Landscape change in the Levuvhu and Nzhelele River catchments, Venda Limpopo Province South Africa

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Abstract. Little is known regarding landscape change, although the factors and implications of such changes are evident each day. Over the past decades rapid urban sprawl, urban land expansion, agricultural intensification and expansion of renewable energy use has had a negative impact on the environment and puts the sustainability of land at risk. This paper seeks to provide knowledge on global environmental change, landscape change and climate change and to identify the drives of landscape change and their implications. Moreover, the research study aims to provide data on the drivers that influence landscape change. It seeks to provide information on how land use change and landscape change in rural areas can be affected by factors such as urbanization, climate change and human activities (rivers, agriculture, deforestation and so forth). The study shall be focused on the Levuvhu and Nzhelele river catchment area, located within the Venda Region of the Limpopo Province in South Africa. Group focus discussions, field work and interviews were conducted to collect data with environmental, geography, landscape surveyors and the local ordinary residents within the areas. The results of the findings were assessed accordingly and provided to give a clear understanding of the importance of landscape change.

1. Introduction

For many, global environmental change still comes across as an opaque and far away concept, yet there are disastrous events taking place such as floods, storms wiping out homes and drought killing crops [1]. Factors such as global warming and climate change also have a direct impact on the overall landscape change of an area. Landscape change is thus a global research interest area. The concept of sustainable development plays an important role in the environmental sector, there is linkage of climate change to development policies [2]. One cannot speak about global environmental change without touching on sustainable development.

Urbanization has influenced the change and reshaping of the structures of cities, towns and rural areas leading to serious consequences such as the loss of vegetation, the expansion of urban areas, rapid urban population growth, environmental degradation and, of course, the exploitation of natural resources which are frequently unfavorable to the provision of the ecosystem service and biodiversity[3]. Moreover, urban sprawl and agricultural intensification has had a negative impact on
the cultural landscape of many homelands within the past decades [4]. In today’s generation climate change is an important factor to global environmental change [5].

Daily activities of people have also shaped and maintained landscapes over the past years, and fundamental change can be seen throughout history [6], and today there is little known information regarding the landscape structure pattern of vegetation existing in urban areas at a universal scale [3]. In order to understand landscape change, one needs have a sound and clear understanding and consideration of the fundamental processes, and, in this context, the concept behind the driving force that is increasingly gaining attention [4]. On the other hand, it is shown that the understanding behind the drivers of landscape change remains challenging, since landscape research is broad and spread across various domains and disciplines [6]. The complex interplay of the processes and drivers are a result of land use changes on operations at different spatial and temporal levels. Landowners are seen to be playing a vital role in land use change and are the target of many policy interventions and instruments [7].

A study in Ethiopia revealed how land use and landscape changes are universal and very much a common occurrence, where particularly agricultural activities and settlements have dominance on rural landscapes affecting the ecosystem services [8]. It is a complex task to analyze the change in landscape particularly when the subject of transformation has no relation in terms of land cover changes or to agricultural land use [9].

Scholarly and scientific literatures review will be provided to bring clear understanding of the concepts behind landscape change and the drivers that influence it. Geographic information, technological techniques and tools will be used to source data for the study. The aim of the study is to showcase the importance of landscape change and how the two drivers that will be discussed within the literature review impact the change in terms of sustainable development, population growth, infrastructure development and socio-economic environmental development.

2. Methodology

The research method used for the study is a descriptive and casual approach. The empirical, primary data, medium control, and insightful ideas and knowledge on landscape change and its impacting drivers were considered. Emphasis was put on the drivers that influence the change in landscape and the period over which the change occurred [10].

2.1. Data collection

Data collection was consisting of primary and secondary.

2.1.1. Primary data. Structured survey questionnaires and focus group discussion were used to collect data plus literature reviews were used to supplement and support the primary data collected from the questionnaires. The questionnaires were structured which covers demographics, the landscape change, livelihood ecosystem services within the area. The climate change and soil erosion were also included.

2.1.2. Secondary data. Journals and articles were used to supplement and provide solid evidence on the concept of landscape change and its drivers and their effect on land use and land cover.

The systematic random sampling was utilized for this study. The population of the study encompassed different people from various selected villages within the study area. The eligibility criteria specified that all participants should be aged 18 and above, reside in one of the villages within the study area and have experienced the change within landscape from the timeframe 1999 – 2018.

3. Results and discussion

3.1. Demographic data

According to questionnaires, the following data for demographic were analysed.
There are more female participants. This is due to the push and pull factor where males are migrating towards areas that offer potential job opportunities to provide for their families. Most data are collected between the various age groups. Generally, the age groups validate the results and the study.

The study area consists of literate residents that understand the GEC, landscape change and climate change. Even though the study area has a high number of literate residents, this does not mean that all residents understand the concept of GEC. Some illiterate residents understood when we explained the concept to them.

The population within the study area consist of largely unemployed residents (42%) due to lack of job opportunities. Only 24% are employed. 8% pensioner, 13% self-employed. The rest are schooling. Due to landscape change there is more negative pressure on the environment. This simply means that the residents use other means of an income through intensive agricultural production, sand mining and cutting down trees for wood and fishing. Their livelihoods are dependent on nature and may not be sustainable. Occupations such as farmers and constructors have a more direct impact on landscape change and affects the natural environment.

3.2. Livelihoods

It is evident from the results shown in Figure 1 that agricultural products are mainly grown for consumption within the study area to alleviate poverty. Only a small fraction of the population also sells those self-grown agricultural products to the community.

3.3. Soil erosion

Figure 2 provides a full analysis on soil erosion along river catchments, wetlands, urban areas, grassland, forest plantations, agricultural fields, natural forest and other places within the study area.

Figure 1. Livelihoods Graph indicating both consumption and selling rate of agricultural products within the study area.

Figure 2. Bar Graph indicating the severity of Soil Erosion within the Levuvhu.
3.4. Landscape change

Due to the factors such as technology, economic growth and politics new innovative ways of doing things are created and these are not always friendly to the environment and its natural state. Road construction causes soil erosion. Settlement growth leads to deforestation of natural forests. Climate change leads to extreme weather temperatures which leads to drought, forest fires and floods. Over grazing and extreme agricultural farming causes land abandonment, loss of natural minerals and extensification of indigenous forests. This is illustrated in Figure 3.

![Figure 3. Diagram indicating the change in urban growth and agriculture within the Levuvhu and Nzhelele catchment areas.](image)

Figure 4 provides a clearer indication that the participants understand the impacts of negative landscape change, the need to preserve the natural & indigenous sites for future generations to come and to regulate and balance the environment.

![Figure 4. Landscape Change Challenges within the study area.](image)
According to Figure 5 over the past 20 years technology (modernization and mechanization), cultural and political factors has had an impact on landscape change within the study area. It is evident that climate change such as temperature increase/decrease impacts landscape change through droughts and floods, moreover it affects the soil type and topography of an area such as change in the pH balance of soil which affects the production of agricultural production [11].

**Figure 5.** Bar Graph Indicating the Underlying Drivers of Landscape Change within the study area.

**Figure 6.** Process Diagram Displaying Underlying and Proximate Drivers of Landscape Change in the Levuvhu and Nzhelele river catchment study area.
Figure 6 indicates a detailed process flow diagram of the correlations and interrelation between proximate and underlying drivers, which provides logical understanding of the major driving forces behind landscape change within the study area. This figure indicates that landscape changes and climate changes are not only imposed naturally. However, they can be influenced by economic, political, cultural and technological factors as well [12] [6].

From the results it is evident that throughout the years landscape change has influenced and impacted largely on the types of settlements being developed. Such as a move away from the old conventional mud buildings within the study area, to rapidness of urban areas and the use of technology has improved throughout the years. The following underlying and proximate driver of landscape change were discovered from the field survey. Political, cultural, socioeconomic, natural and spatial are underlying drivers of landscape change, while urban development, agricultural expansion/intensification, extraction of non-renewable resources and nature & heritage conservation activities are proximate drivers of landscape change. This provides evidence that landscape changes and climate changes are not only imposed naturally. They can be influenced by economic, political, cultural and technological factors as well.

The concept of sustainable development is a very interesting one, in terms of the study area. It is evident that residents don’t understand the importance of sustainable development and how this concept is of significance. Therefore there is need for awareness around this concept and how it can be of benefit to both the environment and its inhabitants. The municipality needs to collaborate with the residents, it needs to pay attention to the needs of the residents regarding the two rivers and that it should provide water reticulation and irrigation as the residents complain of the shortage of water within the study area.

4. Conclusions
The aim of the study was to identify the drivers of landscape change within the Levuvhu and Nzhelele river catchment areas, Venda Limpopo SA for the period of 1999-2018. The method used to conduct the study was a field survey using a questionnaire. The landscape change is not of an interlay positive one, but a negative one due to the intensification of agriculture, deforestation of natural forests, and extraction of non-renewable resources, soil mining, brick construction, settlement growth and increase of urban buildings. There are two drivers of landscape change proximate and underlying, identified proximate drivers within the study area are urban development, agricultural expansion/intensification, extraction on non-renewable resources and natural & heritage conservation, while the underlying driver are political cultural, socioeconomic and natural & spatial. There are plenty suggestions for future interest such as remote sensing and land use management, ecosystem services based adaptation , soil erosion benefits and genitive impacts on the environments, ecosystem services management.

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