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MAPPING LAND AREAS THAT FAVORS' FADAMA FARMING IN BOSSO AND ENVIRONMENT NIGER STATE

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Abstract
Fadama lands are regarded as very rich agricultural areas. They encompass land and water resources that could easily be developed for irrigation agriculture. Because of the importance and scarcity of Fadama land as well as the need for sustainable development, mapping of areas favourable for Fadama farming is likely to be reliable step towards effective Fadama farming and rural development in Bosso Local Government Area. The study uses Remote Sensing and GIS techniques to map out areas that are suitable for Fadama farming. SPOT 5 image of the study area, which has 5m resolution, was used. Hand held GARMIN III GPS was used to pick points which were used to generate Digital Elevation Model of the study area, Arc GIS 9.2 was used to create the DEM of the study area. Ilwis 3.2 software was used to classify the spot 5 image. The result obtained shows that areas lying below 300m above sea level along the banks of Bosso dam and in areas such as Popoi, Nini, Dyafa e.tc. are considered favourable for Fadama farming. The areas favourable for Fadama farming in the study area covers 3690.00 hectares which is an extensive area within the area under study which covered an approximately 10503 Hectares of land. It is therefore, recommended that it is important to create the soil databases and land information system, including soil types, soil fertility, terrain, current land use status, climate, slope, vegetation cover, soil erosion and land unit map.

Keywords: Mapping, Favorable, Fadama Farming

Introduction

Fadama, the Hausa name for irrigable land, is floodplains and low-lying areas underlain by shallow aquifers and found along Nigeria's river systems (Ingawa et al, 2004). Fadama lands are regarded as very rich agricultural areas. They encompass land and water resources that could easily be developed for irrigation agriculture (World Bank, 1992). Fadama land covers about 4.9 million hectares in Nigeria. When Fadama spread out over a large area, they are often called 'Wetlands' (Blench & Ingawa, 2004).

Sub – Saharan Africa farming is said to be risky since it is based on rain – fed systems and

as such developing countries are faced with the challenge of producing adequate food to satisfy her growing population. This has contributed immensely to a widening gap between food supply and demand. However, efforts in the present problematic rain fed agricultural production need to be complemented through dry season farming. This is absolutely necessary because the productive realm of the small scale producer needs expansion.

As a result of the peculiar hydrological characteristics, Fadama soils have the potential to be used for agricultural production in a sustainable way. Such potential is particularly relevant in view of the degradation of the uplands of Nigeria [World Bank, 1992]. The major crops grown in Fadama are vegetables, wheat and rice with initial bias for vegetables (Olugbemi, 1989).

Nigeria's population is now quoted at about 140 million people. The irrigated landscape remains very dynamic which brings about considerable uncertainty about the exact extent, area and cropping intensity of irrigation in different parts of the world, due to the dynamics and systematic problems of under reporting and over reporting of irrigation in different contexts and countries (FAO, 2000).

According to FAO (2000), Nigeria is among those nations that are at the moment technically unable to meet their food needs from rain fed production at a low level of inputs and appear likely to remain so even at intermediate levels of inputs at some point in time between 2000 and 2025.

The low-lying areas which are usually flooded during the wet season, popularly known as Fadama areas, are scattered across the ecological zones of Guinea Savanna, Sudan Savanna, and the Sahel and the area vary from 1.5 to 3 million ha out of the 33 million ha of land put into cultivation (FAO, 1997). These diverse wetlands are valuable for grazing, agriculture, and other domestic uses. The Fadama/wetlands have been used for dry season farming in Nigeria and it has contributed greatly to food crop production in the country. This is more pronounced in the semi arid and arid regions of Nigeria. Over the years many farmers in the study area cultivate small areas in Fadamas during the dry season, using water directly obtained from streams and rivers manually or using electrical power generators to pump water into their lands.

The soils of Fadama are subjected to seasonal flooding and are naturally rich in nutrients deposited in the plains at the recession of the flood. Large volumes of sediments are seasonally discharged into the flood plains and help to renew the fertility of the soils. The abundance of water and the seasonal supply of fresh alluvium make these soils fertile and suitable for rice and other crops such as maize and sugarcane.

Geographic Information System (GIS) and remote sensing serve as tool to access potential land for irrigation/Fadama farming. GIS can integrate many different data sets and information systems to create a broad overview of how potential Fadama area can be

located. This approach to Fadama farming planning enables communities and concerned agencies to potent and increase their productivity. Thus, implementing a GIS analysis will be part of a larger, long term effort to gain a better understanding of floodplains favourable to Fadama farming (Ishaya & Mashi, 2008)

One of the potential approaches of doing this involves the use of Digital Terrain Modeling (DTM) to map out areas that are favorable for Fadama farming. DTM provides a so-called bare earth model, devoid of landscape features .A DTM is a quantitative representation of the topography of the Earth (or sometimes other surfaces) in a digital format. They are a common component of Geographic Information Systems (GIS) and are usually represented by Cartesian coordinates and numerical descriptions of altitude. In contrast with topographical maps, the information is stored in a vector format. The DTM is a valuable component in analyses involving various terrain characteristics such as profile, cross section, line of sight, aspect and slope. DTM also encourages internet mapping, flood mapping, agricultural planning etc. (Natale et al., 2007).

Statement of the Problem

Fadama rural communities are exposed to a wide range of social ailments including: insecurity or uncertainty of land tenure for landless farmers, lack of basic infrastructure and services such as qualitative education, agricultural services and market outlets, adequate health care facilities, potable water and other social services, and gender-based discrimination and social conflicts.

Inappropriate land uses and land management practices contribute to land quality problems such as increased rates of wind and water erosion and accelerated rates of soil acidification, nutrient decline, and carbon losses (FAO, 2000). Arable Fadama land mapping and management practices will be the major approaches for improving the management of land resources for Fadama farming. In this era, a key developmental agenda for many developing countries is the development of their agricultural base through irrigation.

In order to propose any short and long term measures to enhance Fadama farming in the Bosso Local Government Area, it is essential to have reliable data on areas favorable to Fadama farming.

Aim and Objectives

This study is aimed at mapping land area suitable for Fadama farming in Bosso local government area of Niger state with a view of creating data base that would enhance decision making for improved agricultural production. This would be achieved through these sets of objectives;

1. To create Landuse /Landcover map of the study area
2. To generate Digital Elevation Model (DEM) of the study area
3. To identify and map out areas suitable for Fadama farming

Justification of the Study

This study is capable of reducing scarcity of Fadama land in Bosso local government as well as the needs for their sustainable development and management. Mapping of potential areas is likely to be the reliable step towards effective and efficient way in securing the food needs of the populace and as well as developing the rural areas in Nigeria.

There is a gradual shift from paper work to geospatial database building. This is easier to manage and update as well as the fact that it makes the dissemination of information faster. The need to produce a map of areas favourable for Fadama farming is to help government and farmers identify Fadama land for proper allocation and management by the communities.

Study Area

Bosso local government in Niger state is one of the twelve local governments where Fadama farming is currently practiced. Niger state has a favourable climate with distinct dry and wet seasons, vast fertile arable land and the large water bodies (Rivers Niger and Kaduna) with their numerous tributaries as well as Lakes / dams (Shiroro, Kainji and Jebba) which give the state exceptional potential for rain-fed crop farming, Dry season (Fadama) crop farming, Livestock production and fishing. These potentials make the state to be known as the food basket of the nation. The major food and cash crops produced in Bosso are rice, maize, sorghum, millet, cowpea, sweet potatoes, yams, cassava, sugarcane, melon, soya beans and dry season crops such as vegetables, okra, tomatoes, pepper, garden egg and onion. The major livestock produced in the area are cattle, sheep, goat and poultry including chickens, turkey, guinea fowl, duck and pigeon.

The study area (Bosso local government) is located in Niger State. It lies in the middle belt of Nigeria, situated in the wet tropical or Guinea climate in the Guinea savanna zone. It extends on latitude 9^0 31 79N and longitude 6^0 16 65 E.

The climate of the area is a resemblance of any tropical region of the world. The major wind direction is normally along the southwest and northeast axis.

Brief Literature Review

Remote Sensing technology produces an authentic source of information for surveying, identifying, classifying, mapping, monitoring, and planning of natural resources and disasters mitigation, preparedness and management as a whole (Ibrahim et al., 2007 and Graham, 2007). Multiband, multidate and multistage satellite imaging has been extensively used in Asian countries and the developed countries of the world for water resources studies, monitoring and management of agricultural lands (Pramanik et al., 1992; Panagopoulos, 2001).

One of the potential approaches of doing this involves the use of Remotely Sensed and Digital Terrain Model (DTM) to map out areas that are favourable for Fadama farming. A DTM is a quantitative representation of the topography of the Earth (or

sometimes other surfaces) in a digital format (Andreas and Manos, 2002; Ibrahim et al., 2007). The DTM is also a valuable component in analyses involving various terrain characteristics such as profile, cross-section, line of sight, aspect and slope. DTM also encourages, flood mapping, Urban planning, agricultural planning etc (Natale et al., 2007).

Methodology

The materials, used in this study include the following: The topographic map sheet of Minna south west was obtained and the study area was extracted from the same sheet.

SPOT 5 image of the study area, date of acquisition is 05-04- 2009, with 5m resolution, was used. The bands used for this study include Band 1 Red, Band 2 Green and Band 3 Infrared. The software used include ArcGIS; This was employed in the vectorizing of the development map favourable for Fadama farming, and DEM generation and ILWIS this was used in the classification of the image.

Pre-Processing Method

The coordinates used on the digitized and interpolated contour maps were obtained from the scanned topographic maps and checked through ground truthing exercise using a hand held GARMIN 6 GPS of popular points in the study.

Producing DEM

In creating DEM for the study, analytical procedures of ARCGIS 9.2 were employed. The topographic map was digitized on screen. This process of screen digitizing involves creating and/or editing a segment or point map while an existing raster map is displayed as a background in a map window. The digitized contours from value domain were interpolated to obtain rasterized surface of the topography. Subsequently, the DTM of the entire area was produced by interpolating the four glue digitized contour maps that were produced through digitizing in the value domain. Areas of different elevations that were identifiable on the created DTM were digitized to produce a new segment map showing areas of different elevation characteristics.

The spot 5 imagery of the study area produced was overlaid on the DTM in order to identify areas favourable for Fadama farming. Areas identified on the overlaid spot 5 HRV imagery on the DTM (digital terrain model) were overlaid to generate map of the areas favourable for Fadama farming.

Discussion of Results

The DTM, Classified and Unclassified Spot HRV image shows areas favourable for Fadama farming. Alluvial soils are highly concentrated at the valley of Bosso Dam and other rivers like river Suka in the study area. These soils cover reasonable part of the study area. The water holding capacity is very high and the water table around the places where this type of soils is prominent, is usually very high with well decomposed organic matter

content in the surface layer and its texture become heavier with depth, as the weathered parent material, the alluvial soil support to a great extent Fadama farming.

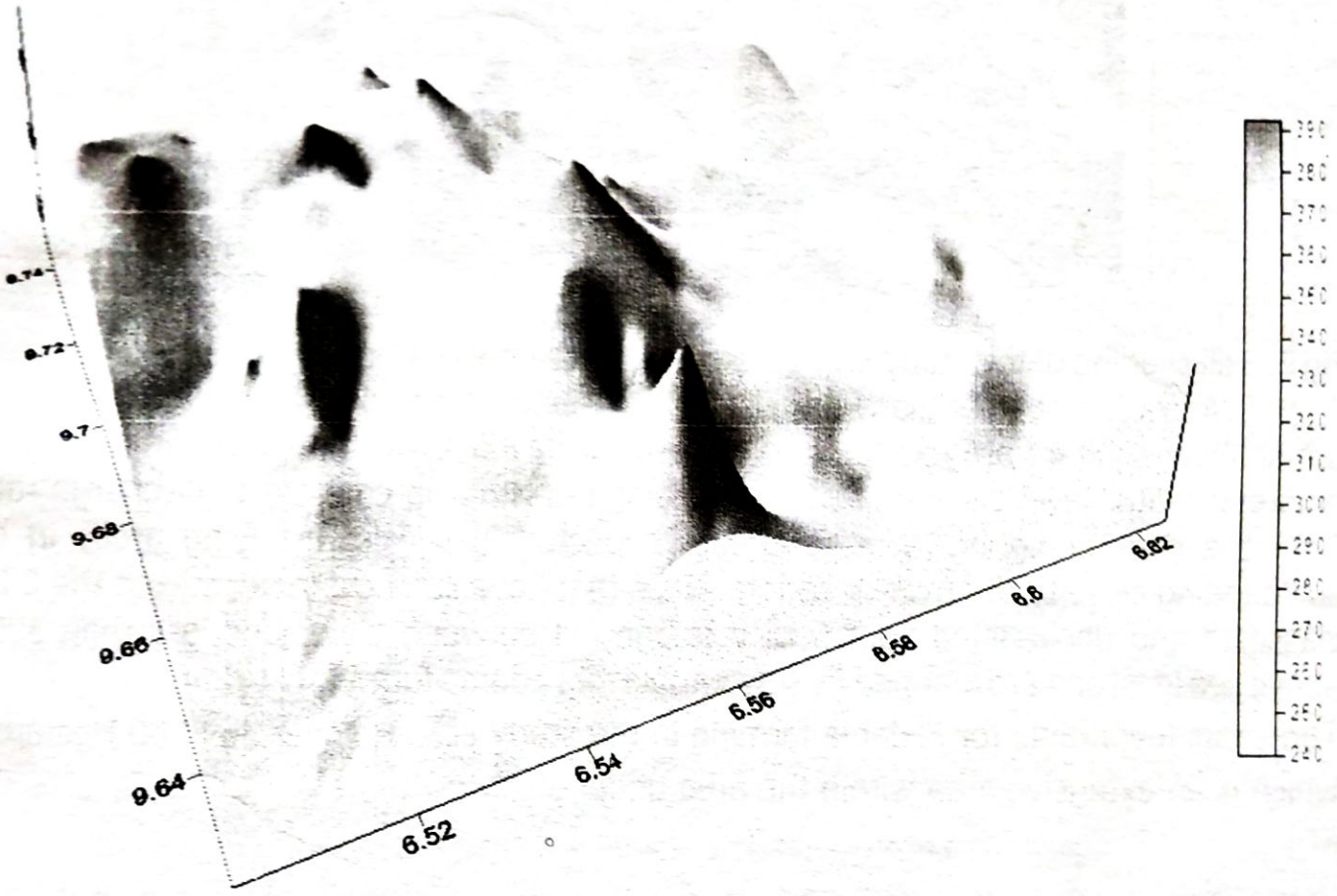

Fig 1. Digital Elevation Model of the study area (Source Authors Analysis)

Figure 1 shows the Digital Terrain Model of the study area which was generated from points picked at different parts of the study area during the data collection phase (Ground Thruthing) using a handheld GPS device. The generated DTM shows the elevation of the various parts and also showed significant evidence of areas that are on the flood plains of river suka etc within the study area. It is evident also that area less than 300 meters above sea level is good area for Fadama farming.

The Hill Shading (Fig. 2) was also generated using Arc Map 9.2 software, this was done to further enhance the finding of the generated Digital Elevation Model (DTM) of the study area and also to aid the easy identification of areas which are suitable for Fadama farming through their ability to retain water from either underground source or accumulation of run – off from high lands or upper portion of the study area.

Fig 2. Hill shading of the study area (Source Authors Analysis)

According to (Meridian Energy, 2007) water level changes with discharge point of the shallow aquifers are expected to be less than what is further away from opposite points as water level discharge will be decapitated through changes in discharge rates from the river or spring. Wetted land is expected in the lowest lying areas in the surrounding close to the river or spring. Areas that have such characteristic on the DTM, classified and unclassified Spot 5 HRV Image fall between elevations less than 300m above sea level and are mapped FV (favourable for Fadama farming).

The areas favourable for Fadama farming in the study area is cover 3690.00 Hectares which is an extensive area within the area under study

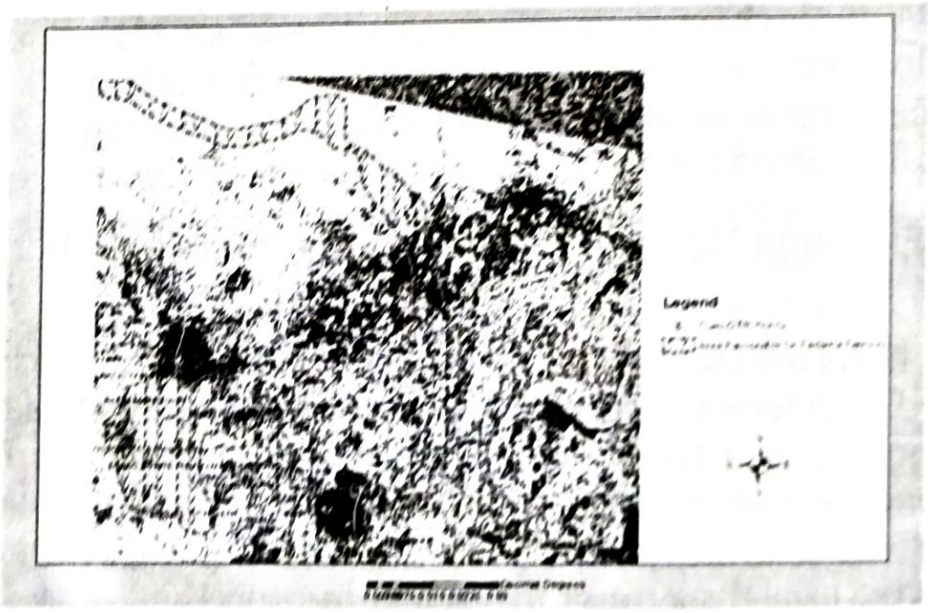

Fig 3. Areas Favorable for Fadama Farming (Source Authors Analysis)

From figure 3, reasonable extents of the areas considered favourable for Fadama farming is dominated by wetland vegetation, vegetation and farmlands rather than developmental structures. Areas considered less favourable for Fadama farming are actually dominated by urban structures, vegetation and upland farmlands within Bosso local government area.

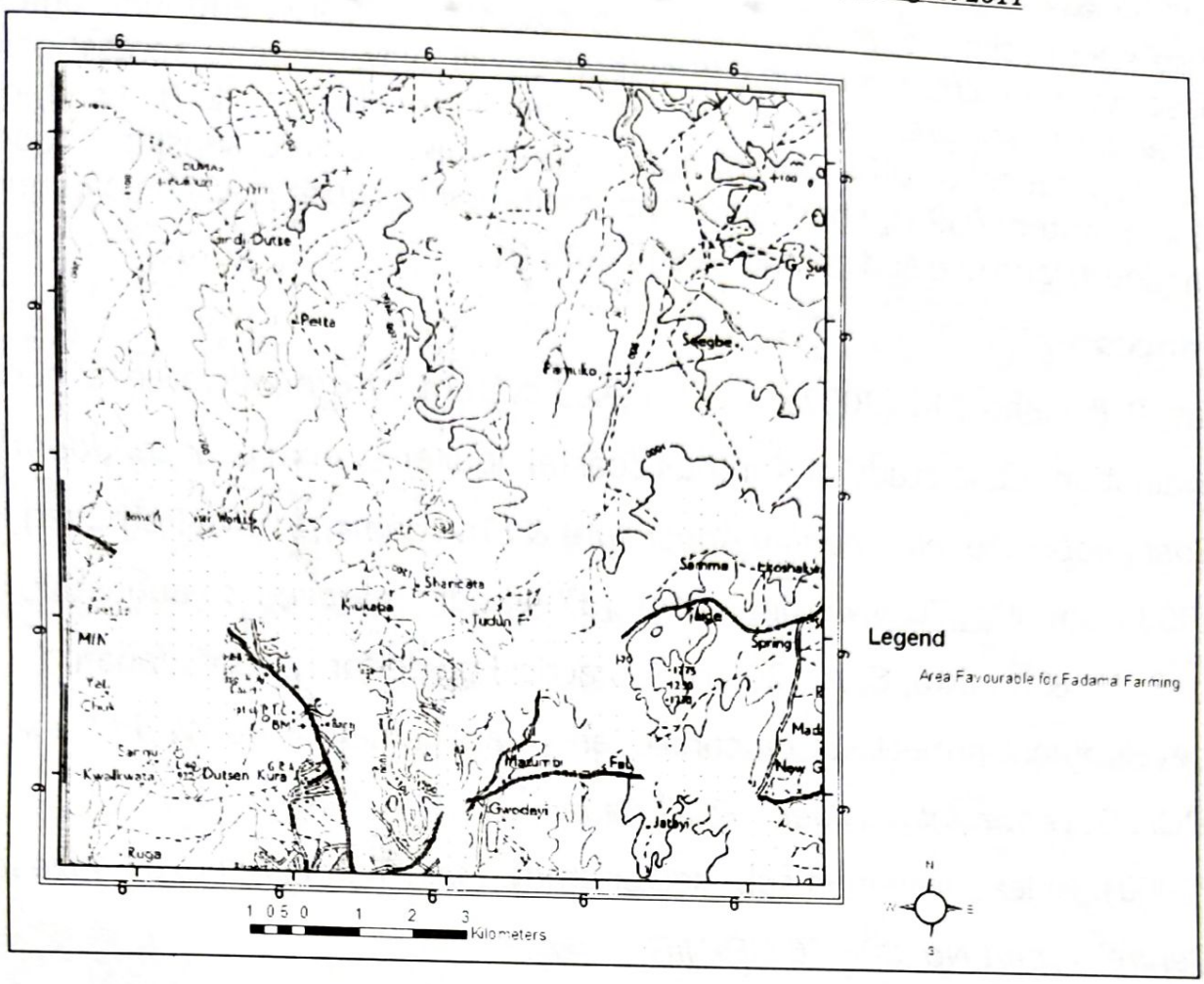

Fig 4. Mapped out areas that favor Fadama farming overplayed on topographic sheet of Minna (source; authour's analysis).

The major potential crops in the study area include Rice, Maize, Okro, Pepper, Water Leaf, Pumpkin, Sugar Cane, Greens, Spinach, and Tomatoes

Conclusion and Recommendations

This study revealed the potential of Remote Sensing and Geographic Information Systems (GIS) techniques in the struggle towards achieving sustainable environmental development and food security with a sole interest in mapping areas favourable for Fadama farming, to know the extent of the area useful for Fadama farming and also to identify the extent of the various land uses within the study.

In this study some of the major findings are: Areas on the DTM considered favourable for Fadama farming fall between elevations less than 300m above sea level which include Popoi, Nini, Dyafa and Gusasa. Potential fadama land in the study area covers 3690.00 hectares of the entire study area on the DTM.

It is recommended that geographic information system be used to create the soil database and land information system, including soil types, soil fertility, terrain, current

land use status, climate, slope, vegetation cover, soil erosion and land unit map. The database system if created using GIS software, will allow users to access, edit, update, overlay and with some analysis will create a new map which could be used for decision making. Application of other information sources like remote sensing images; Global Positioning System (GPS), etc should be encouraged because it will help in bringing real time change in land use and management strategy

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