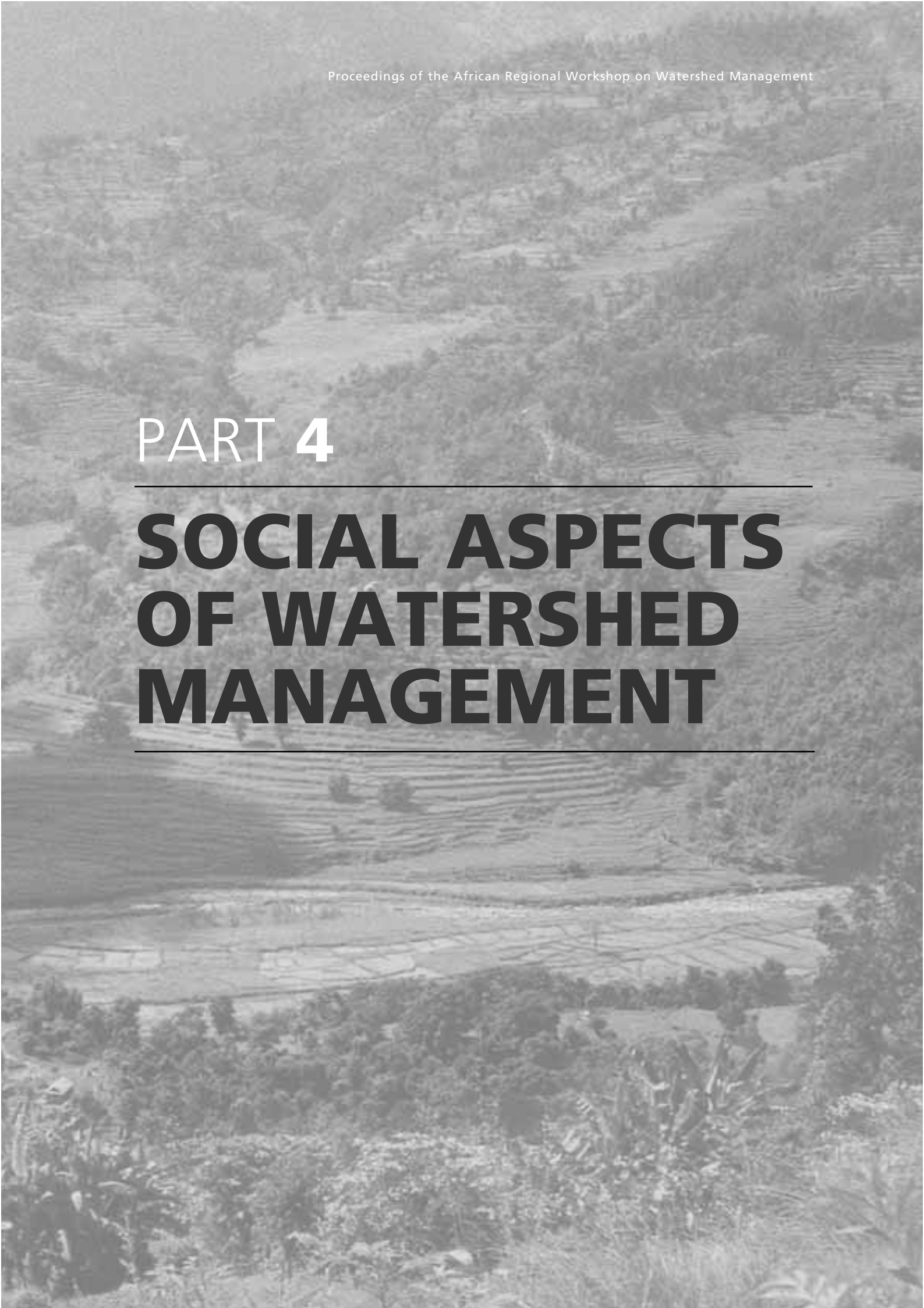

PART 4

SOCIAL ASPECTS OF WATERSHED MANAGEMENT

CHAPTER 9
THE SOCIOLOGICAL APPROACH IN WATERSHED MANAGEMENT: FROM PARTICIPATION TO DECENTRALIZAION

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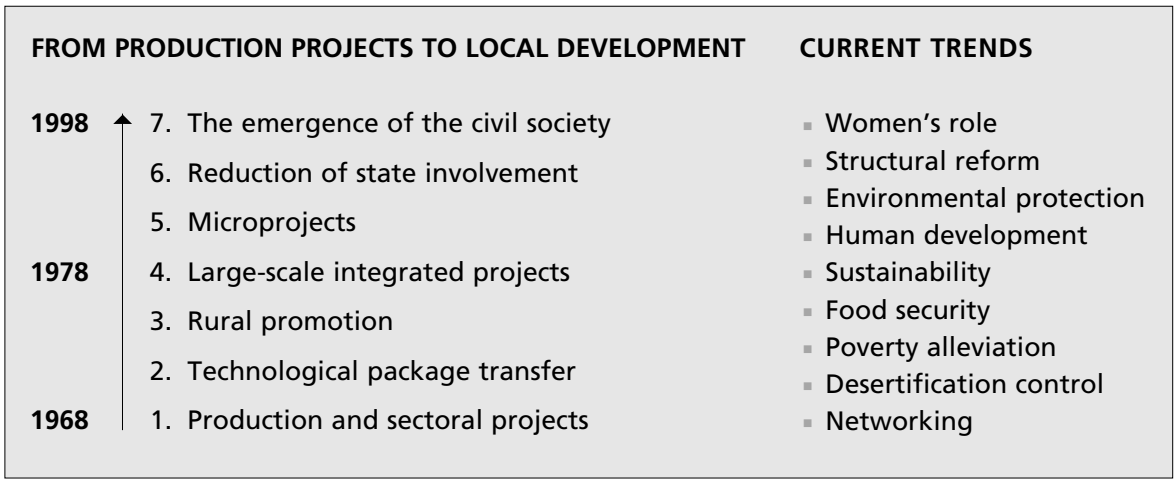
Rural development over the past 20 years has been marked by a gradual shift from the intervention-based method to an approach promoting rural people's involvement in their own development. Initially, projects sought to respond to very low levels of crop production due to countries' failure to make the most of their resources. They dealt with these production problems by introducing technical packages and extension support measures, sometimes using rural promotion and education methods. Because the economic and social environment was ill-suited to the changes introduced and given the populations' growing needs, these projects had to fill the gaps in terms of equipment and management, often becoming difficult-to-manage, large-scale integrated projects. At the same time, the NGOs, which worked more closely with the people, opened the way for village-level micro-projects, where the people could take responsibility for their own development. Although these experiments were limited in scope, they proved their usefulness at a time when there was pressure from within and without for governments to stand back to allow the civil society to emerge. Current trends suggest an increased awareness of the human dimension, women's role, environmental protection, sustainability and food security.

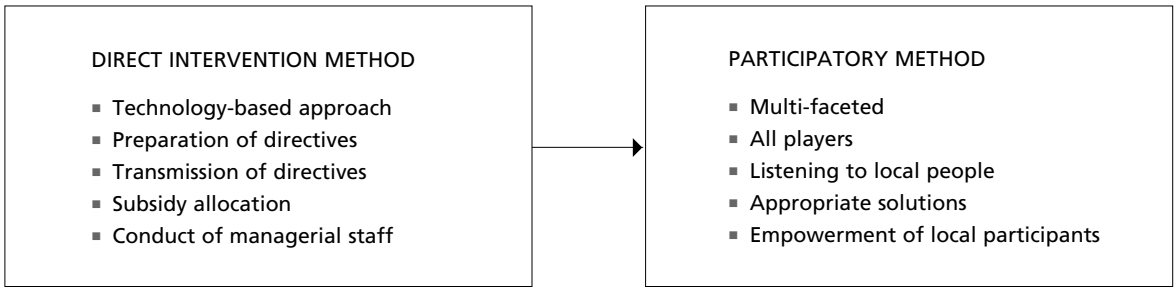
Development programmes and projects have gradually evolved to cover the many aspects of the problems to be dealt with. They have sought to reflect better the complexity of the situations encountered, the numerous causes of the problems and the various solutions proposed. The major change in the last ten years was to design these programmes and projects along participatory and decentralized lines so that more attention could be paid to the people's requirements, the problems on the ground could be better understood and the groups concerned could be helped to improve their situation. However, it must be pointed out that priority with respect to development measures has been given to those regions with a high production potential (e.g. irrigated plains) and, consequently, large parts of watersheds, often subject to migration, received less support. The exception to this rule was erosion control measures, but even these were carried out only to protect dams whose water was earmarked for the rich farmers on the plains.

THE GLOBAL APPROACH AND THE PEOPLE'S ROLE

One of the improvements introduced in recent years is the global approach. Although evaluations of the constraints encountered in and the potential of rural areas revealed the

complexity of the situations, they also highlighted the need to take account of the many aspects of the problems to be dealt with. A systemic analysis showed that all human activity may be considered as an element in a complex system; a system where various elements are interrelated and can be exchanged (goods and information) within and outwith the system in accordance with regulatory mechanisms, thereby providing a result while at the same time ensuring that the overall system is sustainable.





Under these holistic arrangements, the human factor has a vital role in rural systems. If we look at mountain dwellers, we find that they develop survival strategies based on the assets available to them (land, water, inputs, labour and expertise) and are able to obtain results that can be used not only to sustain their system but also, in the best-case scenario, to expand it.

Of course, farmers receive funds in the form of aid and subsidies, as well as non-farm income from family members. Understanding the strategies used by small farmers, as well as how small farming systems work or why they fail, could shed light on the constraints they face and the measures to be taken to overcome them. Such measures could include improving the factors of production (e.g. fertility improvement, improved water management, land management, equipment and mechanization, etc.) and the marketing of farm surpluses (labelling, marketing organization, etc.). This requires decisions to be made by the persons in charge, their families and other persons concerned directly or indirectly with these improvements.

All these partners are also involved in a number of rural systems all governed by the same rules of operation (e.g. marketing systems, the banking system, the political system, etc.). While each system may be an entity in itself, all the systems are inter-related and may also be inter-dependent. The hydrological system is intrinsic to the watershed, a truly complex system. The same may be said of social systems, which may be local, regional, national and even international. They all involve a number of flows and relationships among the various components which, despite the complexity of the task, must be taken into account so that an accurate evaluation of the environmental situation can be made and the most appropriate solutions recommended.

Similarly, the changes in the design and implementation of development programmes in recent years have made it necessary to review the principles and relationships among the players in the rural process, especially the partnership between the people and the outside experts. Indeed, evaluations of the measures taken, often on the initiative of the authorities and outside experts, have highlighted problems concerning the maintenance and sustainability of the measures taken after project completion. The situation is further aggravated by pressure from international donors for government disengagement. The new responsibility-sharing system is part and parcel of a general trend towards decentralization, now taking place in most countries. It also draws on a very strong movement promoting the involvement of grassroots communities in the sustainable management of their resources.

PARTICIPATION AND LOCAL DEVELOPMENT

Although people's participation is recognized as a necessity and has been introduced in many programmes and projects as well as in most national and international plans, it is not always evident that it is being implemented. Some of the problems with involving the people in projects lie with the outside experts who have difficulty changing their method of operation – a management-based and top-down approach – and do not fully understand the reality of the situation in which the people find themselves. The people, on the other hand, find it difficult to enter into a new type of relationship as they continue to see themselves as the recipients and the outside experts as the providers of material assistance. However, what slows things down most often is failure to recognize the local people and their associations as true partners.

What has been seen so far of the participatory system makes one wonder how to deal with the various situations brought about by the use of this approach, even when it is properly implemented. There has been a shift from the top-down approach, based on the provision of services, to one giving priority to individual demand. We have also witnessed governments everywhere disengaging. This could leave vacuums which could adversely affect the less well-prepared communities. By giving priority to the local people – a good step in itself – we now have a situation where more people are making decisions without being able to see the broader picture. So as not to succumb to some of the dangers of the participatory approach, such as dilution, decentralization will have to be strengthened; in other words, the intermediate levels, i.e. the regions and provinces, will have to be given the means to provide the interface between national requirements and local expectations.

SOCIAL RELATIONS AND PARTNERSHIP

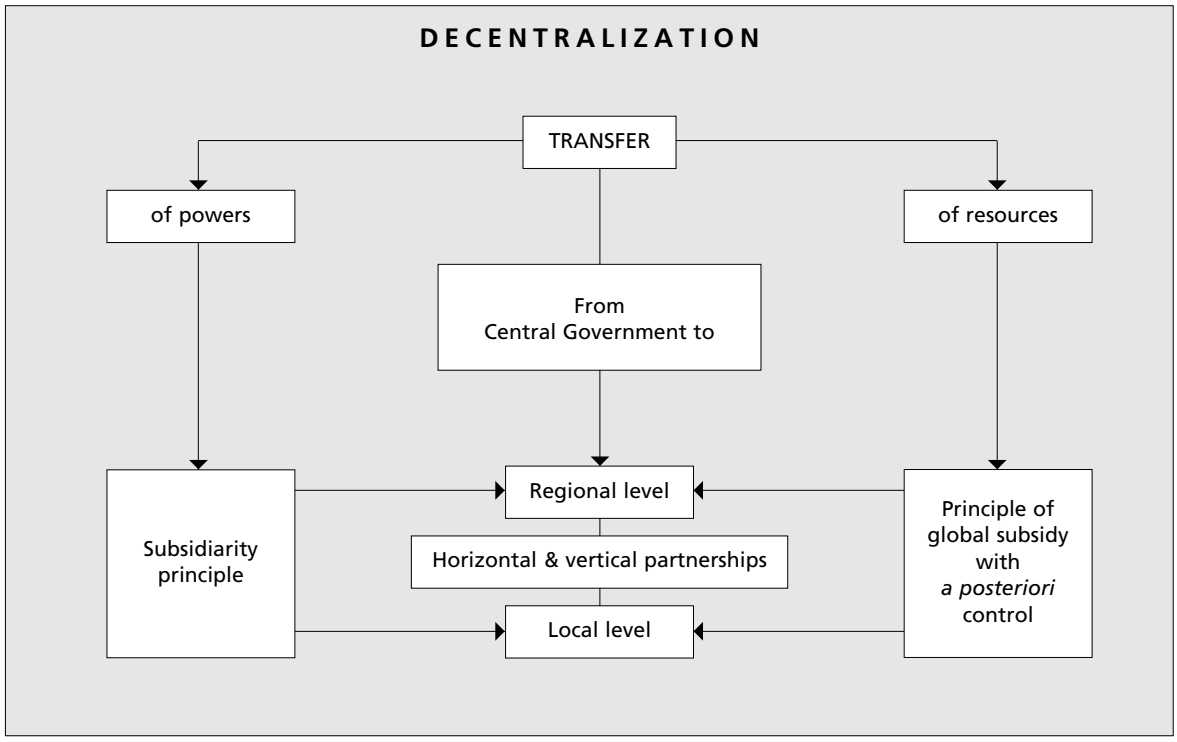
A policy based on local player involvement needs to recognize the demands of local communities and small regions. Conversely, national policies will have to be made more region-friendly. In other words, they will have to take into account the regions' agro-ecological, social and cultural characteristics. However, these two dimensions can only be implemented if accompanied by strong support measures designed to improve information sharing, strengthen the capabilities of people at all levels and organize the countryside. The major challenge here is how to deal with the contradiction between acknowledging local community initiatives and the need to incorporate these initiatives into a comprehensive approach.

With decentralization, the State becomes the mobilizer and facilitator of local development initiatives proposed by the communities. The basic idea behind economic reforms and decentralization is to give free rein to initiatives so that they can cater to special interests, without the local elites once again using their role as representatives of the people to organize, run and take over decentralization. A contractual and partnership approach would seek to establish new relations among the rural development players rather than vertical relations based on strategies that ignore local and regional processes.

Centralized government institutions must be replaced by new institutions capable of creating suitable conditions for dialogue between farmers' organizations and other rural development players. At the same time, these new institutions must work towards the creation, conversion and strengthening of intermediate associations, which will have a central role for the following three reasons: 1) they will provide guidance for the government in drawing up the various policies that must go hand in hand with decentralization; 2) they will collate and regionalize the demands and requests of the rural people; and 3) as they eventually become sufficiently mature consultative partners, they will be able to build partnerships with other rural development players.

This organizational effort by the intermediate associations would help to globalize the decentralization process and the rural development measures based on an ongoing dialogue among all rural development players. In this way, the regional interface would gradually become the point at which mediation and arbitration take place, through the establishment of consultation and participatory arrangements for all levels of the rural communities. The principles of subsidiarity (based on the transfer of decision-making to the most appropriate level) and global subsidy with *a posteriori* control will apply in the case of actual decentralization, i.e. the devolution of power to the regional and local levels.

FAO has developed a RED-IFO analytical model based on experiences gained through its support to countries and projects with a view to strengthening decentralization processes. A CD-ROM and methodological documents are available. FAO has also provided support in the field in various areas and sectors. Significant watershed projects were carried out in Morocco, Tunisia and the Sahelian countries. Their aim was to promote new ways of sharing tasks and responsibilities among governments and their decentralized services, and civil society and its representative organizations (municipalities, farmers' organizations, grassroots groups, etc.). The following diagram shows how this works.



CONCLUSIONS AND RECOMMENDATIONS

The following suggestions are proposed in an attempt to highlight the importance of expanding the use of the sociological approach in tackling upland watershed problems and implementing relevant development measures.

Raising awareness of the people's role in the watershed approach. In order fully to recognize human dimensions in water and land management, it is vital that the partners concerned, in intervention structures and in the village communities, are made aware and are convinced of the advantages of this approach, i.e. the mobilization of the rural communities and their greater involvement in development programmes and projects.

The proposed measures are:

- to launch information campaigns so that all the parties concerned are aware of the principles, methods and advantages of participation and take part in the participatory processes;
- to prepare specific material that may be used by government experts and the people's organizations better to understand the socio-human problems and to promote participation.

Strengthening the capabilities of local organizations. Even when they do exist, rural people's organizations in many developing countries are not fully participatory. Governments often look upon them as their political tools. These organizations do not have qualified managers or local leaders, which makes it difficult for them to become involved in their own development. Efforts need to focus on promoting and strengthening civil society organizations and making them independent.

The proposed measures are:
- to use various types of organizations such as small informal groups, traditional community associations, cooperatives and trade unions to deal with water problems in mountain areas, and to reach all sectors of the rural population concerned. This would involve amending laws and regulations and ensuring that training is provided for those persons who will take over responsibility and for the members of the organizations;
- to pay particular attention to and introduce special measures for the most deprived groups and women, bearing in mind their essential role in socio-economic life and in farming and non-farming activities. This entails giving women equal access to natural resources and services, and equal rights and opportunities to develop and use their skills;
- with regard to the funding of local organizations, to encourage governments to adopt methods designed to help these organizations to become self-sufficient, so that they will not need to have much recourse to aid and subsidies.

Decentralization of decision-making by all players concerned, including those outside of watershed areas. It has been observed that decentralized systems encourage local initiatives and participation. Rural people are probably more likely to support development initiatives that reflect their own views and requirements. So that the hand-over of decision-making powers at the local level may take place according to the rules, appropriate mechanisms must be available to facilitate dialogue and cooperation among the parties concerned.

The proposed measures are:
- to change administrative and budgetary procedures to facilitate the hand-over to the local level of the powers and tasks involved in decision-making, tax collecting and expenditure;
- to set up local planning consultation bodies, which will comprise representatives of the people's organizations, NGOs and the authorities to help in decentralizing decision-making about the future of high mountain areas.

Promoting dialogue, partnership and alliances among players. In many developing countries, governments, development bodies and NGOs help to promote and support village community groups and people's organizations. Promoting the sharing of information and dialogue among all the parties can encourage cooperation at the local level with a view to participatory development.

The proposed measures are:
- to establish national and local-level networks whose task would be to facilitate dialogue and cooperation among the players in these mountain areas;
- at the legal, administrative and technical levels, to facilitate the establishment of bodies made up of civil society organizations in order to help improve the partnership among all the various players.

CHAPTER 10
CATCHMENT PROPERTY RIGHTS AND THE CASE OF KENYA'S NYANDO BASIN

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ACRONYMS

CAPRI	Collective Action and Property Rights programme
ICRAF	World Agroforestry Centre
NEC	National Environment Council
NEMA	National Environment Management Authority
NSWCP	National Soil and Water Conservation Programme
RWSTF	Rural Water Services Trust Fund
Sida	Swedish International Development Cooperation Agency
WRMA	Water Resource Management Authority
WSRB	Water Services Regulatory Board

Attention to watershed management is increasing across the developing world. In India, for example, more than US$500 million is invested in watershed projects every year. There are compelling reasons to believe that this interest will continue to grow. Water resources are becoming increasingly scarce. Tunisia, Kenya, Rwanda, Burundi, Algeria, Somalia and Malawi were already considered water scarce in 1990; by 2025 they will be joined by the Libyan Arab Jamahiriya, Morocco, Egypt, Comoros, South Africa and Ethiopia (as measured by the availability of 1 000 m^3 of renewable water per person per year) (www.cnie.org/pop/pai/water-14.html). Concerns about water scarcity in South Africa have led to the Working for Water programme to remove fast-growing invasive trees from critical catchment areas and areas of valuable biodiversity (www.dwaf.pwv.gov.za/wfw). Across the developing world, ever-greater numbers of people are exposed to flood risks. Soil erosion continues to degrade agricultural potential, while dams, reservoirs and irrigation infrastructure continue to be clogged with sediment.

Integrated water management and ecosystem approaches are now generally recognized as vital to durable solutions to these challenges. In India, for example, the most successful watershed and catchment management programmes involve multiple stakeholders – community groups, NGOs, government agencies – a mix of new techniques and social organization, and give balanced attention to improving resource management and farmers' livelihoods (Kerr, Pangare and Pangare, 2002).

A particular area where more integrated approaches are required is in property rights reform. Insecure property rights to cropland are often cited as the major cause of soil erosion, sedimentation and low crop production (see review in Gebremedhin and Scott, 2003). An obvious policy prescription for dealing with catchment degradation, therefore, is to enhance tenure security on cropland. While more secure tenure may well reduce plot-level erosion, it is possible that less erosion at the plot level will not translate into significant changes in sediment loss at the catchment scale. Catchments are comprised of different types of land, put to different uses and held under different types of property rights. Crop agriculture may or may not be a large contributor to erosion within a catchment. In most catchments, there are other land uses, especially roads and footpaths, which occupy small areas of land but account for large percentages of total erosion (Ziegler, Sutherland and Giambelluca, 2001). In addition, catchments invariably comprise micro and macro sinks where eroded soils accumulate, as well as filters that reduce lateral flows of water, pollutants and sediment (Van Noordwijk *et al.,* 1998; Swallow, Garrity and Van Noordwijk, 2002). It is important, therefore, to take a wider perspective on property rights.

The objective of this paper is therefore to present a catchment perspective of property rights. Following Tiffen and Gichuki (2000) and DENR (1998), we define a *catchment* as "the area of land from which rainwater can drain, as surface runoff, via a specific stream or river system to a common outlet point which may be a dam, irrigation system or municipal/urban water supply offtake point, or where the stream/river discharges into a larger river, lake or the sea" (DENR, 1998: p. 29). On the other hand, a *watershed* is a "whaleback land unit" that forms the upper area of one or more catchments, with hydrologic linkages to lower parts of those catchments (Tiffen and Gichuki, 2000). We use the term *property rights* to refer to claims to use or control resources that are recognized as legitimate by an entity or entities larger than the individual, and the social and/or legal mechanisms that define and protect those claims. The key elements of *catchment property rights* therefore are the claims to use or control the resource stocks, flows and filters that comprise catchments, the individuals and groups that exert those claims, the statutory and non-statutory entities that support those claims, and the institutions that define and protect those claims and enforce duties on others.

The remainder of the paper consists of three components. The second section presents an analytical framework for watershed property rights that builds on a simple model of watershed function and the concepts and approach of legal pluralism. The third section applies that framework to the case of the Nyando river basin in western Kenya. The final section presents conclusions.

AN ANALYTICAL FRAMEWORK FOR ANALYSIS OF CATCHMENT PROPERTY RIGHTS

A watershed model of sources, sinks, flows and filters

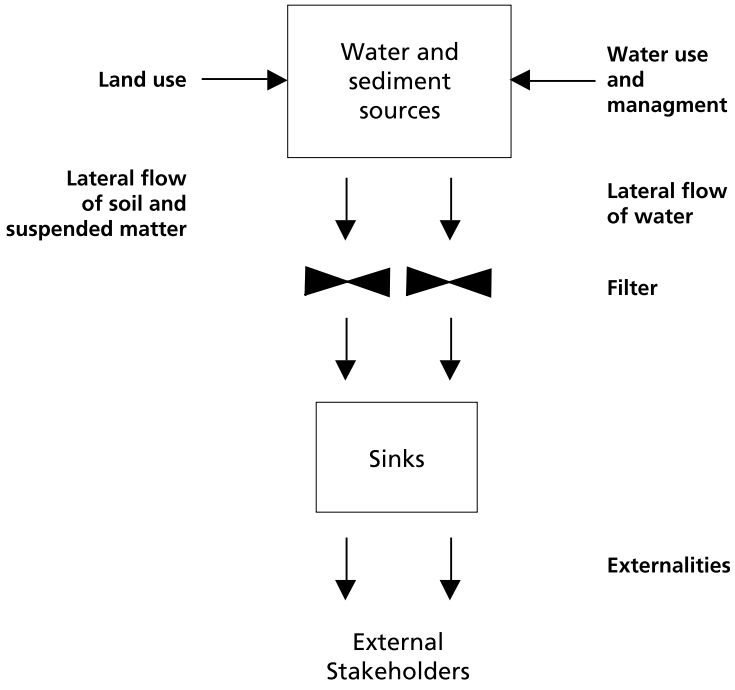
Van Noordwijk *et al.* (1998) and Swallow, Garrity and Van Noordwijk (2002) propose that watersheds be conceptualized as containing four main components: sources, sinks, flows and filters. *Sources* are units of land that yield more soil or water to downstream land units than they accumulate from upstream sources, while *sinks* are units of land that accumulate more soil or water from upstream sources than they yield to downstream sources. Both sources and sinks exist at multiple scales. At a landscape scale, natural forests tend to be net sinks of

sediment and water. At a smaller scale, natural forests usually have undulating land surfaces that contain small areas of source and sink.

Flows refer to lateral flows of organisms, soil, water, air and specific substances carried in such flows. Lateral flows of water are a defining characteristic of hydrologic catchments.

Closely related to the concept of lateral flow is the concept of *filter*. A filter is an element of a landscape that intercepts or modifies a lateral flow. Filters can decouple flows of dissolved particles from a flow of water, or act on flows of air or organisms. Filters have profound effects on the way that people cope with externalities and the scaling up and scaling down of catchment management. There are filters in the landscape at all scales, from field edges, to rice paddies, river vegetative strips and wetlands.

FIGURE 1
Simplified graphical model of sources, sinks, flows and filters in a hydrologic catchment



Source: Modified from Swallow, Garrity and Van Noordwijk, 2001.

Figure 1 presents a graphical model of a catchment that is comprised of sources, sinks, lateral flows and filters. Overall catchment management depends crucially on the particular portions of the catchment that can be identified according to source, sink, filter and flow. Landscape portions that are particularly important include the following:

1. *Water sources:* Catchments usually have discrete water sources, such as springs, that may be subject to multiple use by multiple users. Such sources may be the cause of severe gulley erosion if poorly managed.

2. *Soil erosion sources:* Land areas that are particularly prone to high rates of erosion generally include footpaths and roadsides, which are often public property. Croplands and grazing lands, which may be private or common property, are more variable as sources of sediment.
3. *Pollution hotspots:* Particular commercial farms, such as horticulture farms or agro-industries, may be associated with particularly high discharge of pesticides, fertilizers or industrial residues.
4. *Wetlands:* Wetlands tend to be very important sinks and filters of sediment and nutrients. They also tend to be subject to multiple use, multiple users and conflicting property rights. Wetlands often have important values for preserving biological diversity.
5. *Waterways and constructed canals:* Waterways and canals serve as channels for carrying flows of water and suspended pollutants. Natural waterways are often viewed as public or common property, while canals may be private or group property.
6. *Riparian areas:* Riparian areas along watersheds or water reservoirs are important as potential or actual filters of soil and water (Tabacchi *et al.,* 1998). Riparian areas tend to be declared public areas, and are often used by large numbers of people with divergent interests (Swallow, Garrity and Van Noordwijk, 2002).
7. *Field and farm boundaries:* Field and farm boundaries can be important filters of water and sediments. Depending on the land tenure system, such boundaries may be subject to intense private investment in trees, vegetative fences or stone structures, or intense competition and multiple use.

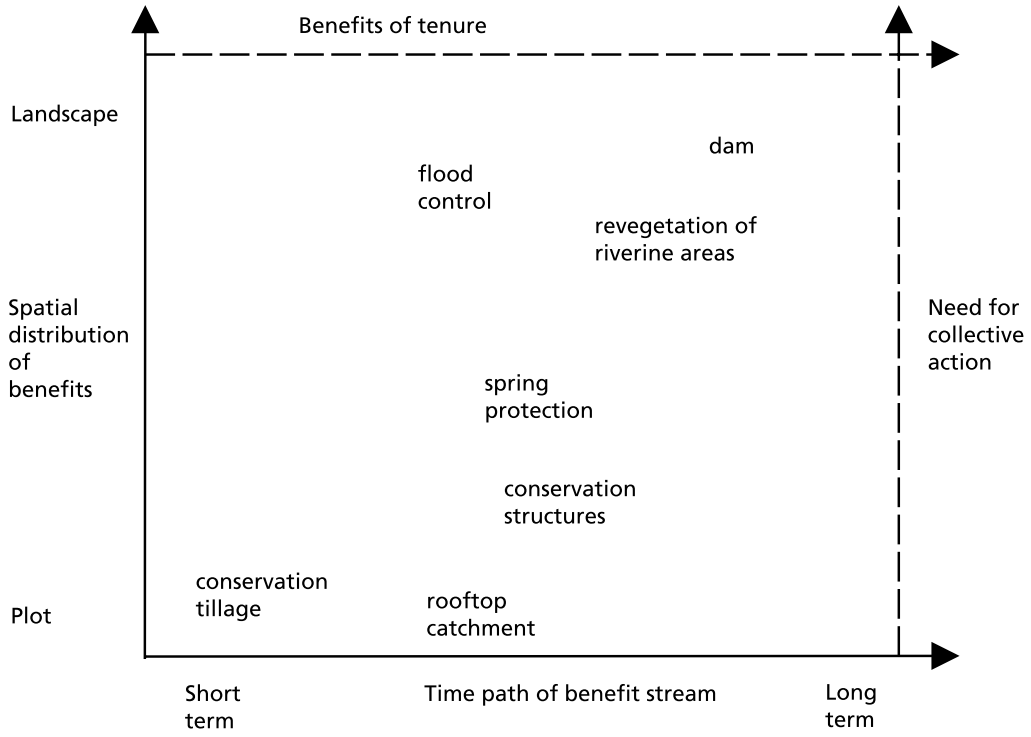
Importance of property rights and collective action over catchment components

The Collective Action and Property Rights programme (CAPRI) offers a simple conceptual framework to depict the importance of property rights and collective action for the adoption and management of different types of agricultural technologies and natural resource investments (Knox, Meinzen-Dick and Hazell, 1998). The key components of the framework are: 1) time duration of investment, which implies the value of long-term security of land tenure; and 2) spatial distribution of effects of investment, which implies the benefits to be obtained from collective action for resource management. Knox, Meinzen-Dick and Hazell (1998) indicate watershed/catchment management as a resource investment that requires both secure property rights and strong collective action. In Figure 2 we use the CAPRI framework to offer some hypotheses about the importance of secure property rights and effective collective action for the watershed components.

A legal pluralism approach to watershed property rights

Conventional treatments of property rights start from the presumption that there is a single legal source of authority that defines and enforces a single set of rules and laws about how people may access, use and manage resources and the benefits that derive from those resources. In contrast, the legal pluralism approach recognizes that there tend to be multiple sources of authority and institutions affecting people's access and use of resources and does not judge the legitimacy or superiority of any particular authority or institution (Meinzen-Dick and Pradhan, 2002).

FIGURE 2
The spatial distribution and time duration of investment in key catchment components



Source: Modified from Knox, Meinzen-Dick and Hazell, 1998.

Analysis of property rights through the perspective of legal pluralism begins with an understanding of how individuals obtain access to and control over resources. The "law" that governs access to and control of resources is not confined to rules and regulations enacted by State organs, but also includes norms and rules of behaviour that are generated by various forms of social organization, including villages, ethnic groups, associations or the State. Various types of law may be important in influencing property rights, including statutory law, religious law, customary law, project law, organization law and a range of local norms. Different types of laws are likely to be supported or sanctioned by different social authorities, which will tend to have different types of strengths and weaknesses. People with claims or complaints regarding watershed resources are likely to appeal to different types of law and social authorities to support those claims (Meinzen-Dick and Pradhan, 2002).

CATCHMENT PROPERTY RIGHTS IN THE NYANDO RIVER BASIN OF WESTERN KENYA

The Nyando River basin covers an area of 3 500 km^2 of western Kenya, and has within it some of the most severe problems of agricultural stagnation, environmental degradation and deepening poverty found anywhere in Kenya. The Nyando River drains into the Winam Gulf of Lake Victoria and is a major contributor of sediment, nitrogen and phosphorus to Lake

Victoria.[1] About 750 000 people reside within the Nyando basin, most of whom live in Nyando District in Nyanza Province and Nandi and Kericho districts in Rift Valley Province. The incidence of consumption poverty is high, ranging from an average of 58 percent in Kericho District, to 63 percent in Nandi District and 66 percent in Nyando District. At the administrative location level, the locations of Nyando District include both those with the lowest poverty rate in the sugar belt of Muhoroni Division (36 percent) and those with the highest poverty rate in Upper Nyakach Division (80 percent) for the entire basin (Central Bureau of Statistics, 2003). HIV/AIDS prevalence varies among 28 percent in Nyando District, 7 percent in Nandi District, and 12 percent in Kericho District.

Land-use and property rights vary across the basin. The upper part of the basin is comprised of gazetted forests, commercial tea production and small-scale agriculture on steep hillsides that were degazetted as forests during the last 40 years. Mid-altitude areas are a mixture of smallholder farms (with maize, beans and some coffee, bananas, sweet potatoes and dairy) and large-scale commercial farms (mostly sugar cane). The flood-prone lakeshore area is mostly used for subsistence production of maize, beans and sorghum, combined with commercial production of sugar cane and irrigated rice. There are clear differences in land use between long-settled areas and resettlement areas. The irrigated areas are owned by smallholder farmers and the moribund National Irrigation Board.

Sources, sinks, filters and flows in the Nyando basin

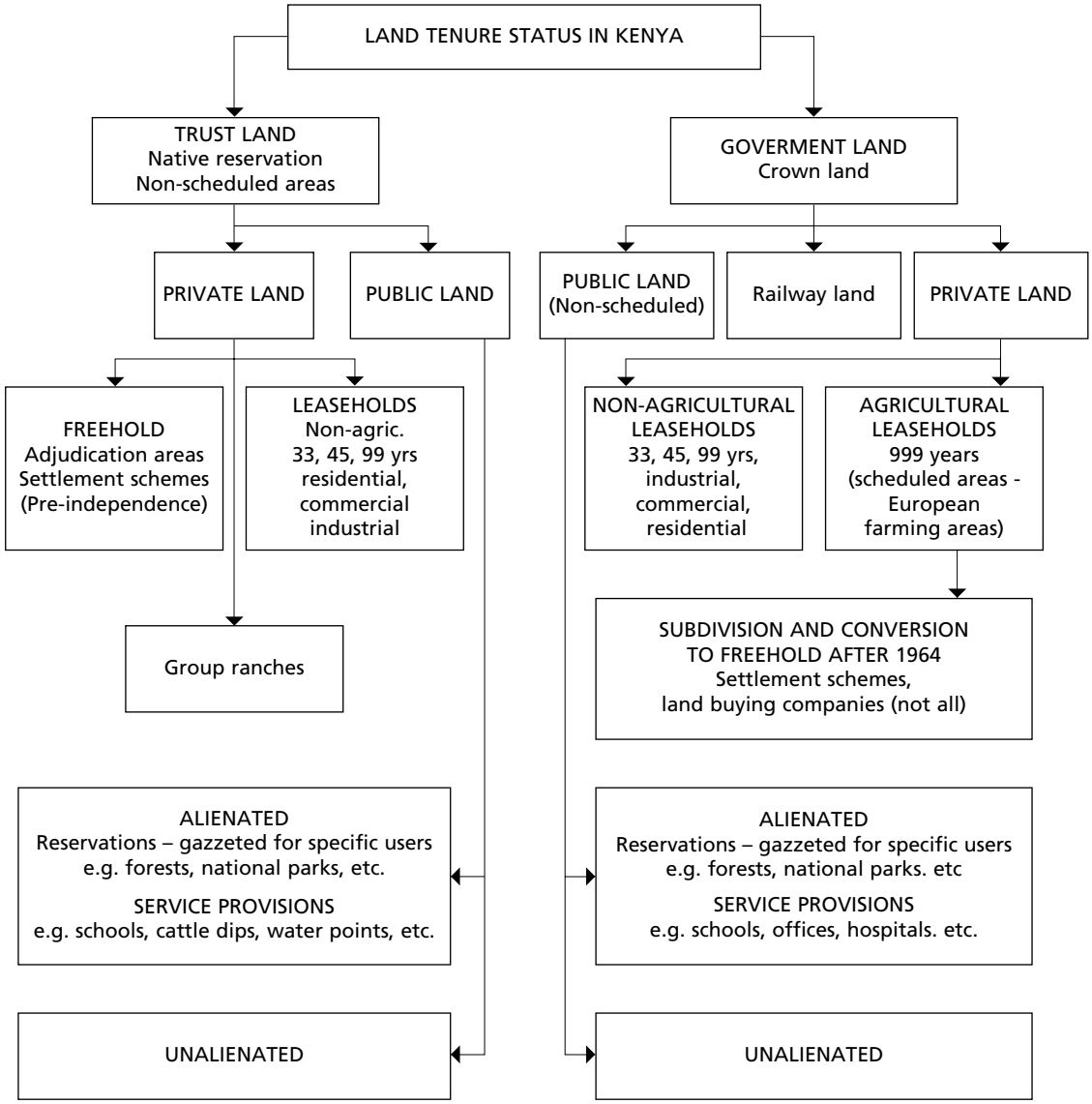
Scientists from the Lake Victoria Environment Management Programme, Water Quality Component and ICRAF have conducted several studies of water quality, land use and soil degradation across the Nyando basin during the last few years. Many of these results are summarized in a proceedings volume edited by Mungai *et al.* (2004). An analysis of sediment cores from the outlet of Nyando River into Lake Victoria shows a historical trend towards higher levels of sedimentation, with strong peaks in sediment deposition during high rainfall events associated with El Niño. Increased nutrient and sediment loads in the Nyando are linked to both point and non-point sources of pollution. Key point sources are sugar processing and agrochemical factories, while non-point sources are the thousands of small farm families who operate throughout the basin. ICRAF scientists estimate that about 61 percent of the land in the basin is sediment "source" area, with average net erosion rates of 43 tonnes/ha per year, while 39 percent of the land in the basin is sediment sink area that accumulates about 45 tonnes/ha per year. Sediment source areas are further distinguished into areas with relatively high erosion rates (fast erosion) and relatively slow erosion rates (slow erosion). Fast erosion is concentrated in hill slopes in the flood-prone Kano plains and some of the steep hillsides in the upper and mid-altitude parts of the basin. The remaining upland forests and wetlands and some of the sugar cane and smallholder farming areas in the mid-altitude zone appear to be net sediment sinks (Walsh, Shepherd and Verchot, 2004). Most of the riparian areas that could be important filters have been systematically deforested over the last 40 years.

1. The myriad problems of Lake Victoria – heavy loading of nutrients, loss of indigenous fish species, invasion by aquatic weeds, bans on fish exports to the European Union – have prompted a number of research, development and networking activities during the last decade.

Statutory land tenure in the Nyando basin

Land and water in the Nyando basin are held under a surprisingly wide variety of statutory property rights arrangements. Figure 3 presents the various types of land tenure as a classification tree, showing that there are at least six types of private tenure, including three types of private tenure on former crown land (large agricultural leaseholds [former white-owned farms], subdivided agricultural leaseholds and non-agricultural leaseholds) and four types of private tenure on trust land (freehold land in adjudication areas, freehold land in settlement schemes, non-agricultural leaseholds and group ranches). At the present time, these different tenure types are administered under a number of statutes, including the Government Lands Act, the Trust Lands Act, the Registration of Titles Act, the Land Adjudication Act and the Registered Land Act.

FIGURE 3
Land tenure characterization in Kenya



Source: Authors' analysis of the legal statutes and key informant interviews.

Land degradation problems appear to be most severe in subdivided agricultural leaseholds and in freehold land in adjudication areas. In the former, there are problems associated with poor land-use planning during the transition from large-scale to small-scale farms in the 1960s and early 1970s. The land buying companies that purchased land on behalf of groups of shareholders did not consider the productive capacity of the land, the terrain or the need for public utilities. Their main interest was to allocate some land to all of their members. Land buying companies have been formed along ethnic lines, thus creating clusters of different cultures living next to each other on the same landscape. This had the effect of weakening traditional systems. As a result, people in these areas find statutory laws more functional. A contrasting situation is found in the areas that were designated as native reservations in the colonial era. Natural growth in the populations in the native reserves has led to high population pressure in those areas and to overuse of all land resources.

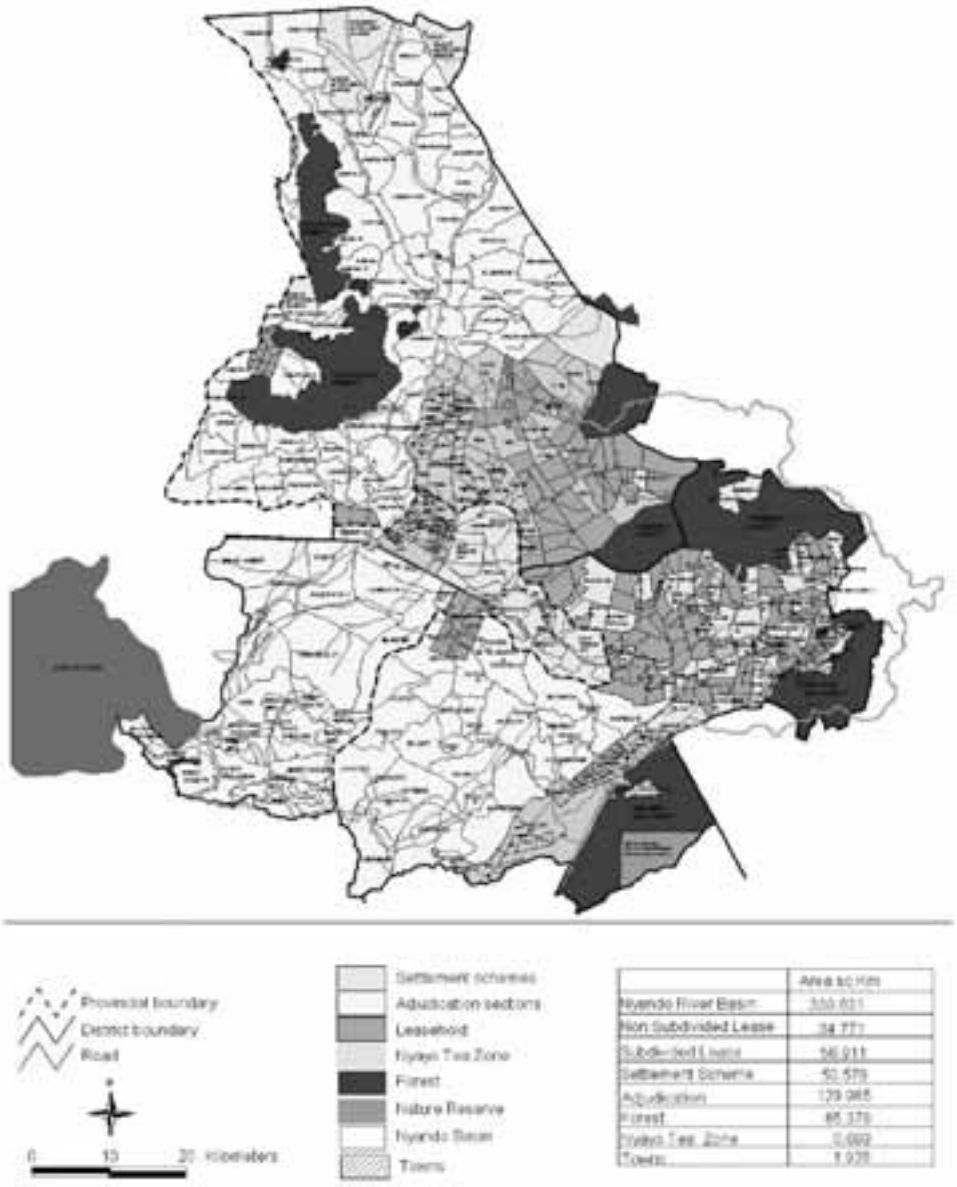
Figure 3 also illustrates that there are at least five types of public land in the Nyando basin. In both government land and trust land areas, there is land that is not alienated to any specific user. This type of public land is very vulnerable and is often subject to abuse because of *de facto* open access. This is the land that is supposed to form the land bank from which the custodians of land draw when a development need arises. In the Nyando basin this bank is almost empty. There is also land that is alienated for specific public purposes such as forests, parks, government institutions, and public utilities such as schools and hospitals. The use for which it is alienated determines the custodian of such land. These are less vulnerable. Preliminary studies indicate that many very important areas for catchment management have been formally designated as private property and not left as public lands. These include spring heads, the catchment areas immediately around spring heads, riparian areas, some wetlands, and water harvesting structures. While private property generally offers the tenure security that is desirable to provide incentives to prevent degradation, inappropriate privatization can also cause problems, such as when the layout of plots results in many holdings cut across steep hillsides, or when key watershed points (e.g. spring heads) that have spatial benefits that go beyond the individual household are privatized and put under the control of one household.

Figure 4 presents a map of land in the Nyando river basin that distinguishes the main types of private and public forms of land tenure. This map is based on data provided by the Ministry of Lands and the Forest Department offices in the relevant provincial and district offices.

Multiple statutory sources of authority for land, water and tree management in the Nyando basin

The *Ministry of Lands* is responsible for land adjudication, survey, registration, settlement, land administration and land-use planning under the statutory land tenure system of Kenya. Currently, there are more than 20 statutes that are used for land administration, which makes the process confusing and expensive. Formal land administration in Kenya is very centralized, with lands, survey, physical planning, settlement and adjudication handled by relatively independent departments of the Ministry. At the local level, the functions of the Ministry of Lands are handled by a number of boards and committees. Land Control Boards are responsible for approving or denying land transactions on freehold land. Liaison committees receive and resolve contentious issues on development applications that have not been approved by the local authorities. Plot allocation committees deal with issues of

FIGURE 4
Land tenure adjudication in the Nyando basin of western Kenya.



Sources: Map produced by the ICRAF GIS laboratory on the basis of data compiled by the authors from data supplied by the Kenya Ministry of Lands and Ministry of Forestry.

allocation of public land to public or private individuals and entities for development purposes. Local adjudication committees and arbitration boards facilitate the process of adjudication of land.

The Environment Management and Coordination Act Cap 8 of 1999 attempts to provide an appropriate legal and institutional framework for the management of the environment. It creates the National Environment Council (NEC), the National Environment Management Authority (NEMA), the Provincial and District Environment Committees and the Public Complaints Committee, the National Environment Action Plan Committee, the Technical

Advisory Committee on Environment, and the Establishment of Standards and Enforcement Review Committee. It also establishes the National Environment Trust Fund and the National Environment Restoration Fund and provides for Deposit Funds.

The *National Environment Management Authority* was established in July 2002 and made responsible for coordinating and supervising all matters related to the environment. NEMA is responsible for preparing environment action plans, and protecting and conserving the environment, including key water resources rivers, lakes, wetlands, hillsides, hilltops and the coastal zone. It establishes guidelines and procedures for environmental impact assessment of policies, programmes and projects likely to have significant environmental impact. It enforces quality control standards and can issue environment restoration orders, environmental easements and environmental conservation orders (Buigutt, 2004).

Department of Forestry: The Forest Act Cap 385 of 1962 (revised 1982 and 1992) is implemented by the Forest Department of the Ministry of Environment and Natural Resources. According to this act, "a forest area means an area of land declared under section 4 to be a forest area". The act addresses the preservation, protection, management, enforcement and utilization of forest resources on forest reserves, which must be reserved through a gazette notice as forestland. This limits forest development by the government to specific regions. Degazettement of forest lands is periodically undertaken to make way for new settlements. Concerns about the continual loss of forest lands and forest functions led to the drafting of a new Forestry Bill. This new bill attempts to expand the definition of forest to include all types of woody vegetation. It also attempts to address issues of gazettement and degazettement and provide for greater community involvement in forest management. The Forestry Bill was rejected by parliament in early 2004.

The Ministry of Agriculture is the leading agency in agriculture matters and the Agricultural Act Cap 318 of 1963 is the principle legislation. The act provides for the development of agricultural land use in accordance with accepted practice of good land management and husbandry. It provides for the conservation of soil and its fertility. It also empowers the Minster of Agriculture to make preservation rules to regulate, control and prohibit the clearing of land for cultivation, grazing or watering of livestock with a view to protecting land against floods, landslides, formation of gulleys and destruction from roads and other infrastructures. Soil and water conservation has been given some level of priority by the Ministry of Agriculture and the Office of the President. The National Soil and Water Conservation Programme (NSWCP) was supported by the Swedish International Development Agency (Sida) for the 25 years that ended in the year 2000. For the last 12 years, the NSWCP implemented a catchment approach to conservation, which was generally considered to be successful (Pretty and Shah, 1999). Until a realignment of the government structure in early 2003, the Ministry of Agriculture was responsible for supporting irrigation development.

The *Lake Basin Development Authority* was set up by an act of parliament (Lake Basin Development Authority Cap 442) to plan for the development of the Lake Victoria basin area of Kenya and to initiate project activities that would boost economic growth and human welfare in the region. A controversial component of the Lake Basin Development Authority was its largely unsuccessful support to the conversion of wetlands into irrigated agriculture.

The *Ministry of Water Resources Management and Development*: Until 2002, the focus of water management in Kenya was on the provision of water for domestic use, agriculture, livestock development and industrial utilization. A number of organizations were involved in the provision of water and sanitation services, including the Ministry or Department of Water, the National Water Conservation and Pipeline Corporation, local authorities, local communities, self-help groups, NGOs, projects in the private sector, regional development authorities and the Office of the President (for water development in the arid and semi-arid lands). There was very little focus on water resource management, and systems of water monitoring fell into relative disrepair. In the late 1990s, concerns about increasing water scarcity, low coverage of water services and declining water quality led to a new water policy, new legislation and a set of reforms of the water sector.

The Water Act 2002 vests all water resource in the State, and provides for the formulation of a National Water Resource Management Strategy and the establishment of the Water Resource Management Authority (WRMA), the Water Services Regulatory Board (WSRB) and the Rural Water Services Trust Fund (RWSTF). The Water Act provides an elaborate structure for water resource management based on catchment areas that are defined by the WRMA in accordance with the NWRMS. The WRMA formulates a Catchment Management Strategy and appoints a Catchment Advisory Committee for each catchment. Water Users' Associations are recognized as the primary authority for water management in rural areas. The Water Act 2002 also creates the Water Services Regulatory Board (WSRB), which concentrates more on the utilization (services providers) of water than the conservation of water. The WRSB is represented in the catchment by Water Service Boards that oversee water service providers. Once all of these new authorities are functional, the Ministry of Water will focus on the provision of information and the implementation of policy.

Multiple social authorities for land, water and tree management in the Nyando basin

The Nyando river basin is comprised of two major language groups – Luo and Kalenjin – with small minorities of other ethnic groups. Luo-speaking people reside primarily in the low and mid-altitude parts of the basin, while Kipsigis Kalenjin and Nandi Kalenjin reside primarily in the upper parts of the basin. The Ogiek is a small ethnic group whose customary habitat is the forests in the upper parts of the basin. Resettlement of the large farms in the "white highlands" has led to the co-existence of distinct clusters of Kipsigis Kalenjin with people of other ethnic groups, including Kikuyu, Kisii and Luhya. One spatial settlement pattern was one of the factors that contributed to politically motivated "tribal clashes" in 1992, 1994 and 1997.

The Luo ethnic group is well known in Kenya for the strength of its customary authorities and the large number of prohibitions and restrictions on individual land use. Polygamy is common, and polygamous households have a complex system of duties and obligations. Clans and subclans are very important sources of social authority; village committees are unlikely to succeed if they do not deliberately include representatives of all clans or subclans.

Women have very little independent access to land under Luo customary law, with the exception of the small home garden (*Orundu*) that even junior wives are entitled to (Onyango, 2002). Lack of control over land also severely constrains women's access to water sources, as

almost all water sources are established in private lands. Women thus have full responsibility for the provision of water for the domestic needs of their households, with almost no authority to manage their water sources.

Land management at the village and farm scales is also affected by the activities of a number of important projects and programmes. Perhaps most important of these are the focal area development committees and common interest groups that have been established, with support from the Ministry of Agriculture, under the National Soil and Water Conservation Programme, the National Agriculture and Livestock Extension Programme, the Lake Victoria Environment Management Programme, and ICRAF. Focal area development committees are elected by local communities to coordinate local contributions to extension and development plans developed by the communities and extension agents. Common interest groups form within these communities to address issues of common interest – often including spring protection, water pan construction, soil fertility enhancement, fuel energy conservation and income diversification. Hundreds of such community groups have been established over the last 15 years. In one part of the Nyando basin, ICRAF and the Ministry of Agriculture have been supporting coordination among neighbouring focal area development committees (Swallow *et al.,* 2003).

At the village level, rights and access to water are also affected by both customary authorities and area-based projects. In this area of rural Kenya, water service projects have been supported by the Ministry of Health, the Ministry of Water and the Ministry of Agriculture, as well as a number of NGOs.

CONCLUSIONS

This review illustrates the surprisingly large arrays of formal land tenure types and sources of statutory and customary authority over land and water management in the Nyando basin. While it appears that this complex land tenure system creates many problems for watershed management, insecure private rights to cropland is not one of the most compelling problems. High rates of erosion in the lower part of the basin are associated with private uncultivated areas that are overused for grazing and wood collection. High rates of erosion in the upper part of the basin appear to be associated more with the private allocation and farming of steep hillsides. Gulley formation and low-quality water in the mid-altitude areas are associated with springs that are used commonly, but located on private land. Deforestation and cultivation of riparian areas are associated with privatization of riverine areas, together with ineffective enforcement of rules on the use of those areas. Lack of public infrastructure for water management is partially associated with the lack of public or collective land on which to locate water storage structures.

The Government of Kenya is currently undertaking a review of its land tenure and land policy. Whatever emerges from that review, however, it is unlikely that there will be a large reallocation of land from private individuals to the government. What is more feasible is that public and collective interests in key components of the watershed are exerted through new instruments such as environmental easements. However, that approach will require engagement with key statutory and social authorities. Catchment authorities or environment committees will be most effective if they are able to operate with the support of social authorities such as clan elders, water and land management projects and local authorities.

The Nyando case is complex, perhaps more so than most other watersheds in Africa. Nonetheless, it illustrates the importance of linking science with policy and institutional design: better scientific understanding of the catchment hydrology can lead to a policy and programme focus on small discrete parts of the catchment. The Nyando case also shows the need to understand the complex linkages between property rights and watershed management problems. And, finally, it illustrates the need to involve multiple social and statutory authorities in watershed management, including the various government institutions whose responsibilities and mandates often overlap and conflict.

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CHAPTER 11
MANAGING MICRO-CATCHMENT RESOURCES: INSTITUTIONAL ARRANGEMENTS FOR WATER USE IN CHIWI DISTRICT, ZIMBABWE

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ACRONYMS

CASS	Centre for Applied Social Sciences
CEH	Centre for Ecology and Hydrology
CIFOR	Center for International Forestry Research
CPR	common pool resources
CPRM	common property resource management
DDF	District Development Fund
DNR	Department of Natural Resources
IES	Institute of Environmental Studies
IH	Institute of Hydrology
LWF	Lutheran World Federation
PRA	participatory rural appraisal
VIDCO	Village Development Committee
WADCO	Ward Development Committee

The last two decades have witnessed a paradigm shift in conservation and natural resource management in most post-colonial African countries from costly State-centred control towards community-based approaches. Within this management framework, there is renewed debate on the role of institutional arrangements[1] for common pool resource (CPR) use. Research on CPR institutions has tended to concentrate on visible and formal institutions (Murphree, 1991; Murombedzi, 1994; Ostrom, 1990), yet there are other hidden and informal institutions, such as social networks, that are important for appropriating natural resources (Sithole, 2001). This study examines the role of both formal and explicit and informal and implicit institutions in water use and management.[2]

1. Rules and regulations governing resource use (Ostrom, 1990).
2. This study was part of a broader micro-catchment management project undertaken by the Institute of Environmental Studies, University of Zimbabwe, and funded by the United Kingdom Department for International Development (DFID).

A diversity of theoretical and empirical material on the complexity of common pool use and management exists. Two strands identified in the literature are of relevance to this paper. First, there are theories suggesting that groups of interdependent CPR users have a strong stake and desire to manage CPR resources collectively (McCay and Acheson, 1987; Ostrom, 1990). Two perspectives exist under this paradigm. One assumes that economic incentives drive self-interested behaviour in CPR management (Ostrom, 1990), while the other suggests that CPR management is motivated by social capital or moral economy providing social bonds for the attainment of collective outcomes (Cleaver, 2000; Mosse, 1997). One of the suggestions made by the CPR theory is that the minimum condition for functioning CPRs includes the need for clearly defined boundaries for resources and resource users (Ostrom, 1990).

The second strand is the new ecology, in which empirical evidence generated from rangeland management (Peters, 2000; Scoones, 1996) shows that flexible boundaries can be more efficient than fixed boundaries. This strand further delves on the politics of resource access and control among diverse social actors (Mearns, Leach and Scoones, 1997). This approach recognizes that communities are not bounded, homogenous entities, but rather socially differentiated and diverse.

Empirical evidence from this study shows that there are fuzzy and overlapping resource units and uses. The use of water resources occurs both within and across administrative and other geographical boundaries. Local controls include explicit as well as implicit norms and taboos that are often voluntarily observed or tacitly enforced through spiritual belief censure, such as in the case of natural springs that are regarded as sacred. A common pitfall is to interpret less intense and passive management systems as lack of management, and to recommend switches to more intense management systems without taking cognizance of transaction costs, net benefits and sustainability considerations.

THE STUDY AREA

The case study was conducted in the Romwe micro-catchment located in Chiwi District, southern Zimbabwe. Chiwi District is characterized by low rainfall, ranging from 450 to 600 mm per annum, poor soils for agricultural production, and severe droughts (Nemarundwe, 2003). Because of the dryness of the area, water is a key resource in the livelihoods of households within the micro-catchment. The households in the physical catchment fall into three traditional villages, presided over by a village head known as the *sabuku* (kraalhead). These villages are Sihambe, Tamwa and Dobhani. Besides the three villages in the physical catchment, seven other traditional villages use natural resources found in Romwe. These seven villages are Chikanda, Matenhese, Ndabaningi, Munikwa, Joni, Magomo and Puche, and are referred to as the social catchment villages.

RESEARCH METHODS

A number of research methods were used in an attempt to cross-check information obtained from different sources. These include key informant interviews with traditional leaders, well owners, well users and members of water committees. Participatory rural appraisal (PRA) techniques, such as resource and institutional mapping, group discussions with separate groups of women and men and participant observation, were also used. During the PRA workshops,

women and men were divided into separate groups to ensure equal participation in discussion and also to help capture perceptions of the different groups, where relevant. These groups had between 30 and 40 participants because an open invitation had been sent out to all village residents. The fieldwork was conducted over 18 months, with field visits in two-week blocks. In addition, a full-time research assistant was based in the village. The research was conducted by two team members, a sociologist and the research assistant, who holds a diploma.

RESULTS: WATER RESOURCES MAPPING

Two broad categories of water sources were identified. These are community- and privately owned water sources. Community-owned water sources include boreholes, Barura dam, streams and deep wells. There are 36 privately owned deep wells in the catchment with various uses and users. These have different institutional arrangements from those of community water sources.

Community-owned water sources

Different villages use community-owned water sources for various purposes and during different times of the year. The boundaries of water resource use shift depending on the type of the water source and the use of that particular source, as seen in the case of Barura dam (Figure 1). A variety of rules and regulations apply to the different community-owned water sources. Some rules are generic, while others are specific to the type of water source.

Boreholes: Although a borehole may be located in one village, neighbouring villages are allowed access to it by the village in which it is located. In years with good rains (more than 650 mm per annum), rules relating to the use of boreholes apply equally to local people and outsiders. These rules are enforced more vigilantly during times of water scarcity. Examples of rules that have been agreed by the community relate to general hygiene around the boreholes. Brick moulding is not allowed at the borehole, and the hand pump should not be hit against the ground. In low-rainfall years, communities may institute rules that regulate the amount of water collected, the frequency of collection, the uses to which the water is put and the number of villages that can use a particular borehole. During times of water shortage, farmers are not allowed to use borehole water for watering fruit or other trees. In all cases, these rules are not written down, but community members seem to know them well and appear to follow them.

Borehole management committees have been set up with the assistance of external agencies such as the Institute of Hydrology, the Lutheran World Federation and the District Development Fund. In theory, their mandate is to enforce the rules regulating access to boreholes, but in practice these committees have been found ineffective. For instance, the Chidiso borehole committee failed to repair a borehole during a four-year period, yet only a bolt costing less than US$5.00 was needed. All users of a particular borehole are expected to pay a yearly contribution (e.g. Z$5 for Tamwa borehole).[3] The money is used for repairing the borehole if it breaks down. However, it is difficult to mobilize all the users, as some people are less frequent users than others.

3. As of June 2001, the official exchange rate is Z$55 = US$1.

Barura dam: The three physical catchment villages use the dam mainly for irrigating crops in the community garden, watering their livestock, brick moulding and laundry. Social catchment villages shown in Figure 1 use the dam mainly in the dry season. The various committees (dam, agronomy, conservation committees) related to the dam in one way or another indicate the different stakeholder groupings at the dam. The different committees, in consultation with the farmers, set rules that regulate the way farmers use the dam. Rules regulating dam use include that livestock should use designated gates in order to control erosion, yearly subscription fees should be paid on time, and cattle grazing, brick moulding and laundry should not be done near the dam. While members of the social catchment villages use the dam for watering livestock and other domestic uses, they are not accorded the right to use it for fishing or collecting large volumes of water. Because water is considered hupenyu (life), there has been no case of denying another village access to water during drought, although rules are enforced more stringently.

Closed deep wells: There are closed deep wells that are used as community water sources. These have been developed and protected with labour contribution from community members through the traditional work parties (*nhimbe*). Rules relating to access to these wells are set by the kraalheads in consultation with advisers. The rules prohibit the use of water for activities such as brick moulding and gardening, and also prohibit people from doing laundry near the well. In practice, there is no evidence that these rules are enforced. The study found that some rules are not enforced because of the transaction costs involved, such as getting shouted at, the time needed to track offenders and the fear of being bewitched.[4] There are also close social ties in the catchment as the majority of the families are related in one way or another, and thus there is fear that penalizing another person may work against the long-established social capital.

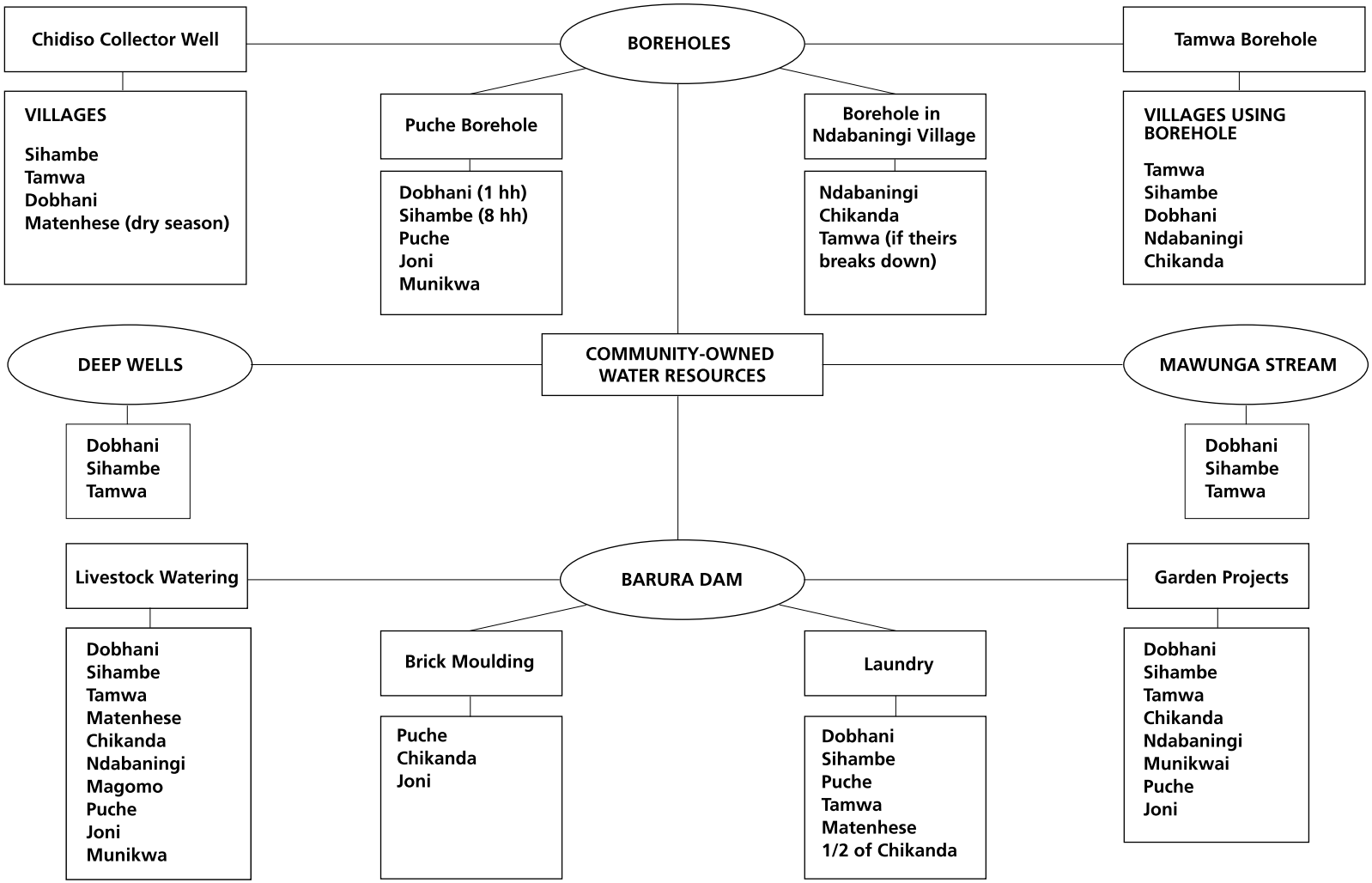
Open deep wells: The open deep wells found in the catchment are not protected and are used as an open-access resource. Some of the wells are natural, while others were abandoned when their owners moved to settle in an area outside Romwe. The wells are used mainly for brick moulding and house construction, but not for drinking purposes. People therefore have free access to these open wells.

Mawunga stream: During the dry season, households water their livestock in Mawunga stream. Some mould bricks along the Mawunga stream as well. This stream is accessible to almost everyone in the adjacent villages. Use of the stream tends to be determined by the distance of the household from the stream. For example, those who live near the stream do gardening, while those who live far away use the stream for watering livestock only. Local Department of Natural Resources (DNR) representatives theoretically enforce rules on the use of streams, e.g. observing the mandatory 30 m distance[5] from the stream bank if one wants to establish a field or vegetable garden. This rule is ignored by most of the users because the soils close to the riverbanks are very fertile and it is easy for them to water their crops. Despite backing by statutory instruments, of late, DNR rules and regulations are ignored by the community, partly owing to inefficient monitoring by representatives and staff members of the department.

4. Nemarundwe (2003) details how witchcraft is a strong social control mechanism in the Romwe catchment.
5. Farmers are not supposed to use the land within 30 m of the stream in order to curb soil erosion.

FIGURE 1

Community-owned water sources and user villages



Source: Nemarundwe and Kozanayi, 2003

Privately owned water sources

Wells: Privately owned water sources are mainly deep wells dug by specific households, through mobilizing their own labour, hired labour or assistance from neighbours. The wells are dug close to homes or in the fields. Ownership ranges from zero to three wells per household. In some cases, the wells are inherited, together with fields, from parents and grandparents. Exclusive use of a well by a single household is highly unlikely. Wells are often open to use by other households, following a basic set of norms. The well owners attach certain conditions to the use of wells. Permission has to be sought from a well, and someone may be granted access to water for domestic purposes, such as drinking, cooking and laundry. Where larger amounts are needed, e.g. for beer brewing, permission has to be sought for that specific activity. Wells in crop fields are more accessible to the whole village, while wells near homesteads are usually fenced.

When identifying a well from which to collect water, individuals consider the following: distance to the well, closeness of their relationship with the well owner, and people whose wells they helped to construct. Cases of denial of access come into play if the person wanting to collect water never assisted the well owner to dig the well, is renowned for being unhygienic, or collects water from the well for purposes other than those for which he or she originally sought permission.

In times of drought, when water is limited, well owners may set a limit to the number of households that can fetch water from their wells, the frequency of fetching water, the purposes and volumes of water to be collected per day. For instance during drought, other households may be allocated 20 litres of water per day for domestic use only. The individual owners institute rules governing access to privately owned wells, but these are not written down. The rules are well articulated by community members because they are communicated informally to potential well users. The local village health workers also set some of the rules, such as those relating to general hygiene. The health workers make frequent visits to different wells to monitor cleanliness around wells and ensure the wells are properly protected. Bans on access to water are generally resented in the community. A well owner who denied others access to his well found a dead dog in the well two days after he had locked the gate to it. People also believe that wells at which punitive rules are in force often dry up or collapse, even if they have a strong lining made of cement.

The foregoing discussion emphasizes what well owners "give" to other community members, and not what they themselves "get" from the other community members. The process of water access is reciprocal, thus well owners also derive benefits from people who use their wells.

Benefits that can be realized by well owners include the following:

- *Access to arable land:* there is general land shortage in Romwe, but land is comparatively abundant in the social catchment villages. Residents from Romwe often lease land from farmers in neighbouring villages. The leasing arrangements are not fixed, but are negotiated on an annual basis. Some well owners allow people access to their wells in order to benefit through access to arable land.
- *Access to draught power:* some well owners do not own sources of draught power, and therefore give access to their wells to fellow farmers who have draught power in anticipation that when the rainy season begins, they will be assisted with draught power at a reasonable price.

- *Access to labour:* well owners may get assistance from those who are allowed to collect water in the form of help in the fields to weed, harvest and process farm produce. Based on cultural norms of reciprocity, the water collectors reciprocate the access they are given to a well in one way or another.
- *Social capital:* people who share the same water points have a higher chance of engaging in other projects together because they can easily mobilize each other. The flow of information is also fast among people who share the same water source.

Natural springs **(Zvitubu):** Only two privately owned natural springs were identified. Given that springs are natural features, private ownership of springs is an example of privatization of a potentially common pool resource. Individual claims are made over springs partly because they are localized and can easily be defended, and partly based on claims of inheritance from ancestors. Water from natural springs is used for drinking, watering livestock, laundry, brick moulding and vegetable production for sale and home consumption. The owners determine the kind of access to and use of the spring by other community members. There are some rules that have been inherited from generation to generation and enforced by kraalheads and chiefs. The most common rules are: no bathing at the springs, no laundry and no soap should be used at the spring. Livestock should also not drink from the same point of the spring as people because springs are normally left unfenced and would be trampled by livestock, thus spoiling the water and also making the spring dry up. Generally, people observe the rules that have been laid down, because they ensure the availability of clean water.

DISCUSSION

Both implicit and explicit institutional arrangements govern communal and privately owned water sources in Romwe. The rules and regulations are generally not written down, but community members appear to know them well. In most cases, these institutional arrangements are defined only in a very general way, giving conditional access based on appropriate use. The importance of this non-specificity is that it allows for flexibility in resolving particular cases (Berry, 1993; Cleaver, 2000). Some authors have argued that it is important to codify rules and regulations for resource use, for instance, through community organizations (Clarke, 1994; Mandondo, 2000; Matowanyika, 1991). Codification should, however, only be done when community needs and priorities justify switches to more managerially costly and intensive management systems. It should be demand-driven rather than prescriptive or supply-led.

Calls for codification overlook the fact that the existing system allows for flexibility in determining who has access to water resources at a given time. To support this latter view, Platteau (1995), using evidence from Africa on land, suggests that formalizing landholdings through registration increases conflicts over land rights. This is more so for groups who customarily had informal access to natural resources such as land and, in our case, water. Customary rights over common pool resources in local communities and the value of flexibility in these arrangements should be recognized.

At Romwe, private water source institutional arrangements are products of social networks of actors created through the family, extended family and kinship ties. Thus, interpersonal relationships are important in determining the degree of compliance with existing rules and

regulations governing access to water resources. The multiple uses of a water source also involve a balance between allocating water for domestic and other uses. In most cases, priority is given to water for domestic use over irrigation or gardening activities. A good example is the Chidiso borehole, where originally two pumps were allocated for domestic and irrigation purposes but, after frequent breakdowns, the irrigation pump is often used for domestic purposes. This balance also allows for flexibility, and people do not rigidly stick to the original uses of a particular water source.

Findings of this study contradict the literature on collective resource use, which assumes that economic incentives drive self-interested behaviour in CPRM (Ostrom, 1990). This study found that social capital rather than economic incentives facilitate CPRM. The social capital provides social bonds that are key for the attainment of collective outcomes for resource management. Compliance to the unwritten rules can be attributed to this social capital. The penalty for lack of adherence is to be refused access to a given water source. Furthermore, there is a high level of complexity in water management, yet the design principles attempt to simplify this complexity.

There is also reciprocal access to water resources with neighbouring villages, as seen in the case of Barura dam. This overrides the traditional and administrative boundaries in favour of flexible social boundaries. In a way, this challenges Ostrom's (1990) design principles, one of which suggests that resource use boundaries should be clearly defined. This fuzziness of resource use boundaries also challenges recommendations for exclusion management, as espoused in the Land Tenure Commission report (1994)[6] and the new Traditional Leaders Act of 1999. Similarly, the uncertainty associated with water resource use and availability suggests the need for flexibility in resource management. Findings of this study concur with the new ecology empirical evidence that shows that flexible boundaries can be more efficient than fixed boundaries (Scoones, 1996). Resource access is a process of negotiating resource user boundaries, as well as access to the various sources of water.

In conclusion, this study has shown that there are many implied rules and controls governing access to water in micro-catchment areas. Development practitioners and researchers sometimes assume that if rules are not written down, they do not exist. These unwritten rules are part of the social fabric, and play an important role in determining access to water. The resilience of these rules, even though not written down, is sustained by their capacity to accommodate change.

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