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**Integrating Social Vulnerability into Water Management in the
Lesotho Highlands: The Case Of Ha Tsiu**

Sukaina Bharwani¹
Moliehi Shale²
Anna Taylor¹
Neela Matin³
Thomas Downing¹

Abstract

Downing *et al.* (2006) highlight a progression in the past decade toward a vulnerability/adaptation science that recognises six key attributes of social vulnerability and four processes for understanding vulnerability. We assess the applicability of these attributes and processes to a Highlands community in Lesotho, vulnerable to a complex combination of stresses, and investigate whether such an analysis furthers understanding of local issues and identification of potential adaptation options.

In attempting to integrate vulnerability in to water catchment planning, we describe: the different kinds of vulnerability that are experienced in this area; the dynamic and multiple-scale nature of this vulnerability; the attributes of vulnerable groups, which may enable them to respond to stresses and threats; and the adaptation choices that are made by different groups (Downing 2006). Such an approach may help to identify the institutional structures that are required to support adaptation factoring in the uncertainty of future predictions of climate change and its implications on the water system.

The vulnerability analysis indicates that those adaptation options which are already being practised by the community are good targets for more for-

¹ Stockholm Environment Institute (SEI), Oxford, UK.

² SEI, Cape Town, South Africa.

³ SEI, York, UK.

malised institutional support. This may reduce the impact of new and emerging vulnerabilities, which are currently difficult to predict. Local adaptation strategies have gradually evolved over time and are integral to the specialised Highlands environment. Although future risks may be quite different to those adapted to in the past, local adaptation strategies (or modifications of them) will be best designed to cope with this.

There are many new and ‘external’ factors which affect the Highlands communities surrounding the Mohale Dam and the compounded causes and impacts of this are difficult to unravel. There are stresses that have little direct association with the development of the dam, but which are made worse by it. However, there are also positive aspects provided by the development which have improved some aspects of life. Many of these stresses will be examined, alongside mechanisms which are in place, or planned to cope with them. Whether these measures will enable communities to adapt in a way that will make them more resilient to future shocks and stresses, supporting a pathway to stability and sustainability, or whether they may result in mal-adaptation and increased vulnerability will be explored.

1. Introduction

We seek to situate the vulnerability of local communities in Lesotho in the wider framing of vulnerability and adaptive management. The Highland communities utilising wetlands ecosystems and environmental services illustrate various aspects of vulnerability, as it changes over time in varying relationships with ecologies, institutions and economies. For the framing of vulnerability, we draw upon earlier work compiled in Downing et al. (2006). Relevant conclusions from the literature surveyed in that state-of-the-art assessment introduce the finer grain of community analysis in Lesotho.

‘The starting point for an analysis of social vulnerability is that vulnerability is the differential exposure to stresses experienced or anticipated by different people. That is, vulnerability is not only and may not be primarily a property of a system or a water catchment per se, but rather reflects a combination of the characteristics of the hydrological system, the livelihood assets and social relations of people and the effects of a range of external factors on these two: water and people... These interactions mean

that different people are exposed in different ways to stresses and threats. Or more simply, Who is vulnerable? To what?’ (Downing 2006).

Understanding the vulnerability of local communities in the Maluti⁴ region of Lesotho and their relationship to the environment is of concern for water management institutions. Future water quality and stream flow is dependent on the status of wetland areas but their increasing degradation and the possible link with the use of rangelands for cattle herding, as is traditional to Basotho culture, must be explored. As early as 1999, Chakela wrote that ‘the reduction of the hydrological regime of wetlands in terms of wetland saturation, water table depth and drainage type has been enhanced by the amount of grazing, trampling, human disturbances, burning of veld and soil excavation processes’ (Chakela 1999: 135). However, the construction of dams has also impacted greatly on the local environment, displacing a large number of people and increasing pressure on limited land and resources. For instance, ‘paths and roads within and above the wetlands cause the channelling of water away from the wetlands, resulting in ‘dry islands’ that become barriers to the surface and sub-surface flow of water...[thus] it is of great importance that an integrated management scheme be implemented to preserve wetlands in order to sustain river flows in Lesotho’ (*ibid.*).

Suggestions for introducing an incentivised scheme that encourages local conservation and management of the wetlands have been proposed. This is partly due to the remit and responsibility of the Lesotho Highlands Development Authority (LHDA) to conserve sites of ecological importance within the dam project areas. This coincides with a government initiative to protect wetlands sites nationally, one large wetland in the south of the country having been declared a RAMSAR World Heritage site. However, local communities are vulnerable to a range of stresses, which are changing at different temporal, economic, social and institutional scales, which must be considered when contemplating such an intervention. Thus, the aim of this analysis is not only to explore how dependent local livelihoods are on ecological services provided by the wetlands, but also to assess how vulnerable they are to the complex combination of stresses that they adapt to on a daily basis. The success and sustainability of such intervention measures will be contingent on a full understanding of the root causes of vulnerability and the potential impact that different development pathways may have.

⁴ Maluti commonly refers to the high altitude mountain range of Lesotho.

Our point of departure is the list of key attributes of vulnerability that should be considered when integrating vulnerability into water management and catchment planning models, as compiled in Downing et al. (2006).

1. Differential social and economic vulnerability.
 - a.) *the differential exposure to stresses experienced or anticipated by different exposure units;*
 - b.) *vulnerability is composed of multiple stresses which are inherent in the integrated vulnerability of peoples, places and systems.*
2. The dynamic element of vulnerable groups and their relationship to water resources and catchment or regional planning.
 - a.) *dynamic processes, which are constructed and change simultaneously on a variety of inter-linked time scales;*
3. The multiple attributes of vulnerable groups and the link to their ability to respond to stresses and threats. Vulnerability and adaptive capacity are:
 - a.) *rooted in the actions and multiple attributes of human actors;*
 - b.) *driven and bound by social networks in social, economic, political and environmental interactions;*
4. The decisions of actors (the managers and vulnerable groups) in the construction of adaptive systems (i.e. in the reduction of future vulnerability) (*ibid.*).

2. Differential vulnerability, exposure and multiple stresses

Research was conducted in Ha Tsiu, a village in the Thaba Tseka District of Lesotho. It consists of an estimated 200 households, overseen by one chief with the support of several headmen. The chief plays an active role in the sustainable management of natural resources (including the administration of land and grazing rights) and in the promotion of social welfare. Located adjacent to the Mohale Dam (part of the Lesotho Highlands Water Project), the Ha Tsiu community have experienced the impacts of its development in many aspects of their lives.

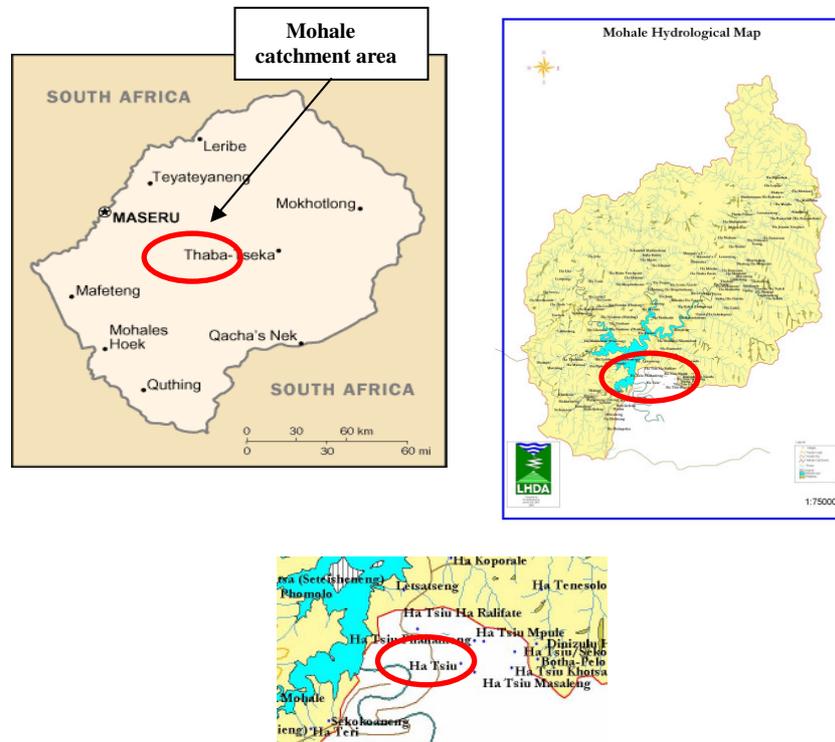


Figure 1 Location of Ha Tsiu within the Mohale catchment.

Local livelihoods

Like most Highland communities in Lesotho, the dominant livelihood activities are cattle rearing, crop farming and vegetable cultivation. A major difficulty faced by residents of the Highlands is the deteriorating condition of grazing land for cattle (as a result of over-stocking) and shortages in land for farming and grazing. This is further compounded by the construction of the dam as relocated households compete for farmland. Those unable to access land for farming tend to enter in to sharecropping agreements⁵, though they are given compensation payments by the LHDA. There is a perception that land shortages coupled with the high unemployment rates are a contributing factor to increasing levels of stock theft (Dzimba 2005).

⁵ Helping other field owners with ploughing and harvesting, in exchange for money or food. This is a traditional activity know as *Seahlolo*.

Other livelihood activities pursued in Ha Tsiu include: making and selling handicrafts, brewing beer, transport operations, teaching at the primary school, and providing labour in local fields. Some community members own or manage small all-purpose shops or migrate to urban centres in search of formal employment. In response to socio-economic changes in recent years, new livelihood activities are being taken up. For example, there are several entrepreneurs in gardening schemes marketing their own produce, and women and men are keen to be trained in making handicrafts with traditional materials. Despite these attempts at livelihood diversification, the community's main concern remains the lack of jobs and markets for produce.

Wetlands and ecosystem services

There are many small wetlands dotted all over the highland areas in Lesotho. The case study village has several wetlands within and around it. Conversations with certain community members highlighted the importance of wetlands in providing valuable goods and services. The village chief in particular recognized that the character and nature of the wetlands is such that certain plants and animals are found there and that these would be lost if the wetlands were severely degraded. The chief's awareness of the need for conservation has resulted in the implementation of a rotational scheme to allow regeneration of local wetlands areas. Furthermore, the educational value of the wetlands is recognized as a tool for learning about how water is supplied and how wetlands feed streams and wells. This was viewed as particularly important for children and herd boys.

Other locally recognized wetlands functions include flood control and sediment trapping by capturing and storing water and eroded soil. The chief outlined the following further benefits of the wetlands:

- supplying water to streams, regulating flow into the Senqunyane River;
- providing an area that is always moist and cool which is good for unique plants and encourages the occupation of certain types of insects which are not harmful;
- nutrient-rich areas which yield nutritious plants, raising the value of agricultural plots near the wetlands⁶;
- providing groundwater purification which produces good quality water.

⁶ Cultivation or house building should never be undertaken in the wetland itself.

Climate related shocks and stresses

The climate of the Lesotho Highlands is described as continental and temperate (Chakela 1999), characterized by very low temperatures associated with snow in the winter, and moderate summer rainfall and temperatures often not exceeding 20 degrees Celsius. Overall, 'the climate of Lesotho is suitable for the production of a wide range of summer and winter crops...through favourable temperatures, precipitation, light intensity and low humidity' (Chakela 1999:120).

Interviews with farmers and elderly people who have lived in the area all their life revealed there has been a noticeable change in the climate over recent decades. There has been more snow in the winter and the summer temperatures have been particularly high. December and January months have become critical for drought as dry seasons are becoming more intense, causing water stress. The onset of both rainy and cold seasons has at times been notably delayed and rain events have been more intense.

The agricultural sector is very sensitive to this variability and change, the timing of the rains being the single most important determinant of planting times (Wilken 1982). While little is documented on rainfall variability in the country, Wilken (*ibid.*) indicates that 'precipitation intensities suggest the likelihood of exceeding soil infiltration rates and storage capacities', resulting in flooding and erosion (Wilken, 1982:10). This can also lead to increased pests and diseases which can affect crops, humans and livestock (see (Ziervogel 2003) for further discussion of the impact of climatic variation on economic, human, natural and social household assets and strategies (including social networks).

Local residents reported that February and March are critical months for rain in terms of crop development (see seasonal calendar in Figure 2 where this is marked with red dots by community members). However, if it rains excessively in these months, crops often fail as they tend to be flooded and cannot be harvested. During these events, wetlands play an important role in trapping sediment. Wilken (1982) also points to hail as a threat, often stripping fruit from trees and flattening grain fields. There is good local knowledge of the area's annual climatic variability and the importance of the onset of winter and summer rainfall. Winter weather can be very extreme and there are occasionally human and animal fatalities due to exposure to the extreme temperatures.

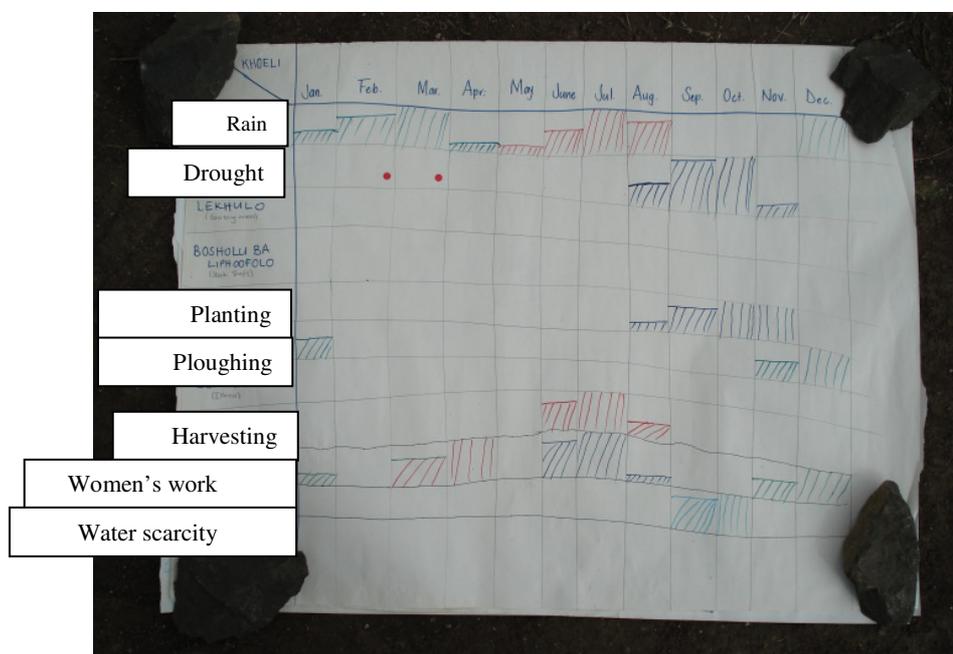


Figure 2 Seasonal calendar exercise.

Agricultural vulnerability can be translated to the vulnerability of the entire community because villagers often buy produce such as maize and green vegetables locally. The recent declaration of famine by the Lesotho government⁷ highlights the overarching sensitivity of agriculture within the country. While alternative income sources derived from formal employment could absorb the effects of extreme climate events, the pool of people engaging in these livelihoods is relatively small due to the lack of demand for unskilled labour and poor accessibility to urban centres.

Declining fuel wood resources

Similar to losses in land, many of the wooded sites that villagers depended on for fuel sources have been inundated by the dam and there is a greater pressure on existing resources. While there are still some places where wood can be found, many are either too far away from the village or they lie in places which are inaccessible because of the mountainous terrain. The demand for electricity for domestic use has increased, as fuel wood has become increasingly scarce and paraffin and diesel are expensive. The

⁷ Mail and Guardian Online. 12 July 2007.

residents of Ha Tsiu see the lack of electricity as a barrier to development and livelihood diversification.

Health services

Though the development of the dam has provided a main road and access to the local clinic, vulnerable people (such as the elderly, the sick, children and pregnant women) who are less mobile often cannot get there as the road leading out of the village is still in disrepair. HIV/ Aids prevalence in Lesotho is substantially higher among women than men under the age of 30, while at age 40-49, the pattern reverses and prevalence among men exceeds the level among women (LDHS, 2004).

Summary of differential exposure, vulnerability and stresses

The first part of this analysis has allowed examination of the groups at risk within the community (cattle-owners, farmers, gardeners, pregnant women, relocated households, the elderly, the sick and children) and the multiple stresses they face. The natural resource base is being eroded in terms of the availability of sources of fuel wood while a significant stress that has multiple impacts is overstocking which affects the quality of the land available for cattle to graze. Increased population pressure due to the relocation of communities further reduces the carrying capacity of the land which impacts farming, grazing and other land-based livelihoods.

3. Dynamic vulnerability

Following the first stage of the analysis of multiple stresses and vulnerable groups, it is important to look at how this vulnerability has changed over time (gradually and through sudden impacts) and at different scales, and how this creates and/or exacerbates vulnerability.

‘Two processes relate to vulnerability: (a) ‘trends’ of gradual change (though not necessarily linear) vary within predictable limits, generally at a macro scale and (b) ‘shocks’ that are sudden and dramatic impact and can fundamentally alter more than one condition of life. The superimposition of trends and shocks may dramatically alter socio-economic conditions at the macro scale (e.g., the Asian tsunami or New Orleans hurricane) or the often hidden catastrophes at a micro level (such as the sudden death of a key breadwinner in a family or the erosion of one’s land and

home in a flood). This is the dynamic nature of vulnerability' (Downing et al., 2006: 6).

Wetlands uses and value

In the village under study, there are four wetlands local to the village. Several plant resources (Appendix 1) used for making medicines are found in the wetlands as well as *Leloli* grass⁸. Villagers (with permission from the chief or a representative of the natural resources committee) regularly collect plants from these areas, such as *Crodile* which is used for treating the common cold. There is a strong feeling that wetlands should not be over exploited since many indigenous treatments and activities would be affected if certain grasses or medicinal plants were lost and some community members would have no means of a livelihood. Some wetlands near the village have been damaged by fallen rocks during the construction of Mochale Dam while others are drying up. Villagers, especially the traditional healer, now have to walk further from the village to collect these plants.

Farming

The implementation of the Lesotho Highlands Water Project has not only impacted the natural system of this area, but has brought with it a number of development initiatives. While there have been attempts to increase the resilience of these communities, the increased pressure on available land can make this difficult. The only available land is on the steeper, rocky slopes that are less fertile and difficult to plough. This limits the potential for expansion of farming activities in the area.

Cattle-herding

There are grazing areas assigned to each village which are divided into A, B and C zones. At different times of year, animals are grazed in the different zones [based on the Range Management Association and the Land Act 1979], a formalisation of the traditional rotational land management practice, known as *Maboella*. Zone A and B are under the authority of the paramount chief who gives instructions on when cattle herders should move from one to the next. In the winter cattle come to the grazing zone close to the village (Zone C) which is regulated by the village chief. The cattle go back to Zone A after the ploughing and planting season in August. Some cattle herders indicated that given a choice they would close

⁸ Used to make mats and bowls.

off grazing in zone A earlier since they have noticed those grazing areas are tending to dry up quickly. However, as the governance of the zones is split between the village chief and the paramount chief, it appears that there is at times inconsistency in the management strategies used, and that the concerns of the cattle herders do not always filter through.

The chairperson of the local range management council expressed concern about the deterioration of grasses in various cattle post areas, the need for their rehabilitation and a clear recognition that grazing should not cause erosion. He displayed good knowledge of the more nutritious grass types for cattle grazing and suggested that if coordination between cattle owners and village chiefs with the Principal Chief responsible for cattle post areas could be improved it would be easier to replant grasses in the cattle post areas and perhaps set aside zones A and B for longer periods to allow the grasses to regenerate. He indicated that the problem in zone A is that there is overgrazing and in zone B fires have destroyed the grasses.⁹

With increased stock theft and the deterioration of grazing areas, many people are trying to de-stock, selling their cattle despite unfavourable sale prices. Cattle owners are concerned about the welfare of their cattle and would rather sell their stock if there is not enough fodder to feed them. Having reduced stock numbers, cattle owners would depend more on farming activities, though it is difficult to maintain a sustainable income from this activity alone, partially due to a lack of land, markets and training in appropriate farming practices. These are identified as high priority areas in which local communities require assistance.

Long term trends in resource availability

When speaking to community elders, it became clear that a huge change had been noted in the use and availability of natural resources over the past few decades. For example, the use of *Moseea* and *Leloli* grasses for making rope for thatching roofs has decreased and corrugated iron has become a common roofing material. *Leloli* is now used only to make mats, baskets and bowls. Another marked change has been in the availability of wood, which in the past was found on the hill slopes in the local area. This is now very depleted and people have to walk longer distances to collect it from

⁹ Not all of the wealthier cattle owners abide by the boundaries for set-aside as land is so limited and they can afford to incur penalties. This causes tension with smaller herders and it is suspected that fires have been started in protest.

trees near the river. Due to the steep terrain only those with horses can carry the wood up from certain areas.

Migration

Livelihood types have also changed in recent years, with more women involved in the labour force, particularly the clothing industries in big towns like Maseru and Maputsoe. In the past, men were more involved in formal employment in the South African mines. However, the gold price collapse in the 1990's resulted in retrenchments causing many Basotho men to return to the country. This coincided with the construction of the Katse Dam as well as the emerging textile industries in Lesotho. However, both demands for labour have diminished as favourable international trade agreements ended, foreign investors left and the dam construction was completed. Locals were left struggling to find alternative sources of income.

Returning migrants often pursued farming and other land based activities (increasing pressure on the limited land available), with a few seeking employment in towns. The insecurity of these emerging forms of industry which temporarily provide new employment is evident. Since very little money can be generated in remittances once the cost of living away from home is taken into account, many villagers would prefer to find employment closer to their homes, but there are not enough jobs available locally.

Summary of areas of dynamic vulnerability

There appears to be a lack of coordination between the different levels of chieftainship in terms of managing the grazing systems in the Highlands. With divided responsibility but cumulative impacts on the surrounding environment it seems there have been limited attempts to achieve optimal grazing and set-aside periods across the A and B zones. The resultant pressure on the natural resource base and on land use has led to escalating problems of degradation. Even if longer set-aside periods were to be implemented, the lack of land means that destocking to more sustainable levels would also need to be undertaken at the same time.

4. Ability to respond to shocks and stresses (adaptive capacity)

The emergence of adaptive capacity from the preceding analysis of vulnerability and multiple stresses may be an indicator of the resilience of the

system. Additionally, this may allow the identification of successful adaptation options. However, '*the notion of system-level adaptive capacity as an emergent attribute of lower order vulnerability remains to be tested and refined*' (Downing et al., 2006: 22). While this may not be sufficient to fully address new forms of future vulnerability (e.g. created by climate change), which are difficult to predict, we argue that areas where adaptation responses are already invoked informally by the community are those which should be supported more formally by government and local agencies, as they are most likely to produce positive results. This is firstly because there are usually existing social, environmental or cultural mechanisms in place that maintain the adaptive strategy, and secondly because institutional support of existing efforts is likely to be well received. They are also likely to be in areas of life that are a high priority to those concerned if the adaptation mechanisms have already been created and implemented by the community. However, much of the capacity of local communities to respond to shocks and stresses will also benefit greatly from institutional and policy-based support. Nevertheless there remain barriers to some of these efforts also. Some examples are discussed below.

Fuel wood

In response to the lack of fuel wood available close to the village, the local community now collects *Motantsi* (as well as *Lengana*) for heating and cooking and as a medicine (for stomach conditions). Many households rely on burning dried cow droppings (*Lisu*) as a source of heat, but with most of the livestock in the distant cattle posts for a great part of the year, the availability of *Lisu* is also limited. When collecting grasses for fuel, thatching or crafts, members of the community consciously collect a little at a time so that there is enough for everyone, as well as to allow their regeneration.

The institutional response to this problem is that the Local Natural Resources Council occasionally 'closes off' the nearby wooded area for a few months a year to allow for the regeneration of trees. In addition, the community has recently received 850 tree seedlings for a communal fuel lot.

Water

In times of water scarcity, community members go to a wetland in the village that has a pipe sunk in it from which they can get water throughout the day. Each of the four wetlands near the village can potentially serve as a water point. If there is no pipe, a hole is dug, into which water from the

wetland can collect. However, animals often drink directly from it, muddying the water and contaminating it.

The Lesotho Highlands Development Authority, tasked with providing water to communities in the project area, installed water tanks and trained a village water committee responsible for maintaining the storage tanks, pipes and taps. There were reports that sometimes tap water is only available between 4am and 6am, after which it runs low and the water pressure drops. They wait for hours for the water tank to fill up (usually over night) but the available water is often still not enough for everyone.

Many of the relocated households have 25 litre rain water tanks on their plots as a part of their relocation settlement. While these tanks are a useful source of water during the dry months, they can only be used for watering gardens and washing clothes and are not suitable for domestic use.

Wetlands uses and adaptive monitoring

In Ha Tsiu, the wetlands close to the village (Zone C) were set-aside for 10 months this year and last (2007/2006) for conservation purposes. Grazing in this area was regulated using heavy penalties against cattle owners to protect the *Lesuaone* grass to ensure that it is still available for cattle fodder when it snows. *Moseea* is also found in these areas, as is *Senchebane*, which is often used as an indicator of the health of the wetland.

There is a high level of indigenous knowledge regarding local plants as indicators of the health of the local environment and the wetlands. For example, reports of an increase in the number 'Toala' bushes that had started to take over certain areas mainly for grasses in Zone A was seen as an indication that grasses are struggling to survive, possibly due to overstocking. There were also reports that cattle that had started eating *Moseea* grass (normally used to make hats) which is another indicator of degradation of grazing land and the lack of suitable grasses for cattle consumption.

When cattle drink directly from the wetlands, they trample them damaging the grass. There was a viewpoint that pipes connected to some kind of water storage unit to store water would prevent this and provide a constant supply at times of scarcity. The in-depth understanding of, and appreciation for a range of wetlands goods and services particularly by the village Chief suggests that engaging in a wetlands management set of activities may be successful and well received.

The value placed on the transfer of traditional knowledge from generation to generation is something which should be supported and encouraged. In certain domains this has been done. For example the office of the National Environment Secretariat (NES) provided educational training to herd boys on the value of certain plant species, vegetation and medicinal plants found in the wetland areas, which should be protected from grazing cattle and conserved.

Pressure on the land

As there is not enough agricultural land that can be allocated to dam displaced households, many people enter into a traditional share-cropping agreement with other households (*Seahlolo*), where they share the provision of inputs during planting and harvest and split the produce. Relocated households receive annual compensation from the LHDA but often this is not enough to buy sufficient food for the family. In some cases, this creates increased dependency especially because of the lack of training in alternative livelihood strategies.

A priority need identified among the community is for training in improved farming techniques in order to mitigate the changes in climate they are experiencing. Current farming techniques are not adequate in dealing with the more frequent droughts. As one villager said:

'Farming is our life because we are able to support our children with food from agriculture. The people need to be taught farming techniques for improved crops.'

Many believe that with improved seeds and alternative techniques they will have a better harvest than they have experienced in recent years.

'There is no problem at present but sometimes when we get assistance in food/crops, it arrives too late for the planting season therefore we need advice on how to mitigate such problems.'

Governance of the grazing zones

In Ha Tsiu, the chief is also the councillor for Land Administration and thus has the authority to grant land, and to seize it if it is not being used in an appropriate manner. Thus, she travels within the Council district educating people on the proper uses of land.

One of the main problems she reports in managing natural resources within the rangelands is the lack of coordination between the local chiefs, to whom all grievances are lodged regarding grazing areas, and the principal chief, who has the control and authority over the large grazing zones further away. This lack of coordination was echoed by the local rangelands management councillor who felt that the problems in range management were attributed to the lack of communication between the cattle owners and the Principal Chief and that the local chief was the necessary bridge for this interaction.

Summary of areas of adaptive capacity

It is clear from the evidence that where possible people attempt to adapt to each situation where they have the knowledge, technology or resources to do so. Responses to sub-system level vulnerability, both multiple stresses (section 2) and dynamic vulnerability (section 3) result in an emergence of some level of adaptive capacity that may not provide adequate systemic resilience. Thus, the climatic, social, and economic thresholds at which this resilience is undermined should be explored further before interventions which may alter development pathways are implemented.

5. Adaptation – present and planned

The adaptation decisions of this community range from adjustments of existing traditional mechanisms to new and innovative strategies to cope with vulnerability that has changed over time and at different scales, causing a variety of impacts at the local level. Some of these adaptations have been formally supported by national programmes, local councils or LHDA initiatives. It appears that those interventions which are most easily implemented and taken up are those which already exist in some form or another in community life, even if this is a very informal arrangement. The framework adapted from Downing et al. (2006) which separates adaptive capacity from vulnerability attributes, makes these potentially viable interventions easier to identify.

Self-regulation

There have been attempts to plant seeds for the regeneration of grasses in the grazing zones. The principal chief oversees these areas but the village chiefs would need to make such a request on behalf of the community for this to happen. However, the RMA would prefer to increase the time for

set-aside as opposed to replanting grasses as this takes longer and can only be done in the summer, which is precisely when cattle graze in these areas. Due to the large numbers of cattle in this region it seems that some destocking would also be necessary to reduce the impacts of prolonged grazing in one area that is set-aside.

Training and diversification of livelihoods

The LHDA have undertaken a number of development projects within the village, such as: construction of a new school building; providing agricultural training; suggesting changes in the maize variety grown; introducing new crops (e.g. apples trees and garlic); and marketing crops. Community members mentioned opportunities for new employment in the production and sale of handicrafts and in providing tourist accommodation. They also felt that there is a need for training and educating young people on the traditional ways of life, which include strategies to cope with the problems they face.

There are opportunities for women in the village that can sew using manual machines to provide clothes to the community. There is a demand for making and mending leather shoes, steel works and making wooden caskets. However, all of these activities require institutional support to access necessary resources and some also require training. Both genders seem receptive to learning new skills such as making handicrafts, though this has traditionally been the domain of women.

Medicinal plants

Due to the dwindling numbers of medicinal plants in the village and surrounding areas, a medicinal herb garden was set up in 2004 to preserve and cultivate plants with the assistance of the LHDA. Harvesting of medicinal plants outside the garden is also regulated. However, the garden was not protected from trespassers and fell into disrepair. It is the traditional doctor's view that this problem can be solved by cultivating these herbs in home gardens.

Healthcare and government support

Local Support Groups have been formed in many rural areas of Lesotho which are to be trained and supported by the Ministry of Health to provide home-based care for the elderly and the ill. Community members involved in these support groups are trained in administering basic Western medica-

tion. These support workers also provide nutritional support by growing vegetables (with seeds supplied by the LHDA) in their own gardens which they then give to the patients' families.

In terms of financial assistance, the government introduced monthly grants two years ago and the elderly now receive a pension. However, children and other vulnerable groups in Lesotho are not supported by a national grants programme.

6. Towards a sustainable future?

The analysis of the many issues surrounding these communities shows that water management cannot take a sectoral, single stressor approach but rather needs to be integrated and adaptive, to address the multiple and complex changing stresses that are faced on a daily basis (Bharwani 2005; Ziervogel 2006).

'The conventional approach to IWRM is not well-adapted to addressing issues of vulnerability, as the driving concerns are to understand and manage hydrological flows and water allocations. But for many policy-makers and others, the need for river basin management to include not just the prediction of issues such as floods but also the capacity to respond in ways that go beyond infrastructure development is a key issue' (Downing et al., 2006: 16).

A step-by-step process of analysis can be idealised as:

current vulnerability → dynamic vulnerability → emergent adaptive capacity → adaptation strategies (informal, formal) → resilient livelihoods

High priorities for vulnerability reduction can be identified from the exploration of the *dynamic vulnerability* experienced by the community. That is, the framework helps us to identify the most relevant questions on which to focus when planning interventions. Though we are concerned with water management, this type of vulnerability analysis underscores areas of life that are under pressure and that must be considered for any water management intervention to be successful. This is particularly true where communities are closely tied to the land and are dependent in different ways on wetland areas, for example.

Groups affected by changes in the resource base also use these resources differently and therefore place different values on them. The values, uses and dependencies that form dynamic vulnerability may be more difficult to uncover if we approached the case study through the narrow lens of hydrology and physical infrastructure alone. In this case, an idealized chain of analysis might be:

catchment hydrology → static vulnerability → single stress focus and interventions

But this may lead to:

unintended impacts on other areas → multiple and cascading effects → mal-adaptation → fragile and insecure livelihoods → increased dependency and vulnerability

Thus, a single stress, one-scale, snapshot approach would reach a different conclusion, which would miss much of the detail captured using the approach described here.

Resilient local livelihoods are more likely if local adaptive capacity supported by institutional structures has emerged by recognising the *multiple* attributes of vulnerability (e.g. declining grazing areas or fuel wood) of the *heterogeneous* groups at risk (e.g. herders or households) and the modification of *existing* knowledge and traditional adaptation mechanisms (such as the extended *Maboella* period or ‘closing off’ wood sites). Thus, the notion of system-level adaptive capacity as an emergent attribute of lower order vulnerability needs to be identified, supported and reinforced (Downing *et al.*, 2006).

For example, cattle herding plays an important role in job creation in the village and thus despite the increasing levels of stock theft it is still an important part of Basotho society. Not only is it a source of income but cattle owners are providing jobs in the community, and creating livelihoods for future generations. The cattle owning community is continuously expanded by the system of paying herd-boys with cattle or sheep at the end of the year, so that they can then start their own herd the following year. Furthermore, people can sell the animals and their products (e.g. wool, mohair, meat) for cash. Thus, not only do cattle play a key role in the long-term economy of the community but the social and cultural value that is placed on cattle and their involvement in different areas of daily life cannot be undermined. Therefore, even if alternative sources of income be-

came available, such as payments for environmental conservation for water management purposes, it seems plausible that people would still keep some animals due to the additional income and security they provide. Interventions (e.g. wetlands management which may include destocking programmes) that would have an impact on this asset base would affect many other areas of life, both directly and indirectly, and this cannot be overlooked by taking a narrow view on the vulnerability of the community and what may appear to be the root causes from a snap-shot or single sector perspective.

Nevertheless, new measures for destocking are needed for the good health of the animals due to overgrazing and grass depletion. The Rangeland Management councillor acknowledges this but is concerned that while people *'need to know what numbers are sustainable...at the same time destocking should not happen in a way that will cause cattle owners to suffer.'* One must appreciate the multi-faceted dependence of this community on cattle, though the appreciation for the welfare of cattle and requests for government advice on sustainable destocking means that a programme of environmental management (e.g. Working for Wetlands) may be well-received. Compensation should consider the social and cultural value that is placed on cattle and not simply its monetary value alone.

This vulnerability analysis has also shown that over time the lack of fuel sources is increasingly limiting the capacity of this community to develop. With little fuel wood available, seasonal availability of cow dung and the expenses associated with electricity installation and maintenance, the community of Ha Tsiu faces enormous stress. Perhaps this should be a high priority area to be addressed by local government and the LHDA as this will significantly support livelihood diversification in the region, particularly in terms of replacing the existing diesel fuelled flour mill and to provide lighting for poultry farming, which is a new livelihood activity in which the community would like to engage.

Clearly, more support needs to be provided to these communities in working towards a long term sustainable future. That is, while its adaptive capacity has been assessed and tested through interviews and observation, it does also need to be *'refined'* (Downing et al., 2006: 22) through institutional support. Sadly, there appears to be a resignation to delayed support and limited assistance with the perception that:

'muso ha o tate' – government rushes for no one, but we hope that change will come eventually.

The loss of local and indigenous knowledge (particularly relating to the sustainable management of communal natural resources) is a negative trend. If such knowledge were protected it could be useful in creating more successful conservation programmes as this would be based on community-driven ethics and an in-depth understanding of the local environment. This would also enable more trust in the process and creation of institutional interventions particularly if they evolve from existing informal adaptive mechanisms and local knowledge.

Despite many challenges, Basotho communities appear resourceful in the face of a variety of stresses and complex changing social, economic and climatic realities. Institutional structures to support these adaptation and coping mechanisms will go a long way to improve the environmental resource base and ultimately the livelihoods of these dynamic communities.

Dynamic vulnerability links naturally to adaptive management frameworks, albeit extending a single-stress, sectoral focus to coupled socio-ecological systems. This is a challenge for adaptive water management, where water links to fundamental stresses in many sectors, economies and vulnerable socio-economic groups. Narratives, at a personal, community and institutional level, may help illustrate the dynamic nature of vulnerability. It is particularly important to capture the qualitative shift from one complex of vulnerability (e.g. resource-dependent self-provisioning livelihoods) to another (e.g. transient communities in economic and social relations at multiple scales).

Appendix 1

Differential vulnerability, exposure and stresses	Dynamic nature (often scale-related) and trends over time	Attributes of groups and ability to respond to shocks and stresses (adaptive capacity or barriers to adaptation)	Adaptation decisions (formal and informal).
Land-use change			
Lack of agricultural land <ul style="list-style-type: none"> • Farmers • Relocated households 	Decrease in yield size and the quality of the produce. Many household incomes are dependent on agriculture which is tied to fluctuations in local climate and economy. Increased pressure on available land and changes in land use – people start to use areas close to the wetlands for agriculture, increasing degradation. This reduces the ecological functionality of the wetlands and the services it provides.	Lack of training and knowledge in crop varieties or new crops to cope with climate variability. Related households receive compensation from LHDA, but this is not enough to sustain a household.	Seahlolo share-cropping agreement. Attempts to diversify livelihoods. There has also been an increase in the number of small businesses (shops, phone booths etc.). The LHDA has introduced new crops into the area both for marketing and for local consumption.
Lack of grazing land, over-stocking and depletion of grasses for grazing. <ul style="list-style-type: none"> • Cattle-owners 	Local chief / Principal chief decision-making and coordination and communication when moving animals between zones. Authority to replant grasses also lies with the principal chief, though knowledge of best grasses to replant is held by the cattle owners and relayed to the local village chief.	Traditional Maboella rotational grazing system Livelihood and income activities such as shop keeping and small scale vegetable farming (potatoes, cabbage) are becoming more visible. However, a lack of skills in other trades makes it difficult to supplement incomes in other ways. Vast amount of indigenous knowledge on plants which are indicators of over-stocking or deterioration of grazing areas.	Adaptation of traditional Maboella system to allow prolonged grazing in certain zones to promote regeneration of grasses. Planned replanting of nutritional grasses in the cattle post areas. Training by RMA for herd boys on conservation of important grasses, vegetation and medicinal plants found in the grazing areas. The RMA are also starting a process of developing rangeland management plans in consultation with local communities. This has not extended to Ha Tsiu yet.
Climate			
Droughts and water scarcity <ul style="list-style-type: none"> • Farmers • Cattle-owners • All households 	Increased frequency affecting yields. Trampling of wetland areas by cattle for water is increased. Affects domestic water supply as springs and rain water harvesting tanks dry up.	Knowledge is lacking on drought resistant varieties and more appropriate crops. Lack of secure potable water supply as well as for animals. Both people and animals drink from the same wetlands during times of drought stress.	Training by LHDA in new varieties of maize and new crops (apples and garlic). Fetching water from distant wetlands and using nearby springs for washing clothes and watering plants. LHDA trained water committee to maintain taps

			and regulate supply.
<p>Floods</p> <ul style="list-style-type: none"> • Farmers • Cattle-owners • All households 	<p>Increased frequency of flash floods affects crop planting and harvesting.</p> <p>Flood water erodes fields.</p> <p>Degraded wetland areas will be less effective in protecting against the impacts of floods.</p>	<p>Irregular flooding may erode seedlings or wash away ripened crops before harvest.</p> <p>Animals can get stuck in the wetland marsh as they attempt to drink from the wetland</p>	<p>Dig furrows and keep grass patches between plots</p> <p>Planting fruit trees between fields</p> <p>Wait for water in wetlands to collect in other areas for safety of animals.</p>
<p>Snow</p> <ul style="list-style-type: none"> • Farmers • Cattle-owners • Elderly and ill • All households • Animals 	<p>Crops can failure if there is heavy snow during the early stages of growth.</p> <p>Increased volumes of snow over extended periods in the winter months.</p> <p>The elderly do not leave their houses often during the winter as snowfall can be very heavy and many areas are difficult to reach.</p>	<p>Temperatures drop during snow months and often result in injuries or deaths.</p> <p>The snow provides moisture for crops and this moisture is beneficial for the soil in the following planting season</p>	<p>Delay planting season so that the crops are less exposed to the cold and snow</p> <p>Penalties imposed if cattle enter zone C to protect long blade Lesuoane grass which is needed for cattle in the winter during heavy snowfall.</p>
Natural resources			
<p>Medicinal plants (often found in the wetlands)</p> <ul style="list-style-type: none"> • Women and traditional healers 	<p>Decrease in availability and longer walking distances to collect them.</p>	<p>Harvesting is regulated - payment required for collection of plants by those other than traditional healer.</p>	<p>Coordination between local Council members and LHDA to create local herb garden.</p> <p>Suggestions to grow medicinal plants in home gardens also.</p>
<p>Fuel wood</p> <ul style="list-style-type: none"> • All households, especially women, children, elderly and ill 	<p>Over time, one has had to walk further and further to collect wood.</p>	<p>Alternative sources of energy (such as gas and paraffin) are often too expensive for the average household.</p>	<ul style="list-style-type: none"> • Self-regulated collection by the community so that there is enough for everyone. • Alternatives are used such as cow dung, Motantsi and Lengana grasses. • Provision of more trees by the LHDA. Wood 'closed-off' by Local Natural Resources Council to allow regeneration. • Suggestions for electricity installation using compensation
<p>Grasses for thatching roofs and grazing (some found in the wetlands)</p>	<p>Resources depleted over time, damaged by the dam's construction and valuable collection sites inundated by the dam.</p>	<p>Shortages of grasses restrict grass crafts making and affects the incomes of households.</p>	<p>Knowledge of plants that are indicators of health or degradation.</p> <p>Self-organised regulation. Collect a little at a time so</p>

<ul style="list-style-type: none"> • All households • Crafts makers • Cattle owners 			that there is enough for everyone.
Health			
HIV/Aids <ul style="list-style-type: none"> • Young women and men 	High infection rates initially seen in returning migrants (from South African mines) and (LHDA) dam construction workers and now increasing among general population.	All 20-40 year olds are high risk category. There are more health clinics in the local area but there is not enough HIV testing carried out. Patient consultation with traditional/ herbal doctor can cause confusion with advice from medical clinics.	Creation of home-based care group with support and training from the Ministry of Health for the elderly, sick and those with HIV/Aids. The influence of the traditional healer is used positively by working closely with (Western based) medical clinic. This should hopefully result in supporting prescribed medicines rather than causing confusion as to whom to trust.
Economy			
Markets <ul style="list-style-type: none"> • Farmers 	Roads have opened up access to nearby towns.	Support required to successfully access local markets. Despite new roads, most produce is still sold locally within and around the village or when people visit the village.	LHDA has attempted to support the formation of a committee of potato farmers to help market their produce.
Unemployment and livelihood diversification <ul style="list-style-type: none"> • All households 	Depletion of natural resource base, as a result of changing population dynamics and pressure on land use over time reduces the ability to depend on traditional livelihood activities. Stock theft is increasing - this is perceived by some community members to be linked to the lack of employment opportunities.	Cattle-herding traditionally provides livelihoods for more people each year as herd-boys become cattle owners, but this is no longer the case with over-stocking the decline of the natural resource base. There is increasing mistrust and conflict between villages and amongst villagers themselves due to cattle theft.	LHDA has provided training in making handi-crafts . Community development fund has been set up by the LHDA for community projects such as the flour mill in Ha Tsui. The community is receptive to work related to environmental services and eco-tourism .

Appendix 2

Ecological provisions found in the wetlands areas

Local plant name	Use	Location
<i>Crodile</i>	To treat common cold. Boil leaves and drink.	Wetlands
<i>Lengana</i>	Used for roofing, brooms and fuel wood (as fuel wood is now a scarce resource). Used for cold relief and by herd boys to sleep on. Used to treat fever in young children.	Grows everywhere even near houses
<i>Leloli</i>	Used to make mats and bowls.	Wetlands
<i>Moseea</i>	Used for roofing/thatching, ropes and brooms. Thick and strong grasses.	Found along streams or moist areas in the village and in the wetlands.
<i>Lesuoane</i>	Used for cattle feed. Tall blades of grass mean that cattle can feed on them even after heavy snowfall. Lesuoane is protected using penalties for trespassing in the wetlands areas to promote its growth.	Wetlands
<i>Selae</i>	A green vegetable used for cooking as it is a part of the local diet.	Wetlands
<i>Qobo</i>	Top leafy part is eaten and the root is used in medicine. This is a sacred medicine ('Pitsa') and only traditional healers and elders know what it is used for	Wetlands
<i>Senchebane</i>	Looks like Leloli grass, though it is thinner and softer. Often used as an indicator of the health of the wetland.	Wetlands

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