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Using Remote Sensing Data to Improve Rice Production in Kutigi Niger State

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Abstract

This research work looked in the used of Remote Sensing to improve Agricultural production in Kutigi, Niger State. The aim of the study is to use remote sensing to improve rice farming activities in Kutigi, Niger State. It is very important to identify such methods to improve Agricultural production because experts are always interested in new researches and findings to better the standard of living in any environment. In view of this, Remotely-sensed data could be used or employed to elevate most of these agricultural problems in Kutigi through the following objectives: Using Landsat imagery to assess the present landuse of the study area, to analyze the Landsat imagery to show the level of agricultural landuse in the study area, to carry out soil analyses in other to know the suitable of un-used land and to recommend the techniques to the relevant authority on agricultural development. The materials collected and used for identification, mapping and classification of agricultural land were topographic map, satellite imagery, journals and articles. This research work demonstrates the ability of remote sensing techniques in monitoring of agricultural phenomenon. Attempt was made to capture as accurate as possible. Except for the inability to accurately map out farmland in the imagery, due to the aforementioned limitation, field survey was carried out to physically assess the terrain of the area, and also identified the different types of soil in the area and their respondent to crop yield. The classes were distinctly produced for the area but with more emphasis on farmland as it is a combination of anthropogenic activities that make up this class. However, the result of the work shows that the level of agricultural practice in the area precisely rice production is increasing and equally shows the areas that are suitable for rice production in the study area. The result of the study shows Kutigi area covering a total of 41.2sqkm, was a well fertile agricultural land, with a little stream passing across the eastern part of the areas, and Settlement of about 44.3%, some scattered Fulani settlement within the areas. Agricultural land covering about 50.5 % of the total land, which prove it more suitable for agricultural production precisely rice production, considering the weather, soil type and the amount of rainfall within the area. The information on the state of agriculture is very essential for general planning and assessing crop yield. Part of the data used for this research was obtained from GIS Vendor. Thus the data acquired has exhibits great spatial and temporal variability. For the purpose of obtaining a standard information and representation on the state of agriculture in Kutigi, a combined effort by government and private individual should be taken, to ensure efficiency and effectiveness in the analysis of agricultural phenomenon.

Keywords: Rice, satellite, cultivated land, remote sensing, GIS

Introduction

Rice is one of the key food grains linked to the food security of growing population of the world. Rice (oryza sativa L) ranks third coming after wheat and maize in total world cereal production. Rice consumption in Nigeria has been on the increase.

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In 1989 alone the demand for rice was 2.31 million metric tons while supply was just 1.38 million metric tons. Rice is high in carbohydrate (75.5%) but low in fact (0.8%) and protein (8.6%). Rice grain contains considerable amount of vitamin E as well as some amount of fat soluble vitamin A and D. Rice bran is a valuable livestock feed, domestic fuel and organic manure. The bran oil is used for cooking, soap making, carrier for insecticide and anti-corrosive and rust resistant oils. Rice is also used for malting in brewing industry. Rice straw is used as a source of fuel in the manufacture of straw board, for thatching and for making hats and mats (AERLS, 1984, NCRI, 1970, NCRI, 1980).

The importance of rice and its volubility in the context of climate change becomes relevant only

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with reliable national level spatial database for monitoring, mitigation and modeling purposes. A significant feature of the last two decade is the application of new technologies for effective Land management. The lacuna is acceptable spatial information that can be filled with the availability of multi-temporal satellite based remote sensing techniques. Remote sensing (RS) offers a wide spectrum of ground resolution that is ideally suited for various scales of mapping. Geographic information system (G I S) is a computer based system for the acquisition, storage, retrieval, analysis and display of spatial data (Badhawar, and Hendersen, 1985). Multi- temporal satellite data is the only feasible source of monitoring large agricultural unit to create a spatial database of the variant components of the existing agro-system.

Rice has important implications for food security because, among other things, it makes up approximately one third of the caloric intake of third world populations. Because countries aim to be self-sufficient, rice trade (which is dominated by Asian countries) is made up of only 17 percent of the global trade of other cereals. The largest rice producers are China, India and Indonesia. While the largest rice exporters are South East Asia and Africa as well as Middle East.

Food security can be described as the condition in which everyone has access to sufficient and affordable food; it can relate to a single household or to the global population. The first Millennium Development Goal (MDG) falls short of food security aspirations in seeking only to reduce by half the proportion of the world's population experiencing hunger. Furthermore, governments signing the Millennium Declaration were overriding a commitment made just 4 years earlier at the World Food Summit of 1996 which applied the same target to the number of people. Rising population figures mean that 170 million fewer will be targeted by the MDG programme than would otherwise have been the case (Haskew, 2008).

Unforeseen changes are linked to rice production. Studies have shown that increased temperature, due to climate change, adversely affect rice crop physiology ultimately decreasing crop yields and grain quality. Because carbon dioxide is an essential component in photosynthesis, increased atmospheric concentration of carbon dioxide is expected to increase plant growth and consequently rice yields. Uncertainty associated particularly in projected precipitation of spatial and temporal patterns caused by climate change, makes it difficult to anticipate the full effect of intensified frequency of floods and severe droughts. It is important to note, that in regions with more radiation, rice production results in higher grain yields. Overall, scholars believe that climate change has a beneficial effect on rice grain yield. The effects of carbon dioxide increase has been found to be nullified by the effects of increase in temperature. However, multiple sources of bias make estimates of climate change impact on rice production: "Their results show the future changes in mean Japanese rice yield and total rice production for the 2070s, predicted by the rice crop model SIMRIW based on future regional climate change estimated by RCM nested within MR1-CGCM2." Uncertainty in projections resulting from climate models, spatial resolution, crop models add to the level of complexity. Rice cultivation strongly depends on farmers' management skills: rice variety, Cropping pattern, infrastructure improvement, etc. (Lam-dao et al, 2009).

The goal of "Mapping the Hudson River valley using GIS'', was to identify clusters of viable farms of 1000 or more acres within state certified acting districts. The geographic extent of the project is a ten country area in the lower Hudson valley. On the east side of the Hudson includes Rensselaer, Columbia, Putnam, and Westchester countries. The study identified farm land ownership, farm type, and contiguous cultivated lands. It also identified natural attributes within the clusters such as soil type, topography, and water resources. The condition of each farm was to be noted, including its structures, management, and farmer morale. The presence of an agricultural protection plan, the existing zoning and adjacent compatible development was also to be recorded. ArcView 3.2 software was used to create the GIS (Meltz, 2001).

Changes in rice cultivation system have been observed in various countries of the world, especially in the Mekong River Delta, Vietnam. The changes in cultural practices have impacts on remote sensing methods developed for rice monitoring, in particular, methods using radar data. The objectives of the study were to understand the relationship between radar backscatter coefficients and selected parameters (e.g. plant age and biomass) of rice crops over an entire growth cycle, and to develop a rice crop inventory system using time series Envisat (Environmental satellite) Advanced synthetic Aperture Radar (ASAR) imagery. Field data collection and in situ measurement of rice crop

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parameters were conducted in Giang province, Mekong River Delta in 2007. The average values of the radar backscattering coefficients that corresponded to the sample fields were extracted from the ASAR Alternative polarization precision (APP) images. The temporal rice backscatter behaviour during crop seasons were analyzed for HH polarization (Horizontal transmit and Horizontal receive), VV (vertical transmit and vertical receive), and polarization ratio data. The relationships between rice biomass and backscattering coefficient of HH, VV, and polarization ratio were established. The study showed that the radar backscattering behaviour was much different from that of the traditional rice reported in previous studies, due to changes brought by modern cultural practices. HH, VV and HH/VV radar values were not strongly related to biomass. However, the polarization ratio (HH, VV) of rice fields at a single date during a long period of the rice season could be used to derive the rice/non – rice mapping algorithm. The predictive model based on multiple regression analysis between in situ measured yield and polarization ratio at 3 dates during crop season attained good results and thus proved to be a potential tool for estimating rice production in the study area (Lam-dao et al, 2009).

Manjunath and Panigrahy (2011), highlighted rice growing pattern in India derived using satellite remote sensing and Geographic information system. Multidate SPOT VGT 10 – day composite normalized difference vegetation index data is used along with RADARSAT SAR and IRS WiFS data to map the rice area and generate seasonal rice cropping patterns of rice crop calendar. The spectral growth profiles of rice crop clusters were modelled to derive spatial patterns crop rice calendar. The result showed that there are two major rice cropping patterns: wet season and dry season. The wet season rice calendar varied significantly. The transplantation starts as early as mid April in Jammu. The transplantation in main land India starts from Punjab by end of May and progresses towards eastern states. Out of 43 Mha of total rice lands, wet season occupied 88.8 percent. Comparatively, less variation of rice transplantation observed during dry season. The average crop duration of wet rice crop was more than dry season rice by 17 days. The prominent state growing dry season crop are West Bengal, Andhra Pradesh and Orissa. Rotation wise, rice – rice rotation accounted for 7.97 percent of the total rice area, mainly found in west Bengal, Andrha Pradish, Tamilnadu and Orissa. West Bengal state has nearly 31.7 percent under rice – rice rotations. This is the first time that a spatial database of rice cropping pattern and crop calendar of India is generated.

This project highlight on the Fadama areas in Kutigi (Fig 1) and will be given the corresponding analysis as it affects agricultural development and planning. These can be seen as catalysts in the Agricultural Land Use maps or resources evolution and Land use maps, soil survey maps, forest land use maps, urban land use maps just to mention few. In Kutigi, Population pressure in agricultural activity has resulted in degradation of the environment in this area. Largely, degradation is due to free and shrub removal for fuel wood and clearing of land for Agriculture. Many of these areas have shallow soil that do not resist erosion well. As population increases and occurrence degradation, desertification deforestation and yearly flooding, agricultural production is relatively low and consequently faced with more people having to leaks with limited food supplies.

The aim of the study is to use remote sensing to improve rice farming activities in Kutigi, Niger State. It is very important to identify such methods to improve Agricultural production because experts are always interested in new researches and findings to better the standard of living in any environment. In view of this, Remotely-sensed data could be used or employed to elevate most of these agricultural problems in Kutigi through the following objectives:

i. Using Landsat imagery to assess the present landuse of the study area.
ii. Analyzing the Landsat imagery to show the level of agricultural landuse in the study area.
iii. To carry out soil analyses in other to know the suitable of un-used land.
iv. To recommend the techniques to the relevant authority on agricultural development.

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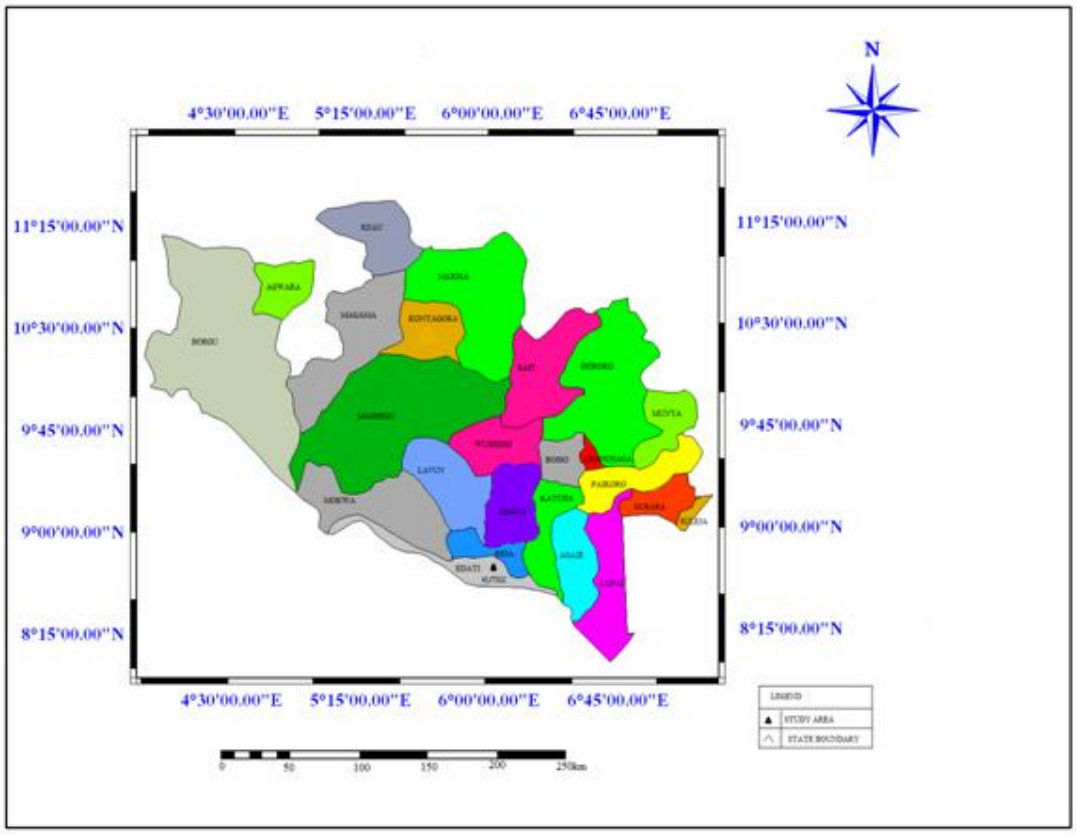

Figure 1: Kutigi the Study Area

Materials and Method

The materials collected and used for identification, mapping and classification of agricultural land were topographic map, satellite imagery, journals and articles. Table 1 shows the types and source of data for these analyses.

Data	Type	Year	Source
Topography Map	Hardcopy	1968	MLTP, Minna
Landsat Image	ETM	2004	GCLF

Landsat Imagery of 2004 covering the study area (Kutigi) was acquired from Global Land Cover Facility from the internet, topographic map covering Kutigi was also obtained from Ministry of Land Survey and Town Planning, Minna, and re-digitized from DataNET Consult. In order to achieved the stated objectives the following methods are employed.

Field Survey: This is a method in which the researcher made observation in the field as noticed.

Secondary Data Source**:** This are ready materials from different relevant field, this includes, thesis, journals, seminar paper, reports, published and unpublished material, maps from different areas.

Remote Sensing Data**:** Kutigi Landsat ETM image of 2004 was used to map out the areas and to analysis the possible problems likely facing agricultural production and also to create awareness of remote sensing techniques on improving agricultural production and monitoring in Kutigi

Hard copy topography map was first scanned, scanner produce raster data and the scanned image is imported into digitizing software environment as raster image, to be digitized on-screen, sometimes referred to as "head on" digitizing, the features from the scanned map are digitized using a standard mouse.

The image must be geo-referenced or geo-registered so as to correlate with the scanned map, before digitizing and the tracing of the features done until a composite map like the one being traced is produced. For the purpose of this project Surfer 8 software was used for the digitizing.

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Results and Discussion

Landsat imagery was one of the most useful data for use in the agricultural development sector worldwide by the organization to detect landuse changes, because it enable and make it very easy for analysis. Kutigi area covering a total of 41.2sqkm, was a well fertile agricultural land, with a little stream passing across the eastern part of the areas, and Settlement of about 44.3%, some scattered Fulani settlement within the areas. Agricultural land covering about 50.5 % of the total land, which prove it more suitable for agricultural production precisely rice production, considering the weather, soil type and the amount of rainfall within the area.

A lot of success have been achieved in the area of crop yield estimation based on satellite imagery interpretation. In principle, the process is very simple and straight forward. In a given study area, the interpreter of imagery need to determine the area of each crop type and estimate the yield per unit area of each crop.

This research work demonstrates the ability of remote sensing techniques in monitoring of agricultural phenomenon. Attempt was made to capture as accurate as possible. Except for the inability to accurately map out farmland in the imagery, due to the aforementioned limitation, field survey was carried out to physically assess the terrain of the area, and also identified the different types of soil in the area and their respondent to crop yield. The classes were distinctly produced for the area but with more emphasis on farmland as it is a combination of anthropogenic activities that make up this class. However, the result of the work shows that the level of agricultural practice in the area precisely rice production is increasing and equally shows the areas that are suitable for rice production in the study area.

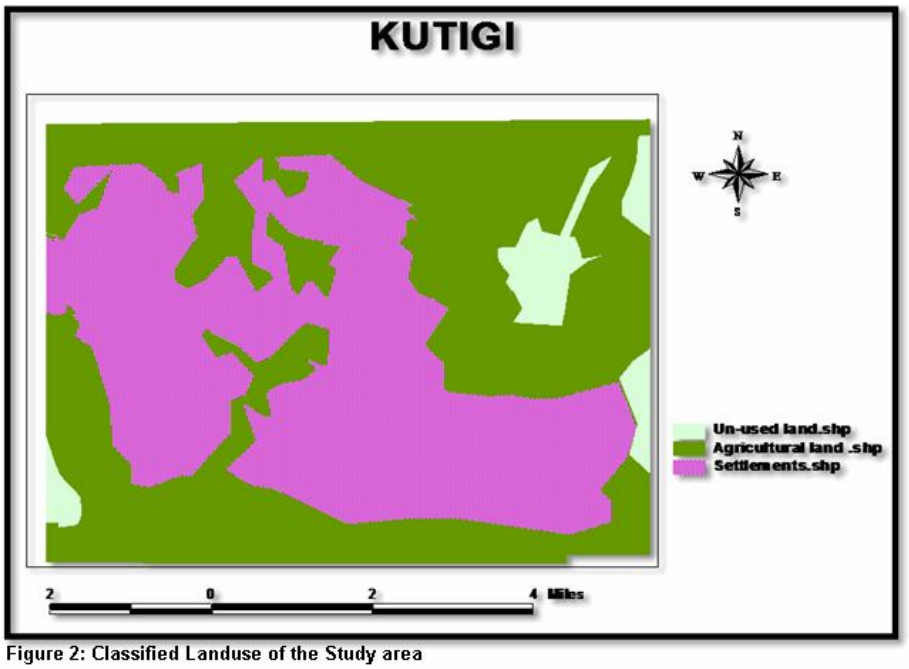

Figure 2: Classified Landuse of the Study area

Table 2: Distribution of Landuse types in the study Area

Landuse	Percentage (%)
Settlement	44.3%
Agricultural land	50.5%
Un-used land	5.2%
Total	100%

Conclusion

Remote Sensing though very expensive, offers a way to know world intimately. The value of remote sensing has been demonstrated clearly enough that its further use is assured. Man typically does not turn away from existing glimpse for the future. Having seen that possibilities, this technique offers, we can never be satisfied without current state of relative ignorance.

With the believe that remote sensing technique will in the near future, have an increasingly important role to play in the execution of agriculture production has been on four assumptions;

(a) That some limitations of the present programme as particularly
(b) That any amount spent presently on data collection and dissemination programme are worth the cost incurred
(c) That many new remote sensing techniques showing promise in research and development stage will soon be operational
(d) That improvement resulting from the remote sensing techniques will result in benefits to the agricultural economy.

Recommendations

The information on the state of agriculture is very essential for general planning and assessing crop yield. Part of the data used for this research was obtained from GIS Vendor. Thus the data acquired has exhibits great spatial and temporal variability. For the purpose of obtaining a standard information and representation on the state of agriculture in Kutigi, a combined effort by government and private individual should be taken, to ensure efficiency and effectiveness in the analysis of agricultural phenomenon. Here are some suggestions to be carried out.

. Further research should employ other advance remote sensing techniques to assess agriculture production and yield estimation
. Assessment of existing agricultural production should cover the entire farmlands of Kutigi locality.
. Government should embark on wide range irrigation project and should also provide irrigation pumps to farmers at cheap prices or in form of long-term loans to improve rice production in the study area.

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