DROUGHT HAZARD MODELLING: EXPLORING AN INDICATIVE DROUGHT INDICATOR FOR MALAWI

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Certification

The undersigned certify that they have read and hereby recommend for examination by Busitema University a thesis titled: ***Drought Hazard Modelling: Exploring an Indicative Drought Indicator for Malawi*** in partial fulfilment of the requirements for the degree of Master of Science in Climate Change and Disaster Management Degree of Busitema University.

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Declaration

I the undersigned hereby declare that this thesis is my own original work which has not been submitted to any other institution for similar purposes. Where other people's work has been used acknowledgements have been made.

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List of Abbreviations

Abbreviation	Meaning
AMC	Available Moisture Content
CDMM	Comprehensive Drought Monitoring Model
CI	Composite Index
CMI	Crop Moisture Index
DCCMS	Department of Climate Change and Meteorological Services
DRA	Disaster Risk Assessment
EOS	Earth Observation System
GCMs	General Circulation Models
GDP	Gross Domestic Product
GMAS	Global Multi-Hazard Alert System
MaDI	Malawi Drought Index
MCDI	Modified Composite Drought Index
NSM	Normalized Soil Moisture
PA	Precipitation Anomally
PDSI	Palmer Drought Severity Index
PET	Potential Evapo-transpiration
PHDI	Palmer Hydrologic Drought Index
PI	Percentile Index
PNP	Percent of Normal Precipitation
RCMs	Regional Climate Models
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SADC	Southern African Development Community

SMDI	Soil Moisture Deficit Index
SMP	Soil Moisture Percentile
SPI	Standardised Precipitation Index
SRI	Standardized Runoff Index
SSI	Standardized Soil moisture Index
TCI	Temperature Condition Index
TRMM	Tropical Rainfall Measuring Mission
TVDI	Temperature Vegetation Drought Index
UNCCD	United National Convention to Combat Desertification
VCI	Vegetation Condition Index
VHI	Vegetation Health Index
VTCI	Vegetation Temperature Condition Index
WFP	World Food Programme

Abstract

With a single growing season, drought as a consequence of climate change has taken a toll on Malawi's agro-based economy. In the context of climate change, an accurate and comprehensive assessment of drought at regional level is very significant to sustain agricultural development and manage natural disasters. Despite considerable improvements, world drought models are still not able to accurately represent a large number of factors that are responsible for causing droughts across different regions of Africa such as Malawi. This research deploys a number of drought input variables, i.e., precipitation, minimum temperature, maximum temperature and potential evapotranspiration to construct a Malawi Drought Index (MaDI) using multiple linear regression and GIS in order to best explain the complex interaction of major drought indicators, as well as to validate the accuracy of global drought models in the country. A strong positive correlation (8.4) was observed between the Malawi Drought Index (MaDI) and the Standardized Precipitation Index (SPI) suggesting that the MaDI does not depart very much from the existing drought models. This research therefore promotes the improvement of the MaDI as a new, easier and better local drought prediction and assessment method in Malawi.

Key words: *Drought, Climate Change, Drought Indicators, Drought Model*

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CHAPTER ONE: INTRODUCTION

1.1 General Introduction

Being an agro-based economy, drought occurrences have been one of the costliest disasters in Malawi: these economically and environmentally impact the country's agricultural systems.

Drought in Malawi is said to occur when seasonal rainfall is lower than 75% of the normal rainfall that the country receives. The whole country is nearly vulnerable to droughts, however, Karonga, Salima, Zomba and Shire Valley are the major drought prone areas (Chabvungma et al., 2010).

The occurrence of drought phenomenon is increasing in Malawi, for instance, between 1980 and 2019 alone, Malawi has experienced eight major droughts, in total affecting over 24 million people (World Bank, 2016). The impact, frequency and spread of drought in Malawi are likely to worsen with the changing climate. More places are becoming drier as climate continues to change (USAID, 2019b).

Consequently, droughts and dry spells in Malawi cause, on average, 1 percent loss of Gross Domestic Product (GDP) annually (Chabvungma et al., 2010). More recently the impacts of drought and resultant food security crisis overwhelmed Malawi's national response capacity to the extent that the government of Malawi declared a national drought emergency in April 2016.

Despite considerable improvements in global and national drought models, most are still not able to accurately represent the large number of complex factors responsible for causing the droughts across various regions of African continent such as Malawi.

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