Effect of Declining Rainfall and Anthropogenic Pressures on Three Wetland Types in Lesotho

Olaleye, A.O & Sekaleli, T

Department of Soil Science & Resource Conservation, The National University of Lesotho, Roma 180, Lesotho
Email: ao.olaleye@gmail.com

Introduction

Lesotho, located within South Africa has a total land area of 30, 350km^2 with four distinct agro-ecological zones (AEZ) based on geology and climate. These AEZ are replete with wetlands of approximately 96, 381 ha (Olaleye unpublished). Wetlands in Lesotho fall into three broad categories (Fig 1): Palustrine, Lacustrine and Riverine. Palustrine wetland include mires (bogs and fens). The Lacustrine are found in artificial lakes, while Riverine are found along river valleys and streams. Wetlands in Lesotho support more than 300,000 households and are used mainly for livestock watering activities.

In Lesotho, wetlands are inextricably linked to livestock management systems and provide critical resources (i.e.water) to support livelihoods, particularly during summer seasons and droughts. Increasing population in conjunction with efforts to increase food security is escalating pressure to expand agriculture within wetlands. Unless wetland ecosystems are managed appropriately, the functions that support agriculture and other food security and ecosystem services are undermined. Wetland agriculture can be a pathway out of poverty for a significant number of poor people if care is taken to ensure that other ecosystem services, including other means of food security such as fisheries, are not jeopardized.

The present investigation aims at comparing the selected characteristics of three wetland types, identifies causes of degradation and suggests plausible management options for a sustainable and continuous use of these fragile ecosystems. To achieve these, the status of soil organic carbon (SOC) these soils were compared and long-term impact of rainfall on these wetlands using CUSUM techniques was evaluated.

Materials and methods

Three wetland types with different levels of anthropogenic impacts (AI) in the Lowland and Foot-Hills AEZ (Fig 1) were sampled. Palustrine has low AI, the Lactustrine and Riverine had medium and high AI (Chips et al., 2006). Two transects (1000m) each were chosen in the Palustrine and Lacustrine wetlands and mini-pits (0.50m) were dug and soil samples collected at intervals of 200m located.in the upper, mid & lower toposequences. In the Riverine wetlands, samples were collected from three land use types (LUTs): cropping and grazing/pasture. Soil samples were collected from the transects that runs across these three LUTs. Soil samples collected were taken to the laboratory, air-dried & analysed for organic carbon using Walkley & Black method (Walkey & Black, 1934).

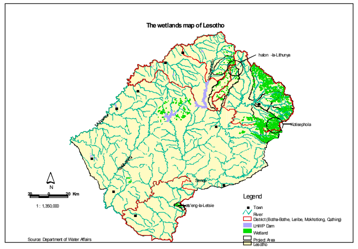

Fig 1: Wetland Map of Lesotho

Climate (rainfall) data for the nearest to the wetlands were collected between 1886 and 2006 from the Lesotho Metrological Services. These data were subjected to cumulative sum (CUSUM) techniques (Beamish et al. 1999):

$$= \sum_{t=i}^{tf} (x_{t-\bar{x}})$$

where xt is the monthly averaged variable at time t (varying between initial *ti* and final *tf*), and $\bar{X}$ is the variable averaged over the whole period of investigation. The CUSUM data were then charted using MS Excel 2007.

Riverine

Lacustrine

Palustrine

Results & Discussion

The co-efficient of variation, CV which depicts the ratio of standard deviation to mean ranges ranged between 58% to ≥ 120% (1886 – 1949) & between 1950 upwards, the CV ranged between 58% to ≤ 120%. (Fig 2). This suggests that rainfall within and over Lesotho is highly variable. An examination of the CUSUM plot (Figs 3a & b) showed two trends: increasing cumulative rainfall trend between 1926 and 1966 (Fig 3a). As from 1967, cumulative rainfall started decreasing at a decreasing rate (Fig 3b). It is evident from the CUSUM plot (Figs 3a & b) that there is a significant decreasing trend in cumulative rainfall from about 1967 The impact of a decline in the rainfalls resulted in serious effects in the loss of most wetlands especially the riverine and Lacustrine wetlands. The extent of wetlands is likely to be sensitive to variation in climatic moisture over decadal time scales. This was in agreement with the findings of Keith et al., (2010). These authors reported that that a mire wetlands over 10 years period.

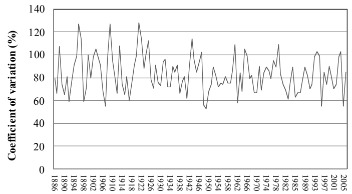

Fig 2: Coefficient of variation of rainfall data in Lesotho (1886-2006)

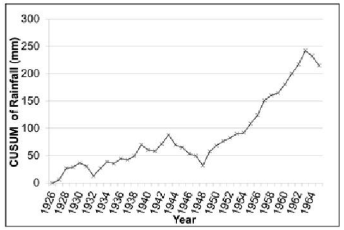

Fig 3a: CUSUM chart for the annual number of rainy days (1886- 1966)

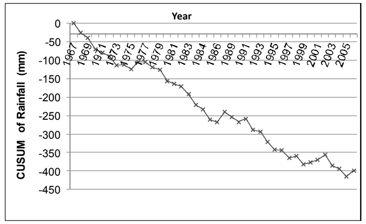

Fig 3b: : CUSUM chart for the annual number of rainy days (1967-2006)

Results showed that there were significant differences in the organic carbon contents within and between these wetlands (Figs 3a-c). A closer observation showed that due to high anthropogenic impacts, the organic carbon was of the following order in the wetland types: Palustrine > Lacustrine > Riverine (Figs 4a-c).

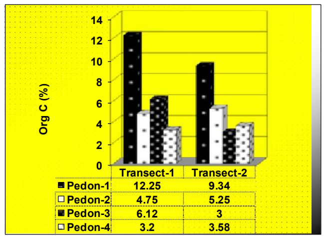

Fig 4a: Org C contents in Palustrine wetlands

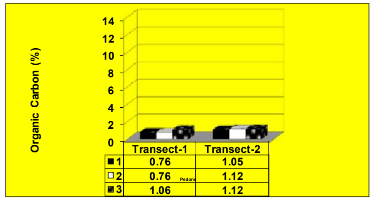

Fig 4b: Org C contents in Lacustrine wetlands

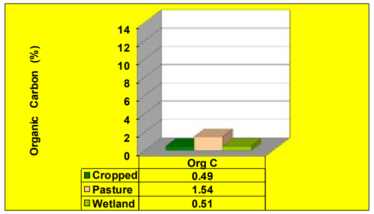

Fig 4c: Org C contents in Riverine wetlands

Conclusions

High CV of rainfall over Lesotho showed that rainfall is not reliable. Declining rainfall over the years has resulted in the loss of most wetlands (i.e. riverine & Lacustrine). This is further exacerbated by increasing livestock activities (i.e. overgrazing & watering). The CUSUM chart showed the cumulative rainfall started declining as from 1967. In addition, the organic carbon content in wetlands is of the order : Palustrine > Lacustrine > Riverine.

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Further information
Cell phone: +266 58599740