Precision Agriculture: Status, Opportunities and Challenges in Nigeria

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NAERLS at a Glance

Established
1963

Funding/Regulator
FMARD/ARCN

Focus
Extension, Research & Training

Staff strength
700+
* To be the foremost institute for agricultural extension research and capacity development for:
  * effective service delivery,
  * increased agricultural productivity,
  * sustainable agricultural growth and wealth creation.
Mission Statement

* Develop, collate, evaluate, disseminate agricultural technologies

* Conduct research in agricultural extension methodologies and policy;

* Provide leadership in capacity building of stakeholders to meet the present and future agricultural and developmental challenges of the country.
Background Nigeria

- Located in the western part of Africa in the Gulf of Guinea and is situated between Longitudes 2°2' and 14°30' east and between Latitudes 4° and 14° north.
- Land mass of over an area of 924,000 km2
- 2012 population of about 166.2 million people.
  - Projected population will reach 450 million by 2050.
- Agricultural production grew throughout the 1990s to attain self sufficiency in major staples maize, sorghum, millet as well as in cassava, yams and cocoyam.
- Food production gains have not kept pace with population growth, resulting in rising food imports and declining levels of national food self-sufficiency.
Background and context Nigerian Agriculture

- Agriculture is the mainstay of the Nigerian economy
  - Agriculture contributes 23% of GDP
  - estimated that more than 60 per cent of the economically active population of the country depends on it for their livelihood

- Agricultural growth however remains unsatisfactory especially when measured in terms of improved productivity- food insecurity and malnutrition

- Increase mainly coming from increase in land area and not more efficient use of resources

- Current rates of increase in yields of main cereal crops will not double crop production by 2050.
Ninety percent (90%) of agricultural production in Nigeria is the output of inefficient methods and very low input use by small-scale farmers as shown below:

- 18kg/hectare inorganic fertiliser use compared to a World average of 100kg/hectare and 150kg/hectare for Asia.
- 5% of the farmers use and access seeds of improved varieties compared to 25% in East Africa and 60% in Asia.
- Low mechanisation 10 tractors per 100 hectares compared to Indonesia with 241 tractors per 100 hectare

Current rates of increase in yields of main cereal crops will not double crop production by 2050.
Agro-ecological Zones in Nigeria
<table>
<thead>
<tr>
<th>Low-level inputs/traditional management-assumption</th>
<th>Intermediate-level inputs/improved management-assumption</th>
<th>High-level inputs/advanced management-assumption,</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Farming system largely subsistence based</td>
<td>-Farming system is partly market oriented.</td>
<td>-Farming system is mainly market oriented.</td>
</tr>
<tr>
<td>- Production is based on the use of traditional</td>
<td>-Production for subsistence plus commercial sale</td>
<td>- Commercial production is a management objective.</td>
</tr>
<tr>
<td>cultivars, labour intensive techniques,</td>
<td>-Medium labour intensive,</td>
<td>- Production is based on improved high-yielding</td>
</tr>
<tr>
<td>- no use of chemical fertilizers, of chemicals</td>
<td>- some fertilizer and chemical application</td>
<td>-varieties, is fully</td>
</tr>
<tr>
<td>for pest and disease control measures.</td>
<td></td>
<td>- uses optimum applications of nutrients and</td>
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<tr>
<td></td>
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<td>chemical pest, disease and weed control.</td>
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Increased demand for food must be met with greater agricultural intensification based on a combination of inputs such as fertilizers, high yielding cultivars and other improved practices with minimal effect on the environment = PA?

Eighty percent of the increase in production in Nigeria will have to come from improved crop yields and higher cropping intensity.

Studies indicate that mineral fertilizer use accounts for a significant proportion of the increase in food production.
Precision Agriculture: Definition

- Precision agriculture is an evolving management strategy that changes with technology and our understanding of what is achievable grows. Further improvements is expected as tech advances.

- **Precision Agriculture** is a management strategy that gathers, processes and analyzes temporal, spatial and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production.

- Innovative management approach that increases the number of (correct) decisions per unit area of land per unit time to optimize long-term, site-specific quantity and/or quality of production, as well as to minimize impacts on the environment.
Precision Agriculture

- Emphasis is on site-specific crop production, but similar issues arise with respect to management of all agriculture including livestock, fisheries, forestry etc.
- Gives precise information to enable more appropriate and cost efficient application of seed, fertilizer, chemicals, irrigation, and other farm inputs.
- Making agriculture more profitable economics are optimized by enhanced efficiency of farm inputs.
- By varying the amount of farm inputs (fertilizers, pesticides, and irrigation) used for crop production, and applying those inputs exactly where they are needed, and with reduced transport of chemicals into the environment.
**Precision Agriculture**

- PA technological options are not yet widely used by farmers.
- Generally at the pilot stage when in use.
- Management tool that has not been adequately utilized.

No studies are presently available to show the status of adoption, the profitability and efficiency (in local context) and the opportunities for the adoption of PA in Nigeria.

Adoption can generally be considered fairly low.
The generation of maps for crop and soil properties is the most important and provide the basis for controlling spatial variability.

Satellite imagery available with National Space Research and Development Agency but little impact due to poor ground truth data for interpretation.

- High-resolution images need to be validated on the ground to ensure the trustworthiness of the interpretation.

Augmentation of database and further development of spatial analytic applications include utilizing some locally unavailable technologies such as Light Detection And Ranging (LiDAR)

-Yield monitoring and mapping is one of the major industries to incorporate drones. Drones are being used in agriculture in order to enhance various agricultural practices.
Hello Tractor: The firm generates tractor operators’ information and tracks the revenue generated during the time it is in use.

Probity Farms: The app solves the problems of recording farm practices, expenses and yield, and provides information on access to market to farmers.

Novus Agro: The Novus Agro’s agricultural exchange information exchange services share farmers’ data, market price intelligence and agricultural advisory and weather information through its online platform and SMS.

Ignitia: This is a Swedish tech company, is providing daily, monthly and seasonal weather forecast updates to rural farmers in Nigeria through subscription. The company uses GPS to create localised weather forecasts that are delivered to farmers via SMS.
Use of ICT tools in Nigerian agricultural sector in recent times started with the sharing of Short Message Service with farmers due to the low literacy level and wide use of mobile phones by 75 per cent of the farmers.

e-Wallet system: This is an electronic system that allows the government to deliver subsidised improved seeds, fertilisers and agrochemicals directly to them based on personal and biometric information they have provided.


**Precision Agriculture** variable-rate (VRT) application

- allows for precise seeding, planting optimization, density and improved application rate, efficiency of herbicides, pesticides and nutrients.
- Variable rate drills and planters, fertilizer spreaders, and sprayers are commercially available.
- IITA herbicide application and CDA nut expert available for upscaling.
IITA Herbicide Calculator

**Parameters for Calculation**
- Enter Dosage of Herbicide (L)
- Enter Volume of Water (L)
- Enter Capacity of Sprayer (L)

**Calculate Volume**  **Reset Fields**

*Note: volume of water is the quantity discharge on*

IITA © 2018
allows for precise seeding, planting optimization, density and improved application rate, efficiency of herbicides, pesticides and nutrients.

- Variable rate input calculators available
- IITA herbicide application and CDA nut expert available for upscaling
- OCP mobile testing Lab
Forecasting crop yields is a valuable strategy for a farmer and aids in the formation of a cropping plan.

NIMET SRP

Combining forecast data with the crop models allows for recommendations that are implementable at small and large scales.

Access to sophisticated modeling methods, however, is limited. Farmers in developing countries often don’t have the opportunity to simulate a multitude of scenarios before making decisions.

“Seasonal climate forecasts aren’t very helpful for farmers without understanding of how that translates to recommendations.
Recommendations from Akilimo will be delivered to farmers through a smartphone application, printed maps and recommendation tables (paper-based tools), Unstructured Supplementary Service Data (USSD) and Interactive Voice Response (IVR) format.

- tailored fertilizer recommendation, the tool will also be used to advise farmers land preparation methods, weed management, planting densities and fertilizer application for intercropped cassava fields as well as planting and harvest dates for high cassava root starch quality and sustainable raw material supply.

- All recommendation given by the Akilimo tools is specific to the location and cropping practice of the farmer seeking advice.
IITA Akilimo Decision Support System For Cassava Farmers in Nigeria

Field trials to test and develop best agronomic interventions
Understand Agronomy × Environment
Crap modelling
Predict response to intervention
Spatial modelling / GIS
Extrapolate recommendations

Cloud-based prediction engine

IVR
Short code messages
Smartphone app
Printable guides / maps

DB logging requests

Extension worker
Cassava growers

...Delivering Innovative and Proven Agricultural Information & Technologies
www.naerls.gov.ng
Optimizing Fertilizer Recommendations in Africa (OFRA)
Much well conducted research with enough site-season-variety trials for determination of robust N, P, and K response functions (RF) for 6 crops = 18 RF

Opportunity to apply economics to fertilizer choices
- Optimizer approach developed
- Enable most profitable crop-nutrient-rate choices

Smallholders responsiveness to perceived opportunities for profit that carry little risk
Much research conducted
National Farmers Helpline launched in 2018 in partnership with the Federal Ministry of Agriculture and Rural Development

To provide timely and relevant information on agricultural technologies and advisory services for farmers to facilitate decisions on activities along various agriculture value chains.

Questions are received via –

- Phone calls
- SMS
- E-mails
- Walk – in
Precision Agriculture - Opportunities

- Farm sizes are already in small units and therefore easily adaptable to PA
- Widespread use of mobile phones provide new info delivery and collection mechanisms
- Marginal cost of distributing info via mobile phones is close to zero.
- High-value crops, could be achieved with higher profitability with the implementation of VR technologies.
- Multiple cropping by farmers to reduce risk no longer necessary
- The low ability for small holder farmers to take advantage of PA options creates a strong opportunity for youths to serve as PA Consultants AGROPRENEURS- CBA concept in Nigeria
- PA gives low hanging options for response to climate change
Precision Agriculture - Challenges

- Special skill sets eg SRP forecast know
  - Data intensive: vast amount of information is required
  - Knowledge intensive
  - Limited technical knowledge by farmers
  - Need of special services and education
  - Availability and cost of management time wrt small holder producers

- Cost benefits of Precision Agriculture management not available:
  - Economic studies in the field are not comparable,
  - Further analysis is necessary is required for improved understanding of local conditions that lead to enhanced profitability of PA
  - Investment/ Relatively higher start up cost
  - Low profitability and risk/ Uncertainty of the investment.
Precision Agriculture - Challenges

- Low public support/ advocacy
- Limited access to extension services due poor funding and inadequate staffing of ADPs
- None-integration into public advisory services/ lack of support
- Other demand and supply issues
- Low capacity to use ICT and emerging technologies at the farmers level
The key strategy to achieve the goal of promoting PA amongst Nigerian small holder farmers is the generation of support and knowledge needed to guide adoption.

It is essential to transfer this knowledge from the research site/laboratories/computers to the farmer's field.

The efficacy of extension programmes depends on the factors that influence technology adoption by farmers.

Extension efforts to deliver specific PA options will have to be based on an understanding of factors affecting adoption of fertilizers.

The goal of PA program in Nigeria would therefore be to improve the productivity and income of small holder farmers through their widespread adoption of best bet PA management practices.
Extension options for PA

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PA Extension issues

- PA’s could better reach their potential leveraging on existing infrastructure/ institutions so that farmers can effectively utilize
- Integration into Extension
- Stand alone vs combination PA’s
- Working in silos
- Private sector role for outsourcing
- Limited access to extension services.
- Advocate for support from public sector to promote more rapid acceptance of PA
- Other demand and supply issues
Conclusion

- Increasing agricultural productivity in Nigeria through improved PA use is a readily adoptable option through strengthened extension.
- The key strategy to achieve the goal of promoting PA amongst Nigerian small holder farmers is the generation of support and knowledge needed to guide adoption through a combined approach of using qualified field extension workers and private sector agripreneurs- CBA
- Decisions to adopt appropriate use inputs especially improved seeds/fertilizer and other improved agronomic practices are often made simultaneously, PA’s should be presented in combination
- The cost benefits of Precision Agriculture management in Nigeria has not been assessed.
Merci beaucoup, French
- Medaase, Ghana
- Eba’- Ogori, Nigeria
- Thank you!

- GOD bless Nigeria
- God bless West Africa

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