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Management of Agricultural Innovations: Implications on Food Security in Nigeria

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ABSTRACT: *The article aimed to investigate the management of agricultural innovations: implications on food security in Nigeria specifically, agricultural innovation methods, benefits of adoption, impact on agricultural productivity, management of innovations and constraint faced by farmers in adoption of innovations. The article was guided by four research questions and two hypotheses tested at $p \leq .05$. The study adopted a descriptive research design, using a total of 103 (51= crop production) and (52 = animal rearing) farmers selected through a proportionate sampling method from 1300 farmers in Jos North, Jos Nigeria as sample for the study. The questionnaire was used to gather data. The psychometric yielded the following: CVR=1 through Lawshe's (1975) method and r-coefficient=0.86 using Cronbach Alpha. Data gathered was analyzed using frequency counts and percentages to answer all the research questions through the application of MS Excel 2012 while, using STATAMP 14, the Pearsman Product Moment Correlation (PPMC) was used to establish the linear relationship between the variables under study. The study found hydroponic-No soil needed, aeroponics-growing plants in midair, aquaponics, water reduction intake and utilization by both plants and livestock, Harvest Quality Vision-HQV among others as various methods of agricultural innovations available to farmers. The study established that, the extent to which these innovations are beneficial to farmers is dependent on the availability of the methods. Although, farmers perceived the importance of innovation as a medium to improve food production if innovators manage their innovations through farm organization. The study found that farmers often encountered high cost of innovations, poor level of awareness and environmental factors as constraint towards adopting agricultural innovations. The study concluded that, to ensure food security in the country, there is the need for adoptable innovations. Therefore, platforms made for management of innovation should be made effective to further encourage farmers towards adoption and continuity.*

KEYWORDS: management, agricultural innovations, implications, food security, Nigeria

INTRODUCTION

Agriculture has an essential role in each of our lives. Historically, the major objective of agriculture was food production. This recently underwent a transformation that enhanced multifunctionality (Knickel, et al., 2009). Agriculture is one of the first

economic industries. It is a significant sector because its purpose is to feed the population. The primary factor in production is the restricted amount of available land. It is a factor whose size is fixed and cannot be restored (Kuzevicova et al., 2013) Thus, using land more efficiently by using the latest knowledge only does increasing agricultural production. Agriculture that incorporates elements of innovation is an important source of economic growth in many nations. (Ayodele, Innocent & Garba, 2019). Currently, the development of any sector necessitates adherence to the principles of sustainability, which includes economic, social, and environmental growth. In addition, agriculture is an essential sector for achieving sustainable development. Environmental concerns are assuming a greater role in fostering robust economic growth. The impact of globalization and urbanization on consumer lifestyles is significant. Sustainable economic development entails the promotion of environmentally friendly policies at any level of funding and the transformation of consumption and production so that human and economic activities contribute to a sustainable society (Aceleanu, 2016).

To enhance productivity sufficiently to provide for food security as outlined in the SDG agenda, agriculture should innovate to gain market advantages while also providing more cost-effective public goods. Innovation can be the outcome of scientific study on the processes or characteristics of a product, the introduction of new or considerably enhanced goods or services, or the utilization of new inputs, processes, organizational or marketing approaches (OECD and Eurostat, 2005).

To create new and useful goods, procedures, and strategies, scientists and technologist must apply their acquired knowledge to the world around them. These innovations can be simple, like changing the crops that are produced, or more complex, like developing a new business model with entirely different production technologies to satisfy different needs for instance, from better production and productivity to more quality such as flavour, fragrance, or colour. Innovation produces better packaging that protects the nutritional content and also a cost system of more for less that allows establishment of more attractive prices. (Latruffe, 2010). Therefore, Innovation is central to development, and effective innovation systems include all the relevant stakeholders who can contribute and manage the discovery of underlying processes and principles, transforming the principles into technologies and practices and further adapting these to improve efficiency and performance. Agricultural innovation often emerges because of the dynamic interplay of the many stakeholders engaged in the production, processing, packaging, distribution, and consumption of agricultural goods. These players bring a wide variety of knowledge and experience to the table, including but not limited to: metrology, safety standards, molecular genetics, intellectual property, food chemistry, resource economics, logistics, slash-and-burn farming, land rights, and far too many other topics to list in full. For innovation to occur, interactions between these many stakeholders must be transparent and based on the most pertinent accessible information. In addition to strong R&D capabilities, the ability to innovate is frequently associated with collective action, coordination, knowledge exchange among diverse actors, the availability of incentives

and resources to form partnerships and develop businesses, and conditions that allow farmers or entrepreneurs to use the innovations (World Bank, 2012).

Even though most of the Nigeria's food supply still comes from subsistence-level small holding farms, the World Bank (2007) found that agriculture in Nigeria employs over 70% of the country's active labour force and amounts for over 23% of GDP (GDP). The bulk of the rural population and, more recently, a sizable share of the urban population in Nigeria rely on agriculture for their livelihood. Transformation lies in using innovation to improve the products and services delivered by actors in the production process (Ayinde et al. 2013a). The objective of the Agricultural Promotion Policy is to boost agricultural output to suit the requirements of a rapidly expanding population and to transition agriculture from subsistence to commercial and export-oriented production. The supplementary Agricultural Sector Food Security and Nutrition Strategy 2016-2025 defines key areas that should direct the operations of the Federal Ministry of Agriculture and Rural Development (FMARD) and allied partners to attain these goals.

According to Charlotte (2014) farmers use Fertilizer Deep Process (FDP) across Burkina Faso, Niger, and Nigeria. Traditionally, rural farmers apply fertilizer to crops by spreading the seeds by hand. Fertilizer deep placement (FDP) is a new way of distributing fertilizer that increases smallholder yields by an average of 18% and reduces fertilizer use by a third. FDP works by using a specialized fertilizer (called 'briquette'), which releases nitrogen gradually. The fertilizer is placed 7-10 centimeters below the soil, which allows less nitrogen to be lost through runoff. Another innovation in agriculture is the introduction of mobile app, which provides farming instructor app that gives agricultural information to rural farming communities. VetAfrica, a mobile application created by the software firm Cojengo, enables veterinarians and farmers to precisely diagnose cattle diseases and locate the most efficient medications for treatment. With over 100 million farmers dispersed over tens of thousands of square kilometers in Africa, the developers foresee significant development in mobile and cloud-based technology sectors in Africa. Another unique app is farming teacher, which connects rural farmers and their communities with online and offline agricultural knowledge.

The article aimed at investigating management of agricultural innovations: implications on food security in Nigeria. Specifically, the article examines agricultural innovation methods, benefits of adoption, impact on agricultural productivity, management of innovations and constraint faced by farmers in adoption of innovations. The article was guided by the following research questions: What are the agricultural innovation methods available to farmers? What are the benefits of adopting agricultural innovations methods? How does innovation methods improve productivity? How do relevant authorities in ensuring quality Agri-business manage innovations? What are the constraint farmers faced in adopting innovations to boast productivity? Two hypotheses were formulated and tested at $p \leq .05$ as follows: There is no linear relationship between the benefits of adopting agricultural innovation by farmers and the availability of innovation methods H_{01}: $\beta \neq 0$. The constraint faced by farmers in

adopting innovations is not dependents on the management of agricultural innovations H_{02}: $\beta \neq 0$.

LITERATURE

Ecker, et al, (2018) in a study; transforming agriculture for improving food and nutrition security among Nigerian farm households found that econometric analysis demonstrate that agricultural transformation and agricultural policy critically influence food and nutrition security beyond the standard parameters of agricultural productivity and farm income. The effects tend to be complex, and the potential impact is often context-specific. Adebayo, et al, (2017) conducted a study on scaling up agricultural innovation for inclusive livelihood and productivity outcomes in Sub-Saharan Africa: The case of Nigeria focusing on the extent to which the use of these innovative agricultural research interventions impact upon the livelihood and productivity in Nigeria. The study finds that participating households had better livelihood, productivity and more diversified income portfolios during the implementation of innovative research intervention as a result of greater linkages to markets and capacity building opportunities; phasing out of the research programme reduced the diversity of income portfolios and led to the erosion of livelihoods. Therefore, agricultural innovation system concepts should be mainstreamed in all public agricultural extension.

However, innovation attempts to increase output per unit of input is a major driver of agricultural growth (Ayanwale et al., 2013). In sub-Saharan Africa, 63 per cent of the population live in rural areas and are employed in agriculture-related work (Gildemacher et al., 2009). Agriculture is highly labour-intensive in sub-Saharan Africa (Mapila et al., 2011). The country's rural women and men depend on agriculture for food and income (National Bureau of Statistics, 2010) though; vulnerability to food poverty in urban areas is huge (Ozughalu & Ogwumike, 2013).
Ikehi, et al (2022) stated that, notwithstanding the benefits of agricultural innovation, a lot of challenges still exists that hinder adoption in developing countries. The authors revealed among others that, rural farmers are aware of and willing to adopt some agricultural innovations to improve farmers farming business. Major challenges reported uncertainty and cost implication among others. Important strategies believed to improve the rate of adoption but not limited to set up agricultural innovation centers, improving agricultural innovation system and offering some form of insurance in case of failure.

Kralovec (2020), found that food insecurity is a major problem in Nigeria. The Food and Agriculture Organization estimates that Nigeria's food security situation has worsened in the past 15 years affected by climate change and Boko Haram insurgency going on since 2009. Adebayo and Ojo (2012) added that no doubt, food is life; hence, food has become an instrument of national power. The study infers that Nigeria needs to come up with functional food policy, which for now it limited. What public policy makers pursue is merely an agricultural policy that still suffers enormously from a wide gap between intent and actual practices. Alomia-Hinojosa, et al, (2018) conducted a

study on maize-legume intercropping is a fundamental component of mixed farming systems in the mid-hills of Nepal. However, its productivity is constrained by several biophysical and social factors, and limited adoption of proven agricultural innovations. Mulyono, et al, (2021) in Indonesian proved that, in general, the farmers' perceptions of agricultural technology have a greater relative advantage, compatibility, trial-ability, observability, and less complexity however, adoption of innovations is a source of additional uncertainty.

METHODOLOGY

The study adopted a descriptive research design, which enable the researcher to take a multifaceted approach; quantitative (surveys) and qualitative (interviews) was used to collect, analyze, and describe data about persons, organizations, or phenomena. The population of the study comprised of 1300 farmers in Jos North, Jos Nigeria. This is because there are many farmers that into crop and animal production. A proportionate sampling method will be used to select the size of the study: N x ξ/φ. This means: N = population farmers for each location within the study area, ξ= total required sample size and φ = target Population. A total of 103 (51= crop production) and (52 = animal rearing) farmers constituted the sample size of the study.

Primary data tools were applied for data collect to gain direct and first-hand information on the desired objectives of the study. A semi-structured interview was used in the study for gathering data. Content validity was determined using panel expects and level of acceptance on expert rating an item essential was calculated to determine the content validity ratio (CVR) using Lawshe's (1975) method thus; CVR = ne - $\frac{\boldsymbol{\beta/2}}{\boldsymbol{\beta/2}}$. Where; CVR= content validity ratio, *ne* = number of experts indicating essential on an item, β = total number of experts. Decisions were taken using Lawshe's table of minimum values of CVR and CVRt, which must be a minimum of 5% level of agreement at $p = 0.05$ on all items to be retained in the instruments' final copies (Hamed, 2016). If all experts indicate essential for all items on the instrument, CVR is computed to be 1.00 and then approximated to .99 for ease of manipulation (Lawshe, 1975).

Prior to collection of the primary data, the researcher conducted a pilot study and after collecting data from the pretesting exercise, data generated was subjected to statistical analysis to determine the internal consistency of the instruments using Cronbach Alpha technique. $\alpha = \frac{k}{k-1}\left(1 - \frac{\Sigma s_y^2}{s_x^2}\right)$ Where α= Cronbach Alpha; *k*= Number of items, *k*-1= Number of items minus, Σs_y^2=Sum of the item variance, s_x^2= Variance of the total score. Selected universities will be visited to physically present the researcher and the study's goal to relevant authorities and to establish a schedule for administering the questionnaire for data collection. The structured interview was administered in observance with ethical standard and the data analyzed using frequency counts and percentages for were used to answer all the research questions while, Using MS Excel 11 while statistical significant impacts were established using parametric statistics: Pearsman Product Moment Correlation (PPMC) on StataMP 14.

RESULTS AND DISCUSSION

The study established the following outcomes.

Table 1: Methods of Agricultural Innovations

Methods of Innovation n=103	Much Available		Available		Somewhat Available		Unavailable	
	f	%	f	%	f	%	f	%
Hydroponics – No soil needed	0	0.00	0	0.00	4	3.88	99	96.12
Aeroponics – Growing plants in midair	0	0.00	0	0.00	10	9.71	93	90.29
Aquaponics – Farming plants and fish together	11	10.68	71	54.62	11	10.68	10	9.71
Reduced Water Consumption	31	30.10	50	38.46	3	2.91	19	18.45
Year-Round Crop Production	9	8.74	83	63.85	7	6.80	4	3.88
Chemical Free Food Production	3	2.91	57	43.85	39	37.86	7	6.80
Laser Scarecrows	0	0.00	0	0.00	36	34.95	67	65.05
Bee Vectoring	0	0.00	0	0.00	51	49.51	52	50.49
Harvest Quality Vision - HQV	0	0.00	0	0.00	68	66.02	35	33.98
Crop & Soil Monitoring & Management	31	30.10	30	23.08	42	40.78	0	0.00

Source: Study Data 2022

The study established that, hydroponic-No soil needed innovation is somewhat available (3.88%) to farmers in the study area. It was found that; majority (96.12%) of the respondents stated clearly that hydroponic innovation is unavailable to farmers to improve agricultural production. Certain respondents (9.71%) acclaimed aeroponics-growing plants in midair are slightly available to farmers while, a vast majority (90.29%) acknowledged unavailability of the growing plants midair. Aquaponic-farming plants and fish together are much available (10.68%) to farmers as many (54.62%) respondents were in solidarity that aquaponics innovation is available to farmers. Some (10.68%) of the farmers admitted the innovation is slightly available while, few (3.88%) farmers declared unavailability of aquaponic innovation to farmers. Innovations in terms of technology to reduce water consumption are much available (30.01%) while, majority of the farmers (38.46%) attested availability. Although, few farmers (2.91%) confirmed slightly available while, certain (18.45%) farmers provided unavailability of innovation for water reduction intake and utilization by both plants and livestock. Few (8.74%) farmers confirmed the availability of innovation that promote year-round crop production and gained solidarity by a vast majority (63.85%) of the farmers. Small proportion (6.80%) of farmers agreed that year-round crop production is somewhat available to farmers while limited number of farmers confirmed unavailability of the said innovation. Farmers (2.92) acknowledged chemical free food production as very much available to farmers and gained support from majority (43.85%) of the respondents confirmed innovation for chemical free food production is not available. The results reveal that, laser scarecrows are somewhat available (34.95%) to farmers and more than half (65.05%) of the farmers confirmed the innovation is unavailable. Bee vectoring is slightly available (49.51%) to farmers while, most of the farmers declared (50.49%) admitted unavailability of Bee vectoring as an innovation to boost agricultural production. The farmers (66.02%) affirmed

Harvest Quality Vision-HQV are slightly available while, certain (33.98%) farmers affirmed that HQV innovation is not available to farmers. Crop and soil monitoring and management was confirmed much available to farmers (30.10%) while, certain (23.08%) farmers confirmed availability but not very much. However, majority (40.78%) of farmers declared that crop and soil monitoring and management innovation are somewhat available.

Innovation in agriculture according to Sunding and Zilberman (2000) are more likely to emerge in response to scarcity and economic opportunities. For instance, labour shortages will induce labour-saving technologies. Environmentally friendly practises are likely to be associated with stringent environmental regulations. In areas with severe water shortages, such as Israel and the California desert, drip irrigation and other water-saving methods are often created. Similarly, food shortages or high pricing of agricultural commodities will likely result in the introduction of a new high-yield variety, and perceived shifts in customer preferences may provide the context for new innovations in agriculture that alter product quality.

The findings aligned with those of Bernet, et al, (2006); Hall, et al, (2007) and the World Bank (2006) who identified series of agricultural innovations across the World, which focuses on, improve food security through a productive process. For instance; cassava processing innovation system in Ghana, cut-flower innovation system in Colombia, medicinal plants innovation system in India, small-scale irrigation innovation system in Bangladesh, golden rice innovation system across the entire globe and potato in Peru.

Benefits of Adopting Agricultural Innovation Methods

The article further examined the benefits of adopting agricultural innovation methods by farmers. The results are presented as follows:

Table 2: Benefits of Adapting Agricultural Innovation Methods

Benefits n=103	Highly Beneficial		Beneficial		Somewhat Beneficial		Not Beneficial			
	f	%	f	%	f	%	f	%	*P*	Sig.
Hydroponics – No soil needed	0	0.00	0	0.00	4	3.88	99	96.12	0.8710	0.05
Aeroponics – Growing plants in midair	0	0.00	0	0.00	10	9.71	93	90.29		
Aquaponics – Farming plants and fish together	21	20.39	71	54.62	11	10.68	0	0.00		
Reduced Water Consumption	31	30.10	69	53.08	3	2.91	0	0.00		
Year-Round Crop Production	9	8.74	83	63.85	7	6.80	4	3.88		
Chemical Free Food Production	3	2.91	57	43.85	39	37.86	4	3.88		
Laser Scarecrows	2	1.94	5	3.85	29	28.16	67	65.05		
Bee Vectoring	13	12.62	21	16.15	17	16.50	52	50.49		
Harvest Quality Vision - HQV	7	6.80	11	8.46	57	55.34	28	27.18		
Crop & Soil Monitoring & Management	31	30.10	30	23.08	42	40.78	0	0.00		

Source: Study Data 2022

Findings showed that hydroponics are somewhat beneficial to few (3.88%) farmers while, multiple (96.12%) farmers confirmed not beneficial to them. Again, aeroponics is beneficial to only (9.71%) farmers while, a large proportion (90.29%) of farmers attested not beneficial to them. A good number (20.39%) of farmers agreed that

aquaponics has been found highly beneficial and gained solidarity from majority (54.08%) of the farmers. However, few farmers (10.68%) affirmed somewhat beneficial. Reducing water consumption has been highly beneficial to many (30.10%) farmers while, almost all (53.08%) confirmed beneficial but not highly. Although, few farmers (2.91%) agreed that the innovation has been slightly beneficial. Few farmers (8.74%) declared that year-round crop production has been highly beneficial to them while, majority (63.85%) confirmed beneficial but not highly. However, few (6.80%) farmers admitted that, the innovation has been slightly beneficial while, small portion (4.88%) of farmers attested not beneficial. The results indicates that, few farmers (2.91%) affirmed that, chemical free food production appeared highly beneficial to them while, majority (43.85%) of the farmers confirmed the innovation has been beneficial but not so good. However, some farmer (37.86%) described the innovation as somewhat beneficial while, 3.88% of the farmers acclaimed the innovation have not been beneficial. Laser scarecrows are found highly beneficial to few farmers (1.94%) while, some farmers (3.85%) agreed it is beneficial but not so impressive although, many (28.16%) farmers admitted the innovation is somewhat beneficial while, nearly all (65.05%) the farmers confirmed the innovation is not beneficial to them. Bee vectoring has been found highly useful to (12.62%) of the farmers though, some (16.15%) farmers confirmed is useful but not quite impressive. A good number (16.50%) of farmers confirmed that Bee vectoring is somewhat beneficial while, half (50.49%) of the farmers declared that the innovation is not beneficial to them. Harvest Quality Vision-HQV appeared highly beneficial to farmers (6.80%) and supported by slightly higher proportion (8.46%) of the aforementioned but not significantly impactful, majority (55.34%) of the farmers identified the innovation as slightly beneficial while, many (27.18%) farmers did not see this innovation as beneficial. Many farmers (30.10%) identified crop and soil monitoring and management has been beneficial to them though, significant proportion of farmers (23.08%) declared the innovation has been beneficial but not effective. However, majority (40.78%) of the farmers attested the innovation is somewhat beneficial. A test of association was calculated to ascertain the linear relationship between adopting agricultural innovation and availability of innovation methods. Pearsman product moment correlation (PPMC) at sig.0.05 indicated p=0.8710 higher than 0.05 α. There is no sufficient evidence at the α level to conclude that there is no linear relationship between available innovation methods to farmers and farmers' benefits of adopting innovations. Therefore, there is a linear relationship between availability of innovation methods to farmers and farmers' benefits of adopting innovations in agriculture.

Ahmed, et al, (2012) found that the diffusion of modern agricultural innovations and practices to increase productivity requires diffusion of information concerning innovations, their adoption, social structures and conditions necessary for their implementation. These processes were expensive, time-consuming, and labor-intensive. Therefore, the success of these actions will result in the eradication of food insecurity, but their failure will result in the waste of money, time, and effort. Hence, most farmers considered adopting these innovations as not beneficial.

Farmers Perception on the Impact of Agricultural Innovation on Productivity

The article x-rayed the perception of farmers on the impact of agricultural innovation on agricultural productivity and the results are presented as follows:

Table 3: Farmers Perception on the Impact of Agricultural Innovation on Productivity

Functionality of Agricultural Innovations n=103	Strongly Agree		Agree		Somewhat Agree		Disagree	
	f	%	f	%	f	%	f	%
Provide an opportunity for agriculture producers to increase productivity	10	9.71	41	39.81	52	50.49	0	0.00
Better managing natural resources	26	25.24	60	58.25	17	16.50	0	0.00
Ensure long-term viability	13	12.62	39	37.86	51	49.51	0	0.00
Reduce the negative environmental impacts of production, such as pollutants and waste	48	46.60	54	52.43	0	0.00	1	0.97
Adaptions of climate change and mitigation of greenhouse gas (GHG) emissions enhance sustainable agriculture production systems.	12	11.65	51	49.51	32	31.07	8	7.77

Source: Study Data, 2022

The article established that (9.71%) of the respondents strongly agreed that agricultural innovation provide opportunity for agricultural producers to increase productivity. Some (39.81%) of the farmers' confirmed agricultural innovation increase productivity but not sufficient and majority (50.49%) of the farmers acknowledged the role of innovation somewhat enhance productivity. Also, innovations plays a significant role for farmers to better manage natural resources (25.24%). Majority of the respondents (58.25%) acknowledged better management of natural resources as a vital role of innovation though most innovations do not promote environmental sustainability. A reasonable number (16.50%) farmers somewhat agreed that agricultural innovation provide a basis for natural resource management. Certain number of respondents (12.62%) strongly agreed that it promote long-term viability while, some (37.86%) farmers agreed but confirmed not sustaining. However, the bulk of the farmers (49.51%) somewhat agreed on the functionality of innovation towards ensuring long-term viability of agricultural products. Most (46.60%) farmers strongly believed agricultural innovation reduces the negative impact of production such as pollution and waste while, more than half (52.43%) of the total farmers agreed with the aforementioned. Only one farmer disagreed that waste and pollution that affects production reduces with the use of innovation. The article established that 11.65% farmers strongly agreed that innovation carter for the adaption of climate change and mitigation of greenhouse gas emissions enhance sustainable agricultural production system. Majority (49.51%) of the farmers agreed that innovation is useful in ensuring environmental quality and 31.07% of the farmers somewhat agreed while, few (7.77%) farmers disagreed with the aforementioned.

This study aligned to that of Djoumessi (2021) who identifies innovation types that impact the growth of agricultural productivity in Sub-Saharan Africa over the 1996 to 2014 period. Among the innovations that increase productivity, the constituents of fertilizer have a mitigated impact on agricultural productivity growth. Also, pesticide use and irrigation practices have a positive and significant influence on agricultural productivity. Crop diversification, a major innovation classified as stabilizing or increasing farmers' profits, has a positive and significant impact on agricultural productivity in SSA, only tractors and harvesting equipment have a major and favorable

impact on agricultural output when it comes to cost-saving or labor-reduction advancements.

Indeed, the impact of threshing machines on agricultural productivity is still extremely low or non-existent in Sub Saharan Africa. Among other factors, variables such as access to electricity and water in rural areas have a positive and significant effect on agricultural productivity. In the end, it is up to policymakers to do things like increase farmers' access to and use of fertilizers and pesticides, encourage farmers to adopt irrigation practices with water access facilities, encourage diversification of crops, and speed up the mechanization process in the sector with appropriate tools.

Management of Agricultural Innovation

The article established various means of managing agricultural innovation to ensure continuity and improve productivity. The results are presented as follows:

Table 4: Management of Agricultural Innovation

Method of Management n=103	Very Effective		Effective		Somewhat Effective		Not Effective	
	f	%	f	%	f	%	f	%
Farmers' organizations	54	52.43	21	20.39	28	27.18	0	0.00
Researchers and breeders who generate the technologies	11	10.68	13	12.62	21	20.39	58	56.31
Private sector stakeholders who build the platforms or market seeds	32	31.07	17	16.50	53	51.46	1	0.97
Policymakers who can change the laws and regulations	5	4.85	9	8.74	32	31.07	57	55.34
Digitization of weather information	3	2.91	7	6.80	43	41.75	50	48.54
Training on improved varieties at seed and livestock fairs.	15	14.56	31	30.10	27	26.21	30	29.13
Training of extension agents on agriculture-oriented insurance schemes	10	9.71	17	16.50	41	39.81	35	33.98
Training of retailers on the fundamentals of 'supply and demand' market dynamics.	2	1.94	6	5.83	31	30.10	64	62.14

Source: Study Data, 2022

Findings showed that innovations are managed through farm organizations (52.43%) and found very effective over the years while, some (20.39%) farmers agreed management of innovation through farm organizations is effective but not very effective. However, 27.18% declared farm organization is somewhat effective. Some farmers (10.68%) identified that management of innovation through researcher and breeders who generate the technologies is very effective. In solidarity, 12.62% of farmers admitted that, the management platform is effective but not commendable while certain (20.39%) farmers declared the platform is somewhat effective. The bulk (56.31%) of the farmers confirmed researchers and breeders' involvement in managing innovations is not effective. Many farmers (31.07%) indicated that private sector stakeholders who build the platforms or market seeds used to manage innovations that aligned to their functionality is very effective. Some (16.50%) farmers affirmed the platform is effective but not very efficient, a significant number of farmers (51.46%) described the platform for innovation management as somewhat effective while, one farmer (0.97%) indicated the platform is not effective. Innovation management through

policymakers is very effective (4.85%) while; some (8.74%) farmers supported those policymakers who can change the law and regulation, as a platform for innovation management is effective. However, many (31.07%) farmers agreed that the platform is somewhat effective while, majority of the farmers (55.34%) disagreed that authorities saddled with the mandate for managing innovations in agriculture through policymakers is totally absent. Innovation has expanded towards digitizing weather information and 2.91% of the farmers confirmed it's been very effective, 6.80% affirmed its effective but not impressive, 41.75% attested that digitization of weather information is somewhat effective while, a vast majority of the respondents (48.34%) declared digitization of weather information is not effective. The results indicate that, 14.56% of farmers confirmed that training on improved varieties at seed and livestock fairs is very effective, many farmers (30.10%) supported the aforementioned but with variations that the platform is not remarkable, certain (26.21%) farmers acknowledged training on improved varieties at seed and livestock fairs is somewhat effective while, a significant proportion (29.13%) of farmers confirmed the aforementioned platform for managing innovation is not effective. Training of extension agents on agriculture-oriented insurance schemes was identified by few (9.71%) of farmers as very effective and certain portion of the respondents (16.50%) agreed the medium is effective but not exciting. However, majority of the farmers (39.81%) indicated that, the management of innovations through training of extension agents is somewhat effective while; a lot (33.98%) of the farmers declined the said and confirmed not effective. Few (1.94%) farmers recognized training of retailers on the fundamentals of supply and demand market dynamics as very effective and gained solidarity from some (5.83%) farmers. However, many farmers (30.10%) attested retailers training on the dynamics of demand and supply is somewhat effective while, most (62.14%) of the farmers acclaimed the alleged as not effective.

Therefore, production and exchange of (Innovation) knowledge are not the only prerequisites for innovation management. There are several indicators that play significant role, such as policy, legislation, infrastructure, funding, and market developments. Agricultural innovation according to Klerkx et al., (2012) is not about adopting new technologies to improve agricultural productivity, it requires a balance amongst new innovation practices and alternative ways of organizing. This process faces potential risks that can be reduced by appropriate education and effective management for through information and communication technologies and the use of optimization processes. The broader view on management of agricultural innovation depends on multiple interactions between components of farming systems, supply chains, and economic systems, policy environments, and societal systems.

Constraints Farmers faced in Adopting Agricultural Innovation

The study determined constraints farmers faced in adopting agricultural innovation and the findings are indicated as follows:

Table 5: Constraints Farmers faced in Adopting Agricultural Innovation

Constraints n=103	Strongly Agree		Agree		Somewhat Agree		Disagree			
	f	%	f	%	f	%	f	%	*P*	Sig.
Difficulties in procurement of innovated breeds	54	52.43	47	45.63	3	2.91	0	0	0.9041	0.05
Environmental factors for new breads	62	60.19	31	30.1	10	9.71	0	0		
Poor market structure for innovated breeds	39	37.86	53	51.46	3	2.91	8	7.77		
Technophobia	27	26.21	21	20.39	31	30.1	24	23.3		
Better Alternative	51	49.51	34	33.01	10	9.71	8	7.77		
Non availability of information in local language	67	65.05	32	31.07	2	1.94	2	1.94		
Unperceived economic benefits	49	47.57	51	49.51	0	0	3	2.91		
Inadequate skills to utilize	34	33.01	63	61.17	3	2.91	3	2.91		
Cost of innovated breeds	58	56.31	39	37.86	6	5.83	0	0		
Insufficient awareness	72	69.9	31	30.1	0	0	0	0		

Source: Study Data, 2022

Findings of the study shown that majority (52.43%) of the farmers strongly agreed that, they often faced difficulties in the procurement of innovated breeds while, many (45.63%) declared agreed with the above-mentioned. However, certain (2.91%) farmers confirmed it is slightly difficult procuring innovated breeds. Environmental factors affects for new breeds is identified by most (60.19%) farmers. Though, some proportion (30.1%) affirmed new breeds most times area affected by environmental factors while, few (9.71%) farmers claimed not often but slightly affected by environmental factors. Most (37.86%) farmers acclaimed they are affected by poor market structure for innovated breeds and gained solidarity from majority (51.46%) of the farmers who agreed poor market structure discouraged them from adopting new technologies. However, some (2.91%) farmers provided that poor market structure slightly discourage them while, some (7.77%) disagreed that market structure do not posed any challenge towards adopting innovations in agriculture.

The study found that limited proportion (26.21%) of farmers strongly agreed that technophobia affects the extent to which they adopt new technologies, while a reasonable number of them (20.39%) agreed with the aforementioned. Also, many (30.1%) farmers somewhat agreed that technophobia discouraged them from adopting new innovations while, some (23.3%) disagreed and provided that technophobia do not affect the extent to which they adopt new innovations. Most farmers (49.51%) strongly

agreed they have better alternative, 33.01% attested there are other better options to enhance productivity than adopting innovated breeds and practices, some (9.71%) farmers somewhat agreed that there are other options while, few (7.77%) of the farmers disagreed with the said. It was gathered that, majority (65.05%) of the farmers strongly agreed information regarding innovations are not available in local language and many (31.07%) farmers agreed with the aforementioned. However, few (1.94%) farmers somewhat agreed while, some (1.94%) disagreed that non-availability of information in local language affects adopting agricultural innovations.

A lot (47.57%) of the farmers strongly agreed that, unperceived economic benefits hinders them from adopting innovations and gained solidarity from majority (49.51%) of the farmers. Also, few (2.91%) farmers disagreed that unperceived economic benefits affects the level of adoption of innovations. Many farmers (33.01%) strongly agreed that they posses' inadequate skills to utilize innovations while majority of the farmers (61.17%) agreed with the aforementioned. Some farmers (2.91%) somewhat agreed that inadequate skills to utilize innovations often play a vital role in adopting innovations. However, most (56.31%) farmers strongly identified cost of innovated breeds as a challenge for adoption. Likewise, 37.86% affirmed innovation are often expensive, therefore adoption becomes difficult. Also, few (5.83%) farmers disagreed that cost of innovated breeds affects the adoption of innovations. Almost all (69.9%) the farmers strongly agreed insufficient awareness obstruct them from adopting innovations while, a good number (61.17%) them agreed with the said and affirmed that lack of awareness tempers with the extent to which farmers adopt innovations.

A test of association was calculated to determine the linear relationship between methods of innovation management and constraint faced by farmers in the adoption of innovation methods. Pearsman product moment correlation (PPMC) at sig.0.05 appeared p=0.9041 higher than 0.05 α. There is no strong evidence at the α level to conclude there no linear relationship exist between management of innovation methods and constraint faced by farmers in adopting innovations in agriculture. Therefore, the study fail to accept the hypothesis.

Numerous factors according to Organization for Economic Co-operation and Development (OECD) (2012) are constraining the adoption of agricultural innovations. Often, agricultural policies and innovations are giving conflicting signals, which hinder the uptake of new technology. Some policies in the agricultural sector promote the use of ecologically vulnerable land for agricultural growth, lead to the excessive use of natural resources, and do not require farmers to consider environmental spillovers into other industries. Many support policies get capitalized into the value of land, encouraging a greater intensity of production and influencing the kind of innovations adopted. Some agricultural policies impose environmental constraints on farmers as a condition for receiving support, but at levels higher than otherwise to compensate for environmental damage caused by other agricultural policies. In some countries, the environmental benefits provided by farmers are remunerated, in others they are not. Inadequate levels of awareness and education, access to advice and pressures on financial resources for some farmers slows the adoption of some technologies,

especially those that require a larger scale of operations and where the initial investment costs required are high.

CONCLUSION

The article concluded that there are many methods of innovation available to farmers but most of the methods are not effective for farmers' adoption and utilization to enhance food production. Also, innovators provided series of platforms to manage innovations introduced and it has been effective rather posed numerous challenges to farmers and do not ensure continuity.

Recommendations.

The article provided the following recommendations:

1. Innovators on agricultural innovation introduced to farmers, to ensure beneficial adoption should provide awareness.
2. To maximize the innovations' potential impact, it is important that information be made available in both English and the native language.
3. Cost of procurement of breeds should be made affordable to farmers to ensure higher adoption.
4. Platforms made for management of innovation should be made effective to further encourage farmers towards adoption and continuity.

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