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Chapter 5

**INDIGENOUS KNOWLEDGE, LIVELIHOODS
AND GOVERNMENT POLICY IN THE OKAVANGO
DELTA, BOTSWANA**

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ABSTRACT

Communities in and around the Okavango Delta are still highly dependent on natural resources, and indigenous knowledge pertaining to the use and management of these resources has helped sustain both people's livelihoods and the environment on which they are based. However, many development initiatives are imposed from outside, and fail to take into consideration local conditions. Focusing on the Okavango Delta generally, and the villages of Sehitwa and Shorobe specifically, in this chapter we explore the extent to which indigenous knowledge is currently used in Okavango communities, and how it has been affected by Botswana's national policies over the years. Not all knowledge is shared equally by all community members – knowledge can be highly specialised (such as traditional medicine) or of relevance to one section of society only (such as women). In the Okavango, indigenous knowledge covers the range of resources on which rural livelihoods are based, from range management and crop production to fishing and wild plants. Within Botswana, two parallel legal systems exist: common law and customary law.

While customary law is to a large extent based on local indigenous knowledge, common law is centralised, and encompasses broader national needs and values. As a result, new policies and regulations do not affect all sectors of society equally. In particular, veldt fire and fishing management at the national level have not always matched condition in the Okavango Delta. Some government officials who have trained in western countries either fail to “see” indigenous knowledge, or discount it as outdated and irrelevant. However, Botswana is currently revising many of its natural resource-related policies, and there is clear evidence of valuing and incorporating indigenous knowledge into policy revisions. What is less clear is how far this intention can be taken as the centralised government continues to promote three practices that directly undermine local knowledge: zoning and fencing, continued centralisation of institutions (removing power from local headmen) and a “modernisation” mindset.

INTRODUCTION

Indigenous or local knowledge¹ signifies the technical, cultural, political and institutional aspects of knowledge and values systems within rural communities (Mosepele *et al.*, 2007; Sillitoe & Marzano, 2009). Indigenous knowledge (IK) is innovative, and it is continually renewed and refined, adopting and adapting practices and techniques from other knowledge systems. Knowledge will disappear if it is no longer used, but many traditional practices and activities within IK systems that have been and are important coping strategies are now in danger of disappearing. In the Okavango Delta, the risk of losing such knowledge comes not through lack of need or use, but through the disregard of outsiders for this knowledge. As is the case in many other African countries, both protectorate and post-independence planning and policy have tended to neglect and denigrate IK. This has been accentuated by the top-down approach to development planning in Africa, which does not promote the participation and empowerment of the local communities in the development process. Such neglect has contributed to a general decline of IK, although certain types of IK have remained resilient, particularly those which play a key role in rural livelihood systems (Mosepele *et al.*, 2007). Indeed, worsening livelihood security in Africa has contributed to the revitalisation of many IK systems (Matowanyika, 1994). The increasing recognition of IK is partly due to an increasing awareness of the importance of common property resources (CPRs) in natural resource management (Matowanyika, 1994).

It has also become clear that development project interventions not rooted in the culture of the local people and IK systems tend to fail (Asibey, 1995). As a result, perceptions about IK systems are now changing. For instance, local farming systems used to be looked down upon during the colonial and the early post-independence eras, but are now increasingly being recognised, because they are based on, and adaptive to, local conditions. Increasingly, there are instances of attempts to incorporate IK systems in the process of development planning and policy (Gata, 1994). This chapter examines how IK is used in the livelihoods of local resource users in the Okavango Delta, and how it has been affected by Botswana's development policies over the years, drawing on existing literature, as well as interviews conducted in selected rural settlements and with district officials.

This study focuses on examples from two rural communities located at the distal end of the Okavango Delta: Sehitwa to the southwest, near Lake Ngami, and Shorobe which is approximately 30 km northeast of Maun. In both communities public *kgotla* meetings were held, where community members were able to discuss and highlight their own knowledge about the landscape and environment in which they lived. These meetings were then followed by key informant surveys, where selected members of the community were identified based on specific areas of expertise for further in-depth interviews. Key informants included the village headmen, traditional healers, male and female elders, as well as those simply identified as having a good understanding of natural resources. A predetermined list of questions was used to probe into the types of information used, and how broadly this type of information was shared amongst community members.

¹ As noted by Chambers (1987) and Sillitoe (1998), many terms exist to describe indigenous, local and traditional ecological knowledge. Following Sillitoe's example, we have chose to stay with the widely-used term "indigenous knowledge", by which we mean knowledge that has evolved over a very long time in response to a series of natural "experiments", as people of a given locale and culture develop ways to best suit their land use practices to the dynamism of local environmental conditions.

INDIGENOUS AND OTHER DIMENSIONS OF KNOWLEDGE

There is an increasing recognition that most indigenous practices are based on sound scientific principles in addition to the experience and knowledge that accumulates in an area over a long period of time (Gata, 1994). Many researchers have tried to describe the differences between scientific or modern knowledge and IK. Kloppenburg (1991) found that a great number of philosophers and anthropologists who have tried to illuminate the epistemological difference between IK and scientific knowledge have done so by contrasting binary concepts, for example *la science du concrète / la science* (Lévi-Strauss, 1962), indigenous knowledge / western knowledge (Posey, 1983) and traditional knowledge / modern knowledge (Huber & Pedersen, 1997). The characteristics found to distinguish local knowledge from modern or scientific knowledge were that the former tends to be practical, collective and strongly rooted in place. Science is said to deal with a more abstract and analytical representation of the world, while IK deals with activities intimately connected to the livelihoods of people (Agarwal, 1995). Geertz (1983) defines IK as a relatively organised body of thought based on experience while van der Ploeg (1993) links it to spatially specific practices. In contrast to the prestige often accorded to centralised western knowledge, there is a common assumption that IK is dispersed and possesses a low prestige value, even for its adherents, while science is systematic, objective and analytical, and is advanced by building on previous achievements. IK, on the other hand, is considered to be common-sense, non-systematic and advances in fits and starts.

There are numerous studies where scientists find IK to be at least as accurate and detailed, if not superior, to scientific knowledge (e.g. local farmers' classification of soil types and fertility levels in Thailand (Forsyth, 1994) and Brazil (Stewart, 1994)). However, when the two knowledge systems clash or are found to be conflicting, for example where outside consultants might report that green riverine grass is suitable for dry season grazing while IK states that the quality of this grass is poor (though it may look good), scientific knowledge tends to reign superior. It is then that IK is often dismissed, as it is not based on "scientific" proof.

Despite the recent recognition of IK as credible, accurate and valuable, it is often only acknowledged because outside knowledge has often been found to fail when not anchored in local systems. Many practices and technologies that are introduced to local areas are considered superior, but are in fact inappropriate to both the physical environment and cultural practices. For this reason, both IK and scientific knowledge must be acknowledged in order to bridge the gap between the two. Indeed, Agarwal (1995) dismisses the claimed differences between scientific and IK, and argues that the labels of "indigenous" and "western" obscure the aim of protecting, systematising and disseminating knowledge. He notes that it is more useful to consider multiple domains and types of knowledge. Nevertheless, IK can be uniquely described and observed as strongly functional systems that persist for long periods of time.

Grounded as it is in the culture and history of a community, IK is recognised as a means of ensuring the genuine participation of local people in development projects (which is often a criterion for funding from donor organisations). In addition, by building on IK, and the information of the local context it brings, innovative projects that introduce new ideas and interventions are likely to be both more appropriate and more accepted. IK still has a long way to go to be fully acknowledged as a respected and credible knowledge system in its own right.

Local people tend to value IK, as something that suits them and local conditions “best”. This is because such knowledge is based on a particular material culture and its related technologies that support specific livelihood objectives. An example of this are the externally imposed practices of row planting and weeding, which might give increased yields, but which may be unsuited to local conditions in terms of risk minimisation and the allocation of scarce resources in space and time. This means that other cultivation practices may be preferable and better suited to local needs. Similarly, the introduced technology of a seed planter may be problematic where it only fits one size of seed grain, while local farmers prefer multiple species and grain size planting as a means of spreading the risk in an unpredictable climate so that least one crop type will germinate. This is where IK becomes highly relevant. It has been tested in a local context and found superior to other methods for various reasons that might not always be apparent to outsiders – such as the concept of diversification for risk management. IK also operates at temporal scales that outside knowledge often fails to take into consideration. For example, IK about the existence of poisonous plants includes both seasonal and multiple year dimensions, in contrast to a vegetation map is that based on one short fixed time period. Finally, introduced knowledge systems may also be based on a goal that is set and imposed by outside parties, and which may not be a priority of an area of interest to local communities. In the Okavango region, many groups can be said to be optimizing their livelihoods through a “minimax” strategy (Voorneveld, 1999), where spreading resources across multiple livelihoods minimises maximum risk (Downing & Patwardhan, 2007), and where open access to communal resources requires a certain amount of competitiveness (Ostrom, Burger, Field, Norgaard, & Policansky, 1999). People living here also need diversified livelihood activities that can be implemented with only limited capital, as often access to both labour and money are limited (Cassidy, 1997; van Hoof & al, 1991, 1993).

WHO BEARS THE KNOWLEDGE

While the notion of collectiveness is implicit in the term local knowledge, it must be remembered that the many socio-economic differences within and between communities in the Okavango Delta may result in variations in knowledge systems. Some aspects of IK tend to be held by only certain sub-groups of a community. For example, post-harvest technologies (such as protection against vermin and treatment of seed products), and nutrition (food preparation) are widely known by farmers and women respectively. Such knowledge is generally accessible to anyone who needs it, but is typically used, developed and reinforced by these groups. Such knowledge is owned and maintained on the basis of need and use.

Other aspects of IK are held by community leaders such as chiefs, ward heads or other people appointed by the chief. For example, deciding when it is time to begin harvesting thatching grass and other plant resources, where the community’s livestock should be grazed, whether, where, and when veldt fires should be set, are all specialised forms of IK that are controlled by only a handful of members of the community (Schapera, 1970). Much of this knowledge is at risk because the centralisation of governance and decision-making to the national level has undermined the ability of local communities to implement traditional practices based on their understanding of the environment (Cassidy, 2000).

Some domains of IK have flexible boundaries. For example, primary health care and childcare is used and shared by most women in the community. This collective knowledge as well as the manifestation of it in the form of herbal medicines, botanical or animal products might be shared amongst practitioners, but is not easily accessible to outsiders. In addition, traditional healers have access to this and a much larger body of knowledge that is highly specialised, and sometimes ritualised and secret. These topics also highlight the dynamic nature of IK, which is constantly evolving and adapting itself to changing conditions. With regard to safety nets and poverty alleviation, IK has undergone substantial transformation since the country's independence in 1966. Bearers of this knowledge tend to be community individuals and leaders alike, and this IK is therefore more secure. Several risk aversion and institutionalised assistance strategies exist in order to avert conditions of indigence and to integrate marginalized members of the community into mainstream societal activities. These strategies include *mafisa* (looking after livestock in return for some), kin-foster care, *masotla* (communal fields and granaries ploughed by ordinary community members for the chief's use or distribution), *letsema* (work parties) and *majako* (seasonal farm migration) and share cropping. Some of these activities have been transformed after political independence, and their development varies from either complete translation (contemporary collective interventions such as cash-based *metshelo* which is rotational distribution to one group member of the group's collective savings), people's banks (service and consumer), *tiro ya nakwana* (piece jobs) savings and credit schemes and *diswaeti* (burial societies) and types of work parties (Ngwenya, 2000).

Because life in the Okavango tends to be unpredictable, it is common to find many, if not most, households relying on natural resources for a range of activities and items that contribute to their total livelihood. This means that there is a lot of IK that is in the public domain, accessed and used by nearly everybody living in the rural communities, whether by most households, or by specialist groups, or by both as is the case for handicraft production. Such knowledge ranges from an understanding of underlying ecological processes to the ways of extracting and transforming the resources for both subsistence and commercial use. This knowledge and its contribution to household livelihoods are explored further below.

INDIGENOUS KNOWLEDGE AND LIVELIHOODS

The Okavango Delta is a highly variable and difficult environment to live in. Its inhabitants are well acquainted with shocks such as floods, droughts and livestock and human disease outbreaks. These circumstances have led the Okavango people to be resilient as well as adaptable in their livelihood portfolios. They are experts at coping, and as is characteristic of resilient rural communities in general (Twigg, 2007), the knowledge they have built up over time is integral to this. Certain types of knowledge, such as the *molapo* farming system, are uniquely adapted to the Okavango region. Others, such as migration in response to shocks (particularly environmental or ecological) are more global (Hunter, 2005). However, in the Okavango, veterinary fences and conservation areas which have been built or declared in the region have removed this option for many people, or at least greatly limited it. This has reduced available livelihood options and rendered some of their IK (about which areas to migrate to in flush or difficult times), redundant.

IK is widely used to support livelihoods in the Okavango Delta through a range of strategies including fishing, basket making, cultural tourism, use and conservation of a range of natural resources, making and using *mekoro* (dugout canoes), water divining, and the use of fire – among many others. Livelihoods within the Okavango Delta are highly diversified both as a risk management strategy and because each livelihood component is typically too small to meet a family's needs. In highly dynamic and unpredictable environments such as the Okavango Delta, households that are highly dependent on natural resources need to accommodate the possibility of any given livelihood strategy having low returns in a particular year. For example, in seasons where rain events are too far between, crops might fail. In years where the flood pulse is low, the fishery will be limited. Through a combination of several activities at different times of year and between different household members, resources can be pooled to provide a relatively steady livelihood base. Many of the livelihood activities have been carried on for many generations, and can easily fall under the IK label, such as beer-brewing from local fruits, basket-making, and flood recession farming. The knowledge related to these activities is not only about meeting inhabitants' immediate needs but also about conserving resources for the future.

The use, management and conservation of natural resources form an important domain of IK. In the Okavango, as in all rural parts of Botswana, plants form a major part of people's livelihoods. Trees provide key resources such as firewood, fruits and structural building materials. Grasses and reeds are used for roofing and walls. Grazing and browsing of livestock is central to most people's lives. Fruits and herbaceous plants provide medicines and food. Understanding the social and ecological factors that influence the availability of these resources is a core component of IK in the Okavango Delta.

According to surveys undertaken for this study in 2003 in the rural villages of Shorobe and Sehitwa which lie on the distal ends of the Okavango, all adults have a thorough knowledge of the locations of a broad range of plants, and their importance to people's lives. They also understand the need to harvest these resources sustainably because without them, their lives would be more difficult. Even though the use of natural resources in rural villages such as Shorobe and Sehitwa forms such an integral part of their lives, it is a very conscious activity. People have a lot of information on species, distribution and plant responses to environmental conditions. They can rate the quality of land from a number of criteria such as grazing quality, occurrence of poisonous plants, distribution of water in dryland, predator risk, disease risk (like tsetse and water borne diseases) or ploughing land. Passing on this information to the younger generation is not a matter of cultural pride, it is considered a matter of survival. Respondents stated that not only did children learn about plants and the environment from being around their elders while the latter are working, but they were also systematically shown and taught these things. In addition, elders and traditional doctors are considered to have a much deeper understanding of both plant species and environmental processes. The other community members treat their knowledge with respect.

In both villages, discussions on local knowledge of plants and the environment tended to cover two main topics: responses to environmental and climatic change, and the uses and importance of certain plants. In both villages, people claimed that, despite different cultural origins, there were no ethnic differences in knowledge about environmental processes or plant resources. They explained that over the last 200 years they had learnt the particular skills from each other. Similarly, even though men and women might use or tend to be responsible for collecting different resources, they shared

such knowledge with each other. Unfortunately the scope of this study is too small to either give substance to these claims, or explain them as a cultural need to appear egalitarian. It is however a special trait of the Basarwa that they regularly use the collection of veldt products for food as an additive staple to their other food items.

HANDICRAFTS AND PRODUCTS

The main forms of handicrafts are wood-working and basket weaving. Wood-working is largely done by men, who make furniture and household items. More recently, such products have gained popularity as tourist curios, and the demand for them is likely to strengthen and solidify the IK base, as well as encourage innovation, in this regard.

Basket-making is one of the more well-known ways in which IK is applied to produce marketable crafts using local resources. As with wood-work, the baskets are functional household items that have, over the years, increased in value as curios in the tourism industry. Basket-making used to be solely the domain of women, but now it sometimes involves different sectors of the community, for the different stages of collecting palm leaves and dye plants for the manufacture of baskets, their preparation, weaving, and finally marketing, with baskets now being sold locally, regionally and internationally (Kgathi *et al.*, 2004).

The raw materials used for the production of baskets are leaf fibre and dye plants. The fibre is obtained from the leaf blades of the juvenile palm tree, *Hyphaene petersiana* (*mokola*, *mbare*). The dye for adding contrast to the patterns of the woven palm leaves is mainly obtained from the roots and bark of various tree species – the most important of which are *Euclea divinorum* (*motlhakola*, *mushetondo*) and *Berchemia discolor* (*motsentsila*, *mokerete*) (Cunningham, 1988). These are the most preferred species because their dye has a dark colour and is unlikely to fade (Cunningham & Milton, 1987).

Communities, which benefit from basket-making as a livelihood activity, try to promote the conservation of the natural resources from which the raw materials are obtained. In the pre-independence period, there were rules and sanctions for the management of basket-weaving resources in some of the areas in the Okavango Delta and Ngamiland. According to Bishop and Scoones (1995), in the islands of Wabe and Qoroga near Etsha, there were rules for regulating the harvesting of *Hyphaene petersiana* and for excluding others from harvesting these resources in the 1950s and 1960s. These rules and sanctions are no longer practised, and this has contributed to the depletion of dye resources (Bishop & Scoones, 1995). This is in part because of the increased commercial demand for baskets, and in part because local depletion close to villages means weavers are less able to obtain their own supplies, and this has led to the involvement of ‘middlemen’, who go out and harvest. However, in the islands of Oxge near Danega, the village headman had introduced rules for harvesting *Hyphaene petersiana* in the 1990s, and basket-makers were advised not to buy the fibre harvested by hoes or axes, as these devices are not selective, and therefore more destructive to the plant. These rules and sanctions were effective in managing the palm resources (Bishop & Scoones, 1995; Kgathi *et al.*, 2004).

Other important natural resources used include reeds and grass. Reeds are used by rural households for making a number of household goods such as walls of houses, palisades, screens, and floor mats. Grass is used to roof traditional houses, and this knowledge is now commercialised as it is used for roofing modern houses and tourist lodges (Bolaane, 2000). In Shorobe, Sehitwa, and Seronga, the various chiefs interviewed

revealed that some of the old rules of conserving resources such as grass and reeds are still practised (Kgathi *et al.*, 2004). For instance, reeds and grass are only supposed to be harvested after their seeds have developed (Schapera, 1970). This conservation rule is also applied by community organisations in these areas. For instance, the Okavango Kopano Mokoro Community Trust (OKMT) has rules for regulating and sanctioning the use of thatching grass in the area it has resource management rights over. According to the established rules, resources such as grass and reeds can only be harvested in June after the new seeds have ripened, and their dispersal has taken place (Kgathi *et al.*, in this volume, Chapter 7).

FISHING

Tlou (1985) and Campbell (1976) provide the best historical account of the Okavango Delta fishery. They highlight that the River San people, who were the first inhabitants of the area, poisoned lagoons/ *madiba* with the rubber hedge (*Euphorbia tirucalli*), speared fish, and also used funnel-shaped traps for fishing. According to Tlou (1972, 1985), the immigration of Zambesian peoples in the area starting from around the 1750's was a turning point in the fishery. The WaYei used nets made from the bowstring hemp (*Sansevieria spp*), and the dark-eyed hibiscus (*Hibiscus caesius*) soaked in a solution from the sweet thorn (*Acacia karroo*) to which were attached floats made from buoyant reeds. They also built long fences across rivers made of reeds (*Phragmites spp*) closely bound with string from the bowstring hemp. The fences contained a series of traps with tubular baskets closed at one end and a funnel of sharp sticks at the other, through which the fish forcing their way going up stream were thus caught. They also fished with iron-barbed spears. The WaYei also introduced some form of trawling which was hitherto unknown in the Delta (Tlou, 1976, 1985). Tlou (1985) concluded that these fishing methods (especially the net) resulted in a more efficient utilization of the swamp fisheries. More fish could be caught, and the surplus sun-dried or smoked and either eaten in days of poor catches or bartered for other commodities.

The earliest fishing activities in the Okavango Delta involved traditional fish traps (Kay, 1962). Maar (1965) observed very few fishing activities in the Okavango Delta between 1963 and 1964, which he attributed to lack of modern fishing gear. Fishers built weirs across channels to trap fish. Fish traps were also used at low flood levels. Gill net (from locally woven nylon twine) fishing was practiced, albeit at a very small scale. Spear fishing was common among the River Bushmen, while angling was practised by children using a baited hook tied to one end of a string (Maar, 1965).

The fishery has, however, largely retained its traditional flavour, despite the passage of time. According to Mosepele (2001), most traditional fishing gear is still in use in the fishery. In an extensive survey of the Okavango fisheries he identified five different kinds of fishers in the Okavango Delta fishery. Almost half of all fishers (45.9%) used hook and line at some point, and nearly as many used baskets (41.8%). Gill nets were used by 13.6% of fishers, spears by 9.4% and traps by 6.1%. Several other studies have also highlighted the widespread use of traditional fishing gear in the Okavango Delta (Merron, 1991; NORFICO, 1986, 1987; Norplan, 1985; van Hoof & al, 1991, 1993). However, the Fisheries Section of the Ministry of Agriculture introduced modern fishing technology, by subsidising gill nets and powered boats, in the early 1980s (Nengu, 1995). The relatively low percentage of gill net fishers (13.6%) in the Okavango Delta (Mosepele, 2001)

therefore suggests that the Okavango Delta fishery is still relatively traditional, or artisanal.²

Fishing has long been an important source of protein in subsistence diets and in local trade. However, common pool resource management systems have been displaced by attempts by the state to nationalise fishing rights. Tlou (1985) indicates that special laws regulated fishing activities among the WaYei and HaMbukushu people of Ngamiland once existed. According to Campbell (1976) and Tlou (1985), each village held exclusive fishing rights to designated areas, and poaching was punished by either heavy fines or confiscation of fishing equipment. Failure by government to acknowledge these traditional management regimes, and the eventual commercialisation of the fishery have displaced these exclusive rights regimes, and turned fish into an over-exploited open access resource, with a current high level of friction between fishing communities (Mosepele, 2001). The fishery has been managed for a long time without any regulations except for an outdated and ineffective Fisheries Act (Bills, 1996; Nengu, 1995) and a national fisheries policy (Mosepele, 2001; Nengu, 1995). While new fishing regulations have recently been implemented to manage the Delta's fishery (Government of Botswana, 2008) there is still no national fisheries policy which would define the form and structure of the Delta's fisheries management regime (Mosepele, 2008).

The new fishing regulations might ultimately imperil the indigenous knowledge that is used by commercial fishers to target their preferred fish species. According to Mosepele et al (2007), fishers have developed an innate knowledge of the biology of their target species and hence know when to set their gill nets and when to remove them from the water. Furthermore, fishers use different fishing methods during different seasons to target their target species. Mmopelwa et al (2009) highlighted that while fish catchability is seasonal, subsistence fishers use different fishing gears in different habitats to exploit different fish species to ensure household food security. Gill nets and hooks are used in deep water (>1.5 m) while other gear such as barrage traps and fishing baskets are used in relatively shallow water either at flood arrival or recession.

In summary, the activity of fishing and the traditional institutions which have until recently governed it represent a highly developed category of IK as well as an example of social capital in the form of regulatory mechanisms. Together with the strong seasonal variation in fish habitat through the annual flood pulse, these traditional institutions have served to stabilise the expectations of fishing communities and mitigate against any perceived threat of over-fishing.

LIVESTOCK MANAGEMENT

The OvaHerero and BaTawana people in the Okavango Delta are pastoralists with valuable traditional knowledge and experience in livestock management. Farmers build up specialised knowledge, interpret their long-term experiences with certain types of resource use, and record the environmental outcomes of their actions. Local farmers and their herders are not only able to perform certain veterinary tasks such as assisting in births or diagnosing illnesses, but have also adapted their management strategies to meet the particular threats and constraints of their local environment. Herdsmen know where specific poisonous plants, such as *mogau* (*Dichapetalum cymosum*) occur, and try to keep stock out of pastures where these plants occur. Chiefs and headmen are aware of the

² According to Hillborn and Walters (1991), artisanal fisheries are characterised by a predominance of simple gear with low fishing efficiency – and consequently probably ensure a sustainable rate of offtake.

impact of heavy grazing on species composition and overall quantity and quality of grasses. As with Botswana generally (Schapera, 1970), Ngamiland pastoralists used to employ a grazing bailiff who would inspect the area and decide which sectors of the lands surrounding a village would be used for grazing each year. With the centralisation of authority away from the local level, such practices are being lost, and resources have been unmanaged under open access. However, many farmers still individually try to move grazing areas interannually. They also practice a seasonal grazing rotation system. The OvaHerero, for example, to exploit pasture resources more effectively without depleting them, have maintained a certain degree of mobility (Vivelo, 1997). Over generations, livestock owners have observed that the fodder value of the *molapo* pastures is poor. They also associate floodplains with diseases like liver fluke or nagana (sleeping sickness in livestock), and predation for domestic stock. However, the floodplains green up at different times of the year to the surrounding savanna, and in the last month before the rains start, are often the only source of grazing. Herds are moved away from the heavily utilized floodplain pastures to dryland grazing areas, as soon as the savanna grasses begin to sprout and drinking water becomes available in semi-permanent pools.

PLANT RESOURCES AND USE OF FIRE

The people of the Okavango Delta have used fire as a traditional management tool for hundreds of years. Originally, the chiefs controlled the location and timing of fires. An area could not be burned in consecutive years nor before late winter, after the grasses used for thatching had dropped their seeds (Cassidy, 2003). By 1930, under the influence of white settlers who perceived burning as destructive, the setting of fire and allowing it to burn was declared an offence (Schapera, 1970). Since the Heritage Preservation Act came into force in 1978, burning is legally prohibited. Permission for the use of controlled fires for clearing of fields is obtained from the district fire ranger. However, for farmers from remote areas, this is a tedious inaccessible bureaucratic process. However, in Shorobe and Sehitwa, people cited only one way in which they deliberately manipulated the natural environment: burning the veldt (Kgathi *et al.*, 2004).

Local knowledge concerning the use of fire to burn the veldt is extensive. The reasons given in Shorobe and Sehitwa for burning are the same as those identified elsewhere in the Okavango Delta (Cassidy, 2003) – improving access and visibility through the removal of moribund vegetation, encouraging sprouting and palatable new shoots in grasses to provide livestock grazing and to attract animals for hunting, and to give new recruits of seasonal plant species space to emerge (among other reasons). There were also interesting observations about its impact. For example, in Shorobe respondents explained how the removal of fire from an area led to shrub encroachment, and that without burning, the build-up of moribund or senescent plant material would prevent the emergence of new grass. Fire was necessary to maintain adequate open grassy areas, both for livestock, and also for wildlife and the environment as a whole. Also in Shorobe, people noted that it did not matter if the year was wet or dry, as long as fires were set in late spring or early summer, it was good for the bush. Here people noted that regular burning led to an increase in favoured grass species. In Sehitwa, some felt that the land had changed, and that fire was no longer appropriate. One exception was on the bed of Lake Ngami, where regular burning is still encouraged to stimulate good grazing for livestock.

LAND-USE PLANNING

Using several ecological and socio-economic indicators, farmers know the areas best suited for particular types of land use. By applying their previous cropping experience, in conjunction with indicators such as the colour and texture of the soil, the shape of the terrain, and the vegetation type and status, Okavango Delta farmers can pinpoint areas with future cultivation potential. They have observed the variations of the flooding patterns in their *molapo* fields over a long period of time, and they can therefore identify lands areas with more stable soil moisture conditions. Most importantly, when the FAO soil and land suitability maps became available (Jamagne, 1990), these confirmed the correctness of this knowledge.

CULTURAL TOURISM

Traditional knowledge and customs are widely used in the tourism sector as a way of increasing incomes for rural households. A number of community trusts have maintained or revitalised cultural practices and traditional activities, which they display to tourists as a way of increasing their income base. These activities include poling in *mokoro* canoes, traditional dancing and music making, taking tourists on game walks and nature trails, and cooking traditional food. Cultural tourism contributes to the conservation of traditional knowledge and customs through utilising it for a new purpose. For example poling was once the only means of transport through the Delta for local populations, but now polers mainly guide tourists in the Delta. The inter-generational transmission of local knowledge is thus fuelled by necessity and use, and not by sentimentality and cultural history alone. Traditional dance, music, and cooking are common activities practised by community trusts such as Bukhakhwe Community Trust in Gudigwa and Teemashane Trust in Shakawe.

Tour operators often hire local boatmen and their canoes for tourist trips into the Delta. Since 1999, a community-based organisation, the Okavango Poler's Trust (OPT), has offered such services directly to clients. This involves taking out tourists on *mokoro* trips, camping in the wilderness on some of the islands, and undertaking short walks to watch game or birds. The traditional wooden *mekoro* have a limited lifespan (4-9 years), and leak as they age (Ecosurv, 1987). They are no longer used at the OPT due to the comfort and safety demands of international tourists. The traditional *mokoro* technology was, therefore, transformed and adapted to meet the specific, growing demands of the tourism industry. Today, most of the tour operators have invested in fibre-glass canoes which have the shape of the traditional *mokoro*, that have the advantage of being longer-lasting, more comfortable, and easy to maintain. The increasing demand from the tourist industry also put a heavier stress on two native species, *mukwa* (*Pterocarpus angolensis*), a sandveld tree, and the sausage tree (*Kigelia africana*), a riparian species. As a result, fibre-glass canoes were introduced as an effort to reduce the pressure on these trees. This adaptation of the traditional *mokoro* is a perfect example of IK being refined in response to new demands and technological developments (Bendsen & Meyer, 2003).

WATER DIVINING

In the Okavango Delta and other environments where people do not have access to modern technology for locating groundwater, there is more dependence on water divining or dowsing for this purpose. The method is quick and reliable, and competes favourably with modern scientific methods.

Water diviners in Botswana use wooden sticks or metal as media for detecting groundwater. By traversing over a site, diviners are able to locate groundwater by the reactions of the dowsing media. Those who use a stick as a medium suddenly feel a force pulling the stick downwards. Water diviners can even estimate the depth and quantity of the water when traversing an aquifer. According to Wolski (2003, *pers. comm.*), it is not difficult to locate groundwater in the Okavango Delta. However, the main challenge is to find freshwater as much of Botswana's groundwater is saline. The diviners are said to be knowledgeable enough to differentiate fresh groundwater points from saline ones. According to one hydro-geologist who preferred to be anonymous, the secret behind water divining is still not understood by modern science.

Water divining is a very rare skill, and in districts such as Ngamiland, there are only a few people with this knowledge. Such knowledge makes a substantial contribution to the livelihood of rural people, as it enables them to identify groundwater sources at a reasonable cost, as those who employ modern detection methods (hydro-geologists) are usually very expensive. Due to the profitability of water divining, even people who are not originally from Africa, are now entering this field as it generates a reasonable income. In Maun, the capital of Ngamiland, Danish water diviner, Mr Pedersen, is consulted throughout the district and the country for locating groundwater.

GOVERNANCE AND INDIGENOUS KNOWLEDGE

The laws and policies surrounding the use and management of plant resources in the Okavango basin form part of the context of residents' livelihoods. A dual legal structure is currently practised in Botswana. Firstly, there is common law, based on the Roman-Dutch or English legal system, and which comprises the written law of the country. Secondly, there is the customary legal system, which is based on oral legal traditions, consensus and the authority of ascribed chiefs and community elders (Stewart & Armstrong, 1990), and which exists outside of the country's written law.

The two systems have largely been complementary, addressing different spheres of life. With regard to natural resources, commercial use is seen as non-traditional, and therefore bound by common law. Customary law has been restricted to subsistence use of resources (Cassidy, 2000). Many of the natural resource management practices that are based on IK were bound by customary law (Schapera, 1970). More recently, the division between the two systems has become less clear. On the one hand, traditions are fluid and changing, and what is defined as customary is changing. On the other hand, some historically strong traditional regulations are beginning to disappear. This is largely because, as unwritten rules, they are only as strong as the authority of the chief or village headman, and the status of such positions have been greatly undermined with the formalisation and centralisation of government since independence.

The potential relationship between government policy and IK is central to rural livelihoods, particularly with regard to natural resources. Firstly, laws affect different social groups (such as women, youth and children, ethnic minorities, immigrants and

elders) in different ways, because there is typically a single 'blanket' set of rules, while each of these groups has different ways of relating to the resource base. Secondly, whether or not policies are built on local knowledge that has been developed through on site hands-on experience and observation over time, can affect their appropriateness and applicability. Thirdly, by building on local knowledge, policies and programmes are more likely to be supported by people living in the area.

Post-independence Botswana aspired to be a "modern" African nation that embraced western concepts of progress, democracy and governance. The socio-economic and political transformation of post-independence Botswana was, and still is, driven by highly centralised government policies and programmes. The effect of this new system has to lower the status and authority of the chiefs and headmen, with national interests taking precedence over local issues. The desire to be "modern," combined with the reliance on "western" professionals, has led to a legal framework formulated at national level using western values and expertise. IK, being implicit and unstructured, was not ascribed any significance, or seen as relevant to the development of policies and laws. As Atteh (1992) has noted, local knowledge is not a new concept, but one that has been lost because of the notion of European superiority, the centralisation of governance and disempowerment of local leaders.

For people who rely heavily on natural resources, knowledge is tightly linked to survival, and may take place as unconscious actions (Dei, 1995). The importance of incorporating IK into natural resources management stems from the fact that the local inhabitants of an area interact most with that environment, and so develop a direct understanding of it (Matowanyika & Sibanda, 1995). While customary law tends to operate at the local level, policies and acts of parliament are normally drawn up at the national level. They represent the interests of the nation as a whole. As documents, they focus on the broad context, and it is through implementation that the intentions behind the documents move down through the hierarchy of region to district to village level.

In addition to the formal, written policies used by government officials, at district level there are also more informal guidelines that come into play. While these informal guidelines serve as an example of local knowledge feeding up into decision-making, increasingly, there is also a move away from earlier policy styles based solely on western scientific values and national level interests. This is particularly evident with regard to valuing community involvement in both policy formulation and implementation related to plant resources management. To a large extent, the inclusion of "community participation" in recent policies is grounded on the acknowledgement that policies are more likely to succeed with local support. With regard to valuing and using local knowledge, none of the legal documents concerning plant resources explicitly express doing so, although implementation documents such as the recently completed Okavango Delta Management Plan and the 5-year district development plans recognise that such knowledge exists and should be used.

Constant change forms the backdrop for the interactions between IK and government policy. This is true of both the socio-economic system in Botswana, and the natural environment. Peoples' livelihoods are dynamic and adaptive. The rate of change of social and economic processes has been rapid, compared to changes in either the ecological processes or the management of resources. In both the environmental and social systems, there are different cycles at different levels. There are seasonal variations in resources, as well as in the availability of labour (due to the seasonal nature of the tourism industry). There are slightly longer-term changes, such as sequences of drought years or changes in the composition of the household due to demographic processes. There are also much

larger scale changes, which from the viewpoint of a livelihood strategy appear permanent. These are changes such as long term drought cycles or changes in the Okavango Delta's flood distribution patterns, global warming, transition towards a cash economy, and the centralisation of government. This means that it is hard to assess how much of a decline in both the management and the local knowledge of various plant resources is due to changes in the legal framework, and how much is due to changing socio-ecological relationships. Nevertheless, concerning the governance of plant resources the change that is most relevant is the centralisation of government.

CENTRALISATION OF GOVERNMENT

Even if laws were to be based on local knowledge, the control over natural resources was, post-independence, removed from local authorities and vested in central government. This was done in spite of the large distances and limited infrastructure that characterise rural Botswana and make policy implementation difficult. There is a clear trend in more recent policies to include local people in resource management, though mainly through the implementation of decisions that are still made by central government. Because resource users still have limited involvement in the formulation stage of policies, IK has yet to contribute in a meaningful way to the substance of policy documents.

Centralisation, though partly a matter of resource allocation, is also in Botswana partly a result of the desire to build a national identity and a common set of rules for the nation. Part of this desire is that all citizens of Botswana should have equal rights of access to and use over resources. All citizens are seen as being part of a "super-tribe" – the nation (Cassidy, 2000). Rapid social and environmental changes have led people at all levels to cling to the notion of equity (in spirit if not on the ground). The political values of the late 1970's and early 1980's – when most of the current legal documents were drawn up – supported the idea of "the nation as a whole". Most government officers still cite "the national interest" as an explanation for why IK may not be accommodated. To consider the local interests of every rural community would make it difficult for the central government to manage the country coherently and cohesively.

Although some aspects of IK may be common in different areas, the name implies some site-specificity. It is therefore not surprising that as decision-making has moved away from the local level to a more centralised national one, it is harder to draw on IK. There is clearly a large compromise required when trying to accommodate national interests and local needs. When dealing with a highly centralised government such as Botswana's, however, it seems that it is the local interest that loses the most ground. National policies, of necessity, are broad with sweeping generalisations. IK is detailed, and accommodates greater variations (local specifics). Thus, the issue of scale is key to determining whether there is room for on-the-ground interpretation of a given policy. The specific interaction between government policy and IK is addressed in terms of three key aspects of rural livelihoods: land-use zoning, natural resources management, and agricultural development.

Zoning Policies

Land use zoning is important in order to further national-level economic development and to a large extent zoning in Ngamiland represents a *'fait accompli'*. Land use zoning

can, for all practical purposes, be seen as permanent and fixed, typically based on ecological conditions at a single snapshot in time. As is the case in many countries in the world, Botswana's land use zones were largely defined during the 1970's and 1980's, mainly determined on the basis of economic activities that were most appropriate to environmental conditions, particularly different types of agriculture (Bendsen & Gelmroth, 1983; Rudell, 1989; Schmidt, 1981). In Botswana, the major distinction was made through the 1975 Tribal Grazing Land Policy, where marginal areas, unsuitable to either crop production or livestock rearing, were set aside for future designation, and ultimately became the wildlife management areas which were given substance by the Wildlife Conservation Policy of 1986. There is also the Forest Act (Cap 38:04), which sets aside land for forest management, while restricting other forms of land use. However, strict land use zoning as defined in these documents does not accommodate changes or long term socio-economic or environmental trends.

People feel that zoning, particularly where reinforced by fences, works against IK and against adaptation to changes. As one respondent in the village of Shorobe put it, "some laws are not done well. Some years ago, people lived being able to keep livestock, plough fields and hunt. Now they cannot do all these things in the same place." This is a reflection of how, under a centralised government, local needs are compromised for the broader national interest. People have lost their ability to move in response to medium-term climate change and disease outbreaks. They are less able to diversify their livelihoods and have lost a measure of flexibility and adaptability. People feel (rightly) that they were not consulted in the determination of regional or district level zones. Though members of Delta households consciously try to diversify their livelihood portfolios in an attempt to spread risk (Bendsen & Meyer, 2003) almost half of a survey of 117 households (44%) were found to be engaged in two livelihood activities or less. Though diversification is an important risk minimisation strategy, it is not always possible (Wilk & Kgathi, 2007).

At the village level, within the framework of customary law, there are still some unwritten regulations that control land use, which the community can change as they see fit. In both Shorobe and Sehitwa, the headmen and Village Development Committees (VDCs) felt that people did adhere to decisions made in the *kgotla* with regard to where and when certain activities, such as the harvesting of building poles and thatching grass, could take place.

Natural Resources Governance

While many examples of IK about natural resources exist, the rights to use and the authority to implement decisions based on local knowledge have been reduced. This is more obvious with regard to wildlife than plant resources.

People were extensively consulted for the preparation of Botswana's National Conservation Strategy (Cassidy, 2001). This meant that IK with regard to the state of natural resources was well documented. However, feeding this information back into policy guidelines and regulations has been limited, and many of the laws still draw on more western science-based assessments of environmental issues.

Within the Agricultural Resources Conservation Act (Cap36:06), there is some complementarity between indigenous and modern knowledge. Because IK and customary law prevent the felling of certain valuable tree species, government has not found it necessary to place its own restrictions on their use. Other resources, such as thatching

grass and reeds, are left to local communities to manage. For many communities this capacity is supported by CBNRM policy of 2008 (see below). This is particularly important because the rate of extraction of these resources has increased dramatically under commercial demand and trade.

An important change to incorporating traditional resource management into national policy is the current preparation of a Wildland Fire Management Policy and Strategy (still in draft form in 2008). This policy proposes a major change to the existing legal structure that calls for the suppression of all veldt fires. Of all the policies and laws, fire suppression, as presented under the Herbage (Prevention of Fires) Act, is most at odds with IK. This is clear from the fact that, at village level, it is under this Act that most criminal charges with regard to plant resources use are brought up. People were not consulted about this law, and feel that their history of experience with fire shows that in fact, fire is important to maintaining environmental processes. Although some villages (such as Shorobe) claim that burning occurs less frequently than before it was made illegal, fires are still set on the veldt every year.

Through the introduction of CBNRM initiatives in the 1990's, IK has regained value as a tool for rural development and resource conservation (Rozemeijer & van der Jagt, 2000). The concept is based on the assumption that communities will have an incentive to sustainably manage the natural resources in their area if they derive tangible benefits from their utilisation. CBNRM offers an opportunity to combine "modern" economic development and IK systems. For instance, the ADMADE programme of the Zambian Department of National Parks and Wildlife Services is seen as restoration of the use rights for wildlife resources in game management areas to the local communities, through their traditional leaders (Mwenya, Lewis, & Kaweche, 1990). The above idea is consistent with the view held by George Dei (1995 p. 149), that many societies are experiencing "a renewal and revitalisation of indigenous knowledge systems and traditions for social development and co-existence with nature". After about a decade of revisions, the CBNRM policy has been finalised. With the implicit mandate for community-level resource management comes an important opportunity for the revitalisation of local IK systems (Government of Botswana, 2007).

Agricultural Development

Because of the greater local presence of government employees through strong extension services, the opportunity for adapting policy to meet local conditions has been greatest in the agricultural sector. Farmers have had more of an opportunity to feed back what they know about crop production, as well as adapt new ideas to suit their changing conditions. Nevertheless, there is still a large gap between policy content and management issues at the community level (see for example the "new" National Policy on Agricultural Development- No. 1 of 1991). Those areas where agricultural development has clearly not interfaced well with IK relate to issues of zoning. This is particularly true with regard to grazing resources. Where zones permit, people do still use IK to move their livestock from place to place as conditions demand. However, this knowledge is no longer applied collectively through local authorities. It is done on an individual basis, and can be seen as an example where common law has removed customary law, without providing a viable alternative.

Implementing Agencies

It is at the district level that policy implementation meets practitioners of IK. That is, district offices of the various government departments are the institutional interface with local communities. The last five years have seen a major restructuring of government departments and ministries responsible for natural and agricultural resources, along with a shift in how interactions between national policy representatives and local stakeholders occur. Interviews with district officials suggest that qualitatively, such interactions have improved over time, with a growing appreciation and respect by district officials for the hands-on experience and knowledge held by local communities.

Most district officers acknowledge that local knowledge filled gaps in current “scientific” understanding. In addition, there is a strong appreciation of the need to work *with* people’s traditional relationship to the resource base, instead of against it. However, in all departments, there is still a strong feeling that western scientific knowledge is more valid than local or traditional knowledge. This sentiment is obvious to community residents. People in both Shorobe and Sehitwa feel that generally, government no longer values their knowledge or opinions (Kgathi *et al.*, 2004). They cite occasions in the past where traditional doctors and chiefs were actively consulted, and compare this to more recent times, such as when Shorobe residents said they needed to keep access to grazing around Ditshipi, but were still made to remove their cattle.

Currently, most interactions are still top-down, coming in the form of district officers addressing *kgotla* meetings to pass information down from the national and district levels to the community level. However, in preparation for each 5-year development plan, people are given a chance to influence planning when the district officers conduct their needs assessment. The councillors are an important part of the interface between local communities and district officials, but it is not a relationship that consciously channels IK to government.

Perhaps because there is a much greater, full-time presence within the communities, the exchange of knowledge between the Ministry of Agriculture and farmers is greater than in other ministries. These government employees have the opportunity to see people at work in their environment, and learn from them. An example given by the Plant Protection Unit is how government was able to adapt and improve an innovative idea developed by some farmers. These farmers had begun using rainwater tanks to store grain. This idea was taken to the Rural Industry Innovation Centre, which added chutes, pipes and locks.

Village-Level Institutions

Within the villages, the headman and VDC are the most important overseer institutions for the management of plant resources. In villages where trusts have been formed to allow the community to take part in CBNRM projects, such bodies have the right to manage commercial use of resources only (Cassidy, 2000). If they take over the management of subsistence use of plant resources, this is done with sanction of the headman and VDC. In Shorobe, there is a community basket-making project that uses *mokola* (*Hyphaene petersiana*) leaves (Kgathi *et al.*, 2004). Both the VDC and the project have an active interest in seeing that the palm leaves are harvested in a sustainable manner.

All villages are meant to have an Agricultural Resources Conservation Committee, to take on responsibility for implementing the Agricultural Resources Conservation Act at village level. However, as is the case in the villages of Sehitwa and Shorobe, many settlements in the Okavango region are challenged by a lack of financial and human resources. Instead, the VDC takes on many of the tasks that would otherwise fall to these committees.

Although the VDC is not a traditional institution, it takes on many development and service provision responsibilities, some single-handedly and others in partnership with chiefs or their representatives, sectoral village level institutions, local branch NGOs or women's groups. This means it has a strong potential to either support or undermine IK. For example, in Sehitwa, it is the VDC, in collaboration with the chief and other community leaders that announces when to start harvesting thatching grass and reeds. Although broader scale zoning issues are decided by district authorities, within the permitted zones it is the chief, working with the VDC, who decides intra-zonal activities such as where people can live, plough fields, or graze cattle. These decisions are still made based on a range of factors such as soils, access to water, grazing availability, the presence of certain plant species and the prevalence of user conflicts. Chapter 14 (in this volume) on village level local institutions will further discuss the role of VDCs in modifying access to natural resources and services

CONCLUSION

There are numerous activities and practices used by the people of the Okavango Delta that can be included under the label of IK. These practices have in many instances been carried on for a long time and have been renewed and refined in response to changing local needs and conditions. Many of these practices, such as planting and harvesting strategies, the use of fire to regenerate growth and land use planning, are tightly linked to the livelihood base of a large number of inhabitants. Other activities, such as tracking animals and poling *mekoro*, are not used for their original purpose but are now used in the tourism industry. As it stands today, IK in Botswana is not fully recognised as a knowledge system in the way scientific knowledge is. Its inclusion in policy documents has primarily been for the purposes of increasing local participation and of easing the transition to externally introduced innovations and economic activities.

IK is actively used on a daily basis by every resident living in rural Ngamiland. At the simplest level, this may include choosing the tree species best for firewood. More complicated practices include evaluating the first rains to see whether or when fields should be ploughed. IK is incorporated into the decisions that village institutions make on behalf of their community. A key component of local knowledge is that, in order to ensure that resources continue to be available for use, they must be used sustainably. Nevertheless, there are instances where community members may go against their own awareness of the environment and the impact of their activities on plant resources. Both government officers and community members acknowledge that the need to survive in the short-term could mean that people do things that they know are detrimental to the resource base in the long term.

Botswana appears to be entering a phase of extensive revision of its national policies. Often, revisions include the recognition of traditional environmental management practices the value of localised IK. While government policies increasingly pay lip service to IK and promote its use, it must be noted that there are still examples where

these same policies structurally undermine the options for using IK. This happens in three ways: a) zoning and fencing, resulting in the sites where IK is relevant being put “out of bounds; b) institutional change, where local direction and control of IK through customary law and traditional chiefs is now being replaced by decisions made by a common law VDC drawn from western-educated community members; and c) the “modernisation” frame of mind whereby society gives western scientific knowledge higher status and recognition than it does IK.

The Government is committed to the integration of IK in development policy. It is in all government documents and donors insist on its inclusion so that at least on paper it is highly recognised and acknowledged. However, there are challenges facing implementation. For example, predetermined notions of its relevance and status, especially in relation to western scientific knowledge, continue to undermine it (Wilk, in press). In practice, therefore, its actual influence on management is limited. IK is not always included in plans because it is not practical, and funding and bureaucratic schedules don't have space for it. Participation is difficult to do in practice even with the best of intentions, because of deadlines. The bottom line is still that, despite its entry into some policy documents, decision-makers don't take IK to heart.

The emphasis of many policies on the need to educate and raise awareness about environmental issues, suggests that government thinks people are ignorant of how to manage plants and other natural resources in a sustainable manner. While it is true that IK may have evolved under conditions of considerably lower levels of natural resources use, its strength is that it has been developed locally to meet the physical and cultural needs of the local environment. Many times local inhabitants are very well informed, but simply lack alternatives. There is often a difference between what people understand in terms of environmental conservation, and what they do. Sometimes their immediate needs dictate their actions.

The general outcome of the introduction of centralised governance in a district with scattered settlement patterns is a large disparity between the policies as formulated and as implemented. The effort to centralise the settlement pattern has however only had a limited impact in Ngamiland. According to the 2001 Census, 35% of the district population still lives in settlements of less than 500 inhabitants (Central Statistics Office, 2002). This indicates that people prefer to live close to areas with good potential for their livelihood activities even though they have to bear the consequences.

Zoning and the ‘fixing’ of settlements through the provision of services (schools, clinics, etc.) in permanent locations have probably had the greatest impact on how people have been able to respond to changing conditions. However, in terms of social and economic development, it is clear that this response is no longer appropriate, and this aspect of IK needs to adapt or evolve. In terms of active management of natural resources, changes to IK have been made. The local authority to make decisions on resources has been removed, but central government lacks the manpower and facilities to implement its own decisions. The result is something of a vacuum.

Both the effort to control the settlement patterns, and the limited alternatives to natural resources use may suggest that additional lessons from outside could be beneficial. New techniques should not be introduced without first evaluating their suitability and performance in relation to indigenous practices. They must be adapted to local physical and cultural characteristics and never be forced blindly upon the communities. However, this doesn't mean that IK is redundant. While specific techniques may no longer be valid, general attitudes and practices, such as diversification and small-scale land use rotation, are still key to conservation and development today.

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