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Agricultural innovation adoption among IFAD-Value Chain Development Programme (VCDP) rice farmers' beneficiaries in southeast Nigeria: A review of empirical evidence

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Abstract
The agricultural sector plays a significant role in food security, employment generation, and livelihood improvement in Nigeria. However, rice production among smallholder farmers remains constrained by low productivity, limited access to improved technologies, weak extension services, and poor market integration. This paper reviews empirical literature on the adoption of agricultural innovations among International Fund for Agricultural Development Value Chain Development Programme (IFAD-VCDP) rice farmers in Southeast Nigeria. The review examined major innovations promoted under the programme, determinants of adoption, and the effects of innovation adoption on farmers' productivity and livelihoods. Evidence from the reviewed studies revealed that the adoption of improved rice varieties, fertilizer technologies, herbicide application, mechanized operations, and climate-smart agricultural practices significantly enhanced rice productivity and income among beneficiaries. The review further showed that factors such as education, extension contact, cooperative membership, access to credit, farm size, and farming experience significantly influenced adoption behaviour among farmers. Despite the recorded achievements, challenges including inadequate extension services, poor rural infrastructure, high input costs, climate variability, and limited access to finance continue to hinder effective technology adoption. The paper concludes that strengthening institutional support systems, improving access to agricultural information, and enhancing rural financing are essential for sustainable rice value chain development in Southeast Nigeria.

Keywords: Agricultural innovation, IFAD-VCDP, rice farmers, technology adoption, value chain development, Southeast Nigeria

Introduction
Agriculture remains a vital sector of the Nigerian economy because of its contribution to food production, employment generation, income creation, and rural livelihood sustenance. The sector provides livelihood opportunities for a large proportion of the rural population and contributes significantly to national food security and economic development. Despite its importance, agricultural productivity in Nigeria remains relatively low due to poor access to improved technologies, inadequate extension services, limited access to credit facilities, poor rural infrastructure, climate variability, and low levels of mechanization among smallholder farmers (Abdulrahman *et al*., 2021; Salihu *et al.*, 2022) [1, 8].

Rice is one of the most widely consumed staple foods in Nigeria due to rapid population growth, urbanization, and changing dietary preferences. The increasing demand for rice has intensified the need to expand domestic production in order to reduce import dependence and improve food security. However, rice production among smallholder farmers continues to face major constraints, including poor seed quality, declining soil fertility, high cost of farm inputs, inadequate access to mechanized equipment, and limited dissemination of improved production technologies (Tiamiyu, Akintola, & Rahji, 2009) [9].

In response to these challenges, governments, research institutions, and international development agencies have introduced several intervention programmes aimed at improving agricultural productivity through the dissemination of modern technologies and value chain development initiatives. One of such interventions is the International Fund for Agricultural Development Value Chain Development Programme (IFAD-VCDP), established in

collaboration with the Federal Government of Nigeria to improve productivity, income generation, food security, and market access among smallholder rice and cassava farmers (IFAD, 2021) [2].

The programme emphasizes agricultural value chain strengthening through the promotion of improved production technologies, farmer capacity building, extension advisory services, cooperative development, input support, market linkages, and rural enterprise improvement. Abdulrahman *et al*. (2021) [1] noted that the participatory approach adopted by IFAD-VCDP enhances farmers' understanding and acceptance of improved agricultural innovations. Similarly, Onyeneke *et al*. (2020) [5] observed that the programme's value chain approach contributed to increased commercialization and improved productivity among smallholder rice farmers in Southeast Nigeria.

Agricultural innovation adoption is central to agricultural development because the success of intervention programmes largely depends on farmers' willingness to adopt and sustain the use of improved technologies. Innovations such as improved rice varieties, fertilizer application technologies, herbicide utilization, mechanized farming operations, irrigation systems, and climate-smart agricultural practices have been identified as important tools for improving rice productivity and rural livelihoods (Rilwanu, Sulaiman, & Bose, 2024) [6].

Empirical evidence suggests that the adoption of improved rice production technologies contributes positively to increased yield, income generation, food security, and poverty reduction among farming households. For example, Onyeneke (2017) [4] reported relatively high adoption levels of technologies such as improved rice varieties, fertilizer application, agrochemical utilization, and optimum seed rate among rice farmers in Imo State. Similarly, Tiamiyu *et al*. (2009) [9] found that farmers who adopted complementary rice production technologies recorded higher productivity than low technology users in the Guinea Savannah zone of Nigeria.

Despite the benefits associated with improved agricultural technologies, adoption among rural farmers in Nigeria remains below expectation due to several socioeconomic and institutional constraints. Previous studies identified factors such as educational level, extension contact, cooperative membership, household size, farming experience, access to credit, and farm size as important determinants of adoption behaviour (Rilwanu *et al*., 2024; Nwankwo & Peters, 2020) [3, 6]. In addition, poor rural infrastructure, climate variability, high input costs, and inadequate extension coverage continue to limit effective utilization of improved rice production technologies among smallholder farmers.

Although several studies have examined agricultural technology adoption among rice farmers in Nigeria, many focused on specific technologies or geographical locations outside Southeast Nigeria. Furthermore, limited attention has been given to a comprehensive review of agricultural innovation adoption among IFAD-VCDP rice farmers in Southeast Nigeria. There is therefore a need to synthesize existing empirical evidence on innovation dissemination, awareness, adoption behaviour, institutional support systems, and livelihood outcomes among programme beneficiaries.

This paper therefore reviews existing literature on agricultural innovation adoption among IFAD Value Chain Development Programme rice farmers in Southeast Nigeria, with emphasis on improved rice production technologies, determinants of adoption, institutional support mechanisms, awareness levels, and livelihood implications of innovation adoption among beneficiaries.

2. Methodology of the Review

This paper adopted a descriptive review approach in examining existing literature on agricultural innovation adoption among IFAD Value Chain Development Programme (IFAD-VCDP) rice farmers in Southeast Nigeria. Relevant literature was sourced from published journal articles, conference papers, institutional reports, textbooks, and related scholarly materials on agricultural innovation adoption, rice production technologies, and value chain development. The literature reviewed was obtained from academic databases and online sources including Google Scholar, ResearchGate, institutional repositories, and publications of agricultural and development organizations. Key search terms used during the literature search included agricultural innovation adoption, rice production technologies, IFAD-VCDP, value chain development, technology adoption among rice farmers, agricultural extension services, and Southeast Nigeria.

The review focused mainly on empirical and conceptual studies relating to improved rice production technologies, determinants of innovation adoption, institutional support systems, awareness levels, and the livelihood effects of agricultural innovation adoption among smallholder farmers. Priority was given to studies relevant to rice farmers and agricultural intervention programmes in Nigeria, particularly those associated with value chain development initiatives.

Information obtained from the reviewed literature was carefully analyzed and synthesized to identify major findings, recurring themes, institutional challenges, and existing knowledge gaps relating to agricultural innovation adoption among IFAD-VCDP rice farmers in Southeast Nigeria.

3. Concept of Agricultural Innovation and Adoption

Agricultural innovation refers to the introduction and application of improved technologies, ideas, and farming practices aimed at increasing agricultural productivity, improving food security, and enhancing farmers' livelihoods. Abdulrahman *et al*. (2021) [1] described agricultural innovation as the utilization of modern agricultural technologies such as improved seed varieties, mechanized farming systems, fertilizer application techniques, irrigation systems, and pest management practices capable of improving production efficiency and output. Similarly, Salihu *et al*. (2022) [8] noted that agricultural innovation plays an important role in improving productivity and resilience among smallholder farmers, particularly in Sub-Saharan Africa where traditional farming methods still dominate agricultural production systems.

In rice production, commonly promoted agricultural innovations include improved rice varieties, fertilizer technologies, herbicide application, mechanized land preparation, irrigation systems, and improved post-harvest handling practices. Tiamiyu, Akintola, and Rahji (2009) [9] observed that the promotion of NERICA rice varieties and complementary production technologies was intended to improve upland rice productivity and enhance rice self-

sufficiency in Nigeria. Similarly, Rilwanu, Sulaiman, and Bose (2024) [6] reported high awareness of improved rice technologies among farmers in Bauchi State, including recommended seed rates, fertilizer application methods, timely planting, disease control measures, and improved harvesting practices.

Agricultural innovation adoption refers to farmers' decision to accept and continuously utilize improved technologies after becoming aware of their potential benefits. Everett Rogers explained adoption as a gradual process involving awareness, interest, evaluation, trial, and continued use of an innovation. Nwankwo and Peters (2020) [3] further argued that farmers are more likely to adopt technologies that are affordable, profitable, and compatible with their existing farming systems.

Empirical evidence indicates that the adoption of improved rice technologies contributes positively to productivity and livelihood improvement among rural farming households. Onyeneke (2017) [4] reported relatively high adoption levels of fertilizer application, optimum seed rate, improved rice varieties, and agrochemical use among rice farmers in Imo State. Similarly, Tiamiyu *et al*. (2009) [9] found that farmers who adopted improved rice production technologies recorded higher productivity than low technology users.

Despite the benefits associated with agricultural innovations, adoption among smallholder farmers remains constrained by poor access to credit, inadequate extension services, high cost of farm inputs, and poor rural infrastructure (Rilwanu *et al*., 2024; Abdulrahman *et al*., 2021) [1, 6]. These challenges continue to limit the effective utilization of improved rice production technologies among rural farming households in Nigeria.

3.1 IFAD Value Chain Development Programme (IFAD-VCDP)

The International Fund for Agricultural Development Value Chain Development Programme (IFAD-VCDP) is an agricultural intervention initiative established through collaboration between the International Fund for Agricultural Development and the Federal Government of Nigeria to improve the livelihoods of smallholder farmers through agricultural value chain development. The programme primarily focuses on rice and cassava value chains with emphasis on productivity improvement, value addition, market access, income generation, and rural poverty reduction among farming households (IFAD, 2021) [2].

The programme was designed to address major constraints affecting small-holder farmers, including low productivity, limited access to improved technologies, weak market systems, inadequate extension services, and poor access to finance. According to IFAD (2021) [2], the programme adopts a value chain approach aimed at strengthening linkages among producers, processors, marketers, and other stakeholders involved in agricultural production and distribution.

Several agricultural innovations are promoted under the programme, including improved seed varieties, fertilizer application technologies, agrochemical utilization, mechanized farming operations, climate-smart agricultural practices, irrigation support, and improved post-harvest handling techniques. Abdulrahman *et al*. (2021) [1] observed that the programme also supports farmers through training, extension advisory services, farmer field schools, cooperative strengthening, and market linkage development. These interventions are intended to improve farmers' technical knowledge, production efficiency, and participation in agricultural markets.

Evidence from previous studies suggests that the IFAD-VCDP programme has contributed to increased productivity and commercialization among smallholder rice farmers in participating states. Onyeneke *et al*. (2020) [5] reported that beneficiaries of agricultural intervention programmes experienced improvements in productivity, access to production information, and participation in value chain activities due to greater exposure to improved farming technologies and institutional support services.

Despite the achievements recorded under the programme, several challenges continue to affect effective implementation and technology adoption among beneficiaries. These challenges include inadequate extension coverage, high cost of agricultural inputs, poor rural infrastructure, limited access to credit facilities, and climate-related production risks (Salihu *et al*., 2022) [8]. Nevertheless, the programme remains an important intervention for promoting agricultural innovation adoption and strengthening rice value chain development among smallholder farmers in Nigeria.

3.2 Empirical Review on Agricultural Innovation Adoption Among Rice Farmers

Several empirical studies have examined the adoption of agricultural innovations among rice farmers in Nigeria and other developing countries. Evidence from these studies indicates that the adoption of improved rice production technologies contributes positively to productivity, income generation, and livelihood improvement among smallholder farmers.

Tiamiyu, Akintola, and Rahji (2009) [9] examined technology adoption and productivity differences among rice farmers in the Guinea Savannah zone of Nigeria. The study revealed that farmers who adopted improved rice production technologies such as NERICA varieties, fertilizer application, and recommended agronomic practices recorded higher productivity than farmers with low adoption levels. The study further identified inadequate access to production inputs and extension services as major constraints affecting technology adoption.

Similarly, Onyeneke (2017) [4] investigated the adoption of improved rice technologies among farmers in Imo State, Nigeria, and reported relatively high adoption levels for technologies such as fertilizer application, improved rice varieties, herbicide use, and optimum seed rate. The study further revealed that educational level, extension contact, farming experience, and cooperative membership significantly influenced farmers' adoption behaviour.

Abdulrahman *et al*. (2021) [1] also observed that agricultural intervention programmes contributed significantly to technology dissemination and productivity improvement among smallholder farmers through extension support, farmer training, and input distribution. According to the study, farmers who maintained regular contact with extension agents demonstrated higher awareness and utilization of improved agricultural technologies.

In another study, Rilwanu, Sulaiman, and Bose (2024) [6] examined awareness and adoption of improved rice production technologies among rice farmers in Bauchi State. The study showed that farmers had high awareness of

technologies such as improved seed varieties, timely planting, fertilizer application, disease control measures, and recommended spacing techniques. However, high input costs, inadequate credit facilities, and poor extension coverage were identified as major constraints limiting effective adoption among farmers.

Nwankwo and Peters (2020) [3] further reported that socioeconomic characteristics such as age, household size, educational attainment, farm size, farming experience, and access to credit significantly influenced agricultural technology adoption among rural farmers. The authors emphasized that farmers with better access to institutional support services were more likely to adopt improved agricultural innovations than those without such support.

The reviewed studies generally indicate that adoption of agricultural innovations contributes positively to rice productivity and livelihood improvement among smallholder farmers. However, persistent institutional and socioeconomic constraints continue to limit effective utilization of improved technologies in many rural farming communities in Nigeria.

3.3 Theoretical Framework

3.3.1 Diffusion of Innovation Theory

The Diffusion of Innovation Theory was developed by Everett Rogers in 1962 to explain how new ideas, technologies, and innovations spread among individuals within a social system over time. The theory explains the process through which individuals become aware of an innovation, develop interest in it, evaluate its usefulness, test it, and eventually decide whether to adopt or reject it. According to Rogers, adoption of innovation passes through five stages which include awareness, interest, evaluation, trial, and adoption. The theory further explains that farmers are more likely to adopt innovations they perceive as beneficial, profitable, compatible with existing farming systems, and easy to understand and apply.

The theory is relevant to this review because IFAD-VCDP promotes several agricultural innovations such as improved rice varieties, fertilizer technologies, agrochemical application, mechanized farming practices, and climate-smart agricultural techniques among rice farmers. The adoption of these innovations by farmers depends largely on their awareness level, access to information, extension contact, and perceived benefits associated with the technologies.

Previous empirical studies reviewed in this paper showed that factors such as extension services, educational level, cooperative membership, and access to credit significantly influence farmers' adoption decisions (Onyeneke, 2017; Rilwanu *et al*., 2024) [4, 6]. This agrees with the assumptions of the Diffusion of Innovation Theory which emphasizes that information dissemination and social interaction play important roles in innovation adoption among farmers.

The theory therefore provides a useful framework for understanding the adoption behaviour of IFAD-VCDP rice farmers in Southeast Nigeria and explains why some farmers adopt improved agricultural technologies faster than others.

3.3.2 Agricultural Innovation System Theory

The Agricultural Innovation System Theory explains that agricultural development does not depend solely on the availability of technologies but also on the interaction among different actors involved in agricultural production, dissemination of information, research, extension services, input supply, marketing, and policy support. The theory emphasizes collaboration among farmers, research institutions, government agencies, extension organizations, financial institutions, and development partners in promoting agricultural innovation and rural development. According to the theory, effective agricultural innovation occurs when relevant stakeholders work together to facilitate knowledge sharing, technology dissemination, capacity building, and institutional support for farmers. In agricultural production systems, farmers are more likely to adopt innovations when they have access to extension services, training opportunities, production inputs, credit facilities, and market information.

The theory is relevant to this review because the IFAD Value Chain Development Programme operates through collaboration among government agencies, extension personnel, farmer groups, financial institutions, and development organizations to improve productivity and strengthen rice value chains. The programme promotes agricultural innovations through farmer training, cooperative strengthening, extension advisory services, and market linkage development. Empirical studies reviewed in this paper showed that institutional factors such as extension contact, cooperative membership, access to credit, and training opportunities significantly influenced farmers' adoption of improved rice production technologies (Abdulrahman *et al*., 2021; Nwankwo & Peters, 2020) [1, 3]. This supports the assumptions of the Agricultural Innovation System Theory which recognizes institutional support and stakeholder interaction as important drivers of agricultural innovation adoption.

The theory therefore provides an appropriate framework for understanding how institutional support systems influence agricultural innovation adoption among IFAD-VCDP rice farmers in Southeast Nigeria.

3.4 Conceptual Gap

Although several studies have examined agricultural innovation adoption among rice farmers in Nigeria, most of the available literature has focused on isolated aspects of technology adoption, particularly in terms of specific technologies, selected farming communities, or individual states outside Southeast Nigeria. Studies such as Onyeneke (2017) [4], Tiamiyu *et al*. (2009) [9], and Rilwanu *et al*. (2024) [6] largely concentrated on adoption levels and determinants of improved rice production technologies without fully synthesizing the broader institutional framework within which adoption takes place.

Furthermore, while empirical evidence has shown that agricultural intervention programmes contribute to improved productivity and technology dissemination, limited attention has been given to a comprehensive review of agricultural innovation adoption specifically among IFAD Value Chain Development Programme (IFAD-VCDP) rice farmers in Southeast Nigeria. Existing studies tend to treat adoption determinants, institutional support, and livelihood outcomes separately rather than integrating them into a single analytical review.

Another major gap identified from the literature is the limited synthesis of evidence linking value chain development approaches with agricultural innovation adoption outcomes among smallholder rice farmers.

Although the IFAD-VCDP programme emphasizes productivity improvement, market integration, and institutional strengthening, there is still insufficient consolidated evidence on how these components collectively influence adoption behaviour among beneficiaries in Southeast Nigeria.

This study therefore addresses these gaps by providing a structured review of empirical evidence on agricultural innovation adoption among IFAD-VCDP rice farmers, with emphasis on awareness levels, adoption behaviour, determinants of adoption, institutional support systems, and livelihood implications within the Southeast Nigerian context.

3.5 Research Gap

Although several studies have examined agricultural technology adoption among rice farmers in Nigeria, many of the existing studies focused mainly on specific technologies, isolated production practices, or geographical areas outside Southeast Nigeria. In addition, most previous studies concentrated on empirical assessment of adoption levels and determinants without providing a comprehensive synthesis of agricultural innovation adoption among beneficiaries of agricultural intervention programmes.

Furthermore, limited attention has been given to review-based studies specifically examining agricultural innovation adoption among IFAD-VCDP rice farmers in Southeast Nigeria. Existing studies also provided limited discussion on the combined influence of institutional support systems, extension services, value chain development initiatives, and livelihood outcomes associated with innovation adoption among programme beneficiaries.

This review therefore fills the existing gap by synthesizing available empirical evidence on agricultural innovation adoption among IFAD-VCDP rice farmers in Southeast Nigeria with emphasis on improved rice production technologies, determinants of adoption, institutional support mechanisms, and livelihood implications of innovation adoption among beneficiaries.

4. Conclusion

The review has examined existing literature on agricultural innovation adoption among rice farmers, with particular focus on beneficiaries of the IFAD Value Chain Development Programme in Southeast Nigeria. Evidence from the reviewed studies indicates that agricultural innovations such as improved rice varieties, fertilizer application, agrochemical use, mechanized operations, and improved agronomic practices play a significant role in enhancing rice productivity and improving farmers' livelihoods.

Findings from empirical studies further show that adoption of these innovations is influenced by several socioeconomic and institutional factors, including educational level, extension contact, access to credit, cooperative membership, farming experience, and farm size. These factors collectively determine the extent to which farmers are able to access, understand, and utilize improved agricultural technologies.

The review also highlights that while IFAD-VCDP has contributed positively to technology dissemination and capacity building among rice farmers, several challenges still limit effective adoption of agricultural innovations. These include inadequate extension services, high cost of inputs, limited access to credit, poor rural infrastructure, and climate-related production risks.

Overall, the literature suggests that agricultural innovation adoption remains a critical pathway for improving rice production and achieving food security in Nigeria. However, sustained adoption requires strong institutional support, improved access to resources, and continuous capacity building for farmers.

5. Recommendations

Based on the findings from the reviewed literature, several recommendations are put forward to enhance agricultural innovation adoption among IFAD-VCDP rice farmers in Southeast Nigeria.

First, there is a need to strengthen extension service delivery within the programme. Regular training, demonstrations, and farmer field schools should be intensified to ensure that farmers have continuous access to accurate and practical information on improved rice production technologies.

Second, access to credit facilities should be improved for smallholder rice farmers. Financial constraints remain a major barrier to technology adoption; therefore, soft loans, input subsidies, and cooperative-based credit schemes should be strengthened to enable farmers to afford improved inputs such as seeds, fertilizers, and agrochemicals.

Third, government and development partners should invest more in rural infrastructure such as feeder roads, irrigation systems, and storage facilities. Improved infrastructure will reduce production losses, enhance market access, and encourage farmers to adopt more efficient production technologies.

Fourth, farmer-based organizations and cooperatives should be strengthened to enhance collective access to inputs, training opportunities, and market information. Membership in cooperatives has been shown to improve farmers' adoption behaviour and should therefore be encouraged.

Finally, policies aimed at climate-smart agriculture should be promoted to help farmers adapt to changing environmental conditions. This will ensure that adopted innovations remain sustainable and resilient under varying climatic conditions.

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