

Modelling the Impacts of Climate Change on Agro-Ecological Zones – a Case Study of Taita Hills, Kenya

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Abstract Climate variations all over the world have huge potential impacts to the environment at large. Human and economic activities are not left behind when climate change issues are concerned. Agriculture, being the core human and one of the basic economic activities is severely hampered by climate variations. In Africa, and specifically in Kenya, there has been rampant change in the growing patterns of some crops. Farmers lack knowledge that ascertains the reason behind the low income from their farm produce. The main research objective in this study is to determine the variation of agro-ecological zones (AEZ) of Taita hills in Kenya based on climate changes. Specific objectives are: Mapping historical climate data (1960-2010) and comparing with future climate datasets of 2050, matching the layers in a grid cell (Agro-ecological cell) using Geographical Information System (GIS) and delineating the AEZ based on selected parameters. This paper shows the development of AEZ for Taita hills in Kenya from a GIS point of view and develops a model of its variation given that climate is varying over a period of time. It gives a prediction for the variation of the zones based on climate change in the year 2050. A comparison of the historical and future AEZ is shown and is used to assess the impact of climate change on agricultural land. Finally it addresses the sensitive question of economical value to the farmers given that there will be a change and gives some remarks on possible farming practices that the farmers can adopt.

Keywords Agro-ecological Zones, Climate Change, Temperature, Rainfall, PCA, Multivariate Clustering, GIS

landscapes into relatively homogeneous regions of expected similar crop performance. Past classification was crop-specific but a quantitative approach is more essential in order to locate and characterize AEZ in relation to different environmental conditions. This zoning is very necessary for improvement of agricultural production and natural resource conservation.

1.1. Agro-Ecological Zone Overview

An AEZ is defined as that geographical unit with similar land resource potential and limitations related to agriculture [1]. Although there is the uncertainty in delineating the boundary between two consecutive zones, using several approaches such as: Fuzzy theory, wavelet analysis and geographical clustering, there is no single method that has been deemed to be the best [2]. GIS on the other part has tremendously improved the processing and visualization of AEZ. Multivariate clustering has given good results in other fields such as geology, constant fertility, uniform regions for crops and many more [3] and [4]. It is a very useful tool for assessment of land resources for better planning and management and monitoring of these resources [5]. AEZ can be used in various assessment applications, including: Land resource inventory; inventory of land utilization types and production systems, including indigenous systems, and their requirements; potential yield calculation; land suitability and land productivity evaluation; forestry and livestock productivity; estimation of arable areas; mapping agro-climatic zones, quantitative estimates on potential crop areas, yields and production; land degradation assessment,

1. Introduction

Agro-ecological zoning (AEZ) is the delineation of