Comparative Study of the Agro-Innovation Adoption among Members and Non-Members of Agricultural Cooperatives in Nigeria

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ABSTRACT

This study compares the level of awareness and adoption of innovative agricultural technologies among members and non-members of cooperative societies. This is to direct policies on the diffusion and adoption of agricultural technologies to facilitate increased food production as Nigeria's economy strives for post-COVID-19 survival and recovery. A multistage technique was used to select a sample of 320 constituting 160 cooperative members and 160 non-cooperative members. Structured questionnaires were used to collect primary data, which was then analysed using both descriptive (Mean, standard deviation) and inferential (regression, ANOVA) statistics. The results suggest that awareness and adoption of new agricultural technologies are higher among members of cooperatives compared to non-members. This study advocates that cooperative societies are veritable vehicles for innovation diffusion. Some challenges of the farmers were explored, and the study recommended that new technologies should be introduced through cooperatives using Small Plots Adoption trial (SPAT) and increased deployment of extension workers to farmers. Furthermore, Cooperative farmers and non-cooperative farmers should be persuaded by the extension workers in ADP to attend agricultural exhibitions where the farm outputs of new technologies are displayed together with the outputs of the old technologies so that they can see the obvious difference and adopt the new technologies.

Keywords: Adoption; agricultural; cooperatives; comparative; new technology.

INTRODUCTION

For many decades, the agricultural sector was the mainstay of Nigeria's economy until oil was discovered in the late 1960s. Unfortunately, the discovery ushered in a period of oil dependency. Since then, Nigeria now depends on oil revenue for national development with agriculture being relegated to the background (Ekperiware and Olomu, 2015). Agricultural productions in Nigeria are mainly composed of small-scale farmers who operate at subsistence levels. The productivity of these small-scale farmers has been plagued by a number of structural and policy issues that have led to slow increases in yield and at times stagnation. Despite having enormous agro-resources and ecological diversity, Nigeria is currently a major food importer (Osuagwu, 2020).

Agricultural innovations have the potential to significantly boost food production, increase farmers' income and improve the health and nutrition. (Kiresura, Nayaka, Gaddib and Khyadagia, 2017, Carletto, Ruel, Winters, & Zezza, 2015). The agricultural sector's technological change has had a significant positive impact on production, security, and supply chain. Farmers who use traditional agricultural methods face numerous challenges when it comes to preparing the land, harvesting crops, and seed sowing (Gulshan, Sharma and Bhadu, 2022). In many instances, however, farmers could want to adopt new farm technologies but are constrained to doing so because of behavioural dynamics and apprehension associated with new technologies. As such, they cannot take the risk of adopting new technologies since they often lack agricultural insurance protections. At other times, new technologies are rather exorbitant and individual

farmers may not be able to afford them. Therefore, small-scale farmers are often caught in a vicious web which is made more difficult because they are not in organised groups like cooperative societies.

Scholars such as (Saz-Gil, Isabel, Ignacio Bretos, and Millán Díaz-Foncea, 2021, Spognardi, 2019; Arando, Gago, Podivinsky and Stewart, 2012; Bauer, Guzmán and Santos, 2012) have argued that cooperative societies provide a platform for individual farmers to acquire social and financial capitals which they leverage in adopting new farm technologies. Okafor and Okafor (2017) firmly averred that in cooperative societies where people come together to pool resources together to meet collective needs which would not have been met on individual financial capacities – provide better and reliable access to credit facilities. Through cooperative societies, farmers can directly access loans from the government or from specialised institutions like the Bank of Agriculture (BOA). Cooperatives also provide the forum where extension agents explore to reach a wide number of farmers to persuade them in adopting new technologies. Importantly, the structure of agricultural cooperative societies enables farmers to explore economies of scale/size as well as protection from risks and uncertainties by conferring on members the capacity to deal with short-term economic/production problems as a group (Saz-Gil, Isabel, Ignacio Bretos, and Millán Díaz-Foncea. 2021).

Despite the inherent and manifest significance of cooperative societies to agricultural development and economic transformation, research attention on cooperatives as vehicles of agricultural innovation diffusion is observably on the decline (Saz-Gil, Isabel, Ignacio Bretos, and Millán Díaz-Foncea. 2021). In practice too, small-scale farmers think less of collaboration or cooperation. For them instead, competition is the game to success. As a result, individual farmers operate with minimal cooperation with its inevitable implications on agricultural innovation diffusion and adoption processes. In the light of this, the following research questions are raised.

i. In what ways are there differences between the Agro-innovation adoption awareness between farmers in cooperatives and individual farmers?

ii. How is the rate of adoption of new agricultural technologies by farmers in cooperative societies different from the adoption of farmers who do not belong to a cooperative society?

iii. What differences exist in the challenges faced by cooperative members in adopting new agricultural cooperative societies and the ones posed to non-cooperative farmers.

Objectives of the study

The broad objective of the study is to compare the level of adoption of new agricultural technologies by members and non-members of agricultural cooperatives. The specific objectives are to:

1. compare the level of awareness of the available technologies by members and non-members of agricultural cooperatives societies.
2. compare the adoption level of new technologies by members and non-members of agricultural cooperative societies.
3. compare the challenges militating against the adoption of agricultural technologies by members and non-members of agricultural cooperative societies.

Hypothesis

The following hypotheses were formulated and tested for the study:

1. H_{o1}: Members and non-members of agricultural cooperatives societies do not differ significantly on awareness of new agricultural technologies.
2. H_{o2}: Members and non-members of agricultural cooperatives societies do not differ significantly on

levels of adoption of new agricultural technologies.

3. H_{o3}: The challenges encountered by members of agricultural cooperatives societies in the adoption of new technologies are not significantly different from the challenges encountered by non-members.

Awareness of Agricultural Technologies

The decision to accept an innovation proceeds in five steps of knowledge, persuasion, decision, implementation and confirmation. Adopters must first learn about the innovation, which begins with early understanding and awareness. The innovation diffusion theory assumes that innovations are well developed but the individual's inability to adopt is due to improper communication (Jamshidi and Kazemi, 2020; Scott and McGuire, 2017). Awareness helps to create perceptions, attitudes and beliefs about a technology that leads to an agent's decision to adopt or not adopt the technology (Rogers, 1995). A good number of research institutes develop new agricultural technologies/innovations to boost agricultural production but getting the end-users (usually farmers) to be aware of their existence is very pertinent if the said technology must be subsequently adopted. In disseminating agricultural innovations, it is expedient and pertinent that farmers are shown the benefits of new technologies, the level of compatibility with existing technologies and how adaptable they are to prevailing circumstances. Awareness is regarded as the stage where an individual learns of the existence of a technology or practise but has little knowledge about it (Jamshidi and Kazemi, 2020).

In order to encourage adoption, the use of extension, experimental station visits, on-farm trials and other means of expression to transmit technical information are emphasised. Before deciding whether to accept or reject an improved seed variety or other new agricultural innovation, a farmer must first become aware of it and develop attitudes towards it. An essential prerequisite for adoption is technology understanding. However, the technology adoption discussion moves beyond the awareness stage and focuses on the long-term extent of adoption, rate of adoption. Individuals may become aware of new ideas through the mass communications media, information from other adopters, among others. At other times, they are exposed to new technologies because they are targeted by researchers or extension workers based on the prejudice of their higher probability of adoption (Stacks, Salwen and Eichhorn, 2019).

Unfortunately, there is limited knowledge on what farmers currently know about the technology, their sources of information about the technologies, the method of information gathering and the factors that determine technology awareness. Knowledge of this is important for a number of reasons: First, it helps researchers to understand the potential usage of the disseminated technologies and this information acts as a check on the impact of the researchers' effort. Second, it helps to compare what they know and what they utilise, which is important to understand the constraints in employing technologies that they know but do not use. Thirdly, knowing what farmers know about technology is important in order to design ways of improving knowledge transfer to intended users. Therefore, it is crucial to understand how much farmers are aware of land development technologies, the networks they join to get that information, and the obstacles to accessing and using technology (Dearing and Cox, 2018)

Adoption of Agricultural Technologies

The decision to implement and maintain an innovation is referred to as adoption. The adoption of modern agricultural technologies is still low in many countries, despite their immense potential to promote economic growth and reduce poverty (Jack and Tobias, 2017). In an empirical study conducted by Ayinde, Adewumi, Olatunji and Babalola (2010) on agricultural technology adoption in Nigeria, they identified socio-economic characteristics of farmers; access to credit or cash resources and information from extension and other media as key factors which influence the adoption of agricultural technology among farmers.

Almas and Usman (2021) acknowledged that the adoption potential of new agricultural technologies in

Africa are site-specific and depends on the local biophysical, socio-economic and cultural environment which needs to be given special consideration in any attempt to identify constraints to adoption. In Ghana, Acheampong, Amengor, Nimo-Wiredu, Adogoba, Frimpong, Haleegoah and Adu-Appiah, (2018) studied the question: does awareness influence the adoption of agricultural technologies? the case of improved sweet potato varieties in Ghana". Using cross-sectional data collected from 526 farmers and employing a binary logit model, they analysed factors influencing the adoption of improved sweet potato varieties. Awareness influences the adoption of improved sweet potato varieties significantly. Extension services and awareness creation through various means such as demonstrations, field days, etc., have been found to be key aspects of technology adoption. Farmers that acquire knowledge about the new technology through extension services or other channels are more likely to adopt the technology.

Challenges in the Adoption of Agricultural Technologies

The adoption of agricultural technologies is widely perceived to be a key means of improving agricultural output and achieving food security, especially in developing countries. The adoption rate of current agricultural technologies is, however, limited by a variety of factors or limitations. Quite a good number of studies in the adoption of technologies in various parts of Nigeria established some constraints which lead to poor adoption levels of agricultural technologies. Kudi, Bolaji, Akinola and Nasa, 2011 identified some of the constraints to include credit facilities, education, extension services, farm size, land tenure system and labour availability.

Ayoade and Akintonde (2012) in a study on constraints to adoption of agricultural innovations among women farmers in Isokan Local Government Area, Osun State, identified some challenges hindering the adoption of new agricultural technologies. These constraints include unstable market price, insufficient finance, high cost of innovations, inadequate supply of innovations, lack of production skill, inadequate agricultural input, shortage of land for farming disease attacks.

In a study by Jack and Tobias (2017) on Seeding Success: Increasing Agricultural Technology Adoption through Information, they identified key challenges limiting the adoption of agricultural technologies. The challenges observed include some of the following: Informational barriers can hinder the adoption of agricultural technologies, and the risk of using below-par agricultural inputs makes it difficult for farmers to adopt new technologies. Information and communication technologies can also play a significant role in promoting knowledge sharing. Finally, Uguru, Ajayi, and Ogbu (2015) recognised that extension agents face numerous difficulties when attempting to introduce new agricultural innovations to farmers in Udenu Local Government Area of Enugu State. Their study sought to determine the level of acceptance/adoption of agricultural innovations by farmers in this area. Most farmers were reluctant to adopt new agricultural innovations/technologies for obvious reasons related to apathy to investment risks and uncertainties.

Agricultural Cooperatives in Nigeria

What is now known as modern cooperatives today started in 1935 when the enactment of the Nigerian ordinance of cooperative societies came into operation with the appointment of Major Haig F.E.C as the registrar of cooperative societies. Since then, the membership of cooperatives in Nigeria has increased across states and local governments of the federation with high built-up capital. Many cooperatives are in operation with involvements in different facets of the national economy. In rural communities, agricultural cooperatives are considered as one of the important economic and social organisations. By providing the farmers with production inputs like fertilisers, seeds, various chemicals, etc., they play crucial roles in the development of agriculture. They also give farmers the knowledge and abilities they need to improve trade and production. Cooperatives are important players in the global food industry, notably in Nigerian local contexts (Nnadozie, Oyediran, Njouku, and Okoli, 2015).

Agricultural cooperatives can be single or multiple purpose cooperatives, agricultural input supply cooperatives, marketing cooperatives, agricultural credit cooperatives, machinery cooperatives, land acquisition cooperatives, livestock producers' cooperatives, fishermen cooperative societies, oil mill cooperatives, rice mill cooperatives, etc. Nwankwo, Ogbodo and Ewuim (2016) and Pooja, Pavithra and Ravi (2023) noted that these cooperatives take various organisational forms as cooperative business enterprises, producer cooperatives, auxiliary or service cooperatives. Agricultural cooperatives are considered as the most important organisations that pay attention and try to support rural development in general and agricultural development, especially through the activities and services achieved for the sake of farmers.

Agricultural cooperatives societies do engage in the production, processing, marketing and distribution of agricultural products. (Adefila, 2011). Group Farming Societies (GFS) is a key form of agricultural cooperative in Nigeria. This society's members produce various crops while also organising the marketing of the finished goods. Some other agricultural cooperatives are devoted to the cultivation of single crops and such societies are named after the crops such as Tobacco Growers Cooperatives (TGC), Cooperative Credit and Marketing Societies (CCMS) etc. Moreover, modern agricultural processing cooperatives for crops such as oilseed and groundnut farmers' cooperatives have played far-reaching roles in agricultural development (Adefila, 2011).

Farmers cooperatives are viewed as mechanisms to help improve the marketing environment for poor rural farmers faced with limited and uncertain consumer demand for the goods they produce. Agricultural Cooperatives can help reduce production costs by organising bulk input purchases for their members and enable small farmers to take collective action to reduce input cost and marketing risks. Farmers can collectively bargain or make purchases through cooperatives to independently find the best prices on seeds, supplies, and equipment (Bikkina, Turaga and Bhamoriya, 2018).

Cooperative societies in Nigeria perform multipurpose functions. They are engaged in the production, processing, marketing, distribution and financing of agricultural products. The most popular agricultural cooperative societies available in Nigeria include; group farming cooperative, marketing cooperative, agricultural thrift and credit cooperatives, agricultural processing cooperative, consumer cooperatives, fishery cooperative and farmer's multipurpose cooperatives. Agriculture is mostly practised in Nigeria by peasant farmers producing the bulk of food, fuel and fibre needs of the rural farmers in Nigeria.

Agricultural cooperatives in Nigeria provide a medium through which services like provision of farm input, farm implements, farm mechanisation, agricultural loans, agricultural extension, members education, marketing of members' farm produce and other economic activities and services are rendered to members (Ominikari, 2022). In view of the low financial capacity and high level of under-development, an individual farmer cannot achieve the desires for large-scale production. It is therefore in the farmers' interest that resources are pulled together so as to gain a tremendous collective advantage and thus widen the industrial base of the economy and the management techniques.

MATERIALS AND METHODS

This study used a descriptive survey as its research design. The study focused on 4 regions in Nigeria and the primary data were generated using a survey tool (questionnaire) from farmers and non-farmers in the Southeast, South-west, Northcentral, and Northwest regions using multistage and stratified random sampling. Data were not collected from North-east and South-South because of the insurgency and militancy in the regions respectively. Two (2) states were selected from each of the 4 regions in Nigeria, and 2 local government areas were selected from each state, making a total of 16 local government areas. Two (2) communities from each of the 16 local Governments were randomly selected, making a total of 32

communities. In the final stage, five (5) individual farmers were selected randomly from each of the 32 communities making a total of 160 individual farmers while 5 cooperative farmers were randomly selected from the 32 communities, also making a total of 160 cooperative farmers. The rationale for selected these farmers was that each of them have accessed the services of the Agricultural Development Programme (ADP). The sample size is 320 comprising 160 individual farmers and 160 cooperative farmers. The breakdown of the regions, states, local governments and communities and farmers selected in the multistage sampling technique is shown in the table i.

Regions	States	LGAs	Communities	Number of Coop. Farmers	Number of Non-Coop. Farmers	Total
Southeast	Anambra	Awka North	Amansea	5	5	10
			Amanuke	5	5	10
		Ayamelum	Umuerum,	5	5	10
			Ifite Ogwari	5	5	10
	Abia	Bende	Item	5	5	10
			Igbere	5	5	10
		Isuikwuato	Umuezeoka	5	5	10
			Umuerem	5	5	10
Southwest	Ogun	Ijebu North	Oke-Agbo	5	5	10
			Oke-Sopen	5	5	10
		Obafemi Owode	Ogunmakin	5	5	10
			Mowe	5	5	10
	Oyo	Egbeda	Erunmu	5	5	10
			Egbeda	5	5	10
		Ibadan North	Dugbe	5	5	10
			Inalnde	5	5	10
Northcentral	Kogi	Ajaokuta	Iyasa	5	5	10
			Adogo	5	5	10
		Ido	Onidoko	5	5	10
			Arola	5	5	10
	Benue	Otukpo	Adoka	5	5	10
			Otukpoicho	5	5	10
		Katsina-Ala	Tiir	5	5	10
			Utange	5	5	10
Northwest	Sokoto	Sokoto North	Mana	5	5	10
			Salami	5	5	10
		Gada	Duka Maje	5	5	10
			Kaddi	5	5	10
	Kebbi	Birnin Kebbi	Junju	5	5	10
			Lagga	5	5	10
		Gwandu	Danjema	5	5	10
			Kwazari	5	5	10
Total				**160**	**160**	**320**

Table i – Multistage Sample Selection Breakdown

The study relied mainly on the primary data collected from the rural farming households of the study area using a well-designed questionnaire. The study utilised a 5-point structured Likert scale questionnaire for data collection in the following order: aware – 1; interest – 2; evaluation – 3; trial – 4; adoption – 5.

The decision rule was a benchmark of 3.05. Below 3.05 means there is low adoption and above 3.05 means high adoption. Descriptive and inferential statistics were used in the analysis of data collected from the respondents. The descriptive statistics used were mean and standard deviation. One way ANOVA was used to compare the mean of members and non-member samples in the test of the hypotheses.

RESULT AND DISCUSSION

Level of Awareness of New Agricultural Technologies by the respondents

Table 1: Distribution of Respondents on the level of Awareness of New Agricultural Technologies by Cooperative Farmers and Non-cooperative Farmers

Variable	Cooperative Farmers			Non-Cooperative Farmers		
	Mean	Standard Deviation	Remarks	Mean	Standard Deviation	Remarks
High Quality Seeds (Improved cassava Varieties, Improved maize Varieties, etc)	4.29	0.781	Aware	3.62	0.987	Aware
Bio Fertiliser Application	4.15	0.904	Aware	3.31	1.192	Aware
Application of agrochemicals (Herbicides)	4.13	0.892	Aware	3.48	1.087	Aware
Small-scale Irrigation like Treadle Pumps	3.01	0.859	Aware	1.61	1.075	Not Aware
Plant Spacing Techniques	4.39	1.017	Aware	4.21	1.002	Aware
Intercropping Techniques (Yam/Cassava/Melon/Maize)	4.01	0.809	Aware	3.54	1.783	Aware
Line Planting Technique	3.99	1.098	Aware	3.17	0.989	Aware
Use of ICT technologies	2.85	1.291	Not Aware	1.78	0.567	Not Aware
Modern Storage Techniques	4.06	0.987	Aware	2.95	0.892	Not Aware
Hatchery Technologies in Poultry Farming	3.91	0.819	Aware	2.89	1.902	Not Aware

Source: Researcher's Empirical Survey, 2023

Table 1 shows the awareness level of agricultural technologies by cooperative members and non-members. The cooperative farmers are aware of 8 of the technologies existing with the Agricultural Development Programme (ADP) with the exception of the use of ICT technologies and small-scale Irrigation like Treadle Pumps while the non-cooperative farmers are aware of only 6 technologies out of the 10 studied technologies.

Test of Hypothesis (H_{o1})

(H_{o1}): Members and non-members of Agricultural Cooperatives do not differ significantly with regards to their levels of awareness of Agricultural technologies.

Table 2: Analysis of Variance (ANOVA)

	Sum of Squares	DF	Mean Square	F	Sig.
Between Groups	47.902	14	3.422	27.979	.000
Within Groups	16.509	135	0.122		
Total	64.411	149			

Source: Researcher's Empirical Survey, 2023

Table 2 is an Analysis of Variance (ANOVA) which was used to compare the means of the various responses from the sample of cooperative and non-cooperative farmers as it relates to their level of awareness of the existence of new agricultural technologies. The result revealed that there is a significant difference between the levels of awareness of cooperative farmers and non-cooperative farmers. The calculated F-value (27.97) is greater than the tabular value (1.75). Therefore, the null hypothesis was rejected while the alternate hypothesis was accepted. This means that members and non-members of agricultural cooperatives differ significantly with regard to their levels of awareness of agricultural technologies.

Level of Adoption of New Agricultural Technologies by Cooperative and Non-cooperative Farmers

Table 3: Distribution of Respondents on the level of Adoption of New Agricultural Technologies by Cooperative Farmers and Non-cooperative Farmers

Variable	Cooperative Farmers			Non-Cooperative Farmers		
	Mean	Standard Deviation	Remarks	Mean	Standard Deviation	Remarks
High Yield Seeds Varieties	3.85	1.313	High Adoption	3.34	1.286	High Adoption
Inorganic Fertiliser Application	3.86	0.836	High Adoption	3.09	0.992	High Adoption
Application Irrigation like Treadle Pumps	2.67	1.066	Low Adoption	2.07	0.976	Low Adoption
Application of Agrochemicals	4.04	1.129	High Adoption	2.01	1.087	Low Adoption
Correct Spacing in Planting	4.42	0.698	High Adoption	4.19	1.029	High Adoption
Alternate Row Intercrop planting	4.13	1.070	High Adoption	2.91	1.298	Low Adoption
Line Planting Technique	4.07	0.812	High Adoption	3.99	1.181	High Adoption
ICT technology	2.91	0.965	Low Adoption	2.85	1.045	Low Adoption
On-Farm Storage Techniques	3.25	1.211	High Adoption	2.16	1.005	Low Adoption
Use of Mechanised Hatchery in Agricultural Poultry	3.09	0.999	High Adoption	2.91	1.183	Low Adoption

Source: Researcher's Empirical Survey, 2023

Table 3 revealed that only 4 new agricultural technologies had a mean score of 3.05 and above, hence have been highly adopted by the non-cooperative farmers while 8 new agricultural technologies have been adopted by cooperative farmers. This indicates that cooperative membership has a high influence on the adoption of new agricultural technologies.

Test of Hypothesis (H_{o2})

H_{o2}− Members and non-members of Agricultural Cooperatives do not differ significantly with regard to their levels of adoption of Agricultural technologies.

Table 4: Analysis of Variance (ANOVA)

	Sum of Squares	DF	Mean Square	F	Sig.
Between Groups	8.511	2	4.256	11.191	.000
Within Groups	55.900	147	0.380		
Total	64.411	149			

Source: Researcher's Empirical Survey, 2023

The Analysis of Variance in table 4 revealed an F-value of 11.191 which is greater than the tabular value (3.00) and significant at 0.05 (5%). Therefore, the null hypothesis was rejected and the alternate hypothesis was accepted which states that members and non-members of agricultural cooperatives differ significantly with regard to their levels of adoption of Agricultural technologies.

Challenges Militating against the Adoption of New Agricultural Technologies

Table 5: Distribution of Respondents on the Challenges Militating against the Adoption of New Agricultural Technologies by Cooperative and Non-Cooperative Farmers

Variable	Cooperative Farmers			Non-cooperative Farmers		
	Mean	Standard Deviation	Remarks	Mean	Standard Deviation	Remarks
Inadequate farmland	4.14	0.602	Challenging	4.57	0.496	Challenging
High cost of farmland labour	4.37	0.847	Challenging	3.56	1.058	Challenging
High cost of new technology	2.55	0.931	Not Challenging	4.29	0.797	Challenging
Inadequate finance	3.78	0.947	Challenging	4.53	0.575	Challenging
Lack of Infrastructure	4.63	0.485	Challenging	3.79	0.964	Challenging
Poor motivation from extension agents	2.15	0.628	Not Challenging	4.26	0.643	Challenging
Insufficient marketing facilities	2.45	1.078	Not Challenging	4.29	0.595	Challenging
Fragmentation of land	4.19	0.992	Challenging	4.83	0.584	Challenging
Poor level of education and exposure	2.01	0.645	Not Challenging	4.43	0.584	Challenging
Complexity of new technology	2.07	0.981	Not Challenging	4.65	0.481	Challenging

Source: Researcher's Empirical Survey, 2023

Table 5 reveals major challenges faced by cooperative farmers which restrain them from adopting new agricultural technologies. They include inadequate farmland, high cost of farmland labour, inadequate finance, lack of infrastructure and fragmentation of land. All the challenges studied hindered the adoption of new agricultural technologies by non-cooperative farmers. The result reveals that the high cost of new technology is not challenging to cooperative farmers but is challenging to the non-cooperative farmers. Furthermore, non-cooperative farmers were poorly motivated by the extension agents whereas the cooperative farmers were not poorly motivated by the extension agents. This could be because the non-cooperative farmers do not have a forum where the extension officers can effectively monitor their progress in the adoption of new technologies. Hence, they were not motivated. It is also clear that insufficient marketing facilities pose a significant challenge to the non-cooperative farmers but not to cooperative farmers.

Sequel to the fact that the number of farm produce outlets are limited to the local markets available in their rural communities but cooperatives through their synergy create other outlets for their farm produce. Through these synergies, they are encouraged to make use of new technologies and increase their output. The poor level of education and exposure were challenging to the non-cooperative farmers, perhaps because they do not have adequate training apart from the formal education. The cooperative farmers in ADP are constantly trained and given the education required to stimulate the adoption of new technology because education, routine training and information dissemination constitute one of the core principles of cooperatives. The results also reveal that complexity associated with new technologies was a major challenge mitigating against the adoption of new technologies by non-cooperative members. This could be a result of their limited and poor exposure to these technologies. On the contrary, cooperative members have new technologies shown and demonstrated to them by the extension agents since they exist in identifiable groups.

Test of Hypothesis (H_{o3})

(H_{o3}): The challenges encountered by members of agricultural cooperatives in the adoption of new agricultural technologies are not significantly different from the challenges encountered by non-members.

Table 6: Analysis of Variance (ANOVA)

	Sum of Squares	DF	Mean Square	F	Sig.
Between Groups	1.617	9	0.180	4.116	.000
Within Groups	6.110	140	0.044		
Total	7.727	149			

Source: Researcher's Empirical Survey, 2023

Table 5 is an Analysis of Variance utilised to compare the variance in mean scores of members and non-members of agricultural cooperatives. It revealed an F value of 4.116 which is greater than the tabular value (1.86) and is significant at 0.05 (5%). Consequently, the null hypothesis is disregarded alternate hypothesis, which states that the problems faced by agricultural cooperative members in adopting new agricultural technologies differ significantly from those faced by non-members, is accepted.

DISCUSSION OF FINDINGS

1. A key discovery from this study is that cooperative farmers were aware of 8 new technologies out of the 10 new technologies available and studied at the ADP while non-cooperative farmers were only

aware of 6 new technologies out of the 10 technologies studied. This result is consistent with the fact that members and non-members of agricultural cooperatives differ significantly with regard to their level of awareness of agricultural technologies. That connotes that cooperative societies provide the forum for the sharing of knowledge related to their mandates or interests. This is consistent with the findings of Abate, Francescomi and Getnet (2013) who examined the impact of agricultural cooperatives on smallholders' technical efficiency in Ethiopia. They used propensity score matching to compare the average difference in technical efficiency between cooperative farmers and similar independent farmers. Their study revealed that agricultural cooperatives are effective in providing support services that significantly contribute to members' technical efficiency.

2. Another outstanding finding of our study is that cooperative farmers have adopted 8 out of the 10 selected technologies studied whereas only 4 technologies have been adopted by non-cooperative farmers. This explains why there is a significant difference between members and non-members of agricultural cooperatives on levels of adoption of agricultural technologies. It supports the conventional understanding that cooperatives serve as platforms for the transportation of agricultural innovations. Again, specialised training and re-training, which can stimulate adoption, can more easily be conducted for cooperative members since they are already in identifiable groups and aligned interests. In effect, cooperative members are usually the early adopters and early majority in an innovation adoption continuum. It is only when non-cooperative see the output associated with new technologies that they are prompted to join the train.

3. The results firmly suggest that the challenges encountered by members of agricultural cooperatives in the adoption of new agricultural technologies are significantly different from the challenges encountered by non-members. This parallels the findings of Uguru, Ajayi, and Ogbu (2015) and Jack and Tobias (2017) in their studies of the adoption pattern of farmers.

CONCLUSION

The perennial problem of extreme poverty, quite prevalent among households in the rural areas of developing countries, can be reduced by encouraging the formation and membership of cooperative societies to improve agricultural outputs. The quicker and faster penetration of innovative technologies can have remarkable impacts on rural income and wellbeing. The fact that there is a considerable disparity in the level of awareness and adoption of new technology between agricultural cooperative members and non-members says a lot.

The formation and administration of cooperative societies should not be taken for granted by policy actors in agricultural productions and value chain development. Instead, innovations designed to improve agricultural outputs (improved seeds, fertilisers, tools, techniques, machines and others) should be considered as sine qua non for national food security and sufficiency. It is, therefore, unambiguously suggested that cooperative societies are veritable vehicles for agricultural development when effectively organised to aid the successful implementation of agricultural programmes and specifically, the adoption of innovative agricultural technologies. This is a major managerial implication of the study which reflects its distinct contribution to knowledge. The results of this study advocating and promoting the formation of cooperative societies to form integral parts of mechanisation policies of developing countries. Essentially, policymakers should capitalise and exploit cooperative societies to drive the rapid adoption of innovative technologies foragricultural development and transformation.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are advisable:

1. Extension services should be improved by the Agricultural Development Programme (ADP). There

should be at least two extension agents to each community who should visit the farms regularly and expose the farmers to the latest agricultural technologies through Small Plots Adoption Trials (SPATS) and On-farm Adaptive Research. Government should make provision for logistics of the extension agents to enable them to visit the farmers with the view to educating them in agricultural technology adoption. These extension agents should be given in-service training to acquaint them with recent innovations for onward transmission to the farmers.

2. The extension service workers in ADP should enjoin individual farmers to form effective groups (cooperatives) for easy diffusion of agricultural innovations or technologies.

3. Cooperative farmers and non-cooperative farmers should be persuaded by the extension workers in ADP to attend agricultural exhibitions where the farm outputs of new technologies are displayed together with the outputs of the old technologies so that they can see the obvious difference and adopt the new technologies, especially those who are retrogressive to change (late majority and laggards).

4. Seminars, workers and symposia should be organised by ADP and secondary cooperative societies to make the farmers understand the importance and correct usage of new agricultural technologies.

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