Wetland sustainability and the evolution of indigenous knowledge in Ethiopia

Alan B Dixon

Abstract

Much research in recent years has addressed the contribution of indigenous knowledge (IK) to development initiatives in developing countries. An IK system that continuously evolves and adapts in response to environmental and socio-economic change is often considered to be at the core of sustainable natural resource management practices and rural livelihoods. In the context of indigenous wetland management in western Ethiopia, this paper examines the relationship between IK and wetland sustainability, focusing on the mechanisms through which IK evolves and how local adaptive capacity is built up. A series of participatory research activities undertaken in four wetland communities revealed spatial variations in the degree of innovation and communication taking place. The paper argues that these mechanisms are key factors influencing adaptive capacity, suggesting a key link between wetland sustainability and the occurrence of innovation and communication among communities.

KEYWORDS: wetland management, indigenous knowledge, Ethiopia, sustainable development, social capital.

Introduction

The perception of wetlands during the last three decades has shifted significantly from one of being largely unproductive wastelands, to being internationally important havens for wildlife and key natural resources for indigenous peoples. It is now widely accepted that wetlands perform an important eco-hydrological role in environmental management, whilst also providing a range of environmental and socio-economic benefits for local populations (Dugan, 1990; Roggeri, 1998; Silvius *et al*., 2000; Stuip *et al*., 2002; Maltby, In Press). Ensuring the sustainability of wetlands, and their associated goods and services, is now a major concern for many organisations, although wetland management policy still tends to be largely dominated by a nature conservation orientated agenda. Whilst there is recognition that wetlands play an important role in livelihood security, especially in developing countries, few governments and international NGOs openly encourage or support their utilisation and development. Indeed, the numerous cases of human-induced wetland destruction both in the developed and developing world remains the principal motivation for promoting many conservation initiatives (Maltby, 1986; Hollis, 1990; Denny, 1994; Lemily *et al*., 2000).

In many parts of the developing world, however, evidence suggests that wetlands have been managed by local communities in a sustainable manner for generations, and that this management does not necessarily lead to degradation (Richards, 1985; Adams, 1993; Denny, 1993; Lema, 1996; Nicholas, 1998). In such circumstances, research has shown that wetland utilisation is often based on community management strategies that have evolved over time through the development of 'indigenous' or 'local' knowledge, via the passing down of ancestral knowledge and / or the process of innovation dissemination. What often remains ambiguous, however, is why some indigenous systems of wetland management remain sustainable, whilst others are characterised by mismanagement and degradation. From a neo-malthusian perspective (e.g. Hardin, 1968) degradation is inevitable once the level of exploitation exceeds the carrying capacity of individual wetlands. Hence, site-specific carrying capacities, based on often unique environmental and socio-economic characteristics, have given rise to the variety of wetland management scenarios seen throughout the world. Alternative perspectives, however, suggest that the situation is more complex and dynamic, emphasising the importance of progressive adaptive management (Boserup, 1965; Tiffen *et al*., 1994). This is supported by the wealth

of literature on indigenous knowledge (IK) and community-based natural resource management, which suggests that the adaptation and evolution of IK in response to environmental, socio-economic or even political changes, is a key factor affecting sustainability (Johnson, 1972; Warren, *et al.*, 1995; Lalonde and Morin-Labatut, 1995; World Bank, 1998; Grenier, 1998; Berkes, 1999). At the root of this adaptive capacity lies the ability to acquire new information, either through innovation or a range of communication channels, which can then be incorporated into new management practices. This paper focuses on these particular components of knowledge acquisition and evaluates their contribution to indigenous adaptive capacity and sustainability in the context of community-based wetland management in western Ethiopia.

Wetlands, indigenous knowledge and social capital

Indigenous knowledge has been recognised in recent decades as making an important contribution to natural resource management and sustainable livelihoods, particularly in the developing world (Brokensha *et al*., 1980; Richards, 1985; DeWalt, 1994; Warren *et al*., 1995). Central to this has been the assertion that IK is dynamic, that it evolves over time within a particular culture, and that as a result, local communities possess the capacity to adapt to changing circumstances (Chambers, 1983; IIRR, 1996; Sillitoe, 1998). Possessing both this knowledge and the capacity to adapt and apply it in the face of changing environmental or socio-economic conditions, in effect the 'social resilience' of a population, is regarded as an important prerequisite to sustainable natural resource management (Adger, 2000; Berkes *et al*., 2000; Folke *et al*., 2002). More recently, concepts such as IK, adaptive capacity and resilience have been placed under the umbrella of social capital; the shared norms and values, knowledge and networks intrinsic to a community. Social capital, particularly where it is considered 'strong', is increasingly being seen as critical to livelihood sustainability (Pretty and Ward, 2001).

Interest in IK and social capital has stemmed from the perceived failure of traditional 'top-down' development approaches to improve the living standards of the rural poor in much of the developing world (Chambers, 1983; Reijntjes *et al*. 1992; Lado, 1998; Adams, 2001). IK, which has its theoretical roots in social anthropology, has subsequently become popularised as a panacea to the problems caused by the application of 'western' or 'scientific' knowledge in development strategies and policies. Although the contrasting epistemologies of IK and 'scientific' knowledge remain the subject of much debate in development thinking (Agrawal, 1995; Purcell, 1998, Sillitoe, 1998; Briggs and Sharp, 2004), it is erroneous to suggest that indigenous knowledge systems exists in a vacuum, isolated from the rest of the world. As Sillitoe (1998) suggests, IK is constantly evolving through incorporating and reinterpreting elements of 'scientific' knowledge from external sources. Indeed, as Mundy and Compton (1995) propose, the indigenous-scientific dichotomy is arguably better expressed in terms of an indigenous-external one, characterised by a two-way exchange of knowledge. Whilst this renders the term 'indigenous' somewhat misleading in an anthropological sense, it could be argued that the practical importance of IK to development actually transcends matters of definition. What is significant is what IK represents, i.e. a local perspective on development issues. Recognising, empowering and incorporating both IK and other aspects of social capital in participatory rural development projects, has become an established formula for pursuing socially, environmentally and economically sustainable natural resource management. By its very definition, everyone has access to IK or social capital in one form or another, hence they represent a common starting point for strengthening adaptive capacity and sustainability.

But not all natural resource management strategies based upon traditional indigenous knowledge are necessarily sustainable. A shift from sustainable to unsustainable natural resource management can occur when environmental or socio-economic change proceeds at a rate which exceeds the capacity of communities or individuals to develop their IK, adapt their management strategies and cope with change (Farrington and Martin, 1988, Grenier, 1998; Adger, 2000). Understanding how this adaptive capacity functions, and how it is influenced, is fundamental to understanding the relationship between IK, social capital and the sustainability of natural resource management.

Whilst adaptive capacity is intrinsically linked to the acquisition of new knowledge, new knowledge itself does not automatically guarantee sustainability. Using farming as an example, new knowledge may be inappropriate, on account of it being developed under a completely different set of environmental and socio-cultural conditions, as has been evident throughout the developing world. Of greater importance is possessing the *capacity* to acquire new knowledge, i.e. engaging in mechanisms such as innovation and communication, that promote the gradual acquisition, modification and evolution of IK. Much research in recent years has focused on knowledge acquisition via innovation or experimentation, particularly in the context of agricultural practices, but also natural resource management strategies (Richards, 1985; Chambers *et al*., 1989; Warren *et al.*, 1995; van Veldhuizen *et al*., 1997; Haverkort and Hiemstra, 1999; Reij and Waters-Bayer; 2001). Johnson (1972) was one of the first to argue that farmer experimentation is a widespread phenomenon and represents an adaptive response to ecological variation. Similarly, Richards (1985) drew attention to innovation as a means of adaptation among wetland rice farmers in Sierra Leone. Rhoades and Bebbington (1995), in a detailed study of potato cultivation among Andean farmers, suggested that experimentation and innovation occur for a variety of reasons, including mere curiosity, problem-solving and the need to try out existing practices under new circumstances. A wealth of empirical evidence suggests that innovation and experimentation are important means of acquiring new

information which, when applied, represents an adaptive response to environmental or socio-economic change.

In contrast to innovation and experimentation, relatively little attention has focused on the other significant component in the adaptation and evolution of IK, namely communication: the process whereby people disseminate new knowledge (Mundy and Compton, 1995). In rural areas of developing countries, IK tends to be communicated through events such as storytelling, village meetings and folk drama (Wang, 1982), in contrast to 'western' knowledge which is characterised more by telecommunication systems, mass media and government officials. Indigenous communication systems are generally developed locally, are under local control, use low levels of technology, and are also characterized by a lack of bureaucratic organisation (Mundy and Compton, 1995). McCorkle and McClure (1995), in their study of Sahelian farmers in Niger, suggested that farmers place a much higher degree of credibility on the information they receive from fellow farmers than from extension agents, especially when knowledge appears to have been well tested and subsequently adopted. Western forms of communication, such as the mass media and television, were identified as playing some role in alerting people to new agricultural possibilities, but interpersonal and group communication, and even direct observation were found to be more significant in stimulating innovation (McCorkle and McClure, 1995). These findings are echoed in a study by Ramirez (1997), who examined the effectiveness of extension in the Philippines, and reported that farmers' primary source of information on new seed varieties was other farmers, rather than agricultural extension services. Wu and Pretty (2004) similarly highlight the importance of informal household communication networks in marginal rural China, that facilitate the dissemination of ideas and agricultural innovations.

The exchange of information through informal communication networks plays an important role in facilitating innovation and adaptation, principally because knowledge is not shared equally throughout a society. Swift (1979) points out that differences occur as a result of gender, age, experience and profession. Mundy and Compton (1995) meanwhile, suggest that individual members of the community can be classified on the basis of their relationship with certain types of knowledge. In their study, 'indigenous experts' are identified as those who are consulted for advice on specific agricultural matters, 'intermediaries' frequently inform other community members about new ideas or developments, and 'recipient disseminators' receive new information and then react to it before passing it on.

The implication, therefore, is that each community potentially has a range of knowledge acquisition mechanisms, networks and channels available, through which new ideas and innovations can be disseminated, adapted and applied. These are, in effect, the building blocks of sustainability, which were the focus of the field-based research discussed in this paper. The research explored these important linkages between knowledge acquisition mechanisms, adaptation and sustainable resource use in the context of changing wetland management in western Ethiopia.

Wetland management in Western Ethiopia

Illubabor Zone in western Ethiopia (Figure 1) is one of the most fertile regions of the country, due to the specific environmental characteristics of the south-west highlands, particularly the dominant montane rainforest vegetation (*Aningeria adolfi-friederici*, *Croton macrostachyus* and *Sapium ellipticum*), and the warm temperate climate. Mean annual temperatures in Illubabor average 20.7° C, and rainfall is often in excess of 1800 mm per annum (Solomon Abate, 1994). The climate and undulating topography, ranging between 1400m asl and 2000m asl, produce an environment characterised by steep-sided river valleys and flat, waterlogged valley bottoms. The accumulation of runoff, poor drainage and a high groundwater table in these valley bottoms promote the formation of both permanent and seasonal swamp-like wetlands, ranging from less than 10 ha to more than 300 ha, although the smaller wetlands located at the heads of valleys are more abundant (Dixon, 2003a).

The wetlands of central Illubabor are vital natural resources, both in terms of their environmental functions and their products which are used by local communities (Table 1). They represent a vital source of water throughout the year, in an area which receives half of its annual rainfall between June and August, and only 5 % during the dry season months of December, January and February (Conway and Dixon, 2000). The storage and release of water from the wetlands and their peripheral springs ensure that local communities have access to clean drinking water throughout the year. The abundance of water in the wetlands also supports the growth of dense sedge vegetation known locally as *cheffe* (*Cyperus latifolius*), which in addition to providing fodder for cattle, is traditionally harvested by local communities for use as a roofing and craft material. It is also used throughout the year in a range of ceremonies and celebrations and as such it is a marketable commodity. The wetlands also provide a habitat for a variety of other plant communities, some of which are used for medicinal purposes by wetland communities. For example, the plant known locally as *balawarante* (*Hygrophila auriculata*) is used as a treatment for various skin diseases (Zerihun Woldu, 1998).

As reservoirs of soil moisture during dry periods, these wetlands are also valuable agricultural resources and many have been used in the past, albeit on a small, informal scale, to cultivate maize much earlier in the agricultural calendar than on the uplands (Tafesse Asres, 1996; Wood, 1996). This practice, which includes the majority of the wetland maize crop being harvested before maturation, i.e. during its 'green' phase, facilitates the production of crops during a period of the year which is normally associated with food shortages. Over the last century, however, wetland cultivation has extended dramatically to include larger areas of wetlands, and in many cases whole wetlands have been drained and cultivated (Tafesse Asres,

1996). The complete drainage and cultivation of wetlands is a common phenomenon throughout several zones in western Ethiopia, notably Western Wellega, Illubabor and Jimma (Figure 1) (Afework Hailu, 1998).

As wetland agriculture has become increasingly common among rural communities in Illubabor, concerns have been raised over its environmental sustainability. Previous research in the area has suggested that over-intensive use of many wetlands has lead to falling water table levels, ecological deterioration and the loss of critically important functions and benefits (Kebede Tato, 1993; Wood, 1996; Dixon, 2002). This has serious implications for livelihood security both among those communities relying on the wetlands and also those living downstream.

In addressing these concerns, the Ethiopian Wetlands Research Programme (EWRP) in 1996 implemented a series of research projects to investigate the causes and consequences of intensive wetland use. One particular aspect of the research focused on how local communities use these wetlands, the state of their indigenous wetland knowledge and the contribution of this towards sustainable wetland management (Dixon, 2003a). This research concluded that whilst farmers clearly based their wetland management practices on extensive knowledge of hydrological, ecological and cultivation processes, this knowledge and experience was in some cases insufficient to cope with the demands of intensified wetland use. For example, the setting aside of areas of natural vegetation at the head of wetlands, and allowing flooding over the whole wetland during the summer months, is carried out because farmers recognise that these practises maintain the supply of water and restore soil fertility. With wetlands being completely cleared and cultivated for the whole year in response to government pressure[1], land shortages and increasing coffee production on the uplands, the ecohydrology of the wetland inevitably becomes more variable, more difficult to manage, and in some cases degradation occurs over a number of seasons (Dixon, 2002).

This scenario, however, was not the case in some wetlands which, despite constant utilisation, retained their ecohydrological capacity to provide a range of benefits. Moreover, some wetlands appear to have been drained and cultivated continuously for over 80 years with little degradation occurring. Although the reasons for such sustainability are complex, and are embedded in the hydrological and geomorphological characteristics of each individual wetland, it has been suggested that wetland sustainability is ultimately rooted in the adaptive capacity, IK and social capital of the local community (Abbot *et al*, 2000; Dixon, 2003a). In particular, previous research has drawn attention to the spatial variability in community knowledge, and experience and understanding of wetland management. Some communities, and individuals within communities, clearly possess more knowledge than others, suggesting a dynamic and evolving knowledge system that is linked to established communication networks and strong social capital.

Those communities with strong social capital and more extensive indigenous communication networks will certainly find themselves in a more advantageous position, given recent reports from Western Ethiopia which suggest that socio-economic and environmental conditions are deteriorating, placing more pressure on wetlands than ever before. Farmers have complained for the past five years that the climate is becoming more unpredictable, making wetland agriculture increasingly difficult to manage. In addition, between 2003 and 2004 the government resettled approximately 120,000 refugees from food insecure areas of Oromiya region to parts of Illubabor and Western Wellega (DPPC, 2004), creating problems of land distribution and food security. Rather than being marginal areas, wetlands are actually becoming the new agricultural frontier for food production, particularly in Western Wellega where land degradation has rendered the uplands largely uncultivable. More than ever, there is pressure upon local people to manage wetlands in a sustainable manner and adapt to the changes taking place.

Investigating wetland sustainability

The field research for this study was carried out during January and February 2002 in Metu Wereda (district) of Illubabor Zone, Western Ethiopia. This area has a history of increasing wetland utilisation and has been the subject of previous research, notably that of EWRP (Wood and Dixon, 2002). The investigation focused on four wetlands (Figure 2), which were selected to be representative of the typical characteristics of wetlands utilisation, and the most common type of wetland (small headwater wetlands) in the study area (Dixon, 2003a). Three of these wetlands (Meko, Tulube and Kodo Hiri) showed few overt signs of degradation, whilst one (Ihud Gebeya) was clearly characterised by a low water table and eroding soils. This contrast between the sites was important in investigating the relationship between knowledge acquisition and the state of wetland management itself.

The principal aim of the research was to identify the mechanisms through which indigenous wetland knowledge is acquired and disseminated, and to evaluate the influence of these mechanisms on wetland management. The main source of data was those individuals and communities directly involved in wetland management. Of the various methods available, the research adopted a participatory rural appraisal (PRA) approach, which in various studies of community based natural resource management, has proved effective in eliciting detailed qualitative information (Chambers, 1994; Brace, 1995; Grenier, 1998; Brown *et al*., 2002). In contrast to the use of more formal questionnaires, PRA methods facilitate discussion among various community members, giving them the opportunity to analyse, investigate and present their experiences. In this respect, there are benefits to both participating individuals and the research team.

The aims of the research were operationalised in a programme of Participatory Rural Appraisal (PRA) activities held with members (usually farmers) from each of the four wetland communities. Semi-structured

discussions formed the core of each programme, but in addition, ranking techniques, Venn diagrams and proportional piling (where participants use stones or seeds to indicate the relative importance of different information), were employed to investigate farmer relations with other institutions and the dynamics of natural resource management IK within the community. Transect walks within each of the wetlands were also carried out to establish contextual information on wetland use. Five PRA sessions, lasting approximately two to three hours each, were held in each wetland community, and the transcripts of these were subsequently analysed for variation and relationships in knowledge acquisition mechanisms.

Sources of wetland knowledge

During initial exploratory discussions with wetland farming communities, participants stressed that knowledge of drainage and cultivation originated within the community and was not influenced by any external factors. Ancestral knowledge was regarded as playing a minimal role, if any, since wetland cultivation in the study areas was initiated within the participants' lifetime. Participants did, however, acknowledge that their interaction with other farmers, either via personal communication or direct observation, was a key source of ideas and wetland knowledge. In some wetlands, this forms the basis of initial advice for wetland drainage and cultivation, whilst in others it acts as an impetus for innovation or small-scale adaptations:

> I introduced potatoes after I visited Haro near Hurumu. I went to visit my son-in-law and I noticed that the farmers there were planting potatoes in their wetland. I asked them when to sow and harvest and then I tried it here. I did this about three years ago and everyone copied me.
>
> Farmer at Ihud Gebeya, January 2002

Despite repeated attempts to discuss the origins of wetland management knowledge in the context of the various strategies and practices utilised, participants were adamant that their knowledge had not been acquired by any means other than personal experience. They were clearly proud of this achievement, yet at the same time extremely critical of the lack of assistance provided by government development agents, who were evidently active in other areas of agriculture and natural resource management. In light of this resolute position and the failure to develop these discussions further, subsequent PRA sessions were widened in scope to explore knowledge acquisition in the context of natural resource management strategies rather than wetlands alone. This ultimately proved more effective in providing a basis for detailed discussion and indicating the range of potential mechanisms through which wetland management knowledge is acquired.

Plate 1 shows the results of one proportional piling session intended to identify and quantify participants' sources of natural resource management information. In addition to those sources highlighted in the diagram, participants during other sessions identified the Ministry of Health, *Cheffe Kore* (wetland committee) and EWRP (the Ethiopian Wetlands Research Programme). One key outcome of these ranking and proportional piling sessions was variation in the perceived importance of different sources of information, in terms of quality versus quantity. For example, ancestral knowledge was seen as playing a fundamentally important role in knowledge acquisition, such that when viewed in terms of quantity it was ranked first on all occasions:

> This knowledge is practical knowledge which we've been taught since the beginning. It's not just having oxen and tools – you have to know how to use them. Our traditional knowledge has taught us about agricultural practices for every crop – how to plough, cultivate, select good seeds for next year…we've learned everything from our fathers.
>
> Farmer at Tulube, 29th January 2002

Yet when these sources were ranked on the basis of quality, (i.e. the most useful or beneficial), government institutions such as the Ministry of Agriculture were repeatedly placed higher than ancestral knowledge. The information supplied by various government institutions was ultimately regarded as more important, since it related to agriculture and, therefore, has the capacity to dramatically improve livelihood security and socio-economic status. Despite this perceived quality, however, government institutions as a source of information were ranked low in terms of the quantity received, participants being critical of the level of support given by development agents:

> When they gave us improved seeds there was a problem with the yield, but no one came to help us, so we went back to using the traditional seed variety. There was no follow-up from the Ministry of Agriculture and no support. When we tell them that the crops have failed, they just tell us that it's our fault – that we didn't do it properly. They just argue with us rather than trying to help.
>
> Farmer at Tulube, 29th January 2002

Knowledge acquisition and communication

The typology presented by Mundy and Compton (1995) was used throughout the study as an analytical framework for interpreting the various sources and mechanisms through which information is acquired. In this typology, different *types* of knowledge interface with different *communication systems* (acquisition mechanisms). The results of the PRA sessions set within this typology are shown in Table 2, the quadrants of which are discussed below.

The indigenous acquisition of indigenous knowledge

Although participants placed great importance on the role of government institutions in providing them with natural resource management information, most of the mechanisms through which farmers acquire new knowledge were indigenous in nature. As shown in the matrix in Table 3, these mechanisms were found to be operational, both within and between different

communities, and in both a 'formal' and informal setting.

The only 'formal' setting through which IK is acquired (quadrant A in Table 3) is *Cheffe Kore*, the wetland committee, which exists in varying degrees of effectiveness in all the study sites. The wetland committee consists of a group of farmers elected to co-ordinate the timing of wetland management activities and settle disputes among the various wetland stakeholders:

> The committee gets together and we pass instructions on which month to start clearing, which month to plough and so on. Usually, the committee leader will tell two or three farmers, who then have the responsibility of telling everyone else. If you don't do what the committee says, then you'll get a warning. If you still ignore this, then further action will be taken – you'll be reported to the *kebele* [local] administration.
>
> Farmer at Adele Bise, 11th February 2002

Whilst the role of the wetland committee is principally one of co-ordination, participants at one site acknowledged that the leader of the committee occasionally provides practical advice on wetland management issues. As a meeting place in which wetland stakeholders can potentially exchange information on their experiences, their innovations and observations, the wetland committee is of fundamental importance in promoting sustainable management strategies at the community level. Outside the community level, there appear to be no similar formal indigenous settings contributing to the acquisition of IK[2].

Intergenerational acquisition According to participants, ancestral knowledge is communicated from one generation to the next via a process of practical demonstration and direct observation. Participants suggested that their parents passed on their knowledge of cropping patterns, changes in productivity, medicinal plants and soil fertility among other things:

> Our parents guided our hand when we were learning to plough. We were with them when they were cultivating land, and when they stopped to have a break for breakfast we would go and handle the plough and have a go for ourselves. First though, we would go behind them when they were ploughing and observe how they were doing it. It was the same thing in the wetlands.
>
> Farmer at Kodo Hiri, 6th February 2002

Farmer innovation Participants generally acknowledged that 'trial and error' represented a significant means of acquiring knowledge and improving community livelihoods. Certain members of each community stand out as experienced innovators who deliberately experiment with new ideas and modify existing practices. In particular, one farmer in his mid 50s at Tulube wetland, recalled how he had experimented with the spacing of coffee seedlings, herbicides and various fertiliser treatments. Similarly, at Adele Bise one old man in his late 60s recalled his success with planting potatoes in the wetland:

> I was the first farmer to plant potatoes in the wetland. I got the seeds from Ferede Negash, the previous landlord, when I visited his place. He gave me 20 tubers and told me that it was *ferenje dinnich* (potato). I planted the 20 tubers in my garden and got a yield of 50 kg. Ato Ferede told me how to cultivate - you need lots of soil under the plant. After I harvested the potato crop, I tried to grow some in the wetland – all 50 kg. It was then that I got a yield of 900 kg from the 50 kg I had planted. I sold the yield for 700 *birr*[3] and bought a house with an iron sheet roof which I later dismantled and brought here. Since then, I continued to grow potatoes and people came all the way from Gumaro to buy tubers from me at Metu market. News must have spread about my crop because so many people came – one person even took my photograph in the market. The potatoes were very big, but as I continued to grow them they started to shrink. When this happened I tried them in a different wetland plot.
>
> Farmer at Adele Bise, 28th January 2002

From these and other examples cited by participants, it appears that innovation and experimentation among farmers is occurring in several contexts which relate to those described by Rhoades and Bebbington (1995). First, new knowledge is being generated through experiments driven by personal curiosity, as in the case of the farmer from Kodo Hiri, who 'wanted to see what would happen' if he mixed DAP (di-ammonium phosphate) with urea fertilisers:

> The development agent told us to sow maize and use DAP, and when the crop is at knee height use urea. I wanted to see what would happen if I mixed DAP with urea and put it together during sowing, so I tried it but found that the productivity wasn't good. I proved that what the development agent was telling us was right. Once the development agent noticed that I'd been mixing urea with DAP at the beginning, he only gave me the urea when the crop reached knee height.
>
> Farmer at Kodo Hiri, 6th February 2002

Secondly, as in the case of the potato grower at Adele Bise, farmers are experimenting through adapting and transferring existing technologies to new environments. In this context, a farmer may have had previous knowledge of the specific practice in a different environment. For example, some farmers at Adele Bise indicated that they transferred the practice of ditch blocking from their pepper plots to the rest of the wetland. Alternatively, farmers may have received new information through direct observation or through communicating directly with other farmers, such as one farmer at Kodo Hiri who cultivated potatoes in his wetland after observing their cultivation in Hurumu *kebele*.

Thirdly, some farmers appear to be carrying out experiments purely to seek solutions to existing problems. For example, during a transect walk at Tulube wetland, the

'active' farmer pointed out where he had placed grass over the top of his drainage ditch (Plate 2):

> Last year during the dry season the land was very dry in this part of the wetland so this year I thought I'd put some shade over the top of the ditch to keep the water in.
>
> Farmer at Tulube, 19th February 2002

Similarly, farmers at Adele Bise and Kodo Hiri have experimented with ditch blocking in response to changes in soil moisture conditions, rainfall patterns and pest problems:

> Previously my ditches were deep and I had a problem with cutworms on my maize crop. I thought that maybe the land was too dry and the cutworm likes the dry land. So last year I just cleared the drains but didn't make them any deeper or dig any new ones. If it is moist, then hopefully the insect will not survive.
>
> Farmer at Adele Bise, 18th Februarry 2002

Whilst many other trials were described in detail by participants, some were clearly reluctant to discuss their experiments for several reasons. First, some did not want the Ministry of Agriculture to chastise them for 'misusing' land and materials. Secondly, unsuccessful trials are potentially embarrassing, and thirdly, any knowledge gained through experimentation is valuable and offers a comparative advantage to that farmer:

> If we've got better information, we don't have to tell each other! If you're successful, then you'll want to keep it to yourself. If you fail then you don't have to tell anyone. Someone might tell the development agent and we'll be accused of doing something wrong. Also, in the past we were all working in different areas so we were sharing less information. If someone wants to know what I've been doing, then they should come to me – it's not my job to go around telling everyone what I've done!
>
> Farmer at Kodo Hiri, 6th February 2002

Intra-community farmer to farmer communication Despite the reluctance of some farmers to discuss wetland or natural resource management with other farmers, discussions revealed that informal farmer to farmer communication within each wetland community is quite common. A clear example of this is in Adele Bise wetland where, on the arrival of settlers, members of the local community willingly passed on their techniques of wetland management:

> Back home we have no wetlands. Our fathers practised irrigation not drainage. When we arrived here the local farmers drained a whole wetland for us, cultivated it and then gave it to us to cultivate – they taught us how to drain, plough and cultivate. After that they handed it over to us to manage. It is from them that we go our knowledge of wetlands.
>
> Farmer at Adele Bise, 28th January 2002

As reported by farmers at Kodo Hiri, Adele Bise and Tulube, an on-going process of information sharing, through which farmers learn from each other and discuss various issues, appears to be the norm:

> … sharing information is very important. It's a kind of social work – like guarding against wild pests and co-ordinating ditch digging.
>
> Farmer at Adele Bise, 21st January 2002

> … we didn't go to anyone [for advice on wetland management]. We just got together in a group and discussed it.
>
> Farmer at Tulube, 22nd January 2002

> …we've talked to other farmers who are working with us, but not everyone in the *kebele*.
>
> Farmer at Tulube, 22nd January 2002

Intra-community observation It is difficult to distinguish between what farmers are learning through observing their fellow farmers' practices, and that information received through informal communication. It can be assumed that farmers within a community know each other well enough to talk directly to each other rather than simply observing their practices. During discussions, several farmers provided examples of how they had acquired new knowledge solely through observation:

> My neighbour tried cultivating tomato and sugar cane near the ditches in his wetland during the dry season. Other farmers have observed what he was doing and copied him.
>
> Farmer at Kodo Hiri, 6th January 2002

On recalling how another farmer had introduced new crops to his wetland, one farmer at Kodo Hiri stated:

> We observed him doing it ourselves. That's how we learn – we just observe what other people are doing and try it out. We noticed how he was preparing the seedbed and how he maintained the crops. We don't have to ask, we just do it.
>
> Farmer at Kodo Hiri, 23rd January 2002

Inter-community observation Farmers' observations of other communities have given them information about cattle management, maize and potato cultivation in wetlands:

> I have seen other farmers blocking the drainage ditches in their wetlands and also planting potatoes in rows with good spacing and lots of soil around the roots. This creates good conditions. Although I've seen this, I haven't tried it – maybe in the future though.
>
> Farmer at Tulube, 12th Februray 2002

> We are travelling to different places, we see what other farmers are doing and we try it ourselves.
>
> Farmer at Kodo Hiri, 6th January 2002

Inter community farmer - farmer communication The impression given from the discussions with participants on 'other farmers' as a source of information, is that new knowledge is much more likely to be acquired through communication with farmers from other communities. The weekly market in local villages in particular, was revealed to be a key meeting place for those from different communities, providing a forum to discuss the quality of different crops, yields and cultivation techniques:

> We started ourselves but we also got some information from other areas like Kakay – Bedessa where other farmers were cultivating wetlands. We talked to people at the market and heard about it. We heard that if you dig a ditch down the middle of the wetland and drain the water from the wetland, you can plough the land and cultivate maize.
>
> Farmer at Ihud Gebeya, 23rd January 2002

Participants also recalled how wetland knowledge had spread throughout central Illubabor as a result of Sheik Abdella, a local cleric who appears to have been one of the first people to introduce wetland drainage and cultivation in the area during the 1920s. Discussions with the Sheik's family and friends revealed that farmers would travel long distances to meet him, specifically to gather advice on wetland management techniques. Similarly, there is evidence to suggest that many farmers during their travels, talk to other farmers and acquire new information. For example, farmers at Kodo Hiri suggested that their knowledge of wetland cultivation originated during a visit to a local village where they bought green maize. After attempting to copy the system of wetland maize cultivation, those farmers returned to the village several times to consult farmers for advice on hydrological management practices. The case of one farmer at Tulube also provides an example of how migration can facilitate the spread of information from one community to the next:

> I came from Nopa *wereda* – from a place called Bilo-Karo. I was living there 15 years ago and noticed that people were selling green maize, so I got together with the other farmers there and we discussed draining our wetland for green maize cultivation. After that we started cultivation. I knew how other farmers were cultivating at the time. We organised ourselves and when there was excess moisture we started to drain and plant maize. The yield in the first year was very good…We were only growing maize, but there was a problem of wild pests so I moved here.
>
> Farmer at Tulube, 22nd January 2001

Indigenous knowledge acquired through external mechanisms

The only means through which indigenous knowledge has been acquired and disseminated via a non-indigenous channel is through the activities of EWRP and the Ethio Wetlands and Natural Resources Association (EWNRA)[4]. Those who participated in workshops and field visits organised by these organisations were given the opportunity to observe the wetland management practices of other farmers and share their experiences. From discussions with participants, it would appear that these visits were successful in disseminating information, and on return to their communities the information was disseminated further via indigenous channels:

> … I've practised ditch blocking after seeing it at Dizi. I knew the technique before, but I felt more confident about trying it when I'd seen it at Dizi. Last year I tried when there was a water shortage when the colour of the plants changed. Now I'm only growing maize – before I was growing potato, but after going to Dizi I've seen that maize is a more productive use of the wetland.
>
> Farmer at Tulube, 22nd January 2002

> …our visit gave me lots of experience – not just visiting, but I also spoke to other farmers and gained new information.
>
> Farmer at Tulube, 22nd January 2002

Beyond the four study sites, discussions held with participants of past EWRP activities suggested that farmers had benefited significantly from visiting other wetland communities, to observe different practices and talk with other farmers (Dixon, 2003b).

Indigenous acquisition of external knowledge

The extension activities of the Menschen fur Menschen Foundation (MFM)[5] were the only example of circumstances in which exogenous 'technical' knowledge is being acquired through indigenous channels. MFM provide technical training for key individual farmers (often selected by the community themselves), who then return to the community where they disseminate the technical knowledge they have learned through indigenous channels:

> There's also an MFM development agent who comes and uses the trained farmers to demonstrate the different technologies they have learned during the training.
>
> Farmer at Kodo Hiri, 6th February 2002

One problem identified by participants, however, was that those trained were often reluctant to return and communicate their information to the community.

External knowledge acquired through external mechanisms

The acquisition of external 'technical' knowledge through external mechanisms is synonymous with the 'transfer of technology' approach. The Ministry of Agriculture and in the past, the Ministry of Coffee and Tea Development, were extensively engaged in transferring technical information to farmers through training and meetings at the *kebele* level. According to farmers, most of the information received in recent years has centred on an extension package which promotes (and enforces) the use of improved seeds and fertilisers. This transfer of technology appears to occur through various channels,

including individual training, meetings and the establishment of demonstration sites:

> We see the development agent when there's a meeting – when they have something to teach us. The development agent also visits everyone's farm, checking what crops we are growing, telling us how to cultivate or how to prepare the seedbed. Sometimes we also go to the development agent's office for advice.
>
> Farmer at Tulube, 29th January 2002

> Currently the development agent will select a plot of land on a farmer's agricultural field and demonstrate to the surrounding farmers about the current technology. This is mainly to do with the new extension package, which means the use of improved seed and fertiliser. He just moves from one site to another demonstrating the technology.
>
> Farmer at Adele Bise, 4th February 2002

In the past, the Ministry of Coffee and Tea Development placed more emphasis on providing on-site individual advice, which was the preferred method of information acquisition by farmers:

> They just came to every farmer's plot, going from one house to the next, and they would give you their personal attention providing you with information about how to grow coffee.
>
> Farmer at Kodo Hiri, 6th January 2002

> The teaching in each plot was the best – we got to discuss our problems with the development agent and that was very productive compared to when we had meetings.
>
> Farmer at Tulube, 12th February 2002

MFM have, in addition, used similar methods of technology extension through the training of key individuals at training centres. The radio also represents an external mechanism of technology transfer through its broadcasting of information on the extension package, although few farmers have access to it.

Knowledge and sustainability: a range of scenarios

Whilst those wetland communities studied are acquiring both external and indigenous knowledge via a variety of different mechanisms, the data suggest that this is subject to both spatial and temporal variation. Some mechanisms of knowledge acquisition were evidently more common, and functioned more effectively in some communities than others. For example, the wetland committee played a more active role in disseminating information and regulating wetland use in Adele Bise, in comparison with the other sites, notably Ihud Gebeya where the committee structure has collapsed due to disagreements among its members. Similarly, at Kodo Hiri wetland, inter-community communication is much more advanced than intra-community communication. The research also suggests that during the early days of wetland utilisation when farmers are unfamiliar with the wetland environment, a wider range of mechanisms contributing to knowledge acquisition are operational. Although the situation varies between sites, fewer of these mechanisms are contributing to knowledge acquisition at the present time, and fewer wetland users appear to be actively seeking to acquire new knowledge.

The information collected through the various PRA activities indicates the origins of IK, the specific nature of the knowledge acquired, and the mechanisms through which it is acquired. In most cases IK is dynamic and evolving, in that both indigenous and 'scientific' knowledge is being acquired by farmers through indigenous and external channels and, critically, some farmers are involved in a continuous process of trial and error. Previous research has suggested, however, that possessing knowledge of wetland management is only significant if those who possess it have the ability to use and apply the knowledge they have acquired (Dixon, 2003a). Although farmers in Illubabor were found to possess extensive knowledge of hydrological management techniques, in many cases the application of knowledge was constrained by a range of factors (e.g. manpower shortages, climatic fluctuations), and arguably the ability to adapt to these constraints. This had knock-on effects in the wetlands, in terms of environmental sustainability and the success of agricultural activities.

Despite some confusion among participants concerning what constitutes 'used' and 'unused' knowledge, discussions drew attention to several recurring constraints affecting farmers' application of their knowledge. Current shortages in land appear to have prevented farmers applying ancestral knowledge of important techniques such as crop diversification, manuring and fallowing, which would arguably sustain crop production at much higher yields. Because of declining productivity, linked to intensification of land use, farmers have placed great importance on the contribution of the Ministry of Agriculture, both in terms of information and technical assistance. This contribution, however, has a financial cost which few farmers seemed able to afford, hence they are actually unable to use most of the information they receive from the Ministry of Agriculture. Beyond the financial costs of the government's extension package, there is also a recognition that capital equipment such as oxen are also increasing in cost. As a result, much ancestral farming knowledge concerning cattle management has also become obsolete.

Co-ordination between farmers is also a key constraint, especially within the community at Ihud Gebeya. Activities such as wetland management and the maintenance of catchment conservation measures, require organisation and collective responsibility among farmers. Whilst this is being achieved to some extent at Adele Bise and Kodo Hiri (they have a recognised wetland committee), at Ihud Gebeya there appears to be very little social cohesion – something which is also evident from their competitiveness with each other. Consequently, it is clear that in all the communities studied, only a proportion

of IK is actually being used and applied, and in some communities this proportion was found to be much lower than others. A critical question, therefore, is whether the proportion being used and applied is sufficient to facilitate the sustainable use of natural resources at the present time, and whether these communities possess the capacity to acquire new knowledge and adapt to a range of constraints.

The research implicitly addressed these issues by examining evidence for the environmental sustainability of the wetlands, drawing on oral histories and using indicative criteria such as soil conditions, vegetation type, hydrological characteristics and current management practices, as established in previous research (Afework Hailu *et al*., 2000). Of the four wetlands studied, only one, Ihud Gebeya, showed clear indications of environmental degradation, characterised by hard, cracking red soils, and vegetation typical of successional change to a dryland environment. This wetland is cultivated annually and farmers acknowledged that by increasing the depth of drainage channels each year, the wetland is now suffering the effects of over-drainage. Overgrazing is also a problem, and whilst most farmers would like to fallow the wetland (and were knowledgeable on how they would go about this), they suggested that the shortage of land in the uplands and the lack of communication and co-ordination among farmers are major problems. Relating this to the IK investigations, of the four sites studied, the wetland community of Ihud Gebeya showed little evidence of either social cohesion or functioning knowledge acquisition mechanisms. The general picture was one of a divided community, where farmers kept any information acquired from external sources to themselves, and where the wetland committee had ceased to function as a result of disagreements over wetland land use. Despite demonstrating knowledge of wetland regeneration, fallowing and sensitive hydrological management, Ihud Gebeya's wetland users appeared to lack the capacity to adapt their wetland management strategies to the knock-on consequences of upland shortages, principally because of the lack of indigenous information exchange or, in effect, social capital.

At Kodo Hiri wetland, a range of problems including cutworms, wild animal pests, soil damage through cattle grazing and changes in the annual pattern of rainfall, are reportedly affecting wetland drainage and cultivation. Population pressure linked to land shortages is also placing more demands on the wetland for crop cultivation, and crop yields are reportedly decreasing. In recent years, a lack of water has caused conflict among farmers, especially when one farmer at the head of the wetland began to block his drainage channels. In response, the wetland committee arranged specific times for different farmers to block their ditches so that the allocation of water was more equitable, but this has not been entirely successful. The wetland outflow is drying out and, despite accepting the decision of the *kebele* wetland committee, many farmers block their ditches for longer than their allocated time. Farmers have also addressed the problems of water shortages and decreasing yields, by halting the drainage and cultivation of the wetland during the rainy season so that only one crop is cultivated per year. Whilst farmers recognise that there is a need to retain natural vegetation in the upper part of the wetland to ensure that it doesn't dry out, shortages of cultivable land prevent this occurring. The situation appears to be urgent in that hydrological degradation of the wetland has started to occur in recent years, and this has already affected crop yields and cohesion of the wetland farming community. For these reasons, the wetland management system is arguably unsustainable.

Placing this in the context of the IK network, the presence of a wetland committee which has reserved specific wetlands for *cheffe* and others for cultivation would suggest that farmers are well organised and realise the implications of *ad hoc* wetland planning. It is common, however, for farmers to reject the authority of the committee and cheat on allocated water quotas. A similar paradox is evident in the way farmers acquire much of their wetland management information. Although several examples were cited of farmers observing wetland practices outside the community, then transferring them to their own plots, farmers are reluctant to pass on this information directly within their own community. Within the community, observation of each other's activities is the most common means of wetland information acquisition. This air of secrecy and non-communication may account for the element of disorganisation within the community, hence the lack of adherence to the wetland committee and, consequently, a lack of capacity to adapt to the changes taking place.

The case of Tulube illustrates another complex relationship between the environmental sustainability of wetland use and community social capital. Although suffering a small decline in crop yields, the productivity of Tulube wetland remains high compared to the uplands. A significant problem, however, is the prevalence of insect pests (cutworm) which are linked to the failure of the rains. The extension of the dry season has also reportedly resulted in a change in the amount of water released from springs around the wetlands. Apart from these physical problems, farmers report that the main problem in the wetland is the co-ordination of farming activities amongst themselves. Several large plots towards the outflow of the wetland are not being cultivated, leading to waterlogging upstream and crop damage.

In its current state, Tulube wetland does not appear to be threatened by degradation unless further extension of the dry season occurs. Whilst the poor state of organisation and co-operation between farmers at the site has to some extent affected the use of wetland resources and created some waterlogging problems, the wetland has remained in a stable condition and continues to provide a range of benefits. Although communication and co-ordination within the community as a whole can be considered poor, a situation exists where those who are cultivating wetland plots do appear to be extremely knowledgeable about wetland management and are in theory at least, prepared to co-operate with each other. The acknowledgement that *cheffe* reservation is an important aspect of wetland water

management suggests that if these farmers were to persuade the *kebele* committee to redistribute the other farmers' plots, then wetland management could continue to be carried out in a sustainable manner. Furthermore, it is clear from PRA sessions that those farmers who are currently cultivating wetland plots are experienced innovators – they are trying out their own ideas and those acquired through observation and interaction with other farmers.

The IK network in Tulube is functional at a number of levels, despite a lack of organisation within the community as a whole. With the absence of environmental degradation and the continuous (if variable) production of crops in the wetland, wetland use can also be regarded as sustainable in many respects. On the evidence presented here, it seems likely that this sustainable use will continue, given the strong level of the wetland community's social capital.

Finally, the wetland of Adele Bise has over 300 stakeholder farmers, most of whom are directly involved in its annual drainage and cultivation. Besides declining productivity and a recent problem with insect pests, there is difficulty in organising certain farmers to cultivate their wetland plots. Several plots towards the wetland outflow have been abandoned and clearly cause waterlogging problems for adjacent farmers. The owners of these plots are women who have remarried and whose husbands have no wish to cultivate wetlands. Other farmers, however, have little power to redistribute the land, since the defiant farmers are themselves on the *kebele* level wetland committee.

In terms of sustainability, Adele Bise was used by EWRP as an example of potential wetland degradation (Afework Hailu, *et al*., 2000). In this earlier study, the major risks of degradation were reportedly from burning the peaty soil, and through the drainage and subsequent oxidation and acidification of these soils. In 2000, farmers suggested that productivity was declining and the maize showed some of nutrient deficiency. Farmers also reported that several springs had dried up, although, given the reported abundance of water in the wetland, the impact of this could be minimal.

In terms of IK, the wetland management community appears extremely well organised compared to other wetlands. The existence of a wetland committee, which was identified as a key source of natural resource management information, is an important mechanism for regulating and co-ordinating wetland use among stakeholders (Afework Hailu, *et al*., 2000). Furthermore, other institutional arrangements, such as *dabo*[6], are also active in the wetland and have the potential to contribute to the acquisition and dissemination of knowledge. Critically, the farmers at Adele Bise also recognise the importance of sharing information among each other, and their recent wetland cultivation assistance to settlers from the north confirms this. Adele Bise clearly has some problems, but compared to most wetlands these are minor. It is possible that this situation is directly related to the current IK system and the functioning knowledge acquisition mechanisms typified by effective local institutional arrangements for wetland activity co-ordination.

It is possible, however, to interpret these findings in several ways. These case studies suggest some relationship between environmentally sustainable wetland management and the existence within communities of a range of functioning knowledge acquisition mechanisms. Where there is evidence for greater innovation, communication and the co-ordination within the community, empirical data suggest the occurrence of wetland management that is not leading to serious environmental degradation. Conversely, in those communities where these mechanisms are not fully exploited or operational, and where co-ordination is poor, wetland management is characterised by environmental deterioration to the extent that people's livelihoods are at risk. In these circumstances, it appears that the environmental sustainability of wetlands is linked to the social sustainability of the managing community, at the core of which is their capacity to acquire and disseminate new knowledge that facilitates adaptation and continuous evolution of environmentally sustainable management practices.

Alternatively, the results of the study may simply indicate that when wetland management is sustainable, and when degradation is avoided and communities continue to derive benefits from wetland use, people have more opportunity and inclination to innovate, communicate with each other and share information. Where wetlands are degrading and their benefits to the community are declining, there is arguably a greater likelihood of farmers struggling to cope with the changes taking place, having less opportunity to innovate, and withholding any information that may give them the upper hand in crop production. The problem with this somewhat Malthusian interpretation is that it leaves wetland sustainability to chance, outside the control of local communities, and perhaps simply a function of the geomorphological, hydrological and ecological conditions at each location. Whilst it is possible that each wetland ultimately has a finite lifespan of use, which is dependent on its physical characteristics, such an interpretation ignores the vast body of theoretical and empirical literature linking the sustainable use of natural resources directly with community-based management and intervention (Boserup, 1965; Richards, 1985; Tiffen *et al*, 1994, Binns, 1995; Reij *et al*, 1996).

Conclusion

This paper has demonstrated that individuals and communities involved in wetland management acquire different types of knowledge from a variety of sources, through a range of different channels, both indigenous and external in origin. In those wetland communities where wetland use has a long history, the intergenerational transfer of ancestral knowledge has played a vital role in providing farmers with basic information on wetland management. In those communities where wetland use has been initiated within a shorter time-scale, the interaction and communication with farmers in other areas has been an important mechanism through which wetland

knowledge has been acquired. The research also identified the presence of innovation as an important source of knowledge acquisition, although the extent to which innovation occurs in all communities is unclear. Although examples of innovation in wetlands are generally less common than those for natural resource management in the uplands, the capacity within communities to test ideas, solve problems and adapt to new situations clearly exists to a larger extent than was previously acknowledged.

The co-ordination of activities within a community was also found to be critically important to the management of key resources such as wetlands, where one farmer's actions directly affect others. Indigenous institutions, such as wetland committees, bring stakeholders together and provide a forum through which knowledge can be disseminated. In addition, where farmer to farmer communication is abundant, and where stakeholders have organised themselves without any external interference, the capacity to adapt to changes is strengthened, and this is reflected in what appear to be environmentally sustainable wetland management strategies.

Despite this indigenous adaptive capacity, most wetland users still regard the extension services of the Ministry of Agriculture as an important source of information, in terms of their capacity to contribute to a level of wetland management where benefits are increased and livelihoods are made more secure. To date, however, extension services have had only a variable impact on improving natural resource management and agriculture in the area, and there is little evidence of community participation or a recognition of the importance of indigenous knowledge. In contrast, other external institutions such as MFM, and to some extent the Ethiopian Wetlands Research Programme, have been effective in the transfer of appropriate or indigenous technologies. Both MFM and EWRP have facilitated farmer to farmer site visits, in which members of different communities are given the opportunity to observe and talk about new or innovative natural resource management techniques in a non-formal setting. Such activities are popular among participants and, in the case of EWRP, wetland management information has been disseminated widely among communities to the extent that it is already being applied in some areas.

With respect to the relationship between knowledge acquisition and knowledge application, whilst there is an IK network which facilitates the transfer of information between and within these communities, and most individuals possess extensive knowledge of wetland and natural resource management, the application of this knowledge continues to be limited by a range of constraints that farmers have problems adapting to. Land shortages, climate change and government policy (particularly recent extension packages), were cited as directly affecting the livelihoods of community members. If knowledge becomes irrelevant or obsolete when environmental or socio-economic changes occur, there is a need to take steps to acquire and develop new knowledge through a variety of channels. This is clearly happening in those sites where local institutional arrangements and social capital facilitate more extensive indigenous communication and innovation.

In practical terms, the research has demonstrated that there is a need for those directly involved in development activities to recognise the contribution of these mechanisms to knowledge acquisition and development, and to focus more on local-level participation and facilitating the exchange of information and technologies through indigenous channels, rather than through traditional extension methods. These lessons have particular relevance to the management of Africa's wetland resources, where sustainable and equitable management scenarios, rather than those focused purely on conservation or development, are essential to meet current and future livelihood demands.

Endnotes

Acknowledgements

The research on which this paper is based was funded by British Academy grant SG-31767 'The role of indigenous knowledge systems in wetland management'. The author is also grateful to Afework Hailu of EWNRA and Tilahun Semu of the Metu Wereda Ministry of Agriculture for their invaluable support in the field, and to Adrian Wood and Tony Binns for their comments on this paper.

[1] Recent government initiatives have sought to increase food production from wetlands in response to poor harvests on the uplands.

[2] In the past, the traditional Gadda administrative system of the Oromo would similarly have been an indigenous 'formal' mechanism of knowledge acquisition and dissemination outside the government sphere. Within Illubabor this is no longer functional, although remnants may exist in parts of Borena in Southern Ethiopia.

[3] The Ethiopian unit of currency. As of March 2005, 1birr = £0.06 and $0.11.

[4] EWNRA is a local NGO which was formed to take forward the work of the EU funded Ethiopian Wetlands Research Programme. It works to promote the sustainable management of wetlands and is involved in various advocacy, extension and research activities.

[5] The Menschen fur Menschen Foundation is an Austrian NGO established in 1981, initially as a relief organisation. It works exclusively in Ethiopia and in recent years has focused on developing capacity in agriculture, child care, hospitals and education.

[6] A non-reciprocal traditional work party (usually containing up to 30 people).

References

Abbot P G, Afework Hailu and Wood A P 2000 *Community organisation for natural resource management and the potential for community based wetlands management* The University of Huddersfield, Unpublished Report.

Afework Hailu 1998 *An overview of wetland use in Illubabor* Ethiopian Wetlands Research Programme, Metu, Unpublished Report

Afework Hailu, Abbot P G and Wood A P 2000 *Appropriate techniques for sustainable wetland management* The University of Huddersfield, Unpublished Report.

Adams W M 1993 Indigenous use of wetlands and sustainable development in West Africa *The Geographical Journal 159 209-218*

Adams W M 2001 *Green development, environment and sustainability in the south* Routledge, London

Adger W N 2000 Social and ecological resilience: are they related*? Progress in Human Geography 24 347-364*

Agrawal A 1995 Dismantling the divide between indigenous and scientific knowledge *Development and Change 26 413-439*

Berkes F 1999 *Sacred ecology: Traditional ecological knowledge and resource management* Taylor and Francis, London

Berkes F, Colding J and Folke C 2000 Rediscovery of traditional ecological knowledge as adaptive management *Ecological Applications 10 1251 – 1262*

Binns T ed 1995 *People and environment in Africa* John Wiley, Chichester

Boserup E 1965 *The conditions of agricultural growth* Allen and Unwin, London

Brace S 1995 Participatory rural appraisal - a significant step forward in understanding relationships between poor people and their environments in **Binns, T** ed *People and environment in Africa* John Wiley and Sons, Chichester, 39-46

Briggs J and Sharp J 2004 Indigenous knowledges and development: a postcolonial caution *Third World Quarterly 25 661-676*

Brokensha D, Warren D and Werner O 1980 *Indigenous knowledge systems and development* University Press of America, Lanham

Brown D, Howes M, Hussein K, Longley C and Swindell K 2002 *Participation in practice: case studies from the Gambia* Overseas Development Institute, London

Chambers R 1983 *Rural Development: putting the last first* Longman, London

Chambers R 1994 Participatory Rural Appraisal (PRA): Analysis of experience *World Development 22 1253-1268*

Chambers R, Pacey A and Thrupp L A eds 1989 *Farmer first: farmer innovation and agricultural research* Intermediate Technology Publications, London

Conway D and Dixon A B 2000 *The hydrology of wetlands in Illubabor Zone* EWRP and The University of Huddersfield, Huddersfield

Denny P 1993 Eastern Africa in **Whigham D, Dykjova D and Hejny S** eds *Wetlands of the world: inventory, ecology and management Volume 1 Handbook of vegetation science* Kluwer Academic Publishers, Dordreacht, 32-46

Denny P 1994 Biodiversity and wetlands *Wetlands Ecology and Management 3 55-61*

DeWalt B 1994 Using indigenous knowledge to improve agriculture and natural resource management *Human Organisation, 53 123-131*

Dixon A B 2002 The hydrological impacts and sustainability of wetland drainage cultivation in Illubabor, Ethiopia *Land Degradation and Development 13 17-31*

Dixon A B 2003a *Indigenous management of wetlands: experiences in Ethiopia* Ashgate, Aldershot.

Dixon A B 2003b The indigenous evaluation of wetlands research in Ethiopia *Development in Practice 13 394-398*

DPPC 2004 Resettlement 2004 – Oromiya (http://www.reliefweb.int/rw/rwb.nsf/db900SID/SKAR-64GEPW?OpenDocument) Accessed 15th March 2005

Dugan P J 1990 *Wetland conservation: a review of current issues and action* IUCN, Gland

Farrington J and Martin A 1988 *Farmer participation in agricultural research: a review of concepts and practices* Agricultural Administration Unit Occasional Paper 9, ODI, London.

Folke C, Carpenter S, Elmqvist T, Gunderson L, Holling C S and Walker B 2002 Resilience and sustainable development: building adaptive capacity in a world of transformations *Ambio 31 437-440*

Grenier L 1998 *Working with indigenous knowledge: a guide for researchers* IDRC, Ottawa

Hardin G 1968 The Tragedy of the Commons *Science 162 1243-1248*

Haverkort B and Hiemstra W eds 1999 *Food for thought: ancient visions and new experiments of rural people* Zed Books, London

Hollis G E 1990 Environmental impacts of development on wetlands in arid and semi-arid lands *Hydrological Sciences Journal 35 411-428*

IIRR 1996 *Recording and using indigenous knowledge: a manual* International Institute of Rural Reconstruction, Silang, Cavite, Philippines

Johnson A 1972 Individuality and experimentation in traditional agriculture *Human Ecology 1 149-159*

Kebede Tato 1993 Evaluation of the environmental components of the Menschen für Menschen projects in Ethiopia Unpublished report MFM, Addis Ababa

Lado C 1998 The transfer of agricultural technology and the development of small-scalefarming in rural Africa: Case studies from Ghana, Sudan, Uganda, Zambia and South Africa *GeoJournal, 45 165-176*

Lalonde A and Morin-Labatut G 1995 Indigenous knowledge, innovation and sustainable development: An information sciences perspective *Scandinavian Journal of Development Alternatives 14 206-221*

Lema A J 1996 Cultivating the valleys: vinyungu farming in Tanzania in **Reij C, Scoones I and Toulmin C** eds *Sustaining the soil: indigenous soil and water conservation in Africa* Earthscan, London 139-144

Lemily A D, Kingsford R T and Thompson J 2000 Irrigated agriculture and wildlife conservation: conflict on a global scale *Environmental Management 25 485-512*

Maltby E 1986 *Waterlogged wealth: why waste the world's wet places?* Earthscan, IIED, London

Maltby E In Press *The wetlands handbook* Blackwell Publishing, London

McCorkle C M and McClure G D 1995 Farmer know-how and communication for technology transfer: CTTA in Niger in **Warren M D, Slikkerveer L J and Brokensha D** eds 1995 *The cultural dimension of development: indigenous knowledge systems* Intermediate Technology Publications 323-332

Mundy P A and Compton J L 1995 Indigenous communication and indigenous knowledge in **Warren M D, Slikkerveer L J and Brokensha D** eds 1995 *The cultural dimension of development: indigenous knowledge systems* Intermediate Technology Publications 112-123.

Nicholas G P 1998 Wetlands and hunter gatherers: a global perspective *Current Anthropology 39 720-731*

Pretty J and Ward H 2001 Social capital and the environment *World Development 29 209-227*

Purcell T W 1998 Indigenous knowledge and applied anthropology: questions of definition and direction *Human Organization 57 258-272*

Ramirez R 1997 Understanding farmers' communication networks: combining PRA with agricultural knowledge systems analysis *IIED Gatekeeper No 66*

Reij C, Scoones I and Toulmin C eds 1996 *Sustaining the Soil: Indigenous Soil and Water Conservation in Africa* Earthscan London

Reij C and Waters-Bayer A 2001 *Farmer innovation in Africa: a source of inspiration for agricultural development* Earthscan, London

Reijntjes C, Haverkort B and Waters-Bayer A 1992 *Farming for the future: an introduction to low-external-input and sustainable agriculture* ILEIA / Macmillan, London.

Rhoades R E and Bebbington A 1995 Farmers who experiment: an untapped resource for agricultural research and development in **Warren M D, Slikkerveer L J and Brokensha D** eds 1995 *The cultural dimension of development: indigenous knowledge systems* Intermediate Technology Publications, 296-307.

Richards P 1985 *Indigenous agricultural revolution: ecology and food production in west Africa* Hutchinson, London

Roggeri H 1998 *Tropical freshwater wetlands: a guide to current knowledge and sustainable management* Kluwer Academic Publishers, Dordrecht

Sillitoe P 1998 The development of indigenous knowledge: a new applied anthropology *Current Anthropology 39 223-252*

Silvius M J, Oneka M and Verhagen A 2000 Wetlands: lifelines for people at the edge *Physics and Chemistry of the Earth Part B 25 645-652*

Solomon Abate 1994 *Land use dynamics, Soil degradation and potential for sustainable use in Metu Area, Illubabor Region, Ethiopia* African Studies Series A13, University of Berne, Switzerland

Stuip M A M, Baker C J and Oosterberg W 2002 *The socio-economics of wetlands* Wetlands International and RIZA, The Netherlands

Swift J J 1979 Notes on traditional knowledge, modern knowledge and rural development *IDS Bulletin 10 41-43*

Tafesse Asres 1996 Agro-ecological zones of South-west Ethiopia Unpublished MSc Thesis, University of Trier

Tiffen M, Mortimore M and Gichuki F 1994 *More people, less erosion: environmental recovery in Kenya* John Wiley, Chichester

van Veldhuizen L, Waters-Bayer A, Ramirez R, Johnson D A and Thompson J 1997 *Farmers' research in practice: lessons from the field* Intermediate Technology Publications, London

Wang G 1982 Indigenous communication systems in research and development Paper presented at the conference on knowledge utilisation: theory and methodology, 25-30th April 1982, Honolulu, HI, East-West Centre

Warren M D, Slikkerveer L J and Brokensha D eds 1995 *The cultural dimension of development: indigenous knowledge systems* Intermediate Technology Publications, London

Wood A P 1996 Wetland drainage and management in south-west Ethiopia: some environmental experiences of an NGO in **Reenburg A, Marcusen H S and Nielsen I** eds *The Sahel Workshop 1996* Institute of Geography, University of Copenhagen, Copenhagen, 119-136

Wood A P and Dixon A B eds 2002 *Sustainable wetland management in Illubabor Zone: Research report summaries* The University of Huddersfield, Huddersfield.

Wood A P, Afework Hailu, Abbot P G and Dixon A B 2002 Sustainable management of wetlands in Ethiopia: Local knowledge versus government policy in **Gawler M** ed *Strategies for wise use of wetlands: Best practices in participatory management* IUCN, Gland, 81-88

World Bank 1998 *Indigenous knowledge for development: a framework for action* Knowledge and Learning Center, Africa Region, The World Bank, Washington

Wu B and Pretty J 2004 Social connectedness in marginal rural China: The case of farmer innovation circles in Zhidan, North Shaanxi *Agriculture and Human Values 2181–92*

Zerihun Woldu *Plant biodiversity in the wetlands of Illubabor Zone* The University of Huddersfield, Unpublished Report

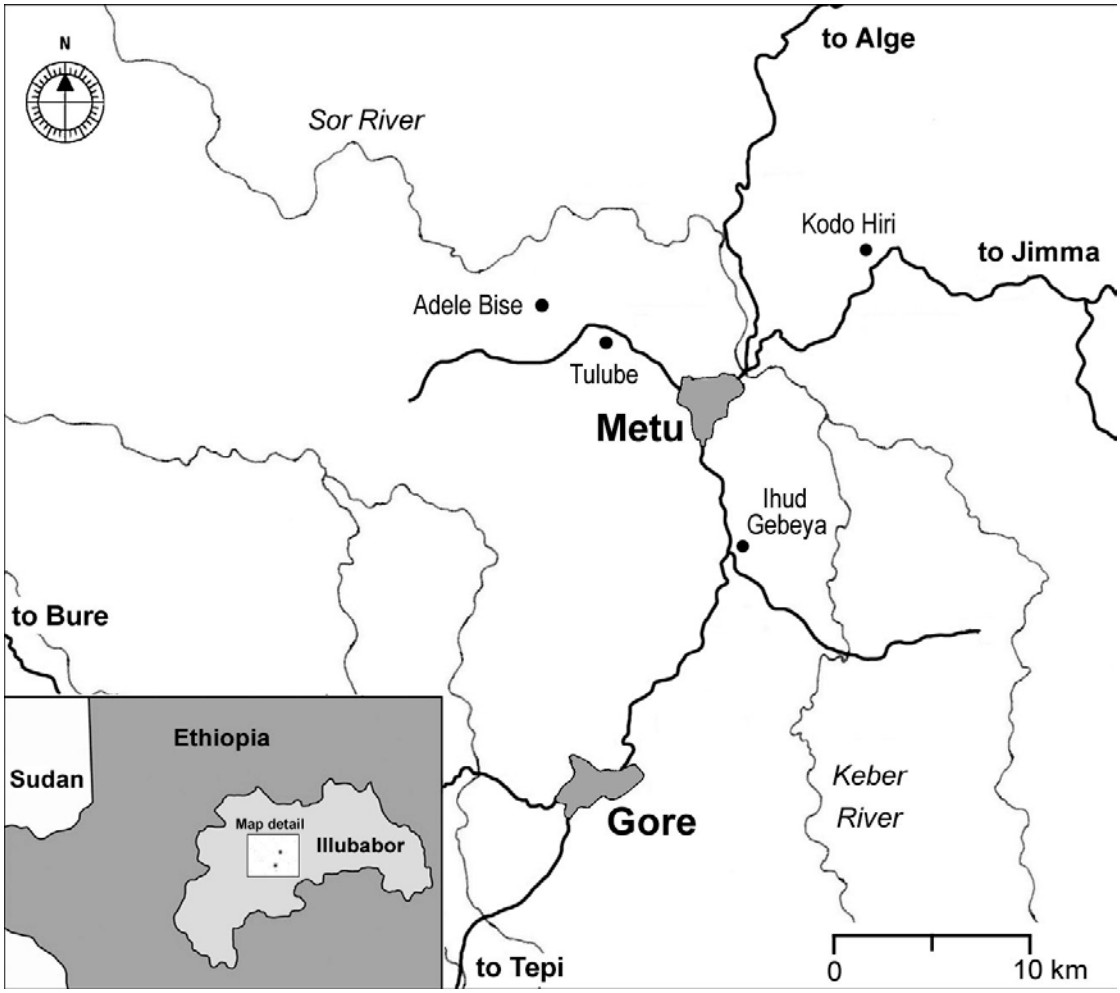
Captions for tables, figures and plates

Figure 1 The location of Illubabor and the study areas within Ethiopia.
Figure 2 The four study areas and their location within Illubabor.
Plate 1 The results of a proportional piling exercise, investigating sources of natural resource management information.
Plate 2 A problem-solving innovation: drainage ditches covered with grass for shade.
Table 1 Wetland uses and beneficiaries in Illubabor.
Table 2 A typology of knowledge acquisition mechanisms.
Table 3 Summary of indigenous mechanisms of indigenous knowledge acquisition.

Figure 1

Source: Author

Figure 2



Source: Author

Table 1

Wetland uses	Proportion of households benefiting
Social /ceremonial use of reeds	100% (including urban dwellers)
Medicinal plants	100% (mostly indirectly by purchase from collectors / traditional doctors)
Domestic water from springs	50%-100% (depending on the locality)
Thatching reeds	85% (most rural households)
Temporary crop guarding huts of reeds	30%
Dry season grazing most cattle owners	30 % of population
Water for stock most cattle owners	30 % of population
Cultivation	25%
Craft materials	5% (palm products & reeds)

Source: Wood *et al*. (2002)

Table 2

Acquisition Mechanism	Knowledge: Indigenous	Knowledge: External
Indigenous Mechanisms	**1** • Farmer - farmer communication (between & within communities) • Direct observation • Innovation (trial & error) • Local NRM institutions • Ancestral knowledge	**3** • MFM (Menschen fur Menschen) trained farmers disseminating information
External Mechanisms	**2** • Ethio- Wetlands and Natural Resources Association (EWNRA) - facilitating site visits	**4** • MFM training • Radio (extension package) • Govt institution meetings & training • *Kebele* meetings • Demonstrations • Radio

Source: Adapted from Mundy and Compton (1995)

Table 3

Setting	Intra-community	Inter-community
Formal	**A** • Local institutions - Wetland committee (*Cheffe Kore*) meetings	**B** • No examples
Informal	**C** • Intergenerational transfer • Innovation • Farmer - farmer communication • Observation	**D** • Observation • Farmer - farmer communication - market place - migration - specific visits (Sheik Abdella)

Source: Author

Plate 1

Source: Author

Plate 2

Source: Author