

2017-12-26

# INTEGRATING GIS AND REMOTE SENSING TECHNIQUES FOR THE ASSESSMENT OF EROSION VULNERABLE AREA: THE CASE OF JABI TEHINAN WOREDA, WEST GOJJAM ZONE, AFRICAN HARA REGION.

Abebe, Mengaw

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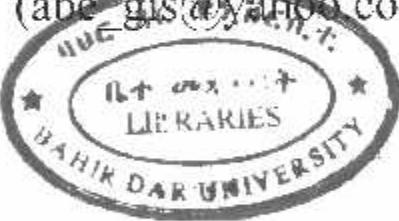
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# **INTEGRATING GIS AND REMOTE SENSING TECHNIQUES FOR THE ASSESSMENT OF EROSION VULNERABLE AREA: THE CASE OF JABI TEHNAN WOREDA, WEST GOJJAM ZONE, AMHARA REGION.**

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June, 2010

INTEGRATING GIS AND REMOTE SENSING  
TECHNIQUES FOR THE ASSESSMENT OF EROSION  
VULNERABLE AREA: THE CASE OF JABI TEHINAN  
WOREDA, WEST GOJJAM ZONE, AMHARA REGION.

Thesis

Submitted in Partial Fulfillment of the Requirements for the  
Degree of Master of Science in Geo-Information System

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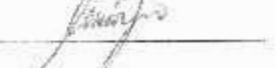
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The thesis titled "INTEGRATING GIS AND REMOTE SENSING TECHNIQUES FOR THE ASSESSMENT OF EROSION VULNERABLE AREA: The Case of Jabb Lehnan Woreda, West Gojjam Zone, Amhara Region," by Mr. Abebe Mengaw is approved for the degree of Master of Science in Geo-Information System.

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Date: June, 13, 2010

## **Acknowledgements**

First and foremost, glory to the Almighty God who willing to me health and strength to complete the entire requirements and finalize the necessary thesis work successfully.

I am greatly express my deepest gratitude and indebtedness to my advisor Ferede Zewdu (Assistant Professor.), Lecturer, Department of Geography and Environmental Studies in Bahir Dar University, Bahir Dar, for his unlimited support, advise and insightful comments in the preparation of this research work.

I am also express my heartfelt gratitude to Dr. Birru Yitaferu, Directorate of water and soil conservation in Amhara Regional Agricultural Research Institute Bureau, for his real hospitality and giving valuable comments, encouragement and kind cooperation to finish this thesis in time appropriately.

I am also thankful to Amhara National Regional State-Finance and Economic Development Bureau, Agriculture and Rural Development Bureau, Amhara Regional Agricultural Research Institute Bureau and Bureau of Statistics for giving all the necessary data. And also my gratitude extends to Bahir Dar University for its accessible internet service and documentations. Further my special acknowledgement goes to Mizan-Tepi University for giving me the chance to enjoy my graduate studies.

I am greatly indebted to all my family members Mengaw Wubie, Netsuh Ejigu, Teyeku Wubie, Gubaye Ejigu and all my brothers and sisters for their supportive nature through my life. And also I am very grateful to all my best friends especially to Dawit Tesega and Alemaychu Tefera for their encouragement and necessary support in different corners.

Finally, I dedicate this thesis to my father Mengaw Wubie, My mother Netsuh Ejigu, my sister Selamawit Mengaw and my lovely friend Titi Abate.

**Abebe Mengaw**

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## **List of Abbreviations**

- FAO- Food and Agricultural Organization  
SCRP- Soil Conservation Research Programme  
ANRS- Amhara National Regional State  
MOARD- Ministry of Agriculture and Rural Development  
SRTM- Shuttle Radar Topography Mission  
NDVI- Normalized Different Vegetation Index  
DEM- Digital Elevation Model  
GPS- Global Positioning System  
GCP- Ground Control Point  
GIS- Geographic Information System  
RS- Remote Sensing  
NRM- Natural Resource Management  
GMOE- Geological Map of Ethiopia  
LULC- Land use/ Land cover  
EWG- Expert Working Group  
ENU- EHS-United Nations University Institute of Environment and Human Security  
MCE- Multi-Criteria Evaluation  
MCA- Multi-Criteria Analysis  
AHP- Analytical Hierarchy Process  
WEPP- Water Erosion Prediction Project  
EUROSEM- European Soil Erosion Model  
UNEP- The United Nations Environmental Programme  
m.a.s.l- Meters Above Sea Level  
RDBMS- Relational Database Management System  
PESERA- Pan European Soil Erosion Risk Assessment

## **Abstract**

*Soil degradation in the form of soil erosion is a serious and continuous environmental problem in Jabi Tekinan Woreda. Uncontrolled land use, deforestation, land over cultivation, overgrazing and exploitation of biomass for firewood, construction and other household uses due to increasing population ultimately leads to severe soil erosion. The impact of natural hazards like erosion hazard can be minimized and ultimately controlled by disaster preparedness maps. Therefore, the overall objective of this paper is to identify and map erosion vulnerable areas for the planning and implementations of sustainable soil conservation and management system in the study area.*

*This study had integrated GIS, RS and MCE models to assess and map erosion vulnerable areas and RUSLE model to quantify an estimated soil loss in Jabi Tekinan Woreda. Slope gradient, soil type, LULC, rainfall and drainage pattern were used as input model parameters/variables. The data had been collected and analyzed from different land sat imageries, SRTM data, topomaps and point interpolations of primary data. Finally the aggregated effects of all parameters had been analyzed and priority rating of erosion vulnerable area was calculated using weighted overlay techniques.*

*After analyzing all model parameters, areas in steeper slope with Lithosols, Entric Nitosols, Orthic Luvisols, croplands, bare lands and river banks have been identified as the most erosion vulnerable areas. Quantitatively, 3,644 ha (3.1%), 12,857.8 ha (11%) and 33,995.5 ha (29%) of the entire land is endangered to extremely vulnerable, highly vulnerable and vulnerable areas respectively. The remaining almost half 39,310.7 ha (50.7%) and 7,165.5 ha (6.2%) of the land is explained to less and very less erosion vulnerable areas respectively. In general the northern, northeastern and a little bit of the southern margins of the woreda is the most exposed or vulnerable areas to erosion. While the south and central parts of the study areas are insignificantly vulnerable to erosion by water. The estimated annual soil loss in Jabi Tekinan Woreda ranges from nearly 0 in south and central parts of the study area to 504.6 t/ha/yr in the steeply sloping mountainous areas of the north and north-eastern parts of the catchments.*

# CHAPTER ONE

## INTRODUCTION

### 1.1. Background

Nowadays, people in developing countries are increasingly forced to use more marginal and sensitive lands for agricultural purposes in every aspect to sustain their living. These uncontrolled uses of land due to population growth ultimately leads to deforestation, land over cultivation, overgrazing and exploitation of biomass for firewood, construction and other household uses, often causing severe soil erosion.

Soil erosion is the direct result of the mismanagement of the soil by man in his effort to obtain a living from it (Gustafson, 2005). Studies reported that, cultivation without using specific control techniques and unplanned land use, such as uncontrolled urban development, deforestation and mal-agricultural practice are fundamental factors of soil erosion (Biard and Baret, 1997). It is clearly evident that the ultimate cause of erosion is human himself contributing about 60 to 80% of all soil erosion and soil degradation (McNeill, 2000). Further Gerrard (2000) stated that soil erosion by wind and water are natural processes, but enhanced by human mismanagement of the land. Due to uncontrolled and unmanageable interference of people to the land, world wide 80% of agricultural land suffers from moderate to severe erosion. Consequently, 65% of the soil in sub-Saharan Africa is said to have undergone degradation (Ludi, 2004).

Because of favourable topographical factors and strong human impact over the environment, especially the northern highlands of Ethiopia have been characterized by severe erosion. At country level, total soil loss by erosion from all land is estimated at almost 1.5 billion tons per year and on average 42 tones per hectare, of which 45% originates from croplands alone. But, in the highlands of Ethiopia, annual soil loss reaches up to 200 - 300 ton per hectare, making the total loss 23,400 million ton per year (FAO, 1984; Hurni, 1993). With the increment of such environmental problems, identification and mapping of erosion (hazard) vulnerable area has become an important discipline in the world of Geo-Information Systems.

Mapping of erosion vulnerable area using the integration of GIS, RS and MCF technique can identify areas that are at potential risk of extensive soil erosion. The formulation of proper soil management for sustainable development requires an explicit inventory and rating of vulnerable areas. This information is very useful in the decision making context to avoid land acquisition in erosion risk areas, or, alternatively, to recommend soil conservation measures to reduce soil loss if developments continue (Yusof and Baban, 1999). On the other hand, the modeling of soil movement and their consequences plays a significant role for natural resource management and/or sustainable environmental planning processes; like optimization of agricultural productivity.

Studies on erosion undertaken at spatial scales covering local to regional areas have provided both qualitative (e.g., erosion vulnerable areas) and quantitative information (e.g., soil loss rates). Methods for evaluating erosion vulnerable area on catchments or regional scales include both the application of erosion models or qualitative approximations using GIS and RS technologies.

Thus, by this study GIS and RS were employed to evaluate potential erosion vulnerable area including the determinations and prioritizations of different factors that accelerate soil erosion in the study area.

## **1.2. Statement of the Problem**

Erosion is regarded as the major and most widespread form of environmental problems in the highlands of Ethiopian. Rapid population growth, cultivation on steep slopes, rugged topographical feature, clearing of vegetation, mal-agricultural practice, overgrazing and even higher demand for firewood are the main factors that accelerate soil erosion in the area. According to Ministry of Agriculture (MOA, 1984) erosion classification algorism, the Northwestern Highlands of Ethiopia has been categorized in to severe to moderate soil loss.

The economic implication of soil erosion is more serious in Northwestern Highlands of Ethiopia because of mainly its rugged topographical features and lack of capacity to cope

































































































































































