THE NEED FOR PRECISION AGRICULTURE IN NIGERIA

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Abstract

Despite the engagement of about 70% of Nigerians in the agricultural sector, crop production has not been sufficient enough to fulfilldemand so that import policy is fully implemented. This is due to the utilization of conventional farming techniques that are geared towards giving equal treatment to crop fields. Precision agriculture deals with crop fields according to their specific requirements. This paper presents a review of the concepts, technologies, tools and benefits of precision farming with a view to enlighten agriculturalists into using it to improve the efficiency of crop production and curtail the much effect of pollutants on our climate.

Keywords: precision agriculture, GPS, Remote Sensing, crop management.

1. Introduction

The need to increase crop productionefficiencyin Nigeria using improved technology has been identified (Abubakar, 2010).This is to ensure food security and improve the standard of living in the country.

Farming fields have variable yields across the landscape. This could be related to the management practice adopted, soil characteristic or environmental characteristics. (Davis, Casady& Massey, 1998).The soil characteristics include texture, structure, nutrients status, organic matter, moisture and landscape. The environmental characteristics include weather, weeds, insects and diseases etc. These characteristics are known as yield-limiting factors. In

precision farming, the reason for the variability isdetermined and analyzed usinghardware and software tools and the management practice that is tailored towards the treatment of each field in the right way at the right time is applied.

The goal of this review article is to provide an overview of the concept of precision agriculture, the benefits attached to the practice of precision farming and the steps that should be taken to ensure full utilization of precision agriculture in Nigeria for sustainable development.

2. Identification and Analysis of variability

In order to improve the efficiency of the future crop production, precision agriculture use technology and tools to determine and assess the effects of the application of fertilizer, seeds, pesticides and cultural practices on the crop yield. Spatial tools such as GPS, GIS and remote sensing are used in the identification of the various causes of the variability. The following subsection discusses the components of precision agriculture.

2.2.1 Components of precision farming

Precision farming utilizes a number of sophisticated tools to monitor and manage variations in crop yield, soil characteristics and environmental characteristics. The following sub-sections describe the tools required for the effective practice of precision Agriculture.

i. **Global positioning system (GPS) receivers**

GPS receivers provide a means for determining the geographic location of objects anywhere on the earth (Pfost, Casady& Shannon, 1998). The receiver which is either mounted on implements (e.g combine harvester) or carried to the field allow farmers to automatically collect site specific soil and crop information for identification and management of crop fields.

ii. Remote sensing

Remote sensing is the non-contact collection of information relating to plant health, soil quality, topography, weed patches, etc. from a distance. It consists of the sensors and the platform; an aircraft, unmanned aerial vehicle, balloons, satellite, rockets etc. on which the sensors reside. The data collected is used for mapping plants condition for later treatment.

iii. Geographic information system (GIS)

GIS is a software application that is used to store layers of information such as crop yield, soil maps, remotely sensed data, etc. for the projection of current and future fluctuations in precipitation, temperature, crop output etc.

iv. Yield mapping

Yield sensors connected to on board computer coupled with a GPS receiver are used to automatically record crop yield as the harvester operates within the fields (Abdulsalam, 2019). The raw yield data is processed by a software programme, such as QGIS, Agro-Map, and Farm ^{TM}Works, etc. to produce yield map. Yield maps provide feedback information on how crops respond to certain soil and crop management practices and are used to determine recommendation rates for many inputs (Zagorda & Walczykova, 2018). The map shows the low and high performing areas of the fields.

v. Soil mapping

In season variability can be identified through the systematic collection of soil samples with precise locations. The interpretation of the grid soil samples in the laboratory resulted in the production of an application map that shows the nutrients and water requirements of the soil samples by location.

3. Management of variability

Yield and quality of crop can be improved by more effective use of inputs. Application of crop management decisions for the removal of variability in the farming fields calls for the use of farming equipment that supports variable-rate technology (Mukesh, Mann & Lohan, 2014). VRT is divided into two, prescription based and sensor based. In prescription based VRT, a GPS receiver and the application map developed from the data collected (usingGIS, Remote sensing) are used to guide material delivery (homelandsecurity, 2018)

3.1 Variable Rate Applicator (VRA)

Variable rates Applicators are machines that can automatically change their application rates in response to their position. The Variable rate applicator has three components; Control computer, Locator/sensor and Actuator. Variable rate application can be sensor based or the map based . In map based type a computer controls the activities of the machine. It is loaded with the map of the desired application rate for the fields as a function of geographic location. It obtains the equipment's current location from the locator which is equipped with a GPS and commands the actuator to adjust the material flow rate as per requirement. The sensor based requires no map and GPS receiver. The control system calculates the input need of the soil and plant based on the information received from the sensors and transfers same to the actuator which delivers the input to the location accordingly (Grisso, Alley, Thomson, Holshonsen & Robertson, 2011). VRT applicators are available for applying varieties of substances such as fertilizer, seeds, pesticides, etc.

i. Seeding VRA

Soil organic matter sensors on the VRA machine detect different levels of organic matter content of the soil and adjust plants population accordingly. Seed rate is adjusted by controlling the speed

of the motor attached to the VRA seeder.

ii. Weed control VRA

Precision weed control uses VRT to reduce the amount of herbicides used for weed control, decrease fuel consumption and increase the farmer's profit (Che'Ya, 2016). Application map produced by GIS software recommends the exact amount of herbicides to be applied to the affected areas.

iii. **FertilizerVRA**

Variable rate fertilizer application refers to the application of fertilizer compound according to the quality of crop fields. Sensor based VRT requires no map or positioning systems in the sensors measure continues stream of soil nutrients data on-the-go. Based on this information, the amount of fertilizer to be applied on the fields is varied as the machine operates.

Nitrogen is often the most common limiting factor for optimal plant growth. Nitrogen sensors can recommend the quantity of fertilizer to be applied for plant to grow under optimum condition. VRT helps to reduce the negative environmental impact caused by the excessive use of Nitrogen and reduces the intra field growth differences (Van-loon, Sperati & Goverts, 2018). The economic benefits of VRT include the potential saving on fertilizer and chemical, yield increase due to efficient use of fertilizer and pesticides and environmental protection from excessive use of fertilizer, herbicides and pesticides.

4. Constraints to the adoption of precision agriculture

i. High initial cost of the equipments and tools needed for the implementation of precision farming is the major constraint in the adoption of precision farming by peasant farmers in developing countries.

ii. Precision farming requires farmers to have some level of knowledge and skill for them to be able to operate someequipments and interpret the data generated for efficient management of crop fields.

iii. Rural areas are not covered by mobile networks, this will hamper the adoption of precision agriculture as mobile network is required by some equipments.

iv. Some farm equipments require electrical power for their operation; this is one of the major challenges in Nigeria.

v. Precision farming is not justifiable for small land holdings.

5. Steps to be taken for implementing precision farming in Nigeria

i. Farmers should be enlightened on the benefits attached to the practice of precision agriculture.

ii. Farmers should be assisted with soft loans from the bank of industry. This will assist farmers in purchasing some equipment.

iii. Farmers' cooperative should be formed.

iv. Employing the services of provision agriculture service providers. Custom services can decrease the cost and increase the efficiency of precision agriculture. The most common custom service that precision agriculture service provider offer are intensive soil sampling, mapping and variable rate application of fertilizer and lime (Devis et al.).

6. Conclusion

Precise management of farm fields is the key to the success of precision agriculture. Farmers in Nigeria are encouraged to key in to the practice of precision farming so as to increase production efficiency, reduce production cost and improve the quality of crop.

The practice of precision farming in Nigeria will attract the young generation into agricultural sector since it is information and technology based requiring less effort, and it will solve the problem of food insufficiency. The government as a matter of urgency should do everything possible to provide the necessary support needed for its full implementation in Nigeria.

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