

Estimation of Soil Erosion in Three Northern Regions of Ghana Using RUSLE in GIS Environment

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ABSTRACT

Soil erosion is a global problem with severe consequences, which has become a widespread environmental challenge in the northern parts of Ghana in recent times. This research integrated RUSLE into GIS to estimate the annual soil erosion rates for the Northern, North-East, and Savannah Regions of Ghana. A soil erosion map was generated with an annual soil erosion rate of $4.0 \text{ t ha}^{-1}\text{y}^{-1}$ for the Northern Region, $5.0 \text{ t ha}^{-1}\text{y}^{-1}$ for the North-East Region, and $7.0 \text{ t ha}^{-1}\text{y}^{-1}$ for the Savannah Region. Relatively higher erosion rates were observed in the Tatale Sangule and Kpandai districts of the Northern Region, with rainfall erosivity being the main driving factor. There was a landuse/cover erosion reduction effect of 66% in the Northern Region, 70% in the Northeast Region, and 58% in the Savannah Region. The cover management (C) factor was overwhelmingly the main erosion-reducing factor in erosion control as opposed to land conservation (P) factor.

KEYWORDS

Damongo, Landuse/Cover, Nalerigu, North-East Region, Potential Erosion, Savannah Region, Tamale

INTRODUCTION

In every country, land is the most important natural resource for development. However, land degradation has become a threat and a serious global problem grossly affecting developing countries (Tesfahunegn, et al., 2017). Soil erosion is responsible for the decline in agriculture productivity and challenges in water resources management, hence making it the most serious environmental problem, responsible for about 80% of the effect of land degradation globally (Biswas, 2012; Sohan and Lal, 2013; Angima et al., 2003). About 38% of the world and 65% of Africa agricultural lands are degraded due to soil erosion (Arekhi, 2008; Kusimi et al., 2016). In some West-African countries such as Burkina Faso, Cameroon, and Nigeria, the productivity of cereal crops such as maize, millet, and cowpea were observed to decrease significantly due to soil erosion (Kusimi et al., 2016).

In a developing country like Ghana where agriculture is a key source of economic development and the main source of livelihood for most of the people, soil erosion has been a major threat. In

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Ghana, soil erosion is the most potent form of land degradation that threatens agricultural production and sustainability (Folly, 1997; Asiamah et al., 2000; Quedraogo et al., 2010). The country is naturally endowed with lands, forest and water resources that could be utilized for agricultural and rural development. However, the land resource is prone to desertification at about 2.0% of Gross Domestic Product (GDP), and the majority of these lands are located in the northern regions (EPA, 2002; IRG, 2005). The land resources of the northern parts of Ghana need proper management to enhance and sustain crop productivity as these regions form the food basket of the country. To achieve the objective of enhanced and sustained crop productivity requires the understanding of the magnitude and extent, as well as the driving factors of soil erosion.

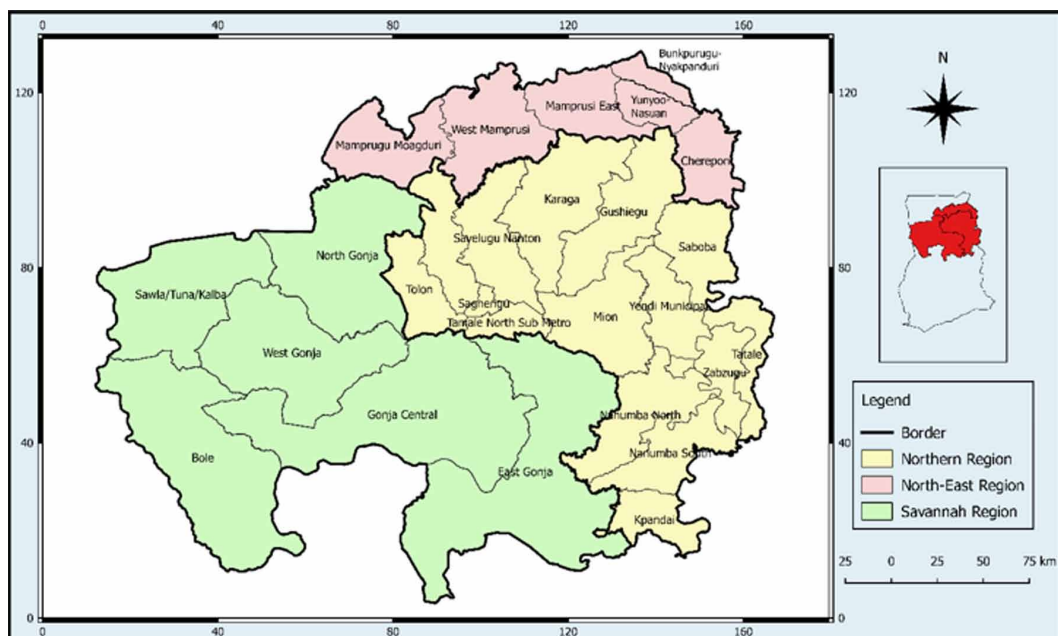
Though the topography of the northern regions is relatively low-lying, one cannot underestimate the rate of soil erosion and its effect on agriculture. This is because the vegetative cover plays a critical role in soil erosion. For this reason, it is important to determine the level of effect of landuse/cover on soil erosion to serve as the basis for developing a long-term sustainable management plan. Hence, the objectives of this study are to estimate soil erosion rates and examine the level of effect of the erosion factors, more especially the reduction effect of the land use/cover factors. By extension, the study seeks to provide an in-depth analysis of the relative effect of the cover management and land conservation factors on soil erosion reduction. This study will also provide validation or cross-referencing for similar studies in the regions in future.

MATERIALS AND METHODS

The Study Area

The study area covers the Northern, North-East and the Savannah Regions of Ghana (Figure 1). The regions have similar topographic and climatic characteristics because they were together as one region until recently (i.e. 2019), divided into three. The Northern Region lies between latitudes $10^{\circ} 17' N$ and $08^{\circ} 15' N$ and longitudes $0^{\circ} 28' W$ and $0^{\circ} 10' W$, approximately 180 m

Figure 1. Map of the Northern, North-East and Savannah Regions of Ghana, showing the administrative districts



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