Lowlands Mapping in Forest Guinea

Slim Saïdi, Territoires, Environnement, Télédétection et Information Spatiale (CIRAD/UMR TETIS), Montpellier Cedex 5, France

Aboubacar Camara, Institut de Recherche Agronomique de Guinée, Conakry, Guinea

Laurent Gazull, UPR BSEF, Biens et Services des Écosystèmes Forestiers Tropicaux (CIRAD), Montpellier Cedex 5, France

Michel Passouant, Territoires, Environnement, Télédétection et Information Spatiale (CIRAD), Montpellier Cedex 5, France

Mamy Soumaré, Institut d’Économie Rurale (IER), Sotuba, Bamako, Mali

ABSTRACT

This article presents a lowland mapping method for the Forested Guinea (Guinée Forestière) using a 30 m resolution Digital Elevation Model (DEM) that is currently the best option to analyze large forested areas. This low cost DEM method applies surface topography analysis processes to better discriminate areas with stagnant and/or accumulated water. The main index selected is the immediate proximity of flat areas to drainage network, the former with slope gradients not exceeding 5% (2.86°). The mapped lowlands potential cover a surface of 4516 km², i.e., 10% of the total area of the region with hydro-agricultural potential.

Keywords: Digital Elevation Model (DEM), Drainage Network, Guinée Forestière, Lowland, Resolution, Slope

1. INTRODUCTION

Natural resources in Forested Guinea have been subjected to significant pressure over the last decade. Its agricultural lands in particular have had to bear a considerable burden, accentuated in part by the massive influx of refugees from Liberia, Sierra Leone and Ivory Coast.

Duration of fallow periods (<5 years), lowered yields (> 1 t/ha for rice) and inefficient use of labor render this region’s agriculture systems unproductive and therefore undermine the existing delicate food balance of the population.

Faced with this crisis of hill rice cultivation, the development of lowlands – hitherto mostly neglected – for rice cultivation was identified by many actors as a way of putting this land to productive use.

Lowland development projects of Guinea benefited for several decades from the donors’ political good will for a sustainable development of this region. However, even though several development projects were initiated from the

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early 1990s, the FAO of the UN estimates that only 5% of the overall potential of lowlands in this region has been completed (FAO, 2010).

But this assessment is based upon much single sources and on non reliable data. The Lowlands of Guinea are lacking reliable data on their extent, location and potential, due to a clear definition of what are these lowlands.

From a geomorphological point of view, lowland is a flat or dished floor of small valleys with hydromorphic soil submerged for a short or long annual period due to the rise of the water table and by rainwater runoff (Raunet, 1985). These lowlands represent noteworthy landscape units in west – Africa: between 2% and 5% of total areas (Lavigne-Delville, 2003). They correspond to the upper parts of hydrographic networks regularly flooded. These are humid zones characterized, by their weak slope, by their hydromorphy and by their soil texture (clayley-sandy texture).

From a hydrological viewpoint, the lowland is defined as part of an annually flooded valley by surface runoff, rather than by the overflow from the main drain. However, from an agronomic viewpoint, lowland is primarily a small valley with a simple hydro-agricultural system (small dikes and canals), allows intensive cultivation of upland rice and other irrigated and rainfed crops.

This study is in the context of a request for assistance to decision-making to develop policies and programs for planning and sustainable lowlands development of Forested Guinea with financial support from FAO.

In this context, we take into account the agronomic concept and lowland has been defined as a valley floor (“thalweg”) whose rainfall characteristics (surface water) and topography (slopes and widths) allow its development with rainfed lowland rice systems.

We present here an original characterization and mapping of lowland areas using a 30 m resolution Digital Elevation Model (DEM). To characterize the lowlands, the use of DEM to any other source of data is justified by local topographic criteria (slopes, rugged surfaces, widths), by the scarcity of data, limited and difficult access, the extent of the area, and limited financial resources allocated to the project.

Our aim is to justify the use of a heuristic approach for lowlands mapping in Forest Guinea. Supported with field validation and local field users, our method proved to be useful in comparable situations. A second application in Mali was implemented in another context and the results showed significant consistency with ground truthing. This satisfactory result reinforces our generic approach.

The epistemological framework developed in the context of Management Sciences around Intervention-Research concept has been used. This situation occurs when all actors turn to research in order to solve problem(s) that they have to deal with. Intervention-Research are procedures which involve actors from the problem identification stage until the innovation design stage (Liu 1997; Hatchuel, 2000; David, 2000).

2. LOCATION AND CHARACTERISTICS OF THE STUDY AREA

Located between latitude 7° and 10° North and longitude 7°30' and 11° West, Forested Guinea is the fourth natural region of Guinea. It is surrounded on three sides by Sierra Leone, Liberia and Ivory Coast (Figure 1).

This tropical rain forest ecosystem covers 20% of the country (Bah, 2001) with a sub-equatorial climate. Annual rainfall ranged from 1750 to 2750 mm, distributed over nine months of the year and the mean annual temperature is above 24.5°C (Boulvert, 2003). Such conditions are suitable for rainfed rice agriculture.

The hydrographic network is very dense. The major rivers have their source in the Guinea Rise with regular hydrological regime, thanks to good distribution of rainfall throughout the year. There are two ways flow of hydrographic network: one to the south and one to the north to feed the watersheds of Upper Guinea and those of Liberia and Ivory Coast (Figure 2).
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