihoods in the study countries, it is not the only source of income. Off-farm occupations are also important for many. This means that many water users must allocate their time between cropping activities, including water distribution and associated activities - such as the demands of WUA membership[15] - and these off-farm occupations. The way they manage water is guided by their access to information about when and how much water will be available to them, and their level of technical knowledge. Furthermore, their willingness and ability to influence water distribution are constrained by social and political factors. These factors included their relations with other water users, their social status, their political influence, and their vulnerability to the actions of others who are more powerful than they are. We found that while many water users observed that water distribution rules were flagrantly being broken, they were reluctant to do anything about it. They did not want to 'rock the boat' with their neighbours, or feared some form of retribution, perhaps from a landlord or otherwise socially powerful person.

The way people combine agriculture with other income earning activities depends on their well-being and location: more than 50% of people in our Kyrgyzstan sites needed to work outside their farm, regardless of well-being. This was particularly the case in Jany Aryk where land holdings are extremely small and there are a wide range of casual and permanent employment opportunities in the adjacent town. The situation is more polarised in Nepal, where barely 50% of poor farmers can survive from irrigated agriculture, as compared to 100% of rich farmers who are able to do so. However, the more wealthy and better educated may choose to rent their land to others so that they can undertake more profitable jobs or businesses. While the wealthy and better educated land owners are in a better

[15] Water users are often expected to contribute labour to maintain irrigation infrastructure. Attendance at WUA meetings also requires an investment in time.

position to get information and manage their access to water, they do not always pass these advantages on to their tenants – who are the ones who actually need the information and use the water.

The nature of these alternative activities and the relationships between the stakeholders in irrigated agriculture are critical for water management. Off-farm demands make it difficult for water users to cope with erratic and unpredictable water flows to their field. These demands also often mean that there are fewer opportunities to make in-field contact with their farm neighbours; this may reduce both the opportunities and the incentives to cooperate and agree on water distribution rules. This is particularly true of Kyrgyzstan, where land has only recently been allocated to individuals – who have not yet been able to form strong social relations with their neighbours in the field. Unpredictability of water supply, the need to fit irrigation in with other activities and weak ties with other water users all make for an individualistic and opportunistic approach to accessing water. This contributes to a downward spiral of deteriorating water distribution.

Box 4: Sources of income at Khageri

67% work outside the village to supplement farm income, but the nature of this is very variable, and depends on the well-being of the farmer.

Whereas 78% of poor people working outside the village are in unskilled casual jobs, only 4% of medium farmers and no well-off farmers work in such jobs outside the village.

Of those who are unable to own or rent sufficient land in the village and who choose to rent outside the village 80% are poor and 20% are medium. It is much easier for medium farmers to rent good land nearby their house as they can convince the landlord that they can afford the inputs needed for a good crop.

Poor farmers find it more difficult to negotiate good terms for renting land: 35% of poor farmers as compared to just 12% of medium tenants are obliged to rent land on the relatively unfavourable fixed contract terms, rather than as sharecroppers.

Poor farmers have less control over when they can be on their land, making them more dependent on a predictable timing, yet they have weaker relationships with the WUA.

As noted earlier, all well-being groups stress the value of reliable and predictable supply of water – even if this means they receive less water in total. This is most critical to poor farmers who are more likely to depend on casual labour or to have little flexibility over the time that they can return to work on the land. They are less able to influence the timing of supply to suit their individual needs, to obtain information on when water will be available to them, or to get local people to guard their share or irrigate their fields if they need to work away from the village.

While reliable and predictable water deliveries are necessary, they are not sufficient for improved water distribution. As we mention in Section 4, another factor is water users' understanding of the way the system is supposed to be managed, and knowledge of how they can make the best use of water in their fields. Thus water users' human resources must also be considered, both in terms of basic literacy and in terms of technical knowledge about what can be expected from the physical infrastructure, how it needs to be maintained, and about on-farm water management appropriate for different crops. Yet as we discuss in Chapter 5, although the need for technical training of farmers is often recognised in programmes to promote WUAs, our observation was that the level of implementation of information and training was inadequate and was mainly given to executive members of the WUAs.

We found that in Kyrgyzstan educational standards are extremely high (verging on 100% literacy), although poor farmers are more likely to be illiterate. However, what was more critical than basic literacy was inadequate crop husbandry knowledge – particularly how to make the most efficient use of the water available. Also, limitations in water users' knowledge about the role of the WUA and of water users' relationship and responsibilities to the WUA made for unrealistic expectations of the service the WUA could provide, without greater cooperation from the users.

Literacy was far more of an issue in India (where only 8% of marginal farmers in the study area are literate) and Nepal (65% literacy amongst the poor at KIS, and 25% at SMIP). Here the method of communication, using channels that do not depend on the ability to read notices, etc, becomes important. But we found that reliance on word of mouth tended to mean that only those with good connections with influential WUA members got information. It is not surprising that the poorer water users and those who are socially marginal, such as women and absentee sharecroppers and tenants, have less knowledge of how the WUA should operate, what their own role in irrigation management is, or how to make best use of limited water supplies.

Finally, reliability and predictability of water supply to the field depends on the willingness of upstream water users to allow water to flow according to agreed rules[16], and not to interfere with the flow in an *ad hoc* and undisciplined way. In all of our study sites water users complained about the indiscipline of others, but they felt unable to do anything about it. They looked to 'someone else' to provide the leadership to make and enforce rules. In SMIP (Nepal) and SRSP (AP – India) they had little confidence in the leadership offered by the WUA. In KIS (Nepal) and in our sites in Kyrgyzstan they had more confidence, but still had reservations about the WUA's ability to prevent water theft by the influential.

A strategy to improve the way water is distributed must take into account the options available and choices made by different categories of water users, and we explore these in Chapter 5.

6 Progress achieved on case studies: diagnosis and improvement

We worked in five projects in three countries to understand the range of problems and develop guidelines which would be comprehensive as well as practicable. We intervened to improve water management in two of them (SMIP in Nepal and Obi Haet in Kyrgyzstan).

For our work we developed a participatory diagnostic process which aimed to facilitate better engagement between water users and the WUA. This helped them (and us) to monitor existing performance and to understand the technical, social and institutional problems. Using this information they were able to develop action plans to solve these problems. The nature of participation by users in WUAs varies according to the type and history of the WUA. The actions that they proposed to take are briefly summarised in Table S.2 and discussed further in Chapter 9 of this report.

At SMIP, the water users prepared and implemented an action plan for maintaining canals, removing illegal structures, monitoring canal operation and ensuring the correct supply to the tails of canals, developing rules for distributing water, monitoring compliance with all rules and penalising defaulters. This involved an intense process of discussion and negotiation amongst the users and with the WUA. It built on our experiences in running water users' schools which helped to build good relations

[16] In Chapter 2 we discuss the distinction between formal and informal rules and how these are reflected in the way that water is distributed in practice.

between users and the WUA in the previous season[17]. The planning and implementation of improvements to water distribution were made possible by following this coherent and comprehensive process. These methods are described in more detail in Chapter 9.

The first step in implementation was to improve standards of maintenance, as illustrated in these 'before' and 'after' pictures of tertiary canal maintenance. This enabled the WUA to proceed with the more tricky issues of illegal outlets and then the implementation of rules for water distribution.

The outcome of this was to help the WUA to make a marked improvement in access to water amongst disadvantaged users at SMIP in Nepal. Before the start of this study, the last two tertiary canals (which serve 30% of the area) received less than 10% of the water entering the WUA command – even though the WUA as a whole received more than its entitlement. Most of this already inadequate supply arrived late in the season when they did not want water. By contrast, at the end of the study (2004), these two canals received the 30% they were entitled to and this was spread as required through the season. This improvement was reflected downstream in the supply from the tertiary canal to water courses and to the end users.

This better distribution was achieved by making use of water that was previously wasted, rather than by taking water from others. This is important for the sustainability of the changes: few farmers will willingly give up scarce water supplies, and we emphasised measures that would benefit everyone. We stressed that irrigation need not be a 'zero-sum' game: everyone benefits from a well-managed system[18]. The WUA developed rules for operation and maintenance of all levels of canals, from sub-secondary down to the field, as outlined in Box 5. They also introduced systems for monitoring compliance with these rules, and penalties for defaulters – which were enforced rigorously.

WUAs did not find direct flow measurements within their areas of responsibility to be of much value, except for monitoring division of flow between relatively large canals. This is because of complexities of measurement and the wide range and nature of unmeasured and uncontrolled inflows and outflows. They were able to develop and

Box 5: New water distribution rules at SMIP

Sub-secondary canals: standard rotation between sub-secondary canals (931 l/sec, for 4 days in 8 except at times of shortage) replaced by a variable rotation managed by the higher tier of WUA, with reliable communications down to end-users

Tertiary canals: users became aware of and agreed with the design principles, and WUA enforced the existing rules which permitted no direct offtakes or other interventions in the tertiary canals

Watercourses: illegal outlets to be eliminated, with field channels to be dug where needed to ensure access to fields. Order of irrigation for land preparation and transplantation to be negotiated by WUA and users at start of season, with water for transplanting taking priority over irrigation of earlier transplanted crops (except that irrigation in the afternoon will be permitted to prevent damage to crops). Once transplanted, irrigation will be in a defined order (rosters for this have been prepared) except at times of shortage when the same order will be followed but farmers will be limited to a specific number of hours per unit area (duration varies according to watercourse: 4.5 hours/hectare in WC-2).

[17] under KaR R8023 (Mott MacDonald, 2003)

[18] It will not always be possible to distribute water more fairly while maintaining the existing level of supply to those who had a previous advantage. However, as listed below, the benefits can also take the form of a more reliable supply, less effort required to guard supplies, or less social tension and conflict with other water users. Reduced social tension may become particularly important in conditions of social unrest and militancy.

implement effective rules for monitoring flows through proxy indicators of time or depth, but even these are difficult and were only required at times of shortage. Improved skills in water management, such as ensuring adequate stream size and defining rotations, made it easier to design and monitor such proxy measures on a trusted and equitable basis. Strong WUAs are also able to improve standards of maintenance and control 'illegal activities such as informal checks and bank cuts: these are a pre-requisite for improved water management.

Box 6: Some achievements at SMIP in Nepal

In 2004, 100% of the design discharge was supplied to the head of the WUA, and the tail watercourses also received 100% of the design discharge. By contrast in 2002, 125% of the design was supplied at the head, but virtually none reached the tail. As a result of these projects, they used less water overall, and tail-end farmers had a much better supply.

Four illegal outlets from the sub-secondary canal were closed, and two open cuts replaced by small pipes, resulting in more water reaching the tail of the canal.

Tulsi Devi Magar, a widow at SMIP reported that *"there were fewer conflicts, less fights, no need to wait in field, no fear of snake bite as one can go to field with a torch this year"*.

The water users saw several benefits following on from this:

- Crop productivity - SMIP is a supplementary irrigation scheme, so most people can get an adequate yield in most years, but those at the tail who have very unreliable supplies do suffer from low yields. These farmers (on the social and physical margins of the system) were particularly appreciative of the improved supplies.
- Time saving – avoiding time wasted on unproductive activities such as guarding one's own supply, removing blockages and illegal outlets upstream; or extra time spent in the field due to uncertainty over when water will reach one's field, or because of a very low flow rate.
- Better social relations – an awareness and understanding of the role of the WUA and a growing willingness to participate in it, recognition of the challenges faced by the leaders, and better relations with neighbours with fewer unresolved conflicts, thereby encouraging cooperation in other activities.

We worked in Obi Haet in the Kyrgyz Republic for a single season[19] so there was little time to identify and implement measures for improving water management. Here the measures focused on improved communication and coordination, so that farmers knew which outlets were entitled to water and could monitor which were flowing. This simple measure – the *mirab* (ditchrider) just wrote the names of those authorised to irrigate on a centrally located blackboard each morning – had a remarkable impact. Farmers reported an immediate benefit in terms of improved relationships and reduced conflict over water.

7 How to improve water management: the approach developed in this study

While it is difficult to improve water distribution, the benefits we were able to observe are considerable. To achieve these benefits in this project we identified and adopted the following measures:

- Identify entry points – where users and WUAs are prepared to attempt improvements
- Improve the technical skills both of individual water users and of the WUA executive

[19] Cropping is only possible between April and October, and thus our field work was confined to a single season. In Nepal we were able to work through two cropping seasons and were able to draw on experiences from the previous year under R8023.

- Promote better communications between water supply agency and WUA; and between WUA and users
- Strengthen social capital and relationships – create opportunities to promote a mutuality of interest in fairer water distribution across groups, and to champion the interest of those without voice
- Promote better institutional governance – bring water users and WUA committee members together to analyse both their irrigation system and the WUA; to encourage more realistic expectations, to increase confidence in, and respect for the WUA so that it is able to adopt and enforce rules for fairer water distribution, and to improve relations with the irrigation department.[20]
- Embed the WUA in the community and build capability for change (including awareness of what they can do and the skills to do it).

When we analysed our implementation experience we identified two further measures which we think should also be part of a strategy to improve water distribution:

- Identify the drivers for change and factors promoting the status quo, and use this to develop an intervention strategy. This should be part of an initial planning activity, but should be reviewed periodically during implementation.
- Provide long term support (at a low level) to help them to solve problems as they arise. Such long term low-level support should be budgeted for from the outset[21].

Participatory social and resource mapping to understand irrigation system, problems and options for their solution

Discussing WUA activities in water users' school

Developing technical skills in water management by the WUAs was the focus of the study and we helped them develop appropriate procedures and rules for this, and indictors for monitoring achievements. This was, however, only possible as part of the coherent, integrated approach outlined above. Guidelines derived from our case studies are presented in Chapter 12 of this report and outlined here, using one of our case study sites (SMIP) as an example.

The WUA in our study site at SMIP was set up a decade ago and clearly demonstrates the pitfalls of failing to make sufficient effort from the outset to "embed" the WUAs socially. For a variety of reasons WUA committee members are seen to be ineffective or corrupt, and the performance of the WUA committees has eroded the relationship between water users and the WUA, and social relationships amongst farmers.

[20] We did not study the broader question of irrigation financing and water charges, which is well-covered in HR Wallingford (2004) (R8027), but we did focus on measures that the WUA is able to finance and ensured that they designed sustainable financing mechanisms for every action they took. In this way we helped to reverse a downward spiral of poor water distribution, dissatisfaction with the irrigation service, unwillingness to pay water charges, insufficient funds for infrastructure operation and maintenance, uninterested or discouraged WUA executives – poor water distribution, etc.

[21] As an action research project our work was constrained to a very limited time frame. By linking our work with a previous research project, R8023, in Nepal we were able to see the benefits of a longer intervention. But at the end of our work we still saw the need for additional low level support – which was outside the scope of our research aims and resources.

Our presence here was spread over two years. The first year was part of a separate project. Activities during this year included a rapid participatory planning study followed by a water users' school (WUS) which was conducted over the course of one cropping season (Season 1). The WUS was needed to recover from a situation in which the users had lost all confidence in the WUA, and to develop new links between users and the WUA. All categories of users[22] were engaged in the programme to varying degrees. At the end of this programme water users had a good understanding of the irrigation system and its constraints; they recognised their role in its management; they identified key gaps and problems. They were able to resolve some problems and were prepared to participate actively in tackling others in the future.

In the second year we implemented a second one season-long programme under this project (Season 2). In Season 2 we focused specifically on measures needed to improve water management: better coordination and communications with the main system managers; control of illegal activities in canals and outlets; improved maintenance; and introduction of systematic field level operating rules – as outlined briefly above in Box 5. Considerable progress was achieved by the end of the season. But it was in the course of the irrigation season that the agreement and initiation of concrete actions took place. This meant that some tasks still remained to be completed. For example, while people were reluctant to give up land for construction of temporary field channels once they had transplanted paddy, they were willing to do so before the start of the coming season. It was only once they had started to implement improved procedures that they were able to see both the benefits and difficulties and to start coping with practical issues such as methods of monitoring flows, managing data, allowing for multiple sources and uses of water, and so on. Designing and implementing appropriate rules takes time, requiring extensive consultation and communication as well as good understanding of the technical requirements.

At the conclusion of our field work it was evident that water users still needed a third season of support (Season 3) to address outstanding technical, social and institutional issues and to put measures which were initiated in the second season on a stronger, and more sustainable, footing. Considering technical elements, this would include helping the WUA committee members to work with volunteer farmer water monitors and water users to prepare pre-season plans more systematically. Socially, more time was needed to control some illegal actions and to agree suitable alternatives with the farmers who have taken them. Additional support for the institutional element could encourage follow through with activating the various tiers of the WUA, including the formalisation of a key sub-committee. The WUA committee members could be helped, with training and technical backstopping, to work more effectively with water users and to provide water users with the leadership not only for water distribution, but also maintenance, which they clearly wish for.

Discussions around furrow irrigation at the tail of Obu Haet (Kyrgyzstan)

[22] Including all well-being categories (rich, medium and poor), landlords, owner-farmers, unofficial tenants, agricultural labourers and landless water users. Both 'ordinary' farmers and executive members of the WUA were involved.

This experience indicates that three seasons of relatively intensive support spread over two to three years is needed to revitalise a WUA and to introduce effective operating systems. It should be noted that this depends entirely on 'software' improvements – no construction or infrastructure development was involved. Maintenance standards were improved, but this was achieved by the WUA and using their own resources. After the third season a much lower level of background support, with periodic visits and specialist consultancy on call, would be needed in the longer term. This would help to ensure that progress is sustained, and that the WUA committees receive the advice they need to help them solve problems as they emerge.

Illegal outlet at SMIP, later replaced by irrigation through field channel from legal outlets

This programme was implemented through a local NGO, with support from a national NGO and the Department of Irrigation as well as from the international team on this project. The role of our teams was important not only for their technical capacity, but also for their explicit aim of highlighting and championing the interests of those who have suffered from existing water distribution – particularly the poor and marginalised whose interests have tended to be neglected. Thus the findings of our study are relevant not only to strategies to improve water distribution in particular, but also to the way the 'institutional development' of WUAs has been promoted. While the creation of new formal associations of water users has been emphasised[23] in the past, there has often been insufficient effort to make sure that the water management institution genuinely responds to the needs, and constraints of all water users, including the poor and marginalised. Without champions these groups are often unable to influence the performance of the WUA. We have shown that it is unrealistic to assume that WUAs will naturally operate according to principles of good governance, democracy and equity even if formal laws, regulations and constitutions are supportive. These are important conditions, but we have seen in our study areas that they have not been sufficient. To be more realistic, a strategy to improve management of irrigation should include an analysis of the drivers of change, as well as the factors and interests that obstruct change, at all levels from the field to the macro. It is then necessary to identify and support the catalysts and champions which will promote institutional development according to the principles that are aspired to.

Extending our approach will depend on the resources and capacity of suitable 'champions'. These will often be local NGOs, and a considerable part of our effort on this project and its predecessor was devoted to building this capacity. Once this local capacity for institutional development has been established we estimate the cost of the WUA strengthening programme to be around $75 per ha: a small proportion of the typical physical rehabilitation cost of over $1,000 per hectare. The process will be quicker if the WUA has been newly formed and is still enthusiastic, where there is no need to recover from a sense of frustration and failure. Such WUAs provide an opportunity which should be grasped while it is still available: this study has revealed the scope for improvements and practical methods for achieving them.

[23] The development of new associations has sometimes been equated with the formation of 'social capital'. As we discuss in Chapter 2, we think this use of the concept of 'social capital' is too narrow and results in a misplaced emphasis on the formation of formal organisations. This neglects wider 'social capital' considerations of how to achieve greater fairness in rules and in actual behaviour.

8 Conclusions

The emphasis in this project was on how to help water users' associations to develop improved procedures for distributing water to farmers' fields, and to show that this would have a beneficial impact on the livelihoods of the poor.

We have outlined in this report the systematic process we adopted for strengthening local institutions, for improving their co-ordination with external water supply agencies, and for helping them improve the distribution of water and thereby reduce losseas and wastage of water. We have not prejudged how the water users should want water to be shared, but enabled a social and political dialogue amongst all classes of stakeholder (including women and poor farmers as well as the rich male farmers and landlords who traditionally dominate WUAs) on the nature of a 'fair' distribution and how the WUA can achieve this. We conclude the report by summarising the achievements of this study in terms of improved water distribution and livelihoods on sample projects.

We have shown that it is not effective to address water distribution in isolation – technical, social, institutional, and policy conditions which affect water distribution must all be considered. Thus there are four 'key ingredients' required to improve irrigation water management:

- Improved technical and management procedures, designed by
- Well informed, involved stakeholders, and implemented by
- A strong, 'embedded' and respected local institution, working within
- An appropriate external environment, which gives WUAs the necessary authority and support, and assures them of a predictable water supply.

Table S.2: Actions proposed for improving water management in the case study sites

Intervention		KIS	SMIP	OH	JA
Institutional reform	Engagement with users	Improve confidence that rules will be enforced fairly and consistently	Strengthen process of engagement started previously through a programme of water users' schools	Engage with users and WUA to build willingness to comply with rules and penalties: use of 'act' against defaulters	
Organi-sational: structure and staffing of WUA	Awareness (and definition, if needed) of roles, responsibilities, willingness to discharge responsibilities	Initiate representation of Kaparkhori on WUA	Revitalise WUC and improving communications	Create awareness of the role and responsibilities of WUA, GA and users	
		Improve representation on WUA	Stimulate greater involvement by WUA management		Stimulate greater involvement by WUA management
		Employ seasonal *dhalpa*	Employ seasonal *dhalpa* or farmer-monitors	Employ part time *mirab* at critical times	Improve performance of *mirab*
Commun-ications	Communications within WUA and with service provider	Improve communications between WUA and sub-committees	Improve comm.-unications between users, WUA and project office		
	Communications between WUA and users	Communications of decisions and aware-ness of main canal operating systems	Agreement and awareness of water delivery schedule	Publicise names of those authorised to irrigate each day	Introduce coupon system, and publish names of authorised to irrigate each day
Maint-enance	Establish and implement rules for maintenance, and finances	Improved systems for timely maintenance of key components of main system.	Develop rules for mobilising resources and implementing maintenance	Introduce systems for regular maintenance of inter-farm canal by WUA and outlet channels by user	
	Reduce need for and opportunities for water theft		Remove illegal outlets and dig field channels from legal outlets		
Operation	Implement systematic procedures for operation of canals and structures	Introduce systematic operating rules for Kaparkhori outlets: coordinate operation of KK and LMC	Introduce flexible operating system for sub-secondary canals		
		Establish target water levels in LMC		Coordinate rice and cotton irrigation	
		Improved rules and procedures for rotati-onal operation of BC1	Agree principles for managing water (systems /situations)	Agree principles for managing water to outlets	Agree principles for managing inter-farm canal, and outlets
		Improve water sharing within large outlets at times of shortage: detailed rules for critical times: indicators for time, depth and duration	Develop rosters for irrigation, order of irrigation, and indicators of target depth to apply as agreed above	coordination between users within outlet to irrigate in a logical sequence and to close outlets at the end of irrigation. Provide technical advice on optimal water management techniques, especially cotton	

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