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Assessment of Causes and Impacts Of Flooding On Agricultural Production of Plains Surrounding Lake Tana, Ethiopia

Master's Thesis

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Assessment of Causes and Impacts Of Flooding On Agricultural Production of Plains Surrounding Lake Tana, Ethiopia

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ASSESSMENT OF CAUSES AND IMPACTS OF FLOODING ON AGRICULTURAL PRODUCTION OF LAKE TANA SURROUNDING PLAINS

By

YIRGA ALEMU AZENE

DEDICATION

To

My Wife Biruh Tesfa

&

My Little Child Edomias Yirga

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ABBREVATIONS

APFM	Associated Programme on Flood Management
CSA	Central Statistical Authority
CV	Coefficient of Variation
DC	Drainage Coefficient
GOs	Governmental Organizations
GWP	Global Water Partnership
GWT	Ground Water Table
ha	hectare
IFM	Integrated Flood Management
IWRM	Integrated Water Resource Management
LT	Lake Tana
LTB	Lake Tana Basin
LTSPs	Lake Tana Surrounding Plains
m	meter
masl	meter above sea level
M2-1	Tepid to cool moist plains
M2-5	Tepid to cool moist mountains and plateau
M3-7	Cold to very cold moist mountains
MAR	Mean Annual Rainfall
MoARD	Ministry of Agriculture and Rural Development
MoWR	Ministry of Water Resources
NGOs	Non Governmental Organizations
PAs	Peasant Associations
SH2-5	Tepid to cool sub-moist plains and mountains and plateau
SH2-7	Tepid to cool sub-humid mountains
SM3-7	Cold to very cold sub-moist mountains
SSD	Subsurface Drainage
WMO	World Meteorological Organization
WT	Water Table

Abstract

The main objective of this study is to identify the main causes and effects of flooding and drainage problems on agricultural production of Lake Tana surrounding plains, mainly on Fogera, Dembia and Kunzila floodplains. The paper intends to answer 1) variability of runoff and rainfall data in identify the cause of 2006 flooding on LT shores 2) the best-fit flood analysis distribution function for major rivers 3) The socio economic impact of flooding on agricultural production and 4) potential mitigation measures that reduces adverse effect of flood and drainage problems.

The rainfall variability analysis of LT basin in 2006 was shows that on average 43% increase in wet season rainfall than the normal (mean). All rainfall gauging stations shows an increase in rainfall in 2006. Similarly the variability analysis of major rivers was also shows that on average 35% increase in flood season stream flow of G/Abay, Gumara, Rib, Megech and Koga. The trend of these rivers shows that maximum runoff for the year 2006 was higher than the mean of the long term maximum flood. Whereas Lake Tana maximum flood level of 2006 (1787.155masl) show an increase by 16 cm only from the mean flood levels of pervious records (1787 masl). Therefore LT backwater effect in 2006 was less and it doesn't have much contribution for 2006 flooding.

Flood frequency analysis of major rivers were done and it is found that Extreme Value Type One maximum likelihood probability distribution is best fit for G/Abay and Koga rivers. Pearson III method of moment probability distribution is a best fit for Megech and Rib rivers. For Gumara river Pearson III probability weighted moment distribution better estimate flood quantiles with less standard error. It is also found that Gamma two probability weighted moment is best fit for Lake Tana water surface level. In general from rainfall and flood frequency analysis 2006 year flooding may have a chance to occur once in six years in LTB.

The 2006 year flood damage indicates that there is high impact on agricultural production of Lake Tana surrounding plains. 107,647 peoples were actually affected by flood. At least 448, 910 quintal of food grain, 1230 domestic animals, 9634 chickens and 1088 bee-hives were damaged by 2006 flood. The impacts of flooding on socio- economic and environmental resource indicators were qualitatively assessed. Totally twenty seven indicators were assessed. Based on the assessment ten indicators gave beneficial impact and thirteen indicators gave adverse impact the rest indicators gave that no impact on flooding or the impact is not identified. In general 2006 flooding has a negative socioeconomic impact, which over shadow the beneficial impact with respect to the environment and socio-economy.

CHAPTER ONE

1 INTRODUCTION

1.1 General

Natural hazards and flood events are part of nature. They have always existed and will continue to exist. With the exception of some floods generated by dam failure or landslides, floods are climatological phenomena influenced by the geology, geo-morphology, relief, soil, and vegetation conditions. Meteorological and hydrological processes can be fast or slow and can produce flash floods or more predictable slow-developing floods, also called riverine floods.

Excessive flooding in rainy season of Ethiopia is becoming problem which in many parts results in loss of life and extensive damage to the infrastructure and agricultural production. Much of the international emergency assistance is directed to alleviate the immediate short-term problems arising as a result of excessive floods. However, more lasting solutions are required to overcome and reduce the negative effects of flooding in a sustainable way.

Flooding on the lower plains of LT due to the overflowing of Rib and Gumara rivers is a recurrent event and each year causes some hazard, in varying degrees and area coverage, to the agricultural production, rural infrastructure and human settlements. Floods reached to disastrous proportions in 2006 with serious damages in food production and human settlement. The floods occur during the monsoon period from July till November and are caused by heavy tropical storms in its drainage basin.

Fogera, Dembia and Kunzila are the areas around LT which are flooded severely. Even if the farmers know that the areas are vulnerable to flood, they are not willing to flee to other areas. Rather the population increases from time to time, because these plains are fertile and high market access. The farmers cultivate at least two times in a year one by the long rainy season and the other by the moisture stored after the heavy rains. The main problems which affect agricultural production on these plains are the recurrent flooding and waterlogging.

Although Fogera and Dembia plains form from repeated deposition of sediments, they are ideal habitats for human settlement and cultivation; these are areas at risk from catastrophic flood events and suffering from water borne diseases (Malaria and Bilharzias). There should be a mechanism of living with flood, adapting to floods, developing local flood warning systems and devising flood mitigation systems are practical alternatives to improve flood use. Furthermore, there is a need to protect against the excess flood water in wetland and swamp areas. Land drainage is required to meet the demand for agricultural land and eradicate breeding ground for waterborne disease causing agents.

This study is therefore an attempt to identify the main causes and effect of flooding on agricultural production and the peoples living in the Lake Tana surroundings.

1.2 Statement of the Problem

Although floods are relatively common during the June to September rainy season in Ethiopia, the magnitude of the current flooding in 2006 is unprecedented. In year 2006 the country has experienced some of the heaviest and most intense rains on record; resulting in flash floods and/or the overflow of rivers, lakes and dams, where local residents have been advised to leave. The impact of the disaster in terms of lives, infrastructure, livelihoods, and basic coping mechanisms has yet to be assessed.

By the end of August 2006, large areas in as many as eight regions had been affected. The map of 2006 year flood vulnerable areas in Ethiopia is depicted on Figure 1.1. According to the latest information issued by the Ethiopian Government Disaster Prevention and Preparedness Agency (DPPA) more than 500,000 people are vulnerable, and about 200,000 people have been affected. The details of the affected and death toll are furnished in the Table 1.1.

Table 1.1 Regional summery of people affected and death by flood as of August 24, 2006 (DPPA, 2006).

Region/area	Vulnerable	Affected	Number of deaths
Afar	28,000	4,600	-
SNNPR	106,300	44,000	368
Amhara	47,100	47,100	5
Oromia	61,300	21,900	8
Tigray	122,300	2,600	-
Dire Dawa	10,000	10,400	256
Somalia	87,000	43,200	-
Gambella	62,000	26,100	2
Total	**517,800**	**199,900**	**639**

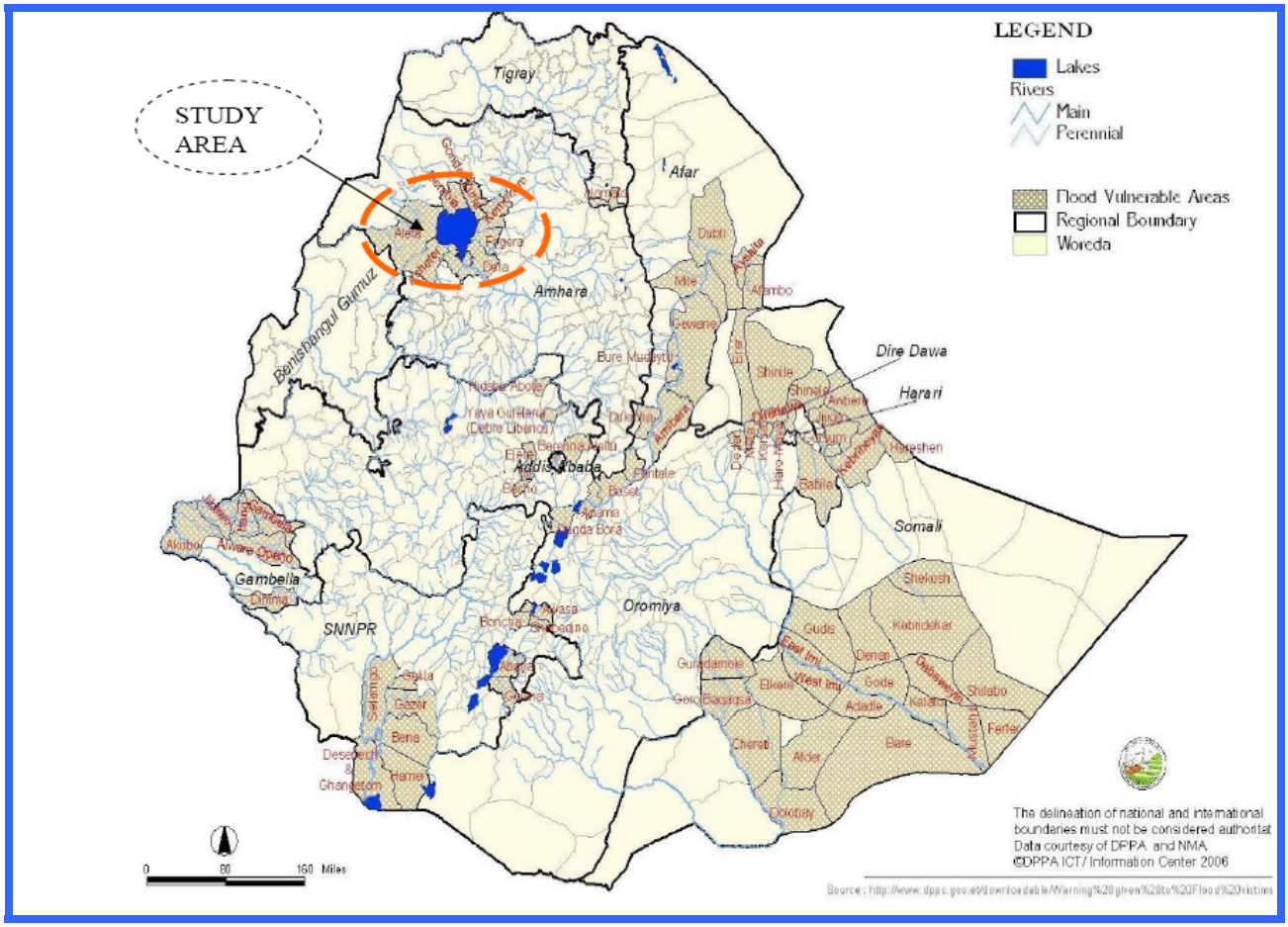

Figure 1.1 Flood vulnerable areas in Ethiopia in August 24, 2006 flood (DPPA, 2006)

There are about sixty one (BCEOM, 1998) large and small streams that draining into the Lake; with only one outlet (Abay). The outlet is already too elevated (by lava flow) to allow the water to gush out as much as it enter the Lake. Moreover, as part of the Tis-Issat hydropower scheme, the outflow is being regulated. These have resulted in a more or less settled water body allowing most of the sediment in suspension to settle onto the bottom of the Lake. As the sedimentation increases, the water holding capacity of the Lake decreases.

The four major rivers (Gumara, Megech, Rib and Gilgel Abay) contribute 93% of water to the Lake (Kebede S. *et.al*, 1998). The amounts of annual flow from the streams in recent years have high fluctuations. For e.g. in 2003, the level of LT became so low that rocks were exposed making navigation difficult but on the other hand, this year 2006 excess inflow that caused large areas to flood.

2006 flood is one of the severe floods which inundated large area of cultivated and grazing land in surrounding of LT (the flood situation in Fogera plain of LT are shown in Figure 1.2). The drainage situation of the area has worsened the problem; cultivated crops were damaged and livestock grazing become impossible which had significant impact on food security. Due to increasing population in the area, the number of people affected by flood will rise in the foreseeable future. The causes, problems and the effect of this flood should be assessed to avoid the damages being caused by future flooding. The occasional advantage of the area should be weighed together with the damage caused by flooding.

Causes of flooding, flood control, drainage investigation of LTSPs in the basin as a whole is not studied separately and in detail except the regional study of the Abay River Basin Master Plan for different development activities as a scale of 1:250,000 (BCEOM, 1998). The project area lacks a detail hydrological and socio-economic study on floods and flood management in order to launch developmental activities in the basin. It is believed that this paper will play an important role towards sustainable development in the basin.