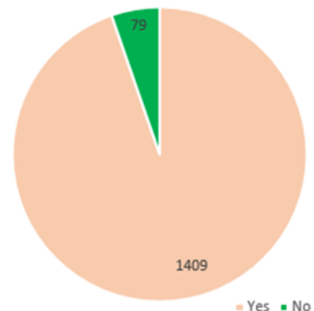
Policy brief: People-Centred Early Warning System EWS for Agricultural disasters in South-West Nigeria

Oyedepo, J.A., Taiwo, A. M. and Orimoogunje, I. O. O.

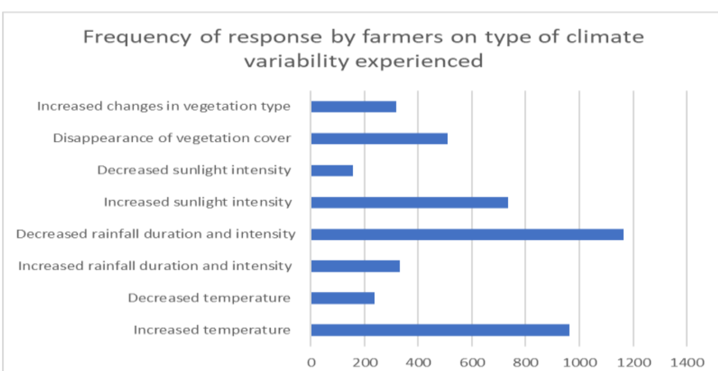
Introduction

Lack of climate information service exposes people in agriculture to high risks; consequently, granting fewer people access to good food, cleaner water, and better means of livelihood. Setting up an Early Warning System against pernicious weather events appears to be an essential action required to prepare farmers against the impacts of seasonally varying environments on agriculture. The infrastructures to ensure effective dissemination of climate information to farmers at the required frequency are, however, grossly inadequate or completely absent in many instances. Seasonal climate predictions have been limited in meeting the information needs of many rural farmers in Sub-Saharan Africa. Uncertain rainfall and climate information affect 70 percent of these farmers (Pereira, 2017; ParkerI, et al., 2019; Azzarr, and Signorelli, 2020).



The proportion of Farmers experiencing climate-change impacts

From our needs assessment of 1440 farmers, we found that an urgent need exists for data infrastructure for the generation and effective dissemination of high-quality agrometeorological information that is accompanied by models for reliable forecast where and when required.



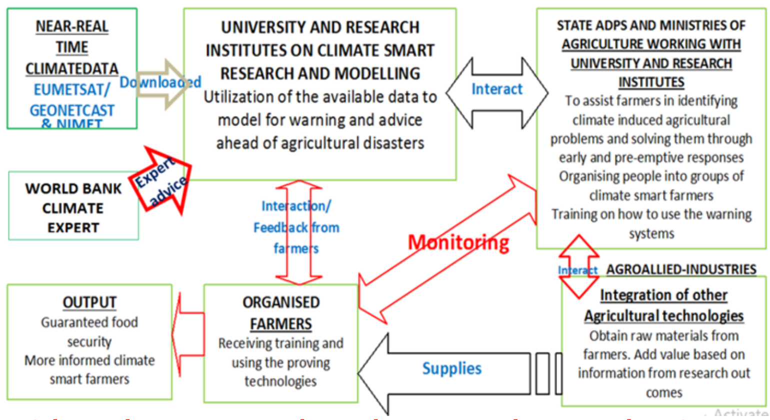
Frequency of response by farmers on type of climate variability experienced

To protect agriculture from pernicious climate-induced failures is to guarantee bumper food production and consequently improve farmers' livelihood, purchasing power, ability to educate the children, and realize the Sustainable Development goals ahead of 2030.

Farmers could use seasonal weather predictions in many ways to boost food production. Studies have shown that demand for climate information is now widespread among many African farmers. For example, a study in Burkina Faso found that 91 percent of farmers participating in a pilot project applied seasonal forecasts to their decision-making (Zongo et al., 2016). Seasonal climate information can therefore be a powerful tool for farmers. However, there is a significant gap between the available information and what farmers need, hence the need for need assessment studies. The outcomes of our study reveal that farmers have a great need for climate information services.

We have also found that if farmers and meteorologists would jointly work out the definition and implications of seasonal forecasting for specific locations, a lot of co-learning would occur. According to (Kumar et al., 2020; Werner, et al., 2020), it is crucial to respond to farmers' location-specific climate information requirements because general seasonal forecasts do not have enough information to help farmers resolve their climate-related issues.

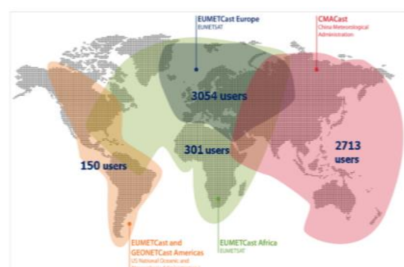
The project embarked on the development of a low-cost ground receiving station for reliable climate information that can be used to model farm-specific weather forecasts in near real-time. The station (briefly described below) needs to be replicated at the local level to provide location-specific advisory services to the rural farmers.



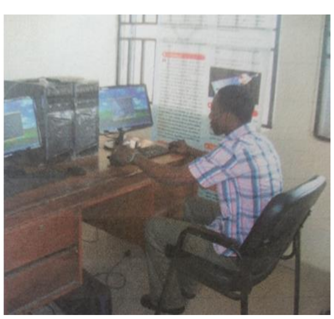
Schema depicting interrelationship in a People centered EWS

Construction of a ground receiving station (integration of Geonetcast) for receiving

The station is essentially a complete Digital Video Broadcasting (DVBS2) system comprising of 2.5-meter satellite receiving dish mounted outside a building at a site with minimal obstructions by trees or physical structures. The dish has a C-band Low Noise Block (LNB); that converts the 11GHz signal down to the 1GHz region; (amplifies it to overcome cable loss) and a good satellite cable terminated with F-connectors to connect the LNB with the DVB cards fitted into the PCI slots of two desktop computers cloned for the project.



GEONETCAST coverage showing EUMETCAST as the service provider for Africa


Receiving and processing

To be able to receive EUMETCast data from Eutelsat 8 W satellite, 2 computers were networked for the system, one was installed with a DVBS2 card as the receiving computer, the other one (Processing computer)was programmed to grab data from the receiving PC and process into useful form was a processing station. Aside from these two computers (connected to the dish), other computers with desktop GIS were connected in server-client architecture, for the purpose of spatial modeling of the data.

- The DVB card with TechniSat software, allows the card to receive data, the T-Systems TelliCast software turns the DVB card into a channel through which files are received from EUMETSAT, and dumped on the computer after which the management of the files becomes the responsibility of the user. Other software includes the Geo-netcast toolbox and the three GIS software namely Ilwis, Idrisi, and ArcGIS

Available Data

- FENG YUN: Data and products from China Meteorological Agency, e.g. FY-2E;
- LRIT: Low-Rate Image Transmitted satellite image data from Geo-stationary satellites (MSG, Meteosat-7, MTSAT2, GOES-East, and GOES-West);
- METOP: Data from the various instruments onboard of METOP;
- NOAA: NOAA-based satellite (AVHRR-GAC) and sounder data (HIRS, GOME, etc);
- VGT4Africa and VGT4LatAmerica: Dekadal processed data from SPOT Vegetation Instrument, like NDVI, NDWI, DMP, etc, for Africa and Latin America respectively;

What we can do with the data

- Prediction of local precipitation from cloud top temperature;
- Application for basin management
- Dynamic monitoring of insect populations
- Remote sensing applications for advanced drought services
- An automated multi-temporal threshold algorithm for forest fire detection
- Aboveground biomass quantification for natural grasslands
- Crop monitoring
- Estimation of Evapotranspiration (ET) in southwestern Nigeria
- Assessment of vegetation coverage as a tool for aiding the decision-making process.
- GIS approach for quantification of plantation productivity
- Development of a tool to monitor crop growth and grain yield
- Estimation of aboveground Net Primary Productivity of grasslands
- Estimation of Evapotranspiration from remote sensing and meteorological and numerous other applications

The project is expected to assist in overcoming climate-related agricultural constraints through the provision of first-hand information on the trend of events in the lower troposphere to farmers. It should assist farmers in planning and synchronizing their farm activities to avoid bard periods. The knowledge of the epi-center and direction of the spread of agricultural disasters (including pests and diseases) will prevent unnecessary agricultural losses.

Policy Recommendations

To enhance the use and benefits of seasonal forecasting, five changes have been suggested and these include integrating seasonal forecasting into agricultural research and development strategies, developing the capacity to use and demand climate information, and giving the agricultural sector and farmers an effective voice regarding climate information products and services. For continuity of the climate information services, national meteorological services could provide services for development and that weather data should be viewed as a free public good and a resource for sustainable development. There is the need for good initiatives on framework for Climate Services and Climate for Development that will re-invigorate seasonal forecast information for the agricultural sector by focusing attention on the design of climate information.

The following are recommended for policy formulation

1. Creation of weather repositories and data management offices in the state and Local Government Secretariats
2. Budgetary allocations for agriculture should include fund for climate services infrastructures (including automatic weather stations.
3. Replication of weather stations in key public places like schools, LGA secretariats etc., from where weather information can be pooled to the created repositories in (1) above.
4. Replication of the Early Warning System Receiving station in major agricultural zones of the states based on the climate information service needs of the farmers

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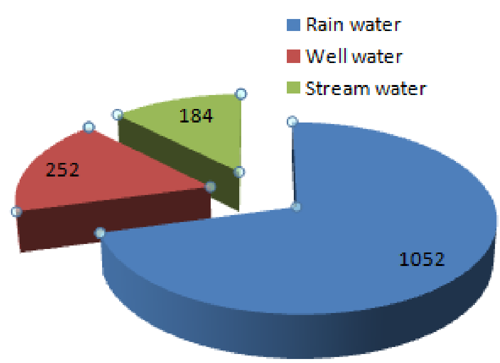
Policy Brief: Locally Available and Affordable (Drip) Irrigation for Sustainable Agriculture in Southwestern Nigeria

Oyedepo, J.A., Taiwo, A. M., and Orimoogunje, I. O. O.

Introduction

Climate is one of the major factors that affect the agricultural sector in terms of fluctuation in rainfall patterns, high temperature, and solar radiation (Agbola and Fayiga, 2016). Changes in atmospheric conditions had grossly affected agricultural production of food, means of livelihood, and access to potable water (FAO, 2017). This is a threat to the global food crisis and water insecurity. Climate and agriculture are keys to human survival, as entrenched in the United Nations Sustainable Development Goals (SDGs). Although southwestern Nigeria is blessed with good climatic conditions, especially in the area of the high level of annual rainfall, however, in the recent times, the scourge of climate change due to prolonged dry spells that could vary from 6 to 365 days and high evapotranspiration had grossly reduced the amount of annual rainfall (Layi-Adigun et al., 2020). There is a necessity to shift away from over-dependent rain-fed agriculture to technological advancement through the use of drip irrigation.



More farmers still depend on rain for agriculture

The introduction of drip agro-technology will encourage all-year-round production of food, in line with SDG numbers 1 (No Poverty), 2 (Erase Hunger), 11 (Sustainable cities and communities), and 13 (Climate Action). The use of a drip irrigation system has the capacity to increase agricultural crop yields by 50-200% while reducing labor by up to 60% (Veggie Grow, 2022). This will improve the farmers' profit and their general welfare.

Overview of Drip Irrigation

Drip irrigation is an agro-technology system where water and nutrients are delivered directly to the plant's root zone, in the right amounts, so that each plant gets exactly what it needs, when it needs it, to grow optimally. This agro-technology helps the farmers to conserve water and save the cost of fertilizer while optimizing the yields. Typically, a drip irrigation system consists of drip tapes or tubes, sub-main pipes, connectors, filters, and the fertigator connected to a water source. Drip irrigation can also be applied for chemigation to send chemicals such as pesticides, molasses, fluid acid, and neem oil to the soil and the root of plants. Drip irrigation is one of the

Drip Irrigation System

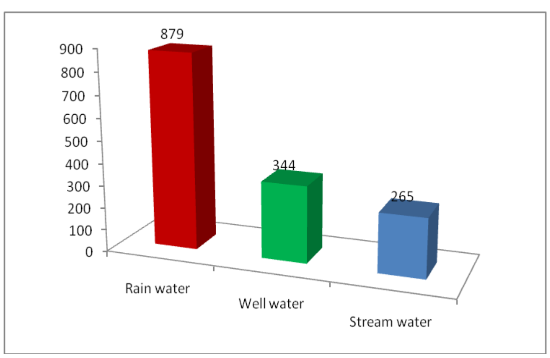
most innovative forms of irrigation that could provide a lasting solution to climate change problems in Nigeria. Our early warning system for farmers' preparedness against climate change impacts in the southwestern Nigeria project established the promising potential of drip irrigation agriculture.

Plastic polution in a street of Lagos

Meanwhile, the issue of plastic pollution is begging for solutions as mopping up plastic pollutants is not as worrisome as what to do with the gargantuan heaps of mopped materials. Agriculture seems to offer a large room to sink the huge menace. Plastic pots for holding potting mixtures in nurseries, hydroponics, and drip irrigation kits alone will mop several millions of tons of plastic annually from the streets, drainages, and water bodies.

Challenges of CSA in Southwestern Nigeria

Farmers in SW Nigeria are confronted with diverse challenges relating to climate change (Fawole and Aderinoye-Abduwahab, 2020). Poor agricultural yields due to the erratic patterns and short rainfall regimes, and frequencies of extreme events such as droughts and floods (Majule et al., 2020) are crippling productivity. The lives and livelihoods of millions of people in the SW Nigeria geopolitical zone are at risk of hunger and poverty (Olagunju et al., 2021). It is necessary to therefore focus on the adaptation activities that will boost crop and livestock productivity, and capacity building for smallholder farmers to increase their understanding of the impact of temperature and rainfall variability on key crops, and build measures for resilience and adaptations to changing climatic conditions in their agricultural productions.



More farmers depend on rain for agriculture

To guarantee food security and improved livelihoods for farmers through increased production, dependence on rain-fed systems must give way to irrigated agriculture since it has been proved that no nation's agriculture can survive on rain alone. Supplemental irrigation (particularly the drip system) is the only method that guarantees the growing of crops by these farmers throughout the year.

The drip system conserves water and minimizes the weed population on the farm. However, the cost of installation is very high at the moment because it is largely imported and is beyond the reach of most farmers. The need for government intervention to make it affordable is long overdue.

Policy Recommendations

Our experience during the execution of the Early Warning System Project, suggests that farmers are eager to have government interventions in drip irrigation systems. A group of farmers in Ekiti has requested our project team to help in the establishment of drip irrigation kits on 1000 hectares of farmland. In view of the above, existing agricultural policies may need to be reviewed, particularly to incorporate the following policy recommendations

Drip irrigation in one of the climate smart villages

- Introduction of 5% of tax from industries within the States to be devoted to supporting agricultural development including, the development of indigenized agricultural technologies to reduce cost and increase availability and affordability of basic tools like drip irrigation system kits.

- Climate-smart agriculture should be incorporated into the existing national agricultural policy through an agro-technological driven drip irrigation system for all-year-round production of foods.

- Government subsidies of drip irrigation system. Farmer groups should have access by soft loans to various modern productivity-boosting implements including irrigation kits.

- Development of more agricultural lands equipped with borehole facilities at local government levels. These farmers can easily apply and practice year-round production. This will reduce overall dependency on rain-fed agriculture, and thus improve people's livelihoods.

- Encouragement of local production of drip irrigation kits should be made by the Federal government. The kits could be produced from recycled plastic. This policy will complement the control and eradication of plastic pollutants, which constitute major environmental problems. The management of plastic pollution is important due to its non-degradability properties, and associated health problems associated with plastic pollution.

- Government should facelift the current crude agricultural practices through the enactment of policies that will educate and train the farmers on smart agriculture, and the use of drip irrigation. This would be achieved through the establishment of smart agricultural cities with demonstration plots to replace the defunct grazing routes and farm settlements.

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Policy brief: Climate-Smart Villages and Climate-Smart Agriculture

Oyedepo, J.A., Orimoogunje, I. O. O., Oyedepo, E.O., Aiyegbokiki, A. O. and Taiwo, A. M.

Introduction

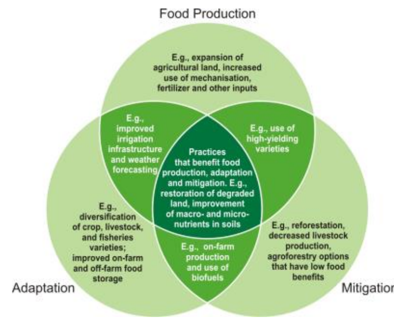
Climate-smart farmers with smart phones

Southwestern Nigeria is one of the most food-insecure region in Nigeria (Omotayo, 2016; ICIR, 2021). The over-dependence of the geopolitical zone on northern Nigeria and foreign countries for food supplies paints a clear portrait of this position. For a long period, agriculture in SW Nigeria has been rain-fed. Furthermore, a very large percentage of the 40 million people of SW Nigeria have quit farming for other jobs in cities; the few people in the rural areas are resource-constrained, elderly, and peasants, relying on rain and crude implements for production. Incidentally, the rainfall pattern is erratic, making it extremely difficult to determine when to commence an agricultural season and when to end it. The onset and cessation of rains have become grossly unpredictable. In 2020 and 2021, there are reports of huge crop loss to drought as a result of planting with false onsets of rains. In 2022, the rainfall pattern has taken up a different behavior, the first to be noticed is the delayed onset and the next is that the onset has become irregular and unstable. At the moment, (mid-April, 2022), the majority of farmers are still studying the weather pattern and have not commenced land preparation for the new season.

C-smart farms can be equipped with solar power

Considering, the huge risks associated with agricultural losses, several smallholder farmers are seeking refuge in various climate-smart approaches to circumvent climate-induced losses. Farmers have shown willingness to pay for climate advisory services (Oyekale et al., 2015) and will not mind giving their all to acquire different ways of building resilience to the increasing climate variability and changes. Meanwhile, Climate-Smart Agriculture initiatives of the World Bank and the United Nations' Food and Agriculture Organisation are in line with some of the Nigerian agricultural policies. The current guidelines for CSA practice in Nigeria specify a wide range of technologies and practices guidance for smallholder farmers. However, choosing the most effective combination of CSA practices for a specific agro-ecological and socio-cultural context remains a challenge for the country (Tiamiyu et al., 2018). This project has successfully identified the comparative advantage of the relative practice and technology applicable to each agro-ecological zone. The team has also extended some of these technologies and practices as complementary input to the climate information services.

Climate-Smart Villages and Climate-Smart Agriculture technologies and practices promoted by the Project



3 pillars of Climate-smart Agriculture

The project team selected three Local Government Areas (LGAs) that are most climate-change impacted from each of the six SW States. From each LGA, four (4) rural and agrarian communities were selected and twenty (20) farmers disaggregated into 12 males and 8 females were selected from each community. This implies eight (80) farmers were selected from each LGA and by extension 240 from each state. All the (240) farmers selected from each of the states were then organized into one Climate-Smart Village (CSV) located at the most central community and LGA. This was important for ease of coordination, training, instruction, practical demonstration, etc.). Each Climate-Smart Village has a meeting hall, a demonstration plot with a drip irrigation kit, a solar power system, and a solar-powered television set. All projects worked to support CSA with promoted technologies depending on the agro-ecological zone where the project was implemented.

Table 1: CSA Technologies extended by the project

Intervention type	How it is expected to build climate resilience	Main CSA technologies promoted by the GCCA
Improved crop production practices	The practices are generally focused on improving water availability and bio-fertility for crops (direct CCA) through soil/water conservation measures. In addition, they increase fertility and/or control pests.	Drip irrigation system,
		Mulching and use of manure / composting
		Agro-forestry, mixing of crops with animals.
Improved livestock practices	Improved goat breed (Kalawad) and improved Poultry breeds (FUNAAB Alpha) were introduced to the farmers to allow for increased income i.e. increased food security.	Improved livestock breeds (goats, poultry)
	The farmers were introduced to free-range birds and swapping of overused farm plots for free-range livestock plots for sustainable soil management	Improved husbandry

Challenges of CSA in SW Nigeria

1. Lower number of Climate-smart villages takes the opportunity to learn and interact on CSA practice away from farmers. CSVs should be at Local Government levels in order to bring interventions closer to the rural smallholder farmers
2. Furthermore, CSA technologies can be unaffordable to many farmers. For instance, promotion of drip irrigation and building sheds for improved goat and chicken breeds require substantial financial investments
3. Since Climate Smart Agricultural practice cannot resolve all climate-change related agricultural problems, farmers may not be too keen in keeping up with it. Adaptation measures that can boost productivity should therefore be emphasized in the Climate-

smart villages. Adoption of good CSA practices will increase average yields even in years with rainfall below average..

4. Willing farmers are often limited by a lack of access to improved seeds and inputs. The majority of smallholder farmers have limited access to improved seeds like the high yielding, fast-maturing, drought-tolerant varieties

Table 2: Factors against the effective practice of climate-smart agriculture

Barriers	Very severe	Fairly severe	Not severe	Mean(S.D)
Illiteracy	891(60.0)	484(32.6)	108(7.3)	2.51(0.63)
Lack of adequate technology to get real-time information	1073(72.4)	336(22.7)	74(5.0)	2.66(0.57)
Theft of climate-smart infrastructure	571(38.5)	478(32.2)	434(29.3)	2.04(0.81)
Lack of continual funding for climate-smart infrastructure	990(66.8)	421(28.4)	72(4.9)	2.59(0.58)
Intensity of storm	430(29.0)	646(43.5)	407(27.4)	2.02(0.77)
Seasonal rainfall pattern	829(55.9)	535(36.1)	119(8.0)	2.44(0.64)
The irregular pattern of rainfall	955((64.4))	378(25.5)	150(10.1)	2.51(0.68)
Prolonged drought	855(57.7)	398(26.8)	230(15.5)	2.38(0.75)
Lack of internet connectivity	876(59.1)	394(26.6)	213(14.4)	2.41(0.74)
Lack of funds	1242(83.7)	225(15.2)	16(1.1)	2.81(0.41)

Policy Recommendations

Our policy recommendations are therefore based on the solutions to the challenges enumerated above namely:

1. States should increase and fund the number of farmer-controlled Climate-Smart Villages. A CSV per LGA may not be superfluous.

2. States should subsidize key CSA technologies; particularly those that boost productivity. Each CSV can be a center for farmers to acquire these technologies cheaply or with a soft loan arrangement.

3. More hubs that specialize in CSA technologies should be encouraged. For example, Universities of Agriculture could produce some of the technologies with research funding agreement with the state government and recognized agro-industries for the promotion of seeds, drip irrigation, and improved livestock breeds

4. Emphasis by extension agents and facilitators visiting the various CSVs should be on the CSA practices that will increase average yields for the farmers.

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Policy brief: Periodic Census for Agricultural planning and Development

Oyedepo, J.A., Oyedepo, E.O., Orimoogunje, I. O. O.

Introduction

The need for agricultural statistics in Southwestern (SW) Nigeria has never been greater. The continuous influx of human traffic from other parts of Nigeria into the South-west, Nigeria which as of 2017 has a population of about Forty-seven million people (NBS, 2017), calls for urgent and recurrent census exercises in the agricultural sector. The rapid increase in the number of industries and human population will put concomitant pressure on the raw materials and available food resources in the not-too-distant future. The government needs to be armed with accurate information on the food and raw material requirements in the six states of SW Nigeria. This will be crucial for the planning and design of government interventions in the agricultural sector. The farmers' locations, enterprises, challenges, and intervention needs must be documented in precision. Foreign investors will want to know where to invest. The respective state ministries of commerce need to understand the value chain of all agricultural produce in order to improve the economy of the state.

Capturing of farmers; data at various communities during the project

Southwestern Nigeria has a massive area of land for arable and permanent crops as well as for pastoral farming (Adeoye, 2017). Available evidence from literature also shows good soil, excellent weather conditions, great water resources, and good vegetation, indicating abundant prospects for enormous agricultural production in southwestern Nigeria. There is ample opportunity for year-round cultivation of arable and export crops such as oil palm, rice, kola- nut, cocoa, cotton, cassava, cocoyam, and vegetables as well as large-scale livestock production. However, current facts and figures evidence does not indicate that the SW geopolitical zone is close to realizing half of the potential in agriculture and food production. Information about the present production capacity of the farmers, their location and distribution, their potentials and predicaments, and their needs and constraints is rather sketchy. The conditions of their communities and their infrastructural needs are vague and the full documentation of the farming communities' activities and relative enterprises are yet to be done. To achieve the aforementioned however, there is a need for agricultural data capture of the entire state by means of a census and consequently mapping.

Our baseline survey of 1440 farmers across the six states of SW Nigeria, reveal that a lot needs to be done to develop agriculture in SW Nigeria. With adequate information, accurate targeting of interventions can be done. Comprehensive census that generates baseline agricultural data is an essential step towards effective planning for the development of the agricultural sector.

Table 1: Distribution according to households' size and farming experience of respondents

Variables	Frequency
Household size	
0 – 4	269
5 - 9	824
10 – 14	307
15 & above	88
Household size (male)	
0 – 4	1107
5 - 9	330
10 – 14	18
15 & above	33
Household size (female)	
0 – 4	1080
5 - 9	325
10 – 14	37
15 & above	46
Economically active Household members	
0 – 4	1294
5 - 9	158
10 – 14	30
15 & above	06
Years of farming experience	
1 - 10	324
11 - 20	524
21 - 30	324
31 – 40	192
41 and above	123

Just as the national census presents the characteristics of human population, such as age, race, and income aid planning and national or regional development so does an agricultural census give valuable information for proper agricultural planning. An agricultural survey provides a basis for identifying various farming activities and enterprise, the constraints, areas requiring government interventions, possible areas that may interest foreign investors, the people and natural resources available for agriculture.

A census and mapping of Agriculture could also help to generate a good database of reliable information. It may be possible amongst other things to know for instance, the number of hectare cassava is currently cultivated this year and how many acres of maize were harvested in the previous years. The state governments in SW Nigeria can also determine how many local poultry or how exotic poultry are currently been reared in the state, how many nomadic cattle are in the land, where are they located, where is the best area to cite a large scale livestock project based on comparative advantage. Such rich database will guarantee absolute correctness in government decision on a number of issues. It will be possible to take precise decisions on for instance, the number of acres of particular crop to produce, who are the producers, where should they produce it, what is the fertilizer requirement of the state, how much should the government spend on fertilizer procurement and where should the fertilizer be deployed.

Policy recommendations

1. State agricultural policies should include capture all Agricultural information and statistics through a comprehensive agricultural census on five-year basis. The census should document size of holding, land tenure, land use, crop area harvested, irrigation, livestock numbers, labour and other agricultural inputs, rainfall, temperature, topography, sun-shine hours, soil profile, soil mapping units, soil properties (texture,

moisture content and fertility), Evapotranspiration, agricultural pest and disease (including types and intensity of infestation at their Economic Injury Levels)

2. The census should be accompanied by mapping of soil types, land capability classes, all agricultural land cover types, activities, production and facilities in the State including extension and advisory services in the state, Agricultural input outlets, major markets and Agro-allied industries

3. The policy should include development of Agricultural Information System for the State using Geographic Information System and other Space technologies through creation of Database in GIS using all captured information from the field. A user-friendly agricultural information system (AgGIS) should be developed and placed in the public domain for easy access to all.

4. The policy should incorporate creation of a department under State Ministry of Agriculture in charge of the agricultural information system (AgGIS). The department should handle regular update of information through farmer participatory approach to data collection. It should also take care of training field level enumerators (farmers) for quality data collection. The department should also be in charge of spatial data infrastructure, storage and database management including query, retrieval and update agricultural census through customized GIS software.

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