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# MANAGING CHALLENGES TO SUSTAINABLE ENTREPRENEURSHIP AND INNOVATION IN THE NIGERIA BIOTECHNOLOGY SECTOR: A CASE OF INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE, KANO STAION

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**ABSTRACT**

The study investigated the entrepreneurship and innovation challenges facing the agricultural biotechnology sector, and the strategies employed in managing them; considering social, economic, and environmental sustainability. The International Institute of Tropical Agriculture (IITA) was selected for the study. IITA was selected for its role in revolutionizing agriculture in Africa for the past 50 years using research and innovation, including biotechnology in recent years. IITA aims to enhance the food security, income, and well-being of resource-poor people primarily in sub-Saharan Africa by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources, in

partnership with national and international stakeholders. The study adopted a semi-structured interview for a comprehensive discussion of the topic. The results showed that lack of youth involvement, farmers' training, improved seed varieties, skilled researchers, collaborative research, and modern farming techniques including digital farming are some of the challenges facing the agricultural biotechnology sector in Nigeria and Africa as a whole. Some of IITA's solutions to the aforementioned challenges are youth development programs, collaborative research using emerging techniques of biotechnology, IITA's mobile applications for farmers, and other innovations in farming; which are now making farming easy and more profitable for farmers in Africa. The study concluded that entrepreneurship and innovation are important factors for economic growth, especially in developing countries, and identification and addressing factors affecting the success of agricultural biotechnology will go a long way in ensuring social, economic, and environmental sustainability in Africa.

## INTRODUCTION

The International Institute of Tropical Agriculture (IITA) is an award-winning, nonprofit and research-for-development (R4D) organization that partners with international and national organizations in providing solutions to hunger, malnutrition, poverty, and the degradation of natural resources in Africa through enhancing crop quality and productivity, reducing producer and consumer risks, and generating wealth from agriculture. The institute was established in 1967 and its headquarters is located in Ibadan, Nigeria, with several research stations spread across Africa. The organization is governed by a Board of Trustees, supported by several countries and the Consultative Group on International Agricultural Research (CGIAR).

IITA's research-for-development (R4D), which is clearly stated on their website, focuses on addressing the development needs of tropical countries, and has since its creation, worked to improve livelihoods, enhance food and nutrition security, increase employment, and preserve natural resource integrity. The institute has been guided by its ambitious strategy-to lift 11.5 million people out of poverty and revitalize 7.5 million hectares of farmland by 2020. IITA is one of the 15 research centers in the CGIAR, which is a global partnership for a food-secure future and has delivered more than 70% of the CGIAR's impact research programs in sub-Saharan Africa through its commitment to the science-driven improvement of agriculture and related food value chains (IITA n.d.).

IITA's R&D programs have attracted the best and brightest minds from all over the world and are focused on four crucial areas: Biotechnology and Genetic Improvement, Natural Resource Management, Social Science and Agribusiness, Plant Production, and Plant Health. To date, IITA has involved and trained thousands of professionals and scientists in these key areas focusing mainly on the institute's mandated crops which are cassava, yams, cowpeas, plantain, banana, and maize(IITA n.d.).

In line with the vision and mission of IITA which focus on providing agricultural solutions to hunger and poverty, and in recognition of the enormous potential of the African youth in achieving these goals in sub-Saharan Africa, IITA has created many direct and indirect jobs for the youths through its Youth Agripreneurs program. The program is integrated into the Business Incubation Platform (BIP) which is the technology delivery arm of IITA and serves as a model to stimulate product development and to provide opportunities for market expansion.

IITA aims to enhance the food security, income, and well-being of resource-poor people primarily in the humid and sub-humid zones of sub-Saharan Africa by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources, in partnership with national and international stakeholders (FAO n.d.).

The main objectives are: (i) To develop and improve systems for the effective management and conservation of natural resources for sustainable agriculture. (ii) To help strengthen national and regional research programs. To accomplish its mission, the Institute conducts research, delivers training, provides information, and participates in technology transfer activities with a wide range of partners (FAO n.d.).

## LITERATURE REVIEW

The success of a business depends on innovation, entrepreneurship, and the business environment. In addition, the fight against poverty, frustration, and depression with employment and education, enthusiasm for business, and concerns about social participation affect an entrepreneurial career (Ephrem, *et al*., 2012). Entrepreneurial success is defined in terms of two main goals: financial and subjective or non-financial goals (Orser *et al*., 2000). Entrepreneurship is considered successful based on their financial performance, such as profits or income (Haber

and Reichel, 2005), and the non-financial aspect of performance comprises factors such as customer satisfaction, personal development, and entrepreneurs' awareness (Masuo *et al*., 2001). Occupational qualifications, family resources, and work environment are the main determinants of the decision to become an entrepreneur (Berglann *et al*., 2011). Moreover, entrepreneurs with managerial experience and skills, impressive entrepreneurs in the family, practical knowledge, and workers with unique skills obtain higher scores in the general index of entrepreneurial success (Staniewski, 2016). Variables such as the total amount of investment, education, and government support policies have positive effects on entrepreneurial success (Fatimah-Salwa *et al*., 2013). Microcredit financing is another factor that has a major impact on the success of entrepreneurial activities (Carter and Shaw, 2005).

In many developing countries, government plays an important role in the success of entrepreneurs. Government incentives and support policies in many ways, such as financial and technical assistance, training programs and workshops, development and consultancy, and information resources (Jill *et al*., 2007). Entrepreneurship is an important factor in economic growth, and favorable government programs can encourage entrepreneurship via programs that provide favorable financial access for entrepreneurs. Government programs that reduce barriers to entry, support growth and development and provide better access to credit encourage entrepreneurial opportunities. Governments can enhance opportunities by improving access to capital, reducing barriers to new investment, and continuing to support entrepreneurs beyond the initial startup phase through development programs (Jang *et al*., 2020).

Lack of infrastructure, political environment, market access, and related skills and experiences have a significant effect on the success of entrepreneurs (Chowdhury *et al*., 2013). Moreover, business and managerial knowledge and skills, personality traits (such as flexibility, risk-taking, discerning, etc.), and entrepreneurial experience are positively correlated with entrepreneurial success (Trang, 2015). Furthermore, the education of entrepreneurs, the demand for products or services, the availability of physical space for business development, and the availability of sufficient financial resources have a positive impact on micro-entrepreneurship growth. Educational support for entrepreneurship development has had a positive effect on entrepreneurial self-efficacy (Alvarez-Risco *et al*., 2021). Professional experience and education are essential success factors for entrepreneurship and have a great impact on the development of entrepreneurial skills and self-employment (Schröder *et al*., 2021).

Motivational factors such as achieving a better business environment and common factors such as having competitive products/services are among the motivations of entrepreneurs in starting new businesses (Robichaud *et al*., 2001; Stefanovic *et al*., 2010). Entrepreneur performance depends on factors such as type of business, ability to take risks, customer service, human capital, and quality of goods sold (Nimoh *et al*., 2011). Developing entrepreneurial capacities, innovation, risk-taking, financial, and infrastructural capacities by entrepreneurs in the agricultural sector were considered a priority (Darmadji, 2016). Entrepreneurship promotion is supported by access to financial resources, entrepreneurial culture, taxes, regulations, coordinated training, and support in all areas mentioned by specialized organizations such as entrepreneurial associations and clubs, government agencies, and business centers. Empirical studies identify factors affecting entrepreneurship such as technology, culture and institutions, level of economic development, demography, government spending, individual characteristics, characteristics of the social environment, education, and ease of access to financial resources (Rusu and Roman, 2017).



## METHODOLOGY

Although agricultural biotechnology has shown the potential of rapidly advancing agricultural productivity to meet up the growing food demands and raise income for developing countries while protecting the environment for future generations, numerous challenges including lack of effective leadership**,** poor funding of agricultural biotechnology research and development**,** lack of research focus and infrastructure**,** and inadequate human resources and expertise (Nicholas, 2008).

IITA was selected for this research considering the role it played in revolutionizing agriculture in Nigeria and Africa at large for the past 50 years using research and innovation. Recently, IITA's focus has shifted to revolutionizing the agricultural sector using ICT and biotechnology which has now made agriculture less labor intensive, economically lucrative, and very much attractive for the youth.

To gain better insight into the entrepreneurship and innovation challenges facing the agricultural biotechnology sector in Nigeria and the strategies employed to manage those challenges taking into consideration economic, social and environmental sustainability, a visitation to the International Institute of Tropical Agriculture, Kano station was organized and a semi-structured

interview was conducted with the Coordinator of Innovative Youth in Agriculture of the organization. The interview was conducted on the 25th of February, 2022 at his office.

The interviewed questions include: 1) *what is IITA and what do they do? 2) What are the entrepreneurship and innovation challenges faced by IITA?* 3) *What strategies are employed in managing the challenges concerning economic, social, and environmental sustainability?* 4) *What are some of IITA's achievements in recent years?*

## RESULTS

The International Institute of Tropical Agriculture (IITA) is an award-winning and leading research international organization that has partnered with many national and international organizations in providing solutions to hunger, poverty, and the degradation of natural resources since 1967. IITA's mandate crops are cassava, yam, cowpea, plantain, banana, and maize. Over the past 50 years, IITA has developed thousands of improved varieties of their mandate crops, making the crops more productive and tolerant to many biotic and abiotic conditions. In addition, numerous technologies and mobile apps were developed and thousands of farmers are trained on the use and applications of the technologies and the apps to agribusinesses, making agriculture easier and more sustainable for the farmers.



### Entrepreneurship and Innovation challenges

IITA in collaboration with its partners have identified numerous agricultural biotech challenges and has worked on resolving them. Some of the challenges IITA identified include; a lack of youth involvement, farmers' training, improved seed varieties, skilled researchers, collaborative research, modern farming techniques, and digital farming. Some of IITA's solutions to the above challenges are given below:

1. **Youth development**

Youth development in collaboration with several national and international organizations, IITA has launched many youth development programs such as ENABLE Youth, IITA Youth Agripreneurs (IYA), Technologies for African Agricultural Transformation (TAAT), Start Them Early Progam (STEP- for pupils), Enhancing Capacity to Apply Research Evidence (CARE), etc. to train and reorient thousands of youths in various value chains of agriculture such as extension

workers, seeds or inoculants suppliers, etc. thereby creating employment opportunities and adding value to the economy.

For instance, with financial support from the International Fund for Agricultural Development (IFAD), IITA launched a three-year project (2018-2020) titled "Enhancing Capacity to Apply Research Evidence (CARE) in policy for youth engagement in agribusiness and rural economic activities in Africa. Under this program, IITA/CARE awarded research fellowships to 50 young scholars (MSc/Ph.D. and entry-level professionals) from 10 countries (26% Nigerians) in two annual competitive research fellowship schemes in 2018 and 2019.

## 2. IITA's Innovations

IITA now partners with private sectors via its Business Incubation Platform (BIP) to commercialize many of its innovations to farmers in Nigeria and Africa. IITA's notable innovations that have been commercialized include IITA GoSeed, Nodumax, and Aflasafe.

IITA GoSeed – through this platform, new varieties of crops are made available to the marketplace in partnership with seed companies. In Nigeria for instance, even with the Covid-19 pandemic in 2019, IITA GoSeed supplied more than 15,000 bundles of cassava stems to Olabel Farms, Riparian Farms, Traxivvest Farms, and Mile 12 Plus farms (Fedrick and Victor, 2019).

Nodumax – Nodumax is an inoculant that helps to increase the yield of soybean. Through consistent data collection and evaluation, it has been proven that Nodumax can increase soybean yield on average by 35-40%. This initiative, combined with good agricultural practices (GAP supported by the IITA Weed Science unit) increased the yield to 2.5 t/ha. The introduction of improved varieties led to a yield increase from the Nigerian average of 1 t/ha to 3.5 t/ha. This resulted in higher income for farmers in Nigeria by US$560-937 per hectare (Fedrick and Victor, 2019).

Aflasafe – is a biopesticide used against aflatoxins in maize and other crops. Its widespread use by farmers has increased access to safe maize in the marketplace and has contributed to reducing health risks for consumers. Alasafe helps lower aflatoxin contamination in crops by up to 100% (Fedrick and Victor, 2019).

## 3. Emerging techniques of biotechnology

Modern biotechnological tools such as genome editing (GE) offer cost-effective strategies for developing improved varieties. Researchers at IITA have established the GE system for bananas

and yams. A robust CRISPR/Cas9-based GE system was developed for bananas and plantain. This technology was used to inactivate the endogenous banana streak virus (eBSV) integrated into the B genome of plantain, overcoming a significant challenge in breeding and the dissemination of hybrids. BSV is a prevalent virus pathogen showing symptoms such as chlorotic streaks on leaves. Advancement of the disease leads to the death of the plant. Through this system, plantains and bananas are made resistant to this viral infection which will lead to an increase in yield and eliminate the cost of buying chemicals for the farmers and also protect our environment against chemical pollution. A similar GE system was also developed by IITA for Yam against pests and diseases which will facilitate the improvement of yam for economically important traits.

### 4. IITA's mobile applications for farmers

IITA is digitalizing agriculture in Nigeria and the African continent at large, by developing many mobile applications for effective agriculture. This is now making agriculture less labor intensive, more profitable, and more attractive for farmers. Some apps developed by IITA include; the PlantVillageNuru app for diagnosing various plant diseases, the Herbicide calculator app for calculating the actual amount of herbicide to be applied in a particular farmland for effective weed control, AKILIMO which provides tailored recommendations to farmers and extension service providers based on digital soil and weather data combined with market and price information, and farmers' cropping objectives and risk attitude.

## DISCUSSION

Most of the entrepreneurship and innovation challenges of the agricultural biotechnology sector identified by IITA are mostly farmers' problems which the institute perceives as their challenges and is working tirelessly in resolving them. Perhaps most of IITA's recent greatest solutions to many agricultural problems in Nigeria and Africa are highlighted by the Director General and Board Chair of IITA West Africa regional head office, Ibadan, Nigeria – Nteranya Sanginga & Amos Namanga Ngongi respectively, in their opening speech of the IITA's 2019 annual report;

"*This year's annual report highlights some of our successes and impact stories on scaling out innovations, from establishing a gene-editing system for important African food crops such as banana and yam with resistance to major pests and diseases to using digital delivery tools to*

*ensure that our innovations reach farmers and other stakeholders to commercializing a technology such as Aflasafe to minimize aflatoxin contamination and deliver safe food for Africans through creative partnerships with the private sector and youth groups, to further expanding the youth-in-agribusiness movement through a new program that introduces agribusiness to school children and changes their mindsets about agriculture*"

These technologies are already being used by farmers in Nigeria and the continent and are impacting millions of lives, the nation's economy, and also protecting the environment from harmful agricultural chemicals. The only exception is genome editing; although it has shown immense potential for crop improvement, its regulation is still in the early stages in countries like Nigeria, Kenya, and India, due to its risk potential.

It is also important to note that as a result of IITA's solutions to Nigeria's agricultural sector, Nigeria is now the number one producer of cassava in the world and the number one producer of soybean in Africa.

## CONCLUSION

Entrepreneurship and innovation are important factors for economic growth, especially in developing countries, and identification and assessment of factors affecting the success of entrepreneurship and innovation are essential. Investigating the motivational factors that lead to the success of entrepreneurs can be useful; it affects the success of investors. Different motivational factors affect entrepreneurship activities, among which willingness to succeed, income and wealth, and the need to feel useful and independent is important. Entrepreneurship in the agriculture sector is more important in developing countries because many developing countries have a comparative advantage in some areas of agricultural activity and production; therefore, by increasing the entrepreneurship activities in developing countries, major problems such as employment and economic growth could be resolved.

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