

Evaluation of Links between Maize Farmlands and Infrastructures in the North Central Nigeria Using Geospatial Techniques

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ABSTRACT

This study, aimed at evaluating the link between maize farmer lands and infrastructures. The main objective of the study was to find out the existing links between farmlands and infrastructures within the maize supply chain in the North Central States of Nigeria. The investigation was carried out using questioners to assess the constraints of farmers in supply chains, multi-stage sampling procedure was adopted to sample the respondents in Kuje Area Council and Mararaba. A total of 130 respondents were interviewed using a structured interview guide. Results indicated that the majority of the farmers have no access to adequate infrastructural facilities such as roads, processing facilities, storage facilities and markets. Proximity analysis was also carried out analyzing GRID3 data for farmlands, roads and market points using ArcGIS 10.8. The result also shows that the majority of the maize farmlands are not close to the markets and there are no major roads connecting the farms to the transportation of farm produce. Farmers are infrastructural constraints at the production, transportation and marketing stage. The study, therefore, suggests a more viable infrastructural facility for farmers to interconnect farmland, to enable farmers to have access to good roads, storage and processing facilities which will enhance the maize value chain.

Keywords: Farmlands, Infrastructure, Maize, Nigeria, Value Chain.

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I. INTRODUCTION

The rapid upsurge of food demand worldwide has made the supply chain ever more complex with resultant emerging and challenging deficiencies and associated threats, which could significantly alter the predictable development in global food production and safety [1]. The consumption depends on geography as well as food security conditions [2]; a food supply chain or food system refers to the process that describes how food from a farm ends up on our tables. The

food supply chain begins with the producer and the food sourced at this stage moves through various methods of processing, which can extort business enterprises for as long as the processing continues [3]. This implies that the phenomenon called food supply chain is a system that connects the farmers to the end users either in raw state or finished state [4].

Agriculture is considered a large sector of the Nigerian economy and employs almost two-thirds of the entire labour

force; hence, it has become imperative to adopt modern strategies and introduce sustainable, new models that raise the bar for all important sector of the Nation's economy; a model that will be lucrative for the farmers and rewarding for the end users [5]. Farmers according to [6] and [7], developing countries are involved in the food supply chain process through cooperative structure. According to [8], the chain connects the agricultural sector, the food industry, and the distribution sectors. The supply chain is thus, important for the sustainable development of food production in Nigeria since it has to structure and function in a systematic way between producers and consumers [9].

Although Nigeria is Africa's largest producer of maize, the country's average maize output still remains amongst the lowest in the world. According to experts, Nigeria could become Africa's greatest maize producer and one of the world's largest producers without expanding the amount of land under cultivation [10]. Maize is one of the Nigerian major staple crops and one of the most important foods in Nigeria. FAO, reports of 2018, revealed that about 10.2 million tons of maize were produced from 4.8 million hectares and making Nigeria the highest producer in Africa. Despite the high-value increase in maize production in the country, maize production has lots of challenges facing her supply chain. Some of them include but are not limited to; low capitalization, price fluctuation, diseases and pests, poor storage facilities, transportation difficulties, processing, multiple taxations, market system, lack of improved seeds and accessibility of credit facilities [11].

The infrastructural deficit in Nigeria value chain has contributed to low agricultural productivity, the farm produce is either stored in cobs or shelled. Sometimes it is also stored in bins, silos, cribs, or in sacks both locally and where available mechanically. Sacks are raised off the ground to allow air circulation during storage [12]. However, because many Nigerian farmers are predominantly smallholder farmers, the majority of them do not have access to sufficient and standard facilities to preserve their products after harvest and/or processing [13]. Therefore, they are mostly left with no choice other than to sell their produce randomly to middlemen (they call it 'on-the-spot' marketing system where a farmer sells off their produce immediately to local agents that afterwards distribute to other buyers [14]. The transportation system that exists within the value chain of

Nigeria involves moving the produce at harvest by either the producer or rural agents using motorcycles to the fairly accessible roads where the urban dealers usually wait to collect and store at central collection centers [15]. Another form of transportation involves moving the product from the collection centers to larger processing factories and subsequently to the markets (they call it mop up) [16].

The efficiency of a country's input supply system, therefore, has a major bearing on the performance of the entire value chain [17]. In addition to the direct functions within the value chain, supporting and infrastructural services are required for the system to function efficiently. According to [18], the supporting services can be represented by interconnected value chains, such as equipment, input supply, and pure services (such as management services to operate storage silos or extension services to provide advice to the farmers) or financial services (including investment capital, working capital, or insurance) which cut across each of the functions of the value chain.

II. MATERIAL AND METHOD

This is a general summary of the data sources, identifying existing farmlands and markets, transportation systems and detailed mapping of the three states under study in the North Central Nigeria.

A. Reconnaissance Surveys

Reconnaissance survey was carried out to locate the various farm settlements and where Maize is being practice in Nigeria. Primary data were obtained from interviewing farmers on the study areas. Information about the cultivation of Maize was acquired from the study area through discussion with the local inhabitants and all relevant stakeholders in the study area during the reconnaissance survey. Also, the location coordinates of each of the identified farms and photographs were taken using Global Positioning System (GPS) receiver and digital camera respectively. Secondary data for the research were retrieved from satellite imageries of Nigeria through National Space Research and Development Agency (NASRDA), GRID³ portal. These data include Landsat Imageries/sentinel data, and they were analyzed using ArcGIS 10.8.

TABLE I: DATA AND MATERIALS DESCRIPTION

S/N	Name	Date	Format	Source	Scale/Resolution	Preparation
1	Maize Farms, Storages, Roads, Markets Rails	Varies	Digital	Study area	Number of farms investigated base on 700 questionnaires Gaps	<ul style="list-style-type: none"> • Collect coordinate ▪ Export to access ▪ Import into ArcGIS
2	Administrative boundaries	2020	Digital	Grid ³	1:231,348	<ul style="list-style-type: none"> • Download/Extract • Clip by selection study area
3	Hardware					<ul style="list-style-type: none"> • Computer: HP ProBook G1 (2.50GHZ, 4GB RAM and 500GB Hard drive) • GPS: Phone Application (GPS Waypoint) • Printer:
4	Software					<ul style="list-style-type: none"> • ArcGIS 10.8 • Microsoft Office

B. Proximity and Optimal Sites Analysis

Remote sensing and GIS techniques were used to determine the locations of the farmlands, road network and markets points. The analysis is to examine how close the farmlands are to market areas and the distance from roads to farmlands and markets.

III. RESULT AND DISCUSSION

The results of the reconnaissance survey for the two different locations visited, Kuje in FCT and Mararaba in Nasarawa State where various maize farming is being practised are shown in Table I. The states under study are the Federal Capital Territory of Nigeria (FCT), Nasarawa and Niger states respectively but only two places the survey was carried out (Kuje and Mararaba). It was observed from the responses of the 130 farmers interviewed that there are some constraints as illustrated in figure and Fig. 1 and 2.

TABLE II: INTERVIEWS OF SOME MAIZE FARMER

Constraints	No of Farmers (Mararaba)	No of Farmers (Kuje)
Incentive	15	35
Pesticide Application	97	96
Access to Fertilizer	111	100
Inadequate Capital	93	56
Poor Road Network	76	34
Insufficient Fertilizer	105	32
Low Yield	103	29
High Transportation Cost	113	89
Poor Marketing	112	69
Lack of Processing Facility	115	74
Insufficient Access to Information	72	5
Multiple Taxation	104	93
Advance Knowledge	110	3
Access to Advance Training	115	6
Insecurity	115	10
Poor Storage	109	12

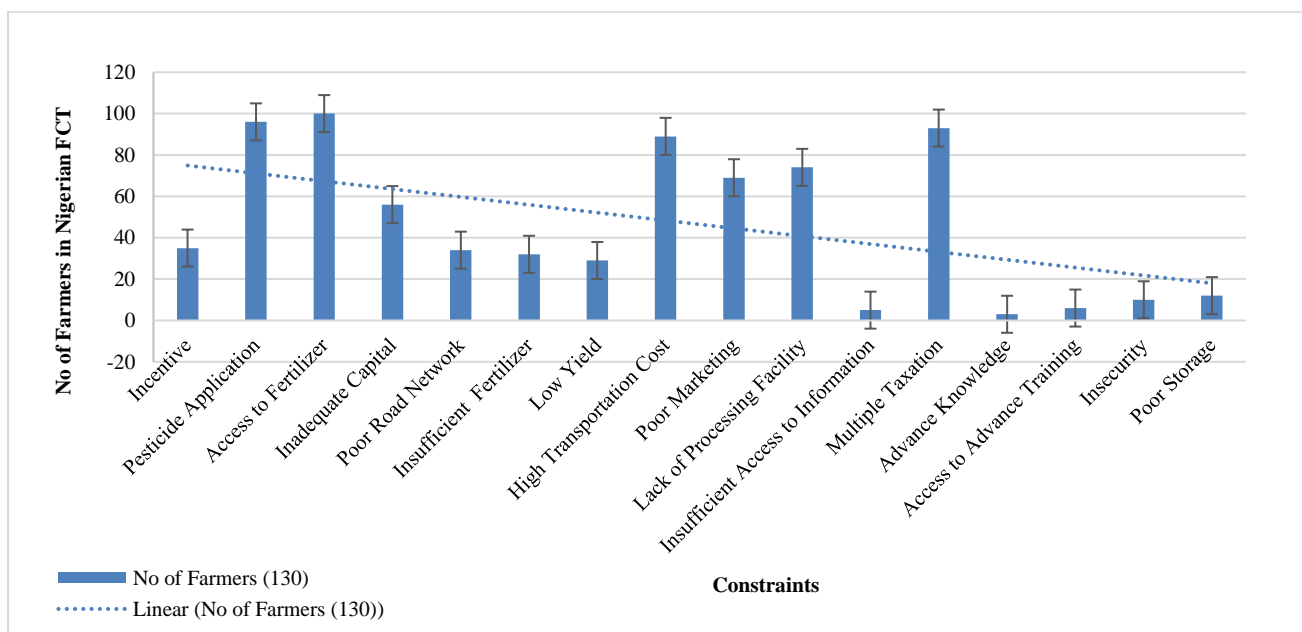


Fig. 1. Constraint of some maize farmers in Kuje.

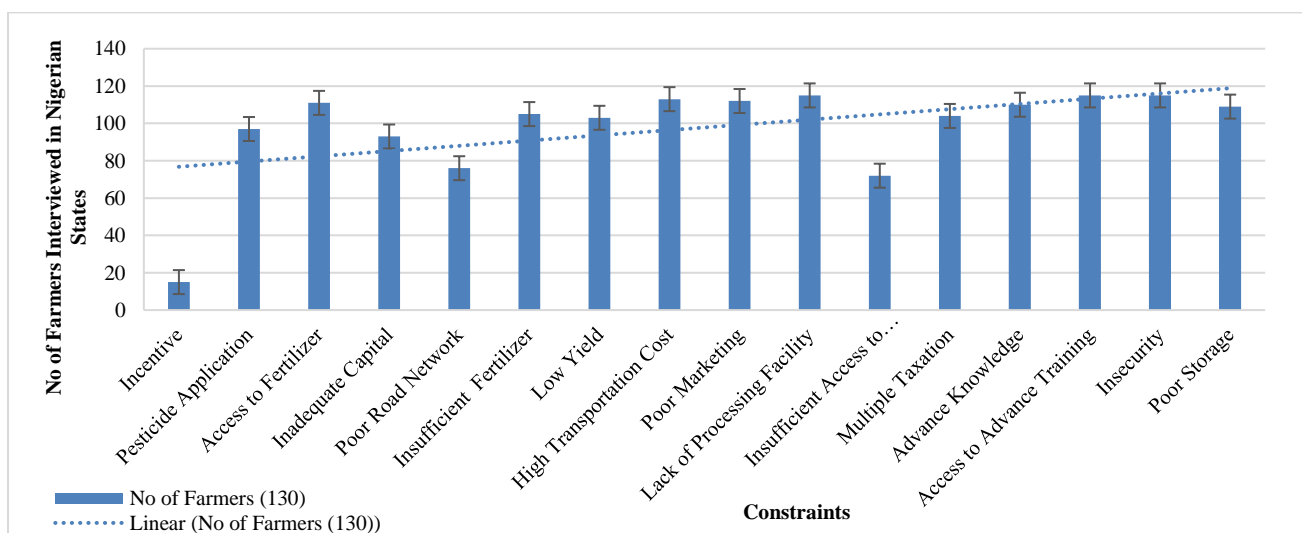


Fig. 2. Constraint of some maize farmers in Mararaba.

In FCT, some maize farms are relatively closer to some existing markets while others are very far from the available markets. It was observed however that even though some markets exist, there are no good roads connecting to the markets which leads to loss of time while transporting the farm produce to the markets which in turn leads to food losses.

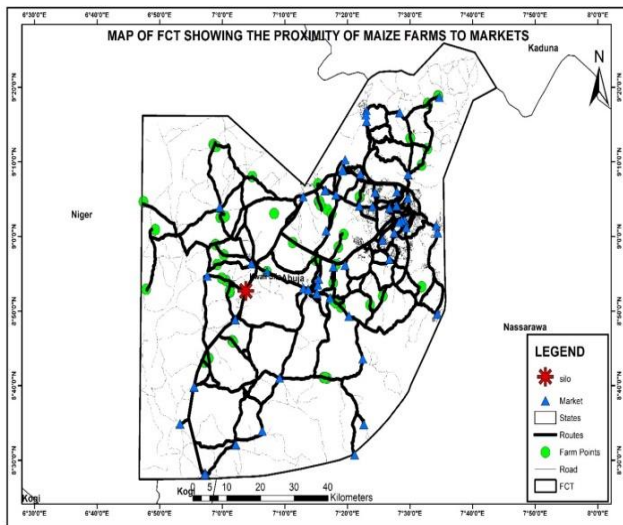


Fig. 3. FCT proximity of maize farms to markets.

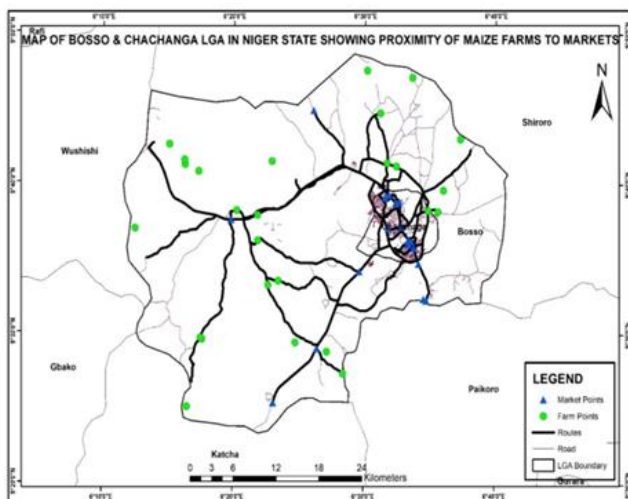


Fig. 4. Proximity of maize farms to markets in Bosso and Chanchanga LGA of Niger state.

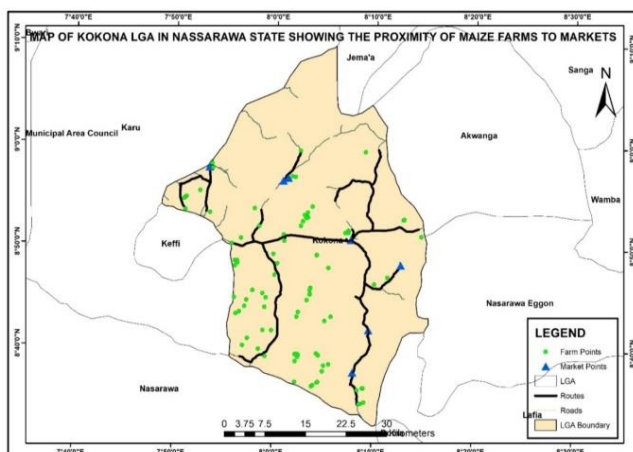


Fig. 5. Proximity of maize farms to markets in Kokona LGA of Nasarawa state.

In Kokona LGA of Nasarawa state, the markets are located specifically along the major roads, while there are no connecting roads from the farms to the markets. Since there are no good roads linking the farms to the markets, farmers encounter losses due to spoilage of their products and also because there are no adequate storage facilities available in the area. The markets are located majorly in the city centre of Bosso LGA while only a few are found in the distant areas of Chanchanga. It usually takes the farmers a longer time to get to the marketing in the city Centre.

Optimal sites for the storage of farm produce were suggested for FCT, and Kokona LGA of Nasarawa state as shown in Fig. 6 and 7.

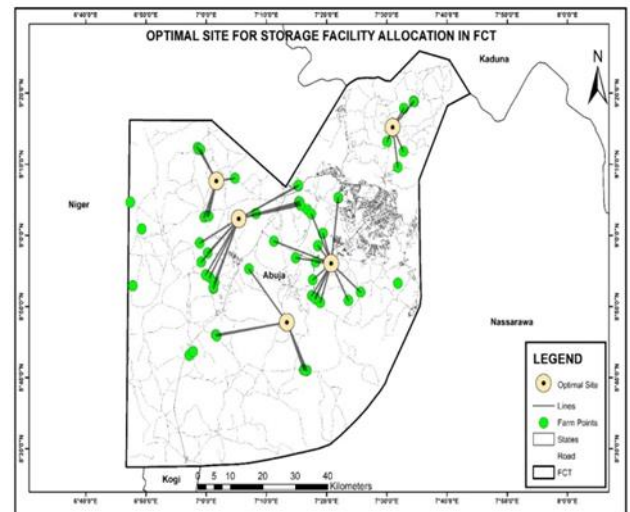


Fig. 6. Optimal sites for storage facilities in FCT.

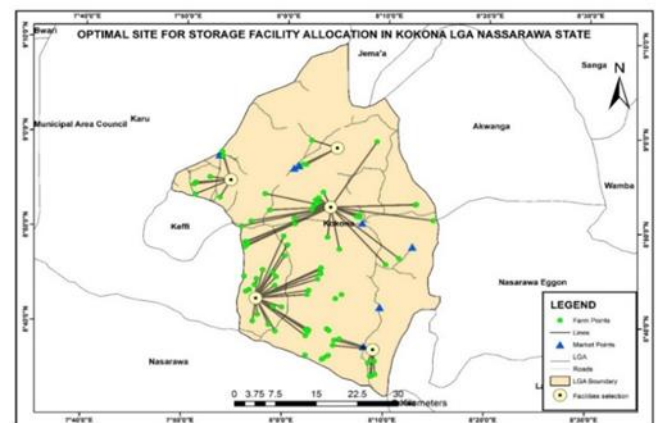


Fig. 7. Optimal sites for storage facilities in Kokona LGA of Nasarawa.

IV. CONCLUSION

Farmers are currently suffering significant losses as a result of insufficient storage facilities, and failure to evacuate products from production areas and get them to the most profitable markets at the right time due to poor roads and unreliable transportation. These losses lower producer pricing, lower trader, and manufacturer profits, and raise consumer prices.

However, this study evaluated the existing links between maize farmlands and infrastructures in North Central Nigeria using geospatial analysis. The study tends to enhance the performance of the maize commodity value chain for Nigeria,

and improvements in the transportation sector across the maize distribution chain through a coordinated effort from the federal, state, and local governments. The results also suggest advanced access to good roads and extension services are socioeconomic and institutional factors that would increase the prospect of a more reliable production among farmers.

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