IJSES

International Journal of Scientific Engineering and Science
Volume 4, Issue 4, pp. 50-54, 2020. ISSN (Online): 2456-7361

# Diversifying Nigeria's Economy through Crop Mapping: A Case Study of Federal Polytechnic Idah Palm Plantation

Ejiga Abubakar Isa
Department of Surveying and Geoinformatics, Federal Polytechnic Idah Kogi State

***Abstract***— *Palm is one of the most important food and cash crop in Nigeria providing food, employment and raw materials for more than 120 million people in Nigeria and beyond. Monitoring palm plantation is thus important to developing successful strategies for food security and economic diversification in the country. This paper aims to develop an approach for acreage estimation / crop inventory and yield estimation / prediction. The approach adopted was the integration of core survey methods namely remote sensing imagery, ground survey and ArcGIS. The set aim of the study was achieved.*

***Keywords***— *Palm, monitoring, economic diversification, food security, crop inventory, acreage estimation, ArcGIS.*

## I. Background

According to Urban Farmers Guide, Crop Mapping has important roles to play in various applications ranging from environment, economy to policy making (Warllow *et al.*, 2007). Owing to the rapid increase in the world population there is a corresponding demand for more food and irrigation water. In global food market, crop type map are necessary dataset that are required in calculation and estimation of crop yield (Doraiswamy *et al.*, 2009), Haboudane *et al.*, 2002, Thenkabail *et al.*, 2009). Irrigation water management and planning is challenged by conflict existing between extensive agricultural development and the limited nature of the available water resources. Crop classification are therefore important in the estimation of regional consumption of water by crops (Stehman and Milliken 2007). Owing to the growing increase in the use of biofuel, there has been a corresponding high demand in biofuel crops and this ultimately speed up the change in cropland distribution, availability of water and conditions of the soil (Hoekman, 2009, Shao *et al.*, 2010). Also estimate of greenhouse gas emission varies per crop types and rotation rates (Pena- Barrayan *et al.*, 2011). Being a business that changes due to the uncertainty in human influences and environment and meteorological effects, agriculture holds in high esteem the ability to have up- to- date and qualitative crop type map (Xiao *et al* ., 2005) Le Toan *et al.*, 1997). For the production of reliable water planning and irrigation schedule in the arid and semi –arid area, a qualitative and up-to-date crop type map is required (El-Magd and Tanton, 2003, Xie *et al.*, 2007). The productivity in crop recorded in the central valley of California was occasioned by the nature of the climate and other allied factors. It should be noted also that the scarcity of water due to dry Mediterranean summer almost hampered the planning of water (Dinar and Zilberman, 1991, Zilberman *et al.*, 1994). In the planning of agricultural water requirement and management, a knowledge of the crop types is used to estimate the water use since the quantity of water needed in land parcel is a function of the type of crop therein. Therefore crop type map is very important in modeling water need/ use requirements on a farm (Alle *et al.*, 2005, Norma *et al.*, 1995, Anderson *et al.*, 1997, Bastiaanssen *et al.*, 1998). The most commonly applied method of estimating agricultural evapotranspiration, given by Food and Agricultural Organisation (FAO) makes use of reference evapotranspiration ($ET_O$) along with crop coefficients (Kc) to estimate or calculate evapotranspiration in farm fields (Allen *et al.*, 1998). By estimating water use through incorporating crop types in the model, water use data can be compared to proposed water supply in order to arrive at water balance for the evaluation of the extent and effect of shortage of water to aid in proper water planning.

At present, agricultural land is available through farmer information or survey conducted to identify crop types in order to manage land use change (Pena- Barrage *et al.*, 2011, Pinter *et al.*, 2003). The approaches aforementioned provide precise agricultural information, the time required to acquire the data is so long and cost implication is high and so limit their use for regular mapping endeavours (Wade *et al.*, 1994). In California, land use survey is a yearly activity by state authorities. The area covered hardly passes beyond two counties as the survey techniques which is tedious, time and money consuming. Beside it is also labour –intensive.

Since 1960 when Nigeria gained independence, agricultural sector has not performed, agricultural sector has not performed maximally since food production has not being proportionate to the increase in population. The attendant effects of these has been decline in agricultural export and internal food scarcity with an increase in the demand for food importation with its resultant harsh effects on the foreign exchange. The saving grace for the country has being the oil resources which presently is in dwindling stage. The call for diversification of the economy and need to maximally invest in agriculture becomes pertinent. Oil palm production has also been hampered over the three decade ago owing to unfavourable government policies that affected the technological capacity and the environment, as well as the production and marketing of the oil palm sector (Hyman, 1990)

Volume 4, Issue 4, pp. 50-54, 2020. ISSN (Online): 2456-7361

As a result of the high demand for palm oil occasioned by the increases in population in relation to the low production rate, Nigeria has been an importer of palm oil. The devaluation of the naira has not helped to favour the use of imported oil above the local type. The challenges of Nigeria therefore are to, first meet the domestic demand for the commodity and also strive to become an exporter.

Oil Palm processing has the potential of providing income and employment to the teeming population of Nigeria especially in the south-east geo political region if certain hindrance namely inefficiency in production system which breed high cost of labour, lack of good roads to aid transportation, steady electricity supplies, and water and credit facilities among other are resolved. An inexpensive crop mapping methodology that can be routinely used to provide annual crop map over large area as this is very desirable. Remote sensing gives a reliable and potent means to map crop types and estimation of areas. Before now various attempt have been tried. Radar dataset are not affected by cloud cover but has the problem of low resolution, high noise condition and cost (Del Frate *et al.*, 2003, Tso and Mather, 1999, Soares *et al*., 1997). According to Pal and Mather (2006) the use of hyper spectral images in crop mapping is uneconomical.

Agriculture unarguably is the principal economic activity of the vast majority of the populace in Nigeria as 70% of the population is engaged in agriculture but more than 70% of these only aims at subsistence level (Okubanjo, 1990, Nigeria Millennium Development Report, 2004). The Food and Agriculture Organization FAO, 1993 concluded that new commodities and methods of production must be developed in order to improve agriculture. Institutions abound in Nigeria that generate agricultural information and they include agencies, research institutes, Universities and College of Education etc. (Ilevbaoje, 1998).

According to CTA (1996), Ozowa (1997) and Connoy (2003) the quantity of agricultural information available as developed by various agencies and organs is high. The challenges are how to get this information across to the end users in seamless fashion. Good information is characterized by relevance, timeliness, accuracy, cost effectiveness reliability among other. (Statrast, 2004).

According to Oladele (1999) information intended to help the performance of farmer must be disseminated accurately and timely to them in a format that allows easy comprehension and usage and must have a feedback mechanism to the inventor of the information to be abreast with success or otherwise of the information.

The oil palm originated in West Africa. It was spread to South America in 16$^{th}$ century and also to Asia in 19$^{th}$ century. Later Asia overtook Africa and become the leading producer in 1970s. At the moment, the consumption of the product is greater than its production rate in Africa with the result that Africa produce 7% of the world 14.4 million tons.

Kei *et al*. (1997) compared oil palm sector in Malaysia and Nigeria and discovered significant differences. While that of Malaysia is based on coordinated approach that of Nigeria is dispersed. The Malaysian one is based on plantation mode of production and classified by large scale monoculture under unified management. On the other hand in the Nigerian one, 80% of the production comes from dispersed small holders who harvest semi wild plants and use archaic processing techniques.

## II. Review of Literature

This subsector of oil palm has presented itself as a potential productive one that can help diversify Nigerian economy in a variety of ways. The numerous economic potentials it has can attest to its ability to create growth in any stagnant economy (Purvis, 1970). Ahmed (2001) enumerated the economic importance of this tree and pointed out that it can provide direct employment to over 4 million people in twenty (20) oil palm producing states as well as providing indirect ones to other numerous people who are involved in its marketing and processing. Omoti (2001) opined that if improved oil palm processing capabilities are embraced Nigeria can improve her potentials in both the oil and palm kernel. Agboola (1993) was of the view that improved technologies should be employed to meet growth and sustainability goal by palm oil processors. One challenge faced by farmer is that although they use imported seed gotten from research institution, they lack corresponding application procedure and packages to be used along with them to improve the yield. In raising yield expected from production and consequently farmer's living standard, introduction of improved farm implements and technologies along with affordable power and energy should be supplied. The case in Nigeria is that farmers operate at subsistence level of production (Obezas *et al*., 1995). Jalani *et al*. (2000) highlighted that producers must embrace organized large scale, high extraction rate and high volume method in order to fast track the high intensive transformation of the oil palm industry in the country. Kei *et al* (1997) stressed that oil palm production in the country was slowed down three epochs in Nigeria. Immediately after independence (1960-1970), the industrialization in his epoch was financed through export taxes coming from commodity marketing boards where certain commodities like cocoa, groundnut etc. were monopolized. The result of this was that the producer price had a bad effect on the production of export crops. The second epoch was civil war from (1967-1970) with its attendant damaging effects on the economy. The oil boom period (1970 - 1985), oil export was the dominant source of Government revenue.

As a result of the devaluation in Nigeria and reduction of import duties on food material, imported foods became cheaper than domestic ones which led to bias against agricultural exports. When SAP was introduced (1993-2003) small businesses benefited due to the rise in output prices and increase in opportunities on the positive side. On the negative, however there was increase in output price and increase in opportunities on the positive side. On the negative, however there was increase in the output prices and in the cost of living in relation to nominal income (CBN/NISER, 1992). Kei *et al*., (1997) in their study revealed that owing to increase in the demand for palm oil products due to increase in both population and growth in income with a corresponding low productivity of palm oil sector, Nigeria in its effort to meet the

International Journal of Scientific Engineering and Science
Volume 4, Issue 4, pp. 50-54, 2020. ISSN (Online): 2456-7361

demand of the product become a net importer of oil palm. Next was the devaluation of the currency (Naira) coupled with high cost of transportation from the port to local markets which made imported oil to have a competitive disadvantaged position?

Nigeria's goal therefore should be the ability to meet the domestic demand for the product and further strive to become a major exporter in the global arena.

Transformation of oil palm sector is the next level agenda in order to enhance the overall economic development accruable from employment and income effects in the semi-urban, rural and even urban economies. This research has a mandate for the shift from mono –economy to a diversified one which is the goal of the present government to highlight the opportunities inherent in foreign direct investment in Nigeria through agriculture in general and oil palm production in particular.

Nigeria has a population about 120 million, it the most populated and third biggest economy in Africa. Oil has being dominating the economy by accounting for about 80% of government revenues

In 1970, it emerged from a poor agricultural based economy into a rich oil producing one. In 1969, the oil sector generated only less than 3% of GDP with US $ 370 million in export (42%) of total export and per capital income of US $ 130. Here more than half of the GDP was contributed by the agricultural sector. In 1980, oil sector contributed 30% of GDP. After r the discovery and exploration of oil, the exchange rate appreciated greatly in 1970s (Ahmad and Singh, 2002) with the steady supply of oil, the non-oil tradable sector had sharp decline in pre-eminence and this eroded Nigeria's competitiveness and the agricultural sector was the most affected when it was totally neglected (Ajakaiye, 1996, EDR, 2001)

With the Buhari administration coming on board in 2015, the emphasis of the Government on diversification of the economy became very paramount and one such ways of actualizing this was through the oil development, processing and marketing.

Taking into account and borrowing from the Malaysian experience, Nigeria can encourage palm plantation farming as this has greatly enhanced Malaysia productivity. Surveying and Geoinformatics approach can be utilized to monitor such plantations for detection of diseases infested stands, due to be harvested ones and other surveillance operations that may be needed from time to time

*Aim and Objectives*

This paper aim to develop an approach for acreage estimation, crop inventory and yield estimation /prediction. The objectives included integration of core survey methods namely remote sensing imagery, ground survey and ArcGIS i.e.

1. Establishment of Ground Control Points (GCPs).
2. Collection of imagery of the Federal Polytechnic Idah using Google Earth PRO
3. Georeferencing of the imagery using the. established ground control points
4. Digitizing of the imagery and creation of geo data base and feature classes as appropriate using ArcGIS 10.1 software

## III. MATERIALS AND METHODS

*Study Area*

The Federal Polytechnic Idah, formerly college of technology, is a federal government owned tertiary education institution that established in 1977 in Idah, Kogi state (Obahopo, 2014) and Abah, 2015). It is approved by the National Board for Technical Education and it offers National and Higher National Diploma courses at undergraduate level with the aim of training competitive middle level manpower for development.

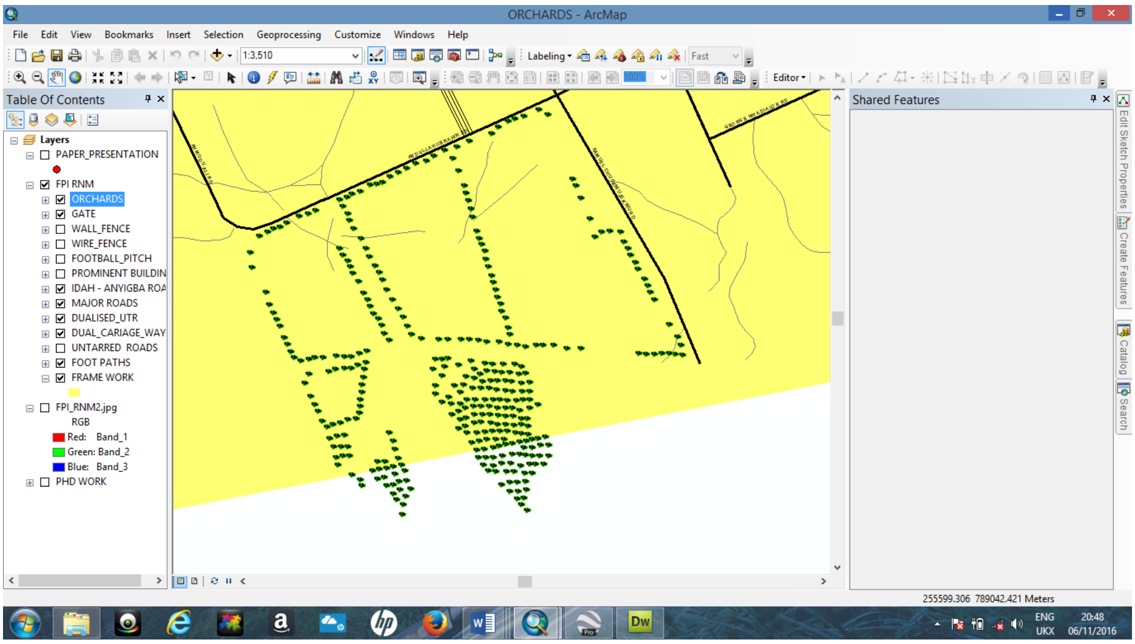


Fig. 1. Showing the orchard

*Methodology*

The imagery was downloaded from Google Earth PRO of 2016. This was georeferenced using GPS coordinated point and had a residual error of 0.02m using ten (10) points. It was further rectified and projected. The imagery was exported into ArcGIS 10.1 software and geodatabase was created as Road Network Mapping. Under this, other feature classes namely major roads, road, dual carriage way, untarred road, foot paths, frame work and orchard were created.

The on screen digitizing method was adopted for each feature class and coordinate of points were generated as the cursor was used in tracing over the feature. The database of each of the digitized feature was automatically generated and saved in the system

## IV. Result and Discussion

As the imagery was digitized, the database of the palm orchard was generated and from the click of the button the total number of the palm stands can be seen, the acreage of the orchard is also generated. A further inquiry into two number of bunches produced by each stand on the average would also give the yield. With an average bunches at twelve and the number of strand at three hundred and seventy one, we arrived at an average yield per harvest of four thousand, four hundred and fifty two (4452) bunches. This information can be utilized as encouragement to boost economic diversification as many other products usable in a variety of ways are accruable from this.

Mathematically represented thus:
Area = Acreage =163,671.12m$^2$
Total number of stand = 371
Average number of bunches = 12
Total yield per harvest 4452 at an average.
It can be harvested of 6 times in a season
Total yield estimation = 4452x6 = 26,712

## V. Conclusion and Recommendations

The map of the crop produced can be used for obtaining the C of O of the farm land which is turn can be used as a collateral for accessing bank facility which could be engaged in maintaining the existing farm or for further expansion with the total acreage known as yield estimate, the farmer is propelled to strive to achieve the estimated target hence ensuring maximum productivity. All effects would be geared towards protecting the farm against possible danger like bush fire, pest infestation etc. as possible routes for such setback are mapped.

It recommended that farmers be encouraged to engage in crop mapping especially by the public extension workers as the benefits are enormous

## References

[1] Abah, Adah (2015) 'Idah: Traditional Capital of Igala Kindom'. Leadership Newspaper – Nigeria's most influential newspaper. Retrieved 13th September 2015.
[2] Allen, R.G., Pereira, L.S., Raes, D., & Smith, M. (1998). Crop evapotranspiration: Guidelines for computing crop requirements.
[3] Allen, R.G., Pereira, L.S., Smith, M., Raes, D., & Wright, J.L. (2005). FAO-56 dual crop coefficient method for estimating evaporation from soil and application extensions. *Journal of Irrigation and Drainage Engineering-Asce, 131*, 2-13
[4] An Urban Farmer's Guide to Crop mapping http://growmycitygreen.com and Prospects. Proceedings of an International Seminar, Mountpelloer, France.
[5] Anderson, M.C., Norman, J.M., Diak, G.R., Kustas, W.P., & Mecikalski, J.R. (1997). A two-source time-integrated model for estimating surface fluxes using thermal infrared remote sensing. *Remote Sensing of Environment, 60*, 195-216
[6] Bastiaanssen, W.G.M., Menenti, M., Feddes, R.A., & Holtslag, A.A.M. (1998). A remote sensing surface energy balance algorithm for land (SEBAL) - 1. Formulation. *Journal of Hydrology, 213*, 198-21
[7] Conroy (2003). New Direction for Nigeria's Basic Agricultural Services: A Discussion
[8] CTA (1996). The Role of Information for Rural Development in ACP countries Review
[9] Del Frate, F., Ferrazzoli, P., & Schiavon, G. (2003). Retrieving soil moisture and agricultural variables by microwave radiometry using neural networks. *Remote Sensing of Environment, 84*, 174-183
[10] Dinar, A., & Zilberman, D. (1991). The Economics of Resource-Conservation, Pollution-Reduction Technology Selection - the Case of Irrigation Water. *Resources and Energy, 13*, 323-348
[11] Doraiswamy, P.C., Hatfield, J.L., Jackson, T.J., Akhmedov, B., Prueger, J., & Stern, A. (2004). Crop condition and yield simulations using Landsat and MODIS. *, 92*, 548-559
[12] El-Magd, I.A., & Tanton, T.W. (2003). Improvements in land use mapping for irrigated agriculture from satellite sensor data using a multi-stage maximum likelihood classification. *International Journal of Remote Sensing, 24*, 4197-4206
[13] FAO (1993). Agricultural Extension and Farm Women in the 1980s. Rome FAO Series 0125. pp. 1 – 6.
[14] Haboudane, D., Miller, J.R., Tremblay, N., Zarco-Tejada, P.J., & Dextraze, L. (2002). Integrated narrow-band vegetation indices for prediction of crop chlorophyll content for application to precision agriculture. *Remote Sensing of Environment, 81*, 416-426
[15] Hoekman, S.K. (2009). Biofuels in the US - Challenges and Opportunities. *Renewable Energy, 34*, 14-22
[16] Ilevbaoje, I. E. (1998). *Agricultural Research in Nigeria.* Journal of Agricultural and Rural Development. Vol. 6, No. 1, pp. 1 – 7.
[17] International Communication Union (2003). World Telecommunications Indicators. 2002. www.itu.int/itu-ed/ict/statistics.
[18] Le Toan, T., Ribbes, F., Wang, L.F., Floury, N., Ding, K.H., Kong, J.A., et al. (1997). Rice crop mapping and monitoring using ERS-1 data based on experiment and modeling results. , 35, 41-56
[19] Nigeria Millennium Development Goals (2004).
[20] Nigerian Millennium Development Goals, 2005 Report. Federal Republic of Nigeria Abuja. The National Planning Commission. August, 2005.
[21] Norman, J.M., Kustas, W.P., & Humes, K.S. (1995). Source Approach for Estimating Soil and Vegetation Energy Fluxes in Observations of Directional Radiometric Surface-Temperature. *Agricultural and Forest Meteorology, 77*, 263-293
[22] Okubanjo, W. (1990). Importance of Agriculture. In: The Nigerian Farmer's Authoritative Agric. News. (No. 003). P. 12.
[23] Oladele, O. J. (1999). Analysis of the Institutional Research – Extension Farmers Linkage System in South Western Nigerian. An Unpublished Ph.D Thesis in the Development of Agricultural Extension and Rural Development, University of Ibadan, Nigeria (Internet).
[24] Ozowa, V. N. (1997). *Information Needs of Small Scale Farmers in Africa: The Nigerian Example.* Quarterly Bulletin of the International Association of Agricultural Information Specialists: IAALD/CABI 40(1):15 – 20.
[25] Pal, M., & Mather, P.M. (2006). Some issues in the classification of DAIS hyperspectral data. *International Journal of Remote Sensing, 27*, 2895-2916 Pena-Barragan, J.M., Ngugi, M.K., Plant, R.E., & Six, J. (2011). Object-based crop identification using multiple vegetation indices, textural features and crop phenology. *Remote Sensing of Environment, 115*, 1301-1316

[26] Pinter, P., Ritchie, J., Hatfield, J., & Hart, G. (2003). The agricultural research service's remote sensing program: An example of interagency collaboration. Photogrammetric Engineering and Remote Sensing, 69, 615-618
[27] Shao, Y., Lunetta, R.S., Ediriwickrema, J., & Liames, J. (2010). Mapping Cropland and Major Crop Types across the Great Lakes Basin using MODIS-NDVI Data. Photogrammetric Engineering and Remote Sensing, 76, 73-84
[28] Soares, J.V., Renno, C.D., Formaggio, A.R., Yanasse, C.D.C.F., & Frery, A.C. (1997). An investigation of the selection of texture features for crop discrimination using SAR imagery. Remote Sensing of Environment, 59, 234-247
[29] Starasts, A. M. (2004). Battling the Knowledge factor: A Study of Farmers' Information
[30] Stehman, S.V., & Milliken, J.A. (2007). Estimating the effect of crop classification error on evapotranspiration derived from remote sensing in the lower Colorado River basin, USA. Remote Sensing of Environment, 106, 217-227
[31] Thenkabail, P.S., Biradar, C.M., Noojipady, P., Dheeravath, V., Li, Y., Velpuri, M., et al. (2009). Global irrigated area map (GIAM), derived from remote sensing, for the end of the last millennium. International Journal of Remote Sensing, 30, 3679-3733
[32] Tso, B., & Mather, P.M. (1999). Crop discrimination using multi-temporal SAR imagery. International Journal of Remote Sensing, 20, 2443-2460
[33] USDA. (2009). 2007 Census of Agriculture, California State and County Data, Volume 1, Geographic Area Series, Part 51. National Agricultural Statistics Service, Washington, DC
[34] Wade, G., Mueller, R., Cook, P., & Doraiswamy, P. (1994). AVHRR Map Products for Crop Condition Assessment - a Geographic Information-Systems Approach. Photogrammetric Engineering and Remote Sensing, 60, 1145-1150
[35] Wardlow, B.D., Egbert, S.L., & Kastens, J.H. (2007). Analysis of time-series MODIS 250 m vegetation index data for crop classification in the US Central Great Plains. Remote Sensing of Environment, 108, 290-310
[36] Xiao, X., Boles, S., Liu, J., Zhuang, D., Frolking, S., Li, C., et al. (2005). Mapping paddy rice agriculture in southern China using multi-temporal MODIS images. Remote Sensing of Environment, 95, 480-492
[37] Xie, H., Tian, Y.Q., Granillo, J.A., & Keller, G.R. (2007). Suitable remote sensing method and data for mapping and measuring active crop fields. International Journal of Remote Sensing, 28, 395-411
[38] Zilberman, D., Macdougall, N., & Shah, F. (1994). Changes in Water Allocation Mechanisms for California Agriculture. , 12, 122-133