

Chapter 13

Resilience and Sustainability of the Maloti-Drakensberg Mountain System: A Case Study on the Upper uThukela Catchment



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Significance Statement The chapter describes the conflicting interests of water users in the uThukela catchment of the Maloti-Drakensberg (MD) mountain system, including the implications of poor management on ecosystem health and livelihoods. As this is a strategic water resource area for both Lesotho and South Africa, effective management towards sustainability is critical, but is currently retarded by the complexities of shared but disputed boundaries, and competing land uses. Improved rangeland management practices, backed by education and awareness, can improve the resilience of the system. However, this requires the buy-in of all stakeholders to reduce degradation and invest in improvement of the catchment. Otherwise, degradation will exacerbate water shortages in an already water scarce region – especially during El Nino-linked droughts, predicted to become more intense with climate change.

Keywords Alpine · Degradation · Livelihoods · Mountain system · Stewardship · Wetlands

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1 Introduction

The Maloti-Drakensberg (MD) mountains cover c.40000 km² and include much of Lesotho, and marginal areas of the Free State (FS), KwaZulu-Natal (KZN), and the Eastern Cape Provinces of South Africa (Carbutt, 2019). The MD is home to montane vegetation unit types of the endangered Grassland and fragmented Afro-temperate Forest Biomes (Mucina & Rutherford, 2006), and hosts some of the highest numbers of range-restricted flora and fauna in southern Africa, many of which are of high conservation significance (Clark et al., 2011; Carbutt, 2019). Furthermore, it captures an array of cultural heritage sites and spectacular rock formations that serve as a major tourist attraction (Duval & Hoerle, 2018). This mountain system is also crucial in providing water to many people across much of South Africa, Lesotho and Namibia (Taylor et al., 2016; Ngwenya et al., 2019) – and in future, Botswana (Mahlakeng, 2020). Wetlands are a characteristic feature of this mountain system (Zunckel, 2003), helping to ensure a sustained flow of high-quality water into major rivers such as the Senqu–Gariiep (Orange) in Lesotho/South Africa, and the umZimvubu and uThukela in South Africa.

MD water flows are primarily regulated by alpine wetlands i.e. wetland systems >2800 masl (Chatanga et al., 2019). The key ecosystem service provided by these wetlands is storing moisture from precipitation (Taylor et al., 2016). Their ability to absorb moisture buffers against extreme events of high intensity rainfall (floods) while their slow release during the dry seasons and drought periods ensure long duration of base-flow. These wetlands also trap sediments and sequester carbon - vital functions in an area inherently sensitive to erosion due to the steep topographical gradients and intense summer thunderstorms (Grab & Linde, 2014). Maintaining the integrity of the wetlands in the upper catchment areas is vital as they support perennial runoff with low sediment loads, which supports the associated land use systems.

Unfortunately, the MD is experiencing degradation and subsequent disturbance to water flows with consequences for all land use systems it supports (Turpie et al., 2021). This case study presents an opportunity to unpack the complex reality of shared boundaries, competing land-uses, livelihood needs, and the crucial role of the MD as a water tower. This hybrid scoping review unpacks the current state of degradation on the upper uThukela as a component of the MD and implications on land uses. It is intended to lay a conceptual framework for more rigorous work on deriving innovative strategies that ensure sustainable solutions to the problems affecting the MD. The review is supplemented with qualitative field notes and photographs to further elicit a descriptive narrative of the region's current reality and implications for the system's resilience and sustainability.

2 Description of the Study Area

The upper uThukela catchment is part of the northern MD Strategic Water Source Area, and includes the Royal Natal section of the uKhahlamba Drakensberg Park and the upper Tugela location. This topographically rugged catchment ranges in elevation from c.1150 m in the east to ~ 3282 m in the west. The catchment comprises 1876 km² and consists of nine quaternary catchments (Fig. 13.1).

The uThukela catchment is characterised by a high variability of climatic variables, with mean annual precipitation ranging from about 2000 mm in the high elevation areas to as low as 600 mm in the lower-lying areas (Blignaut et al., 2010). Mean day temperatures in winter range from below zero in the mountains to 10 °C in the valley region with frost occurring from late April to early September and almost daily in winter (June and July) (Everson et al., 2007). Natural vegetation in the catchment is dominated by the Grasslands Biome (Mucina & Rutherford, 2006) – from mid-elevation grassland vegetation units to alpine vegetation units – and with extensive patches of Afro-temperate forest on shaded, southern slopes <2000 m.

The upper uThukela catchment supports three main land-use systems:

1. Alpine wetlands and grasslands – formally “conserved” in the uKhahlamba-Drakensberg Park: Royal Natal (but in reality dominated seasonally by intense Basotho rangeland use);



Fig. 13.1 Location of the Upper-uThukela catchment (V11A) in South Africa and its associated quaternary catchments. (Adapted from Blignaut et al., 2010)

2. Conservation areas on and at the foot of the escarpment and associated leisure recreation (uKhahlamba-Drakensberg Park: Royal Natal);
3. Commercial and smallholder crop and livestock farming

The system's water flows are regulated by alpine wetlands and associated grasslands on the summit, closely interlinking these seemingly distinct upper and lower systems.

3 Land Use and Water Linkages

3.1 Alpine Grasslands and Wetlands

The integrity and health of the grassland ecosystem found on the alpine wetlands of the upper uThukela is the essential force of water flows in this catchment, supplying water to rivers and for inter-basin transfers (Fig. 13.2). These wetlands are extremely fragile and vulnerable to disturbance yet essential to present and future water security in the region (Taylor et al., 2016). The alpine wetlands of the uThukela fall under South Africa's protected areas, but they suffer from the same problem of uncontrolled grazing by livestock as many of the less protected alpine wetlands in the MD. The alpine wetlands are primarily grazed by livestock from Basotho herdsman, providing a key livelihood strategy for many people in the high-elevation areas of the MD of Lesotho. Especially during droughts, the alpine wetlands attract large numbers of herdsman and their livestock, being one of the few places remaining with palatable forage.



Fig. 13.2 Water flows and linkages between the uThukela and associated land uses. (Edited Google earth images <https://earth.google.com/web/@-28.67004297,29.23896474,1293.58353365a,185866.37439854d,35y,43.16894092h,0t,0r>)

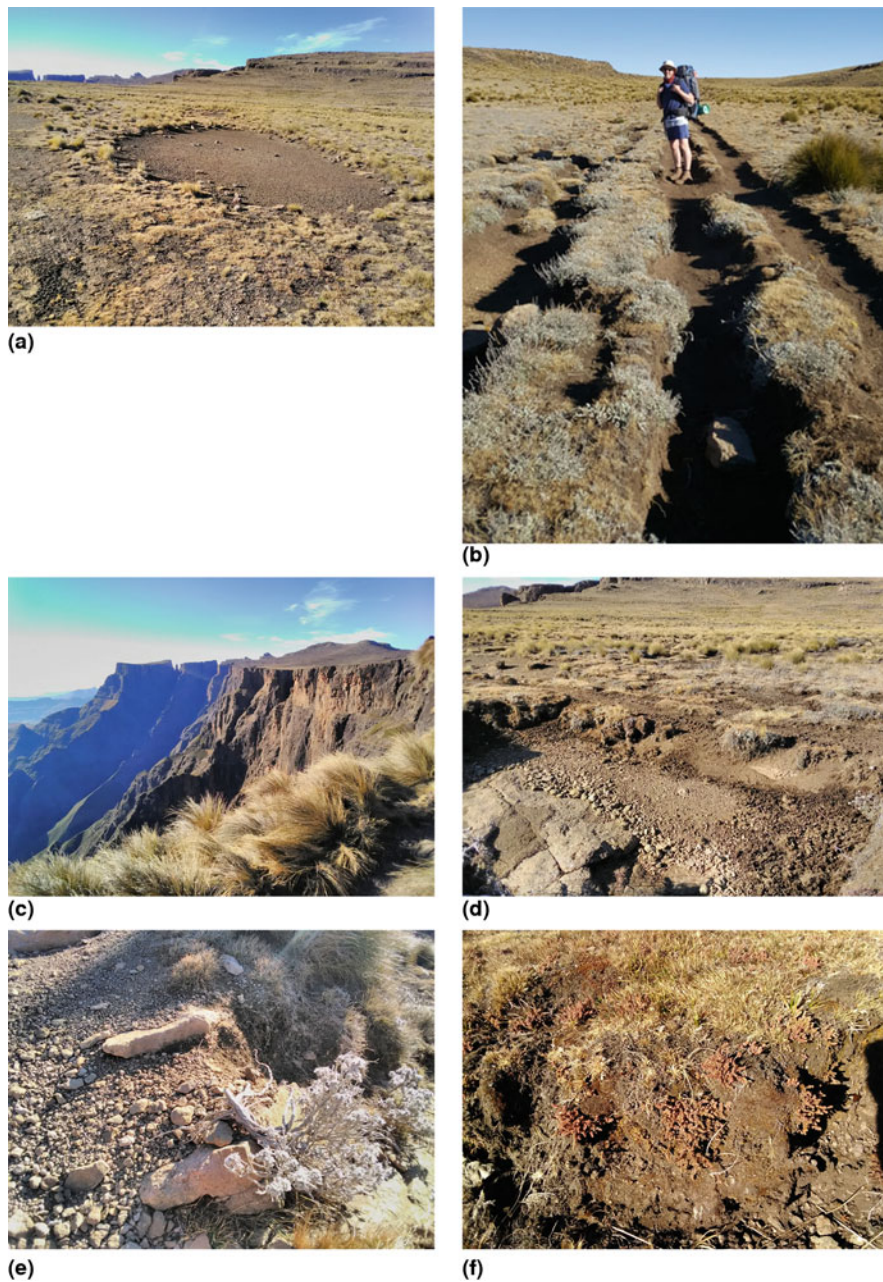


Fig. 13.3 A selection of photographs from the upper uThukela catchment: (a) loss of vegetative cover. (b) further incision of gullies. (c) poor grass composition. (d) loss of the alpine peat-biocrust layer. (e) bare gravel and hard rock. (f) tussocks and shrubs on soil pedicels. (Credits: V.R. Clark)

Figure 13.3 depicts the current state of degradation in the catchment. A proportion of vegetative cover has been lost as evidenced by large barren areas, and widely spaced distances between remaining grass tussocks (Fig. 13.3a). This bare soil is prone to cryogenic activity (e.g. needle ice action), resulting in the fine soil being elevated on small pedicels and dispersed by strong winds. In spring, persistent winds exacerbate this loss (Grab & Linde, 2014). Increasing barrenness results in less absorption of rain and snow, resulting in faster run-off during high intensity summer thunderstorms. As a result, gullies have developed (Fig. 13.3b) that are eroding these alpine wetlands, and combined with sheet erosion, are causing the banks of the uThukela River on the summit to retreat.

The grass composition (Fig. 13.3c) is poor and unrepresentative of intact alpine summits in the catchments of the MD. The current grass compliment has a poor palatability (wiry tussock grasses and tough shrubs), suggesting that the palatable grass and herbaceous component has been grazed out. The alpine peat-biocrust layer, which acts as a moisture absorbent and sponge has largely been eroded (Fig. 13.3d). As this peat-biocrust layer is lost, it is replaced with bare gravel and hard rock (Fig. 13.3e). Evidence of this can be seen from tussocks and shrubs on soil pedicels (Fig. 13.3f), indicating the original soil surface. This is the start of “alpine desertification”, where the result is an alpine desert of gravel and bare rock (Sun et al., 2019) – the final stage of ecosystem collapse in this context. This is already evident elsewhere in Lesotho, e.g. in the Mokhotlong area (Grab & Linde, 2014). The degradation of the alpine wetlands leads to a major increase in the variability of water flows – from perennial to seasonal, and even to episodic and associated flash flooding.

High footpath traffic of tourists to the uThukela Falls, with the footpath running through the wetlands and along the edge of the river, may be exacerbating the degradation situation in the catchment. However, as the Elands Alpine Catchment (immediately adjacent to the uThukela Alpine Catchment, in FS) shows the same degradation as the uThukela –but sees very little tourism activities in comparison - the tourism component of the degradation challenges can be filtered out, highlighting the pervasive impact of unsustainable rangeland use.

3.2 Conservation Areas and Associated Recreation

A large proportion of the escarpment of the MD, bridging the alpine wetlands with the lower lying agricultural areas in South Africa, are protected by a string of national parks. The national parks provide a key tourist attraction in South Africa and harbour numerous tourist resorts. In general, the wilderness areas of the parks are the ‘least degraded’ of the three land use types, but also experiences encroaching challenges to the parks (Kruger, 2007). One of the more serious issues here is invasive plant species threatening ecosystem services (notably water production and biodiversity conservation) (Simberloff, 2001; Van Wilgen et al., 2011). These species are introduced through increased tourism activity beyond their natural

dispersal range. Given the high international tourist numbers, vigilant biosecurity is necessary to ensure new potentially problematic species are detected early and addressed timeously.

3.3 Commercial and Smallholder Crop and Livestock Farming

Mixed crop-livestock farming is a dominant land use in the catchment practiced both by commercial and smallholder farmers (farmers owning small plots of land on which they grow subsistence crops and a few cash crops and rear livestock relying almost exclusively on family labour). Commercial farmers are predominantly found on lower lands of the catchment, while most smallholders are located at the higher elevation areas at the foothills of the mountains bordering the nature parks. The smallholders in these former homelands (racially and ethnically-based regions created in South Africa under the apartheid government as nominally independent tribal states) depend almost entirely on surface water streams for their drinking water, and their arable and livestock farming activities (Giller et al., 2013). On over 70% of the catchment's arable land, commercial farmers grow rainfed maize and soybeans during summer and irrigated wheat and vegetables during the winter season, while smallholders mainly grow rainfed maize and, to a lesser extent, dry beans and sorghum (Mthembu et al., 2018).

Although at different scales, both commercial and smallholder farmers own livestock. Due to the seasonal nature of the climate in the region, some commercial farmers grow irrigated pasture crops as supplemental feed for livestock. Smallholder farmers move livestock away from the fields to higher surrounding grasslands at the border of the parks to graze freely in the summer. During winter, the post-harvest season, animals are allowed onto the fields to graze on crop residues when vegetation in rangelands is largely unpalatable.

Farmers are faced with policy challenges, socioeconomic issues such as crime including livestock theft and biophysical constraints such as variable rainfall. These challenges are indirect drivers of the environmental impacts of agriculture in the catchment. Commercial agriculture mainly affects water quantity and quality. The quantity of water is affected through abstractions for irrigation, which reduce natural flow levels, and by replacing natural grassland by crops that use more water, therefore decreasing the groundwater recharge. Deterioration of water quality is through the application of agrochemicals that eventually make their way into streams and rivers. In addition, water quality is affected by soil cultivation methods, causing erosion through soil surface crusting and resulting in sedimentation of water resources. Smallholder farming mainly affects the environment through land degradation, because of (i) unregulated livestock trampling and grazing, (ii) cropping on steep slopes, and (iii) harvesting of indigenous trees for domestic purposes. As a result, the contrast in the status of the natural grasslands between the communal

farming communities and the national parks is immense. For example, the water in the rivers is clear when flowing out of the parks but muddy when flowing out of the communal areas due to erosion, especially after heavy showers.

4 Implications of Degradations on Livelihoods

Upon degradation, the loss of ecosystem services provided by the alpine wetlands in the catchment threatens its sustainable function for water provisioning, affecting livelihoods in various ways. Firstly, Basotho herdsman consider wetlands a critical grazing resource and depend on it for their livelihoods. However, overexploitation of wetlands leads to wetland degradation through a loss of the diversity of plant species, biomass reduction, peat loss, and soil erosion. A common sight is several hundred animals in the alpine catchment at any one time in summer (Du Preez & Brown, 2011). The ultimate losers in this are the herders themselves, as they currently have limited livelihood options other than herding, and are effectively 'locked in' to this lifestyle through macro-political and macro-economic situations (Du Preez & Brown, 2011). The political climate of South Africa (having some of the world's highest levels of societal inequalities due to its political history) and the socio-economic climate of both Lesotho and South Africa as developing countries with high poverty and unemployment rates, offers limited rural livelihood alternatives. As such, there is a predominant reliance on herded animals both as a food source and employment opportunity in rural areas. The cultural status associated with large herds of animals also deters the exploration of alternative livelihoods.

Secondly, water is a crucial component of the geo-landscapes required to maintain the tourist value of the conservation areas. It is also important for economic development keeping nearby hotels functional and landscapes green and attractive to encourage tourism. Regardless of the cause, degradation of the alpine areas affects water flows, increasing the likelihood of peak flows leading to more erosion. Subsequently, these changes diminish the tourist value of the area. For instance, observations over the past decade suggest that the uThukela Falls – the second highest in the world, and a major tourist attraction – has switched from being perennial to seasonal. Whether this is true, or only linked to El Niño phases of ENSO, would need to be determined more robustly, but there is the potential (through wetland degradation) for Falls to shift permanently to short flow events after local rain showers.

Thirdly, changes in weather patterns have rendered pasture availability for live-stock grazing more irregular and unreliable. In drought periods, smallholder live-stock searching for quality-forage tends to concentrate in and around the wetlands, further degrading their roles for water storage and delivery in dry periods. Although literature provides no strong evidence for changes in rainfall due to climate change (Taylor et al., 2016), the impact of overgrazing is thought to be compounded by the impact of changes in weather patterns manifesting as more extremes in rainfall and droughts. It is therefore not surprising that households farming downstream are now

finding it difficult to meet their food and nutrition security due to ensuing challenges of water shortages. The plight of water shortages is also felt among the commercial farming community through irrigation water pricing and associated water rights regulations increasing production risks (Agholor, 2013). At a wider scale, the otherwise perennial Orange River has run dry several times in recent years, something unheard of in the past, with major impacts on the ecological reserve and diverse livelihoods downstream in parts of Lesotho, South Africa and Namibia (Mahlakeng, 2020).

5 Challenges and Opportunities for Effective Stewardship

The upper uThukela study area is exemplary of the complex multiple national and international boundaries, diverse land-uses and needs in the mountain catchment, all interlinked by water flows regulated by the threatened alpine wetlands. The primary challenge is that wetlands are treated as a communal land, making effective stewardship by actual landowners difficult to achieve. Furthermore, shared boundaries present a challenge for maintaining the integrity of upstream wetlands sourcing water for all associated land uses across borders. International and provincial borders make it difficult to design and implement effective conservation policies. In addition, disputed location of the boundary lines between South Africa and Lesotho make responsibilities unclear. Additionally, the rugged nature and high elevation (3000–3300 m) of the terrain makes it difficult to deploy staff for management. Although the Maloti-Drakensberg Transfrontier Programme (MDTP) provides the best available platform for engaging on these issues, as yet, tangible positive results in terms of competing uses in the alpine zone in the study area are under-appreciated and remain unresolved (although in 2020, MDTP took major steps to engage on this).

Reducing stocking rates and implementing sound grazing management systems that provide for extended rest periods can restore and preserve wetlands outside protected areas. However, there is always the risk that improving grazing and livestock management may simply lead to more animals. Therefore, the removal of herdsmen out of the protected areas may be justifiable, but in the end, the trade-offs between the goals of protecting ecosystem services and provision of livelihoods need to be balanced. While eco-tourism would be the next logical livelihood option, the relatively small capacity of this industry and its associated seasonality and instability requires alternate forms of livelihood strategies. Therefore, governments need to create and foster conducive environments for small businesses to thrive by reducing the red tape, providing efficient essential government functions (e.g. health), and by not overtaxing initiatives and efforts.

A main challenge to effective solutions is the conflicting interests of the area's diverse land users. Sustainable solutions will ultimately require good diplomatic relations coupled with practical arrangements between South Africa and Lesotho. Given that this is an alpine environment with short growing seasons and that we

know tremendously little about its ecology, resilience, and successional processes, recovery might be a slow process requiring direct intervention for restoration.

In the protected areas, restoration of the catchment post-livestock exclusion may be achieved using the following engineering methods: (1) Stone packs and stone-walls to slow water flow and soil loss in the worst affected areas. (2) Gabions along the rivers to allow the wetlands to recover (Wilson & Norman, 2018). (3) Revegetation using local species and artificially reseeding (Moreno-Mateos et al., 2015).

Lower in the catchment, commercial farmers could be assisted with decision support systems for their input use to reduce agrochemicals polluting water resources. Additionally, conventional cultivation methods could be supplemented with conservation practices. As complete switch from conventional to conservational practices may not be in the immediate financial interest of the farmers, the immediate trade-offs could be off-set through payments for ecosystem services as this has been shown to be a popular incentive for adoption of conservation practices by farmers (Salzman et al., 2018). In terms of smallholder crop production, ongoing development activities in the communities such as conservation agriculture (already prevalent in some communal areas around the Bergville region in KZN supported and promoted by the Mahlathini development foundation: <https://www.mahlathini.org/>) could be further up-scaled. Water harvesting techniques may provide some relief to water limitations and soil loss challenges as was the case for communal farming around Black Mountain in Thaba Nchu, FS (Woyessa et al., 2006). Governments could also provide alternative sources of energy to reduce reliance on indigenous trees for firewood. Alternatively, they could encourage private enterprise initiatives to harvest feral alien timber for fuel in the area on a commercial basis.

In the communal grazing areas, grazing activities are currently trapped in a classical ‘tragedy of the commons’ where sustainable agricultural practices are unpopular as people continue to farm the same way they have for decades due to cultural beliefs and indigenous knowledge, creating barriers to increase productivity through novel techniques. The situation may be remedied through education and novel partnerships with livestock farmers and the government, private sector as well as non-governmental organisations (e.g. Meat Naturally PTY (<https://www.meatnaturallyafrica.com>)) that provide communities with the knowledge and tools to break down former economic barriers, while motivating them to invest in restoring rangelands and wetlands. For example, the Meat Naturally model entails that farmers be trained and then required to implement environmentally-friendly grazing plans, while Meat Naturally creates an economic opportunity and sustainable livelihood for farmers by linking them with commercial buyers of meat products.

In terms of macro-economic solutions, uplifting the entire value chain of smallholder livestock farmers so that they can get more value from their livestock products could improve the catchment’s ability to drive livelihood diversification away from herding and more towards value-addition (processing), an important long-term initiative to reduce overall pressure on rangelands. Although only a limited number of Basotho herdsmen may end up working as tour guides or at a

tourist lodge, education on the importance of nature conservation could help minimise degradation, while securing the tourism industry. Furthermore, the current trend of emigration to urban areas from the former homelands downstream could be encouraged through education for the younger generations and better job opportunities and access for the older ones. This proposition is hinged on the idea that population pressure leads to land scarcity and to make a livelihood out of agriculture one needs to acquire or rent land. Therefore, together with the general disinterest of the youth in agriculture in the former homelands (Swarts & Aliber, 2013), this idea supports the encouraged emigration of youth as they are more flexible, more mobile, more agile and are increasingly landless (Bezu & Holden, 2014). Additionally, people generally switch out of low productivity sectors such as agriculture to more prominent ones such as manufacturing in South Africa.

Quantifying and monitoring climatic variables as well as effects of land management on water flows in MD catchments is crucial for better planning of future water security. Long-term trans-boundary socio-ecological research is required to foster a deeper understanding of the social, geopolitical, ecological as well as biophysical factors governing this alpine system.

6 Conclusions

The upper uThukela catchment is important for ecosystem services and providing livelihoods to surrounding communities. The primary driver of degradation in the catchment is overgrazing by livestock. Degradation of alpine wetlands directly affects the system's water flows with effective management retarded by the complexities of shared and disputed boundaries as well as competing land uses.

Improving the health and integrity of alpine wetlands through direct intervention can buffer them against climate change. Through better land-use and management practices, backed by education and awareness, the resilience of the catchment could be improved. Whilst ensuring resilience requires governance that takes into account socio-economic diversity in the use of a system and spatial diversity of natural resources utilization, all stakeholders must first buy into reducing degradation and investing in the improvement of the system. Otherwise, degradation will lead to increased water shortages in an already water scarce region.

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