Journal of Inventive Engineering and Technology (JIET)
ISSN: 2705-3865
Volume-1, Issue-2, January, 2020
www.jiengtech.com
Research Paper Open Access

PROSPECT OF PRECISION AGRICULTURE IN NIGERIAN ECONOMY

[1](Ifeanyichukwu , H. I., Department of Agricultural and Bio-Environmental , Engineering Technology, School of Engineering Technology, Federal Polytechnic, Oko, Anambra State, Nigeria)
Corresponding Author: **hifeanyichukwu2016@gmail.com**
[2](Aneke, V. I., Department of Agricultural and Bio-Environmental , Engineering Technology, School of Engineering Technology, Federal Polytechnic, Oko, Anambra State, Nigeria. **anekevictor2016@gmail.com**

ABSTRACT*: Diversification and advancement in Nigerian economy has brought forth the prospects of precision agriculture into existence. Traditional systems of farming in Nigeria are giving way to precision type of agriculture. The paper elucidated the sublime nature of farming systems in agriculture which transformed into precision agriculture. This present paper provides an overview of precision agriculture and examines the potentials in monitoring crop production and processing using remote sensing and geographic information systems. It is very fitting then that the paper is made expository using these aspects like knowing the farming systems in agriculture, principles of precision agriculture, needs and prospect of precision agriculture, constraints of precision agriculture and Nigerian economy. In conclusion, the inherent potentials of precision agriculture is highlighted and recommendation made to bring to bare the way forward*

KEYWORDS*: Precision, Agriculture, Prospects, Nigerian, Economy*

Date of Submission: 07-02-2021 Date of acceptance: 12-02-2021

I. INTRODUCTION

What is Precision Agriculture? Precision agriculture is a very modern aspect of agricultural practice. It is a welcome technology in managing and controlling all our resources to achieve sustainable development of agriculture based on information technology. Precision agriculture or farming's another name can as well be "site- specific agriculture or spatially- variable crop production. This is bringing agriculture into the information and digital age. This incorporates technologies like geographic information system (GIS), satellite remote sensing and global positioning system (GPS) in her practice. Precision Agriculture is an agricultural mechanization method which depends strongly on electronics, information communication technology with technical skill of man power for plant and animal specific needs respectively (Asoegwu's, 2007). Garry (2004) defined Precision agriculture as a comprehensive system designed to optimize agricultural production through the application of crop information advanced technology and management practice. Precision agriculture is an information and technology – based farm management systems. This aims at the application of technologies and principles to identify, analyse and manage spatial and temporal variability associated with all aspects of agricultural production within fields for near optimal profitabiliy, sustainablity, improving crop performance, protecting land resources and safe guarding the environment (Mc Bratney et al; 2003; Pierce and Nowak, 199; Shibusawa, 1998; Stafford, 2000; Zhang et al; 2002). Precision agriculture is greener. Precision agriculture is a multi disciplinary approach that covers a broad array of topics like, characterizing variability in soil resources, soil tillage, irrigation, crop rotation, machinery performance, plant genetics and chemical, physical and biological crop inputs (Zhang et al, 2002). The concept of precision agriculture is to fine tune the agricultural production system by emergence and convergence of several technologies for enhancing profit and reducing environmental risks (Whelan 2007). Engineering parameter related to soil and crops like soil strength and compaction, measuring draught force, irrigation requirement of crops; can be determined using precision agriculture. Precision agriculture is as well the act of measuring, sowing, fertilizing and spraying with regards to

soil type variation and plant pollution. This is an agricultural concept having to do with on the existence of infield variability .This practice allows the farmer to vary the rate of input across the field according to the need identified by global positioning system (GSP) guided grid sampling, there by optimizing its use .To account for within field variability, both proximal and remote sensing technologies have been developed and used in (1st) first world countries. Precision agriculture has the potential and wisdom in utilising natural resources efficiently and effectively. According to experts , precision agriculture is the technique of optimizing existing inputs and fertilizers, tillage tools, fields and crops, for the purpose of improved control and measurements of farm yields, has the potential of playing a key role in meeting the incremental food demands of the growing population worldwide. It is said that the concept of precision agriculture is based on four pillars; right place, right source, right time, and right quantity (Hussain, 2017).Precision agriculture reduces wastes, example is agrichemical residuals, making farmers and soil work better not harder. The information technology on farming begun to develop in the 1990s. Precision agriculture addresses the challenge of tailoring management to site crops and environmental traits and promotes the use of new technologies to address heterogeneities of the field (Swinton and Lowenberg DeBoer, 1998).Precision agriculture is not driving tractor or feeding animals but entails the collection of data using drones or handheld sensors which are processed for efficiency and profitability by solving problems like poor irrigation, diseases, plant population etc. Precision farming is an agricultural management concept based on observing measuring and responding to inter and intra field variability in crops.

II. FARMING SYSTEMS IN AGRICULTURE

Farming systems over centuries has experienced various advancements by notable researchers especially in developed countries. Farming systems has greatly been transformed from the traditional methods of farming to very modern methods like precision farming. Low and behold in Nigeria, the practices are still very much traditional and non scientific to a large extent .Farming systems can be defined as an assemblage of components which are united by some forms of interaction and interdependence which operate within a prescribed boundary to achieve a specified agricultural objectives on behalf of the beneficiaries of the farm and all the enterprises in relationship to each other. These are types of farming systems; (1) Extensive farming (2) Intensive farming. The above systems types can be carried under large scale or small scale farming depending on level of technology availability of land, capital and skilled labour. That is (c) Small scale farming (d) large scale farming. Extensive farming involves cultivating large piece of land for maximum yield per unit area using modern farming technologies. Intensive farming system is a commercial production of large quantities of crops and livestock on large farm while large scale farming is the growing of crops and rearing of animals on large piece of land applying modern farming technology. These farming systems operations involve a complex combination of inputs, managed by farming families but influenced by political, environmental economic institutional and social factors. The farming system operations take into account the components of soil, water, crops, capital, livestock, labour, energy and other resources. These type of farming like arable/pastoral which can take the form of nomadic (moving livestock in search of suitable farm land for grazing), commercial/subsistence, the amount of inputs/outputs, processes when integrated properly according to choice gives a particular farming system type as afore-mentioned. These can be considered as other methods of farming systems which are; (1) Irrigated farming system, here water is supplied to the farm artificially to avert lack of sufficient moisture to crop's growth. (b) Mixed farming system is having two or more independent agricultural activities in one farmland example; a combination of crop farming with livestock farming whereby they complement each other by dependency. (c) Tree-crop farming system is that farming which is done for economic or environmental benefit. The most common industrial tree crop grown are cocoa, coffee, oil palm, rubber etc, which are inter-planted with food crops mainly for subsistence i.e. for farmer and family. (d) Integrated-farming system is done to reduce pollution and increase income by combining different types of farming using high-quality organic food and renewable energy integrating rearing of livestock for a more sustainable agriculture. (e) Crop rotation and shifting system. In crop rotation, we practice the planting of different crops in a particular order over several years in the same growing space. This type helps retain nutrients in soil, reduce soil erosion and prevent plant diseases and pests. In shifting, the farmer cultivates the land for three to five years, on loosing her fertility, he leaves it to lie fallow and move to cultivate another piece of land only to come back to the land at the expiration of another three to five years when it must have regained its fertility. The population of humanity increased with high demand for food bringing forth large-scale mechanization of agriculture. Labour was replaced using machines with the concomitant results of high yield and less drudgery. These inventions favoured development of larger and more areas to be managed. Under this practice, a more uniform way was sought using information technology called precision agriculture or farming which is the crux of this research work.

III. PRINCIPLES OF PRECISION AGRICULTUREETHICS IN ENGINEERING EDUCATION AND PROFESSION

The basic steps in practicing precision farming are:- (1) Assessing variation or sensing variability (2) Managing variation or variability and (3) Evaluation or evaluating variability. Assessing variation involves surveys, interpolation of point samples, high-resolution sensing and modeling. Managing variability entails precision soil fertility management, precision pest management and crop management while evaluation encompasses economics, environment and technology transfer. In precision agriculture, the synergy of 3 elements are required (1) Positioning capabilities currently known as global positioning system on (GPS), to know where equipment is located (2) Real time mechanism for controlling nutrients, pesticides, seeds, water or other crop production inputs. (3) Data bases on sensors that provide information needed to develop responses to specific situation condition.

Intensive soil investigation is carried out using the global positioning system (GPS) consisting of 24 satellite that transmit signals picked up by the user receivers. The use of GPS allows soil and yield sample sites to be accurately located within a field and fertility levels mapped and then compared to certain soil results. Agriculturists can pin point locations of significant soil variability in terms of fertility level. Precision agriculture involves the determination of physical, chemical and biological components within fields in ways that optimizes returns with minimized chemical and environmental hazards (T'.M. biebeka, 2004). The goals and objectives of precision agriculture is to get analysis and information about the variability of soil and crop conditions so as to maximize the efficiency of crops fertilizers and chemicals which will be used should be placed where needed. This efficiency gives out economic values and environmental conservations, being that environmental costs are difficult to quantify in monetary terms. The reduction of soil and ground water pollution from farming activities has desirable benefits to the farmer and society (Gary, 2004). Technological tools or components of precision agriculture required for effective practice of precision agriculture include:-

1. **Yield Monitor:** These provide information on crop yield at regular intervals by time or distance, i.e the yield e.g. moisture content, which data produces the yield maps. Interpreting yield maps are key steps in developing precision management skills.

2. **Differential Global Position System (DGPS):** This is a network of 24 satellites orbiting the earth which transmit precise satellite time and location information to ground receivers. It is used to pin point the location of yield data collected and provides accuracy of one to three months. The ground reviewing units are able to receive this location information from several satellites at a time for use in circulation in triangulation for the exact location of the receiver. DGPS is used to identify location of data, points of crop and soil attributes in latitude, longitude and elevation.

3. **Geographical Information System (GIS):** This consists of a computer (hardware)-software database system used to input, store, retrieve, analyze and display in map all forms of geographically reference information.

4. **Variable Rate Technology (VRT):** This consists of farm yield equipment such as sprayer, tillage implements having the ability to precisely control the rate and tillage operations. It provides a means of assuring that fertilizer applications are made only accurately and in locations where they are needed i.e optimize fertilizer application in areas of high productivity and increase fertilizer application to areas of low productivity.

5. **Remote and Proximal Sensors:** Data from remote and proximal sensors have been used for many years to detect water, determine salinity and nutrients, to distinguish crop species, to monitor yield and to locate crop stress in fields (Adamchuk et al., 2004; Gowrisankar and Adiga, 2001). This equipment produces image data from the crops which are processed and added to the GIS database.

6. **Computers and Electronics:** These are avenues for processing and storing data in the shortest possible time for further mapping in precision agriculture.

Summarily, principles of precision agriculture are based on these (1) Information (2) Technology and (3) Management. Information (data) is modern farmers' most valuable tool in all phases of production from planning through post harvest. These information are crop characteristics, soil properties, fertilizing requirement, role of populations, plant growth, response harvest data and post-harvest processing data.

Technology is the application of those data mechanically with the use of machinery and the harmonization of those information/data for maximum yield which gives the managerial aspect.

A. BENEFITS AND PROSPECTS OF PRECISION AGRICULTURE

These benefits and prospects are multifaceted with regards to environment and economy. The aim being most especially to apply the nutrients that plants require, and can be used on soil fertility, soil type and environmental sensitivity, whose inputs include water, pesticides, nutrients etc. These benefits and prospects include;-

1. **Agronomical Concept:** Whereby alterations of cultural practices are imbibed to meet real needs of the crops.

2. **Technical aspect:** Viewed with better time management in the field. Enrichment or Reduction of Agricultural Impacts on the environments/fields are considered as the case may be.

3. **Placement of Projects**: This will help one to know the farm's spatial characteristics and so be able to establish very needed projects on suitable sites and be well taken care off.

4. **Economical Concept:** Inputs and yields will richly be maximized and achieved.

5. Effective use of equipment information on soil characteristics and weather can be used to plan land improvement, scheduling operations, which increases machinery utilization rates and allowing farm machinery operations to achieve greater field efficiency. They can help fatigued operation maintain higher field efficiency.

6. Risk Reduction: At field in-site, precision agriculture provides site-specific management that can point problems with growing conditions, reducing variability in net return. Information can be used to improve variety, crop rotation, crop growth and other agronomic practices that reduce risk.

7. Management and Differentiating products can be done perfectly within a particular field.

8. **Environmental Stewardship or Protection:** Precision application of chemical and fertilizer will better match crops requirement. This can prevent over application which may be non-beneficial to the environment, thereby promoting good land stewardship of better quality and fertility.

   Other benefits include: (1) Geostatistics restoration (2) Integrated farming (3) Integrated pest management (4) Nutrient bridgeting (5) Nutrient management (6) Increase product quality (6) Increase product quality (7) Improve sustainability (8) Food safety using product traceability (9) Rural development (Robert, 2002) (10) It serves as a source of livelihood (11) It is a business opportunity in agricultural sector (12) It gives employment opportunity (13) It contributes to economic development of a country (14) It serves as a source of raw materials for cotton, sugar, tobacco etc. (15) It boosts foreign exchange when its produce are exported.

B. CONSTRAINTS OF PRECISION AGRICULTURE AND NIGERIAN ECONOMY

In our world today, the process of changing ones way of life is not usually easily welcome but we must adopt cleaner and better ways of living of which precision agriculture is one. This precision agriculture is the most accepted method though with their concomitant effects. There are challenges posed by precision agriculture and are discussed in alignment with Nigerian's economy. Some setbacks encountered with this new technology are reeled out below which when combated will give a good farming practice and they are:-

1. Precision Agriculture is not compatible with every crop. Research and verifications on various technological, technical and economical conditions has to be done before its adoption.

2. Interoperability of various standards need all the devices and gateways be integrated to a holistic and farmer friendly platforms.

3. The learning curve as local farmers need to be acquainted with the knowledge of smart farming using all the sensors and networking. The combination of mapping and real-time systems.

4. Rural areas network connections: Strong, reliable internet/network connection is not readily available. Digital farming may not work very well in remote rural areas especially in third world countries. Agrosensors and gateways depend on cloud services for information transmission/storage. Moreso, farms with tall dense trees or hilly terrains may suffer lack of GPS reception signals. The precision of positioning.

5. Unknown farm production functions: To ensure bumper yields on farm, internet tools must correlate with inputs made. This is the correct production function i.e optimizing output concepts by making the best use of available input concept knowing models of calculating the optimal amount of applied factor.

6. Farm size management: Different soil sampling requires different soil requirements, so as to economize inputs and maximize outputs. We have to know models of economic analysis.

7. New Technology: This precision agriculture, no doubt is a new technology working with different big hardware/software which may lead to loss of data and incompatibility experienced with heavy energy consumption. We have to understand the algorithms for the reduction and the processing of the amount of collected data.

8. Breakdowns Technically: Technology wise, since it is to do with mechanization which will come with their breakdowns no doubt with lethal effects especially with no back up power alternative.

9. E-waste Experience: Electronic wastes are obtained especially with obsolesce and breakdowns of devices cum machinery.

10. Unemployment: This precision agriculture has created unemployment because the manual jobs in agricultural labour are overtaken. This displacement can lead to depression and other ill-healths among people.

Agriculture was the backbone of Nigerian economy before the oil boom. Performance of agriculture in Nigeria has not been encouraging in recent decades. Food production has failed to keep up with rapid population growth and hence need PRECISION agriculture. Agriculturally, there are factors that militate against Nigerian's economy in terms of food production examples are;

1. Most farmers rely on rain-fed agriculture, they are under-developed.

2. Absence of scheduled irrigations in arid or arable lands.

3. Lack of adoption of improved seeds and fertilizers due to poverty.

4. Natural disasters disrupting and wrecking havoc on farm lands causing environmental degradation.

5. Prevalent civil strife leading to severe destructions.

6. Low level funding of research institutes.

Agriculturist cannot adopt appropriate technology to help bumper harvest rather they depend on transferred technology preoccupied with mechanization of heavy machinery and only very few can afford them. Our people are more of peasant farmers and government are not helping out in subsidizing the practice. Even with their policies, which do not encourage the subsistent farmers. Precision agriculture aids holistic use of resources. Realizing the sublime role of precision agriculture to Nigerian economy by researchers with their compendium, government should put in place certain policies, measures and programmes with a view of increasing the contribution of agriculture to Nigerian economy. Federal government capital budget on agriculture should portray a boom future for the country's economy due to precision farming. Precision agriculture being a rapid advance in agricultural production if introduced into existence in Nigeria will be a powerful leverage; example technology has vastly increased the productivity of farm labour of acres of land leading to mechanization.

Farmers are not faced much with infestation of crops by pest and diseases, inadequate rainfall, retardation in the conduct of extension activities due to proper management and precision having the adoption of new improved farming techniques. The current conditions of unfavourable position of agriculture as a competitor for productive manpower among other lucrative sectors of the Nigerian economy, faced with ever-increasingly

aversion of Nigerian youths to the drudgery, indigence and indignity associated with present agricultural practices. Precision agriculture must be recognized and practiced as a crucial input needed to modernize, energize and revitalize the Nigerian economy (Ifeanyichukwu, 2020). Precision agriculture can be seen as a key element in the successful transformation of most economies yet to see steady rise in their per capita income. High-quality data constitutes a major component for the industry. This precision agriculture will play a catalytic role in a modern economy having many dynamic benefits crucial for economic transformation. This is a medium for increasing productivity in relation to import substitution and export expansion, creating foreign exchange earnings as well as wider and more efficient linkage among different sectors. Precision agriculture begets processing and manufacturing, whose values cannot be over-emphasized with regards to Nigerian economy in varying sectors. In all, motivation or shift to invest in new technology is not easy as it is needed to help vary crop requirements of different plants from multiple farms. A good farmer's knowledge of nutrient algorithms is needed for optimization (Hussiain, 2017).

IV. CONCLUSION

Precision agriculture should be embraced in its totality because it has a lot of things to offer. Its interventions to increase economy cannot be over emphasized. This study established facts that exposed other methods of farming or farming systems, precision farming was cited as the best. The principles to this very modern system were x-rayed for better understanding. The dividends, prospects and challenges were exposed, so that a better approach and applications of this precision agriculture can be practiced through minimum inputs, maximum outputs for effectiveness and efficiency in the pursuit of Nigerian economic sustainability.

V. RECOMMENDATIONS

By the nature of this work, it is recommended that policy makers can be called upon to factor-in conditions that will enhance the practice of precision farming or agriculture having seen the benefits of this kind of farming system. Non-governmental organizations cooperate bodies, extension service personnel, research institutes, parastatals of government and institutions of higher learning can massively embark on this practice due to the large sum of funds involved. The use of grants or funds from government so as to meet economic demands globally is a welcome development in achieving the researched work.

REFERENCES

Adamchuk, V. I.; Hummel, J. N.; Morgan, M. T. and Upadhyaya, S. K. (2004a): On-the-go-Soil Sensors for Precision Agriculture. Computer and Electronics in Agriculture 44(1): 71-91.

Asoegwu, S. N. and Asoegwu, A. O. (2007): An Overview of Agricultural Mechanization and its Environmental Management in Nigeria.

Garry, T. R. (2004): Precision Agriculture; A Compulsory Approach.

Hussain Fakhruddin (2017): Precision Agriculture; Top 15 Challenges and Issues. Teknowledge Software Iphone Application Development Company India, August 8, 2017.

Ifeanyichukwu, H. I. (2020): Prospect of Precision Agriculture in Nigerian Society of Engineers.

McBratney, A. B.; Mendonva, M. L. and Minasny, B. (2003): On Digital Soil Mapping. Geoderma 117 (1-2): 3-52.

Pierce, F. J. and Nowak, P (1999): Aspects of Precision Agriculture. Adv. Agron, 67: 1-85.

Robert, P. C. (2002): Precision Agriculture; A Challenge for Crops Nutrition Management, Plant and Soil, Vol: 247 No. 1 Pp 143-149.

Shibusawa, S. (1998): Precision farming and Teora-mechanics. The fifth 15IVS, Asia-Pacific Regional Conference, October 20-22 Korea.

Stafford, J. V. (2000): Implementing Precision Agriculture in 21st Century. Journal of Agricultural Engineering. Res 76: 267-275.

Swinton, S. M. and Lowenberg-DeBoer, J. (1998): Evaluating the Profitability of Site-Specific Farming. J. Prod. Agric 11(4): 439-446.

T'Mbiebeka Walla (2004): Optimizing Agricultural Yields in Nigeria Using Remote Sensing (GPS).

Whelan, B. M. (2007): Current status and future Directions of Precision Agriculture in Australia. Processing of Second Asia Conf. on Precision Agriculture Pyeongtaek, Korea Pp. 60-71.

Zhang, N.; Wang, M. and Wang N. (2002): Precision Agriculture. A World Wide Overview Computers and Electronics in Agriculture 36(2-3): 113-132.

