Data-Driven Analytical Approach to Agricultural Development in Nigeria

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Abstract
The Nigeria agriculture sector is receiving a lot of attention in recent years due to the need to diversify its economy. Two key gaps facing the agriculture sector have been identified. They include the inability to meet domestic food requirements and the inability to export at quality levels required for market success. We envisage that these problems can be solved by using data analytics approach. In this paper, the application of data analytics approach in agriculture are discussed. The benefits and challenges of deploying the Data analytics approach are presented. Followed by rapid development of modern technology, data-driven farm management supports farmers to measure all aspects of their business, from soil and crop performance to financials. That way, farmers are able to make business decisions based on data, instead of relying on gut-feeling. After all, having an insight into data is crucial for increasing farmer's productivity, sustainability, and finally, profitability.

Keywords—Agriculture, data-driven approach farm performance, management, modern technology.

Introduction

The world is embracing technology. It is now a massive part of everything we do and has been integrated into the most essential industrial sectors. The agricultural sector is not ignored/left out. Technologies have been integrated into agriculture to make farming easier for farmers. On the indication of making farming smooth for farmers through technology, Agri South Africa (AgriSA) and Aerobatics have partnered to provide South African farmers with free satellite farming data. The free satellite farming data and the latest Aero view in field scouting application will be made available to farmers without charge. The partnership will be a means to quicken access to investigative information, that will assist farmers in early identification of pest, disease and improvement of yield.

A more data-driven, information-rich and knowledge intensive agriculture industry is rapidly evolving across the world. Data-driven agricultural management is "thoughtful use of big data to supplement on farm precision agriculture. It means having the right form of data, at the right time, to make better decisions. Ongoing digitization has created vast streams of data, forcing business to become more data driven than ever before. While the benefit of being a data – driven organization are clear (improved performance, more profitability, stronger innovations) (Dellotte 2016). The concept of data driven agricultural management and rural development are closely related to notions of digital farming and agriculture 4.0. an extension

of this concept is to use data and information flows within and across agri-food chains to improve efficiency of the chain and this is normally seen as ways to maximize profitability (Benson 2018).

Two key gaps have been identified from the 2016 agriculture promotion policy which are: the inability to meet domestic food requirements and the inability to export at quality levels required for market success. The inability to meet the domestic food requirement is largely attributed to inefficient statistics farming models and lack of adequate data on inputs such as fertilizers, irrigation crop protection and necessary support from the agricultural communities. On the other hand, the poor knowledge of target markets and inefficient system for enforcing the food quality to meet international standards are the limiting factors to exportation and successful market. These problems can be addressed by shifting from manual driven agricultural system to a data driven approach model or smart agriculture data approach models.

The former Permanent Secretary FMARD Dr. Bukar Hassan said "the only way agricultural production can be sustained is when the farmers can be able to reach out to various markets to sell their products, and make some returns to enable them to invest; this event gives us a unique opportunity to move away from traditional marketing system, monitor and evaluation system to a more digital and sustainable method where farmers will be able to ensure that whatever they have produced is accurate, and therefore food security will be ensured". In a bid to ensure Nigerians have easy access to more data on agriculture, the Food and Agriculture Organization of the United Nations (FAO) in Nigeria handed over the Computer Assisted Personal Interview (CAPI) system developed with the support of the Agricultural Market and Information System (AMIS) to the Federal Ministry of Agriculture and Rural Development. (FAO Nigeria News May 31, 2017).

Data driven organization rely on vast amounts of Data–and analytics–to improve and speed their decision –making process. By having superior analytics, they can be superior insights. At data driven organization, decisions that aren't supported by data are considered questionable, smarter analytics technologies now enable every organization become more data driven. Decision no longer have to be made in the dark or based gut instinct; they can be based on evidence, experiments and more accurate forecast (Mckinsey, 2018). This initiative will enhance a framework for the application of data analytical approach in agriculture and rural development by supporting different sectors such as banking, governance, healthcare etc. It will also enhance the following

1. Possible collaboration with relevant organizations and exploring potential collaborative pilot engagements
2. A follow up event to learn about the outcome and commitment and actions of training (clients) and programmes.
3. To facilitate a cross sector community of practice committed innovation for data-driven agricultural management, training and rural development.

Farm Performance with Data-Driven Decision-Making

In real terms, every farmer who makes decisions based on true and real-time facts is data-driven. For instance, farmers who fertilize their crops based on soil analysis results**,** are data-driven. However, today the term "data-driven farming" usually includes using various modern technologies which collect precise and accurate farm data, as follows:

Modern Technology	Various Performance
Soil and crop sensors	that measure various soil and crop conditions (i.e. soil moisture sensors help farmers manage irrigation more precisely)
Variable rate technology	provides the application of the right amount of inputs (such as seeds, fertilizers or pesticides) based on the requirements of each part of the field
Yield mapping technology	collects the spatial data about the yield and other crop characteristics during the harvest
Weather stations	for tracking weather conditions
Farm management software	a cloud-based technology for tracking, collecting and analyzing the entire process of farm production

Each of the above technologies will provide a farmer a few pieces of information and data. irrespective of the method of data collection, the only essential thing is that a farmer has access to accurate and fact-based support for making business decisions. Yet, one method for collecting the data stands out. It's a farm management software that gathers all farm data in one central place. Data-driven farm managers measure all aspects of their business, from soil and crop performance to financials.

Factors Affecting Data-Driven Farm Management in Nigeria

This is an innovative approach for agriculture practices which is becoming popular amongst the farmers. Data-driven farm management supports farmers to measure all aspects of their business from the information of enhanced agricultural practices, livelihoods, soil health, soil type, nutrition to agricultural product marketing along with the latest developments required for the field. The agricultural technology system is dependent on certain factors. These factors influence the flow of technology and information between farmers and extension.

Agro-ecological: The natural environment strongly influences agricultural planning and operations. The variation represented by different agro-ecological zones in a given country can be significant. The variations in temperatures, rainfall, soil types, evapotranspiration and so forth are reflected in the diversity of farming conditions and production systems.

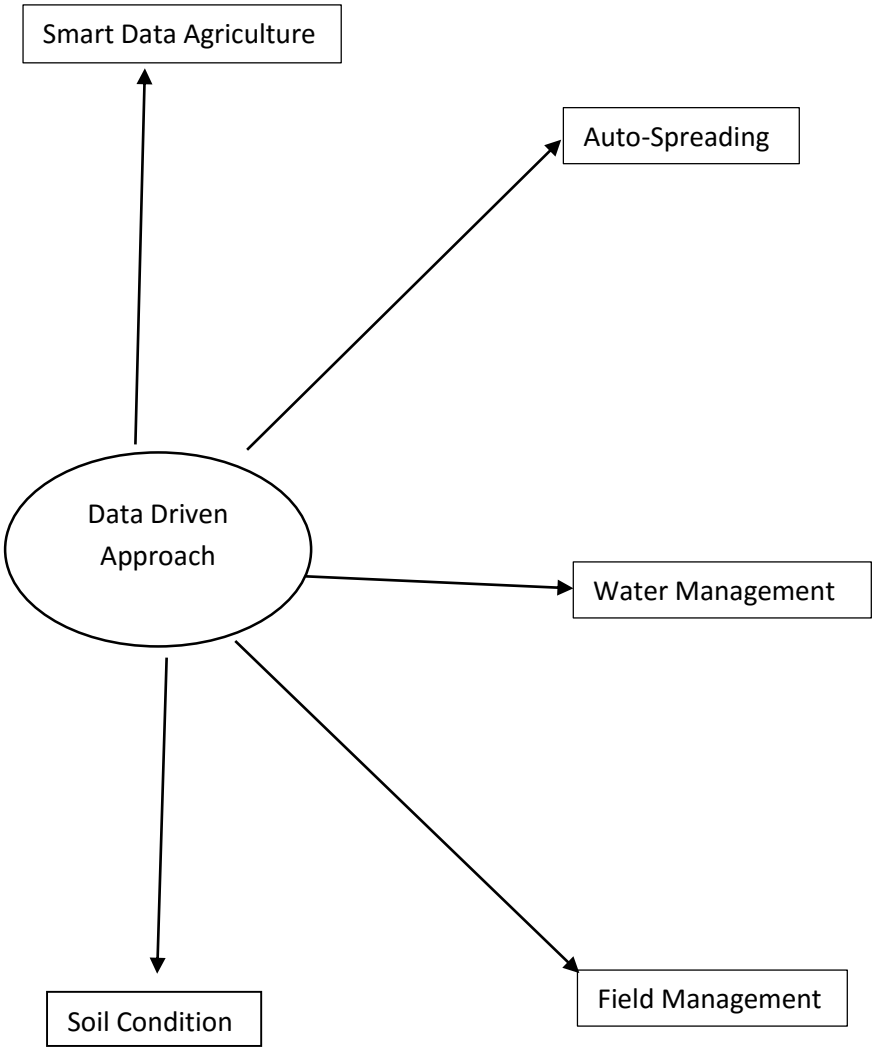
Political-Economic: The political and economic environment plays a crucial role in agriculture specially in our country. Also, the economic dependency on agriculture and proportion of population economically active in agriculture is more in India.

Sociocultural: Language differences and illiteracy becomes a factor which hinders the effectiveness of technological implementations in field. The division in labour force between

sexes can change with cultural lines and it influences the nature of farming systems in different regions of country. In many regions the women are more into farm operations and off farm activities are done by men. According to regions the farmers required knowledge of different subject matter and so different strategies are required to transfer technology to them.

Policy and Infrastructure: In this the government policies, transportation and communication facilities come under consideration. Transportation comes into play for sending and receiving inputs and harvest. Communication here means mediums of providing information about new farming techniques, any news related to the world and any upgradations in product prices. Through this, the farmers now get acquainted with the market they should target so as to get maximum profit after selling the yield. This also includes the construction of cold storage which help farmers to store their yield for any future crisis in the country.

Data Driven Approach Chart



The data collected from analytics related to market prices help farmers to get best prices for their crops, now the mediators are removed and farmers can directly coordinate with the wholesale market. Weather analytics helps to cope up from unpredictable weather conditions and Specifically, the decisions based on the insights from the data that is on the true and real-time facts are data-driven. (David 2018)

Smart Data Agriculture helps in the automated farming, collection of data from the field and then analysis it so that the famer can make informed decision with respect to optimal time of sowing/planting of the crop, optimal time for application of pesticides, insecticide and fertilizer starting with sowing, and time for harvesting.

Auto-spreading; there are also drones currently available and in development for crop spraying applications offering the chance to automate yet another labour intensive task using a combination of GPS, lesser measurement and ultrasonic positioning, crop- spraying drones can adapt to altitude and location easily. With accurate data available, this will enable the drones to perform crop spraying task more efficiently and with greater accuracy and less waste.

Soil conditions; can be define as the capacity of a soil to function, within land use and ecosystem boundaries, to sustain biological productivity, maintain environmental health and promote plant, animal and human health. Soil conditioning means improving several aspects of the quality of soil such as tilth, water holdings capacity, nutrient holding capacity and percentage of organic matter.

Field Management; in term of Real Time Monitoring and Analysis**,** one of the most useful tasks data driven approach can take on is remote monitoring and analysis of fields and crop. This is where the connected farm is essential, as all this data needs to be seen to be useful. Farmers can review the data, and only make personal trips out into the fields when there is a specific issue that needs their attention, rather than wasting time and effort by tending to healthy plants.

Water Management; also known as Automatic Watering and Irrigation using Subsurface Drip Irrigation (SDI) is already a prevalent irrigation method that allows farmers to control when and how much water their crops receive. By pairing these SDI systems with increasingly sophisticated data driven Internet of things IoT-enabled sensors to continuously monitor moisture levels and plant health, farmers will be able to intervene only when necessary, otherwise allowing the system to operate autonomously. farms can connect all this equipment to sensors that stream monitoring data directly to a computer or smartphone. they could operate completely autonomously in a smart farm context, relying on data from sensors deployed around the fields to perform irrigation as needed.

Key Opportunities for Data Analytic Approach

1. Adding precision to agriculture: Knowing when and what to plant; being demand-driven; sharing what farmers are growing and how much; measuring changes in practices and their relative benefit(s)
2. Enabling frequent feedback: Via 2-way feedback loops for better decision making, service delivery and programming; understanding farmer demands; for influencing extension info delivery; for localized and tailored services
3. Increasing cost-effectiveness and time savings: Proven reductions in cost; leveraging tools across projects; linking systems to reporting mechanisms and requirements
4. Increasing reach: Greater farmer reach and engagement that is difficult to achieve through analog processes

The Relevance and Need for Data Approach to Training in Agric Sector in Nigeria

The need to understand farmers' social and economic contexts is crucial in understanding their needs, concerns and motivations. Farmers in different contexts will access data and technology differently, in a broader context, data and technology may be irrelevant if a farmer lacks reliable access to market and has no power to set price for goods (e g when middle men set price and the market lacks competition). In this sense, the success of data and technology innovation may be tied to the amount of equity and stability in social and economic system (Boyera 2017).

Data in agricultural development remains a challenge. some data is not available at the resolution needed. (e g high resolution is lacking for observed weather data and information on agricultural yield). Other data is of variable, inconsistent, or of poor quality. (e g Data is lacking for on-farm management activities in many locations). Collected data may not be of use to stakeholder or researchers if it lacks relevance or if not collected with actionable information for sharing to allow for use in a broad range of contexts. (e g meta data is often lacking which provides the key information on how data is organized and its relevance and is critical for easily finding and using data for analysis (Beer 2016).

In view of this, it is important for Agricultural training institute in Nigeria to create a way of being a data driven organization and design a technology or chasing a channel for information dissemination, it is important to understand the full context of small holder farmers and other stake holders social and economic value and even the demand of their environment including other actors such as extension agents, agrovets, lead farmers and middle men. As it is in value chain, each actor is driven by her/his own needs and concerns that come into play when designing and implementing a new service or product.

Agricultural training institute in Nigeria could do much better to encourage government to use data to achieve her goal, even though their ultimate use is not necessary within institute control. Weakness in promoting data use have been a major issue for the past years. Agricultural training institute in Nigeria has a well-established approach to building the capacity of data producers, (most especially in agriculture and other related discipline) but it has not yet

formulated a conceptual model for assessing user capacity. It could promote data user, including government and non-governmental data user in the design of its projects. Agricultural training institute in Nigeria can also promote a user –centered culture among agencies that produce, share, and use data as to improve data literacy and constraints in weak research community. (FAO 2018)

International demands for data are increasing while new technological developments are revolutionized data production methods. Evidence based data approach is under some threat from policies restricting access to data. At the same time, it is important to strengthen Agricultural training institute in Nigeria data-related work. All over the world, statistical development is a critical area of policy reform and development, if Agricultural training institute in Nigeria want to deliver more on its mandate and maximize the use of more and better-quality data. (Ahmed 2019)

1. Contribute to the development of course materials through research analytical input
2. It will assist training by identify the existing gap through reliable data gathering
3. It will create more awareness for Agricultural training institute in Nigeria and assist faculty members to have access to current data for training and development.
4. data driven organization help in developing appropriate policies and related institutions and structures; devising incentives that deliver benefits to farmer; developing capacities of farmers and small and medium entrepreneur and institutional capacities to managed support system for data and information sharing and exchange; providing necessary infrastructure and connectivity within the reach of small holders.
5. They perform better: the data shows where they can stream line their process
6. They are more profitable: constant improvement and better predictions help to outsmart the competition and improve innovations.
7. They are operationally more predictable: data insight fuel current and future decision making.

Conclusion

As agricultural has become more industrialized, research data needs within agricultural training has changed, with greater emphasis now being placed on data in agribusiness. In particular, there is an ever- increasing need for data in research on the operations of the agribusiness sector or as supply chains become more tightly aligned; Agricultural training institute in Nigeria need to feed on relevant data which is also refer to as Training Data. Agribusiness can perform better with enough relevant data and training. Using this we can model to find relationship, detect patterns, understand complex problems and make decisions. Eventually the quality, variety and quantity of your training data determine the success in Agribusiness in Nigeria. The forms and content of the training data often referred to as labeled or human labeled data or ground truth data set is designed for to train specific models with an end application in perspective. The advantage of been a data- driven organization also make Agricultural training institute in Nigeria more shock resistive and less likely to fall victim to the next economy, technology or competitive disruptions.

Suggestions

1. Data driven approach should be used by Government to transform the way Agriculture company interact with other sector of the economy.
2. Data driven approach should be used to optimally allocate resources to achieve effective agricultural development
3. Government should use data driven approach to identify the right talent to fill critical roles and develop key capabilities in Agricultural system in Nigeria
4. Government and its agency should use data driven approach to track executions; current applications in data processing can help leaders manage large scale change in a volatile business environment, giving them greater transparency about the overall status of the programme.

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