Sustainable Agricultural Data Collection: Insights from the United States of America for Nigeria

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Introduction

Facts and statistics are critical to agricultural production. The collection and analysis of agricultural data fosters investment and innovation adoption in the agricultural sector. To this end, the United States Department of Agriculture (USDA), points out that farmers, ranchers, and consumers alike-use data on a daily basis. The needs range from deciding crop planting, harvesting, and marketing periods; to when to take cattle or other livestock to pasture; or where to buy fruits and vegetables. Hence, data availability and accessibility are necessary to facilitate the best-informed decisions.

The history of agricultural data collection in the United States of America (USA) can be traced back to one of their founding fathers, the first President, George Washington. He spearheaded accurate record keeping on his and other farms. Starting from 1790, the US recorded census in agriculture and counted some 4 million Americans, 9 out of 10 of whom lived on farms. The focus of agriculture during this period was about what crops to plant and how to ensure a bountiful harvest. Spurred by an inquiry from an Englishman named Arthur Young, President George Washington wrote to several farmers requesting information on land values, crops, yields, livestock prices, and taxes. This was perhaps, the Nation's first agricultural survey and the first crop report was made available by November 18, 1791 (USDA, 2017).

A major feat was achieved in1839, when Commissioner of Patents Henry Ellsworth prevailed upon Congress to designate $1,000 from the Patent Office Fund for "collecting and distributing seeds, carrying out agricultural investigations, and procuring agricultural statistics". In

Highlights

- Most agricultural data is collected annually in the USA
- Data collection processes are funded by both the Federal and State governments.
- Agricultural data is collected at individual farm level from different counties or Local Government Areas (LGAs) within a State. These are further aggregated at the LGA, State and national levels to produce data for the LGA, State and the Country, respectively.
- Use of ICT devices and software for agricultural data collection.

1840, detailed agricultural information was collected through the first Census of Agriculture, which provided a nationwide inventory of production. When the 1840 census information was released, Ellsworth was able to combine it with other information to estimate production by States and Territories. His estimates, made yearly through 1844, established the general trend of annual agricultural reports that continues to this day (USDA, 2017).

In 1862, President Abraham Lincoln signed into law an act of Congress that established the early beginnings of the USDA. Formerly known as "The People's Department", the USDA was created to follow the interest of American farmers and farming communities, who made up over half of the American population at the time. The history of the USDA shows four proposals establishing a Department of Agriculture, a Homestead Act, the construction of a Union Pacific-Central Pacific railroad, and the Morrill Land

Grant College Act. Upon the establishment of the USDA, Lincoln appointed Isaac Newton as the first Commissioner of Agriculture. Newton outlined several objectives in his first annual report which included amongst others, collecting agricultural data and establishing an agricultural library. These initial objectives shaped the legislation that Congress put in place to determine the USDA's layout and divisions. Thereafter the National Agricultural Statistics Services (NASS) was set up in 1863. NASS conducts hundreds of surveys every year and prepares reports covering virtually every aspect of U.S. agriculture (USDA, 2017).

In the Nigeria context, the Federal Ministry of Agriculture and Rural Development (FMARD) performs similar functions as that of the USDA. The FMARD is primarily funded by the Federal Government of Nigeria; the Ministry currently superintends almost fifty parastatals operating either as key departments or agencies across the country.

At the U.S.A. State level, the Michigan Department of Agriculture and Rural Development (MDARD) is in charge of agricultural data collection. Such data is aggregated by the U.S. Department of Agriculture. The MDARD is comprised of six divisions that use a customer-driven, solution-oriented approach to cultivate and expand new economic opportunities for the food and agricultural sector. The department's objectives are: safeguard the public's food supply; inspect and enforce sound animal health practices; control and eradicate plant pests and diseases threatening the food and agriculture system; preserve the environment by which the farming community makes their living and feeds consumers; and protect consumers by enforcing laws relating to weights and measures (MDARD, 2017).

Annual Surveys

Most U.S.A. agricultural data is collected annually. Specific areas of data collection and the annual survey types are given in Table 1 and Table 2 respectively.

Table 1: Categories and Nature of Data Obtained

Categories	Nature of Data Obtained
Animal production	Population and value of livestock, number of animals slaughtered, size, type and value of farms, cattle inventory, catfish production and processing, census of aquaculture, chicken and eggs, dairy products prices,

	milk prices, milk production, off-farm grain stocks, on-farm energy production
Crop production	Crop output, yield and prices; volume of chemical used and production costs.
Farm enterprises	Information on human resources, and rents paid
Price	Agricultural prices paid and prices paid in indexes, agricultural prices received and price received indexes,

Source: USDA, 2017, www.agcensus.usda.gov

Table 2: Types and Frequency of Surveys

Survey	Frequency
Land area survey (acres)	Yearly
Cattle inventory	Biannually
Agricultural labour	Quarterly
Crop production	Yearly
Hog and pig inventory	Quarterly
Sheep and goat inventory	Yearly
Farm production expenses	Yearly
Cash rent and land values	Yearly
Farms, land in farms, livestock operations and cash rents	Yearly

Source: USDA-NASS, (2017).
https://www.nass.usda.gov/Data_and_Statistics/index.php

In addition to annual data collection, the USDA-NASS also conducts the Census of Agriculture, first carried out in 1997. Prior to this period (1846-1996), the Census of Agriculture was done by the U.S. Department of Commerce of the Bureau of Census. The 1997 Appropriation Act transferred the responsibility to conduct this census from the Bureau of Census to the USDA-NASS which now does so in all the 50 states, Puerto Rico, Guam, U.S. Virgin Islands, Commonwealth of Northern Mariana Islands, and American Samoa.

The Census of Agriculture is a complete count of U.S. farms and ranches and the people who operate them. Even small plots of land (whether rural or urban - growing fruit,

vegetables, other food crops and animals), count if $1,000 or more of such products were raised and sold, or would have been sold, during the Census year. This census, taken once every five years, looks at land use and ownership, operator characteristics, production practices, as well as income and expenditures. For America's farmers and ranchers, the Census of Agriculture is their voice, their future, and their opportunity. The 2012 Census of Agriculture revealed that over three million farmers operated more than two million farms, spanning over 914 million acres. This was a four percent decrease in the number of U.S. farms from the previous census in 2007. The questionnaire for the 2017 census of agriculture is currently online. The simple questionnaire is user-friendly, accessible on any electronic device, calculates totals automatically and skips questions that do not pertain to the respondent's operation (USDA-NASS, 2017, www.agcensus.usda.gov).

Funding Data Collection

Data collection processes are funded by both federal and state governments. At the federal level, funds are appropriated by the U.S. Congress for Annual Estimates and Census of Agriculture. Such estimates are presented in Figure 1 for a period of fifteen years (2003 – 2017). Taking year 2016 as an instance, the figure showed a budget of $180 million for NASS operations, including $46 million (26%) for the Census of Agriculture (USDA – Budget, 2016). Apart from funding by the federal government, individual states also fund the production of county level statistics. Agricultural data usually collected at individual farm level from different counties within a state are aggregated to produce/generate the county data. The data from counties are aggregated at the state and federal levels to represent state and national data respectively.

Figure 1: NASS FY Budget Summary (Dollars in Millions)
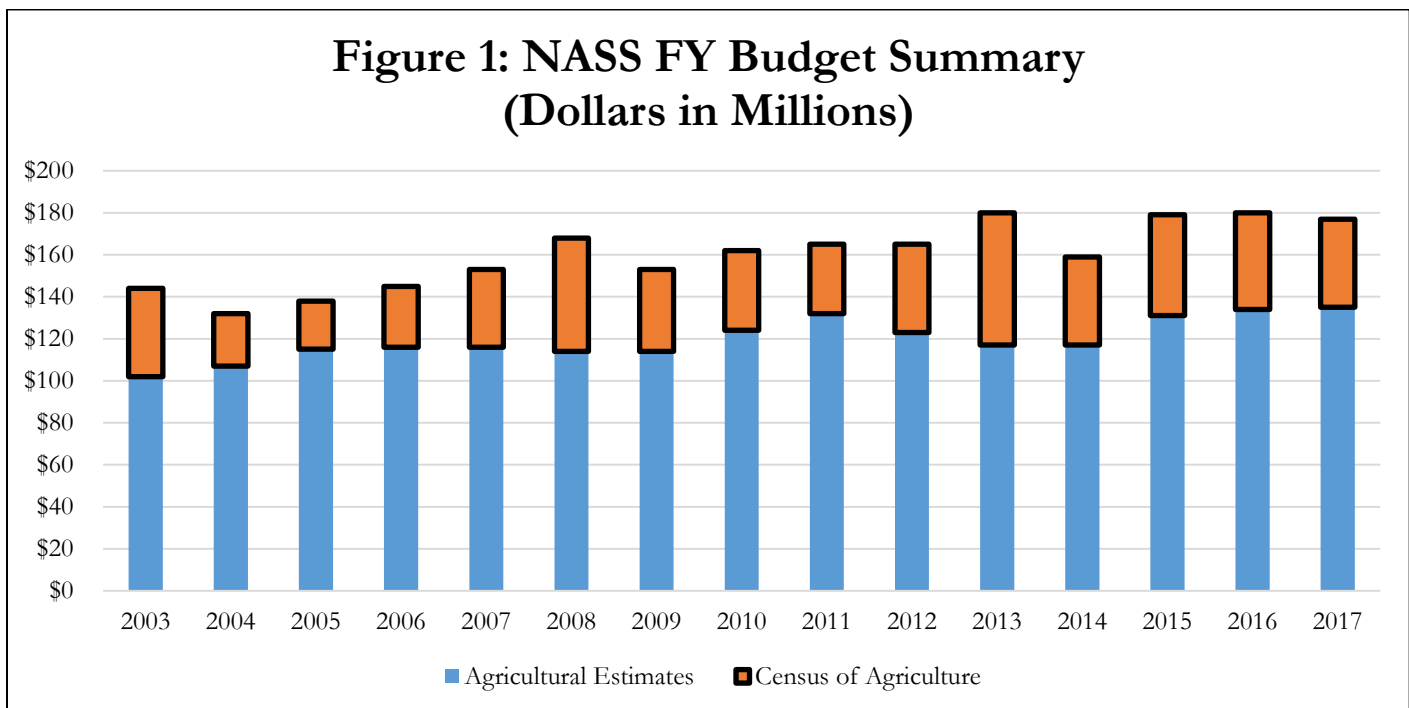
Source: USDA, FY Budget Summary https://www.usda.gov/our-agency/about-usda/budget

Information and Communications Technology (ICT) Advances

As far back as 1900, agricultural data was prepared and aggregated with the use of an electric tabulating machine. However, inconsistencies in data aggregation prompted the use of various statistical tools for data collection (NASS-USDA, 2017). ICT has facilitated better data collection and improved methodologies in agricultural research. These

include the use of satellites and networks, as well as automated data processing using Statistical Analysis Software (SAS). In 1978, the AgRISTARS program, a joint agriculture related remote sensing research effort involving USDA, NASA, National Oceanic and Atmospheric Administration and the U.S. Department of the Interior was started. The program identified seven areas of USDA interest for which aerospace remote sensing is applicable: early warning of changes affecting production and quality

of commodities, commodity production forecasts, land use classification, renewable resources inventories, land productivity estimates, conservation practices assessments and pollution detection and evaluation.

Continuing advances in research and technology led NASS to provide new ways of collecting agricultural data and customer services. From 1980 - 2000s several new technologies were implemented; software for conducting Computer Assisted Telephone Interviewing (CATI) is used to increase data quality, reduce non-sampling errors and decrease the resources necessary to conduct surveys. The use of Computer Assisted Personal Interview (CAPI) was introduced in 1988 by NASS. With CAPI, enumerators use laptops to collect data during face to face interviews. Both CATI and CAPI are usually designed in line with the paper version of questionnaires. Another development through ICT is the Interactive Data Analysis System (IDAS). It was the first Local Area Network (LAN) based interactive analytical tool developed by the agency and is now the workhorse for reviewing all survey data (USDA-NASS, 2017).

Following increased agricultural productivity in the US, an Enhanced List Maintenance Operations (ELMO) system was created in 1997, making it the first large scale centralized database software system built by NASS. This system is the primary tool used to maintain the list of farm operators to whom NASS sends surveys. ICT has also empowered NASS to collect weekly crop progress and condition responses over the internet using a secure survey instrument. In 2001, the use of Electronic Data Reporting (EDR) started with the Cotton Ginning Report and was used for the 2007 Census of Agriculture. NASS researchers used CAPI for data collection. This research used the Apple iPad which proved to be lighter and more cost effective in field interviews. iPads are still use up to now. In 2010, through ICT, the creation of CropScape, https://nassgeodata.gmu.edu/CropScape/, a geospatial web portal was developed which allows interactive browsing and querying of the national cropland data layer (USDA- NASS, 2017 https://www.nass.usda.gov).

As illustrated in the foregoing, NASS surveys are conducted in many ways. The way the agency presents its reports to the general public and what the end users do with the information released, is very important. The type of agricultural data collected initially determines the end users. Once the information is gathered and interpreted, NASS issues estimates and forecasts for crops and livestock through media such as newsletters, meetings, the internet and other publications. After this process, reports on

agricultural data of major crops are released to farmers and other stakeholders. The end users of agricultural data include: farmers, producers, agribusinesses, researchers, policy makers and other government agencies. They all rely heavily on the information produced by NASS for use in relevant areas. (USDA-NASS, 2017 www.agcensus.usda.gov). These areas include:

- Planning/administering federal and state programs in consumer protection, conservation and environmental quality, trade, education and recreation;
- Ensuring an orderly flow of goods and services among agriculture's producing, processing and marketing sectors;
- Maintaining a stable economic climate and minimizing the uncertainties and risks associated with the production, marketing and distribution of commodities through the provision of reliable, timely and detailed crop and livestock statistics;
- Enabling farmers and ranchers to make various production and marketing decisions, such as how much grain to plant, how much livestock to raise and when to buy or sell agricultural commodities; estimates and forecasts are used by the transportation sector, warehouse and storage companies, banks and other lending institutions, commodity traders and food processors;
- Supporting the businesses that provide farmers with seeds, equipment, chemicals and other goods and services to use the data when planning their marketing strategies; supporting analysts to transform the statistics into projections of coming trends, interpretations of the trends' economic implications and evaluations of alternative courses of action for producers, agribusinesses and policymakers.

Implications/thoughts for Nigeria

Timely and accurate data collection in the agricultural sector is pertinent to improving Nigeria's agricultural statistics. The availability of such statistics is critical for any evidence based policy recommendations to be made. While several efforts exist, there appears to be a need for more coordination of efforts (to avoid duplication) and a better integration of different stakeholders in the process.

For example, the process of data collection could start at farm level and at markets. This could typically be done by extension agents from the Ministry of Agriculture or the State Agricultural Development Project tasked to visit and

train Nigerian farmers. However, extension agents in Nigeria are overstretched with 1 agent for every 8,000 farmers (Federal Ministry of Agriculture and Natural Resources, 2016). They are not only in need of updated training but additional infrastructural and institutional support to enable them to reach and interact adequately with farmers. One key area that could be explored to secure agricultural information in Nigeria could be through faculty and students of relevant departments in tertiary institutions across the country (e.g. agriculture and statistics related departments) to host, at low cost, a data bank on agricultural produce/activities in their respective states. Such an arrangement could have several benefits related to quality, cost and sustainability.

Prices of major agricultural produce can be collected in a simple, cost effective way, using agricultural zones in each state of the federation as delineated by the Agricultural Development Project (ADP). In doing this, an agent or opinion leader (identified among the farmers and marketers of agricultural produce) can obtain information from farmers and marketers respectively. The agent can do so by going around various markets and farm households under his jurisdiction. The agent can further complement this process through phone calls to farmers and marketers. The tertiary institution in each case can verify the quality of information or data obtained by the agents. Apart from data verification, the institution can also be involved in designing the data collection instrument, setting up the data collection mechanism, training of identified agents/opinion leaders, and working with the opinion leader in ensuring total compliance. Basically, the essence of the identification and the follow-up by institutions involved is to ensure accurate and complete information from stakeholders. The opinion leader can help identify and collate prices of produce from major markets in each zone, before central collation of same, after which the tertiary Institution takes over.

In funding this data collection, the process can be incorporated by various agricultural zones as part of their services. These zones, located in all the 36 States and the Federal Capital Territory have their services funded by both the Federal Government and the respective State.

The information obtained and processed/analyzed by the tertiary institution is taken back to the farmers for their inputs and use alongside other stakeholders in their local government area and state. The participating farmers and marketers thus benefit from frequent information on prices in neighboring markets. The farmers also benefit from specific advice based on the performance of other markets. For wider coverage and effectiveness, the processed information on prices can be communicated to farmers through mass media such as radio and television in farmers' local dialects. This process is cost effective because participating agents or opinion leaders for each main market only receive incentives in the form of transportation and call allowance instead of salaries. While starting with price data, once the process is institutionalized and the benefit of such information is demonstrated, it is likely that stakeholders will clamor for additional information. Data could also be collected on agricultural practices, yields and other farming indicators.

Apart from its benefit to the farming enterprise through improved performance, the results assist in decision making by government on issues of policy. Evidence based policy decisions should have a multiplier effect on better or more appropriate outcomes/development in the agricultural sector. Additionally, this information can be widely used as the basis of providing extension services and advice to farmers.

Students and researchers at institutions of higher learning can use the price information for their academic studies with the potential of increasing the relevance of their findings to the needs of farmers and communities.

For cost effectiveness, departments can develop mechanisms to institutionalize this practice through coordinated effort of already existing departmental requirements such as field work and research reports (required of students) and information needs of communities. These institutions of higher learning (emphasis on Faculties of Agriculture and Social Sciences) will collaborate with the ADP. Once the data is aggregated from various ADP zones at the State level, it can further be collated at the national level with the involvement of the Federal Ministry of Agriculture and Natural Resources (FMANR) and the National Bureau of Statistics (NBS).

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