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Determinants of Agricultural Technologies' Adoption by Smallholder-farmers in Ogoja Agricultural Zone of Cross River State

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Abstract
The study examined determinants of agricultural technologies' adoption by smallholder-farmers in Ogoja Agricultural zone of Cross River State. It was guided by two research questions. The study employed a survey research design. A total sample of 200 respondents, from a target population of 497 registered farmers, was selected for the study using simple random sampling technique. An instrument named Determinants of Technologies Adoption by Smallholder Farmers Questionnaire (DTASFQ) was used to elicit the required data. The data collected was analyzed using mean and standard deviation. The findings of the study indicated that institutional factor and household-specific factor have influences on smallholder-farmers' adoption of agricultural technologies. The study recommended, among others, that agricultural policies and programmes that favour smallholder-farmers should be formulated and implemented judiciously, and that government at all levels (Federal, State and Local) should encourage and motivate smallholder-farmers by provision of needed agricultural incentives.
Keywords: determinants, technologies, adoption, smallholder farmers, agricultural.

Introduction

Agriculture plays a vital role in economic growth, enhancing food security, poverty reduction, creation of employment, mitigating migration and fostering rural development. It is the main source of income for an estimated population of over 2.5 billion people in developing world (FAO, 2018). In Nigeria and other counties across the globe, and especially in the sub-Saharan Africa, small-holder agriculture is considered a viable and crucial development tool for achieving food security objective (FAO, 2018). However, majority of smallholder farmers rely on traditional methods of production and this has a direct effect on the level of productivity (Dawson et al., 2016). For instance, over 70% of most crops produced in majority of developing countries are basically from smallholder farmers who use traditional method of production (Kekonmen, 2017).

As noted by Ngango and Hong (2021), these farmers generally obtain very low crop yield because the local varieties used by them has low potential yield, most grown under rain-fed condition and irrigation is used only in limited areas, little or no fertilizers are used and pest control is inadequate. This has thus triggered much of discussion on the need to increase

productivity and sustainability in agriculture globally, but much less information is available on specific means to achieve this aim. Challa (2023) posits that increasing agricultural productivity is critical to meet expected rising demand and as such, it is instructive to evaluate recent performance in cases of modern agricultural technology. According to Lovison (2020), the most common areas of technology development and management regimes, as well as soil fertility management are weed and pest management, irrigation and water management.

By virtue of improved input/output ratio, new technology tends to raise output and reduce input average cost of production, which in turn results in substantial gain in farm income (Challa, 2023). According to the submission of Owusu et al. (2021), adoption of improved agricultural technologies has been associated with higher earnings and lower poverty, improved nutritional status, lower staple food price, increased employment opportunities as well as earnings for landless labourers. In support of this assertion, Khan et al. (2019) maintain that adoption of improved agricultural technologies is believed to be a major factor that can guarantee food security and sufficiency in any country. Raballion and Chen (2014) on the other hand believed that non-adopters can hardly maintain their marginal livelihood with socio-economic stagnation leading to deprivation.

Indeed, adoption of new agricultural technologies by smallholder farmers is highly imperative, considering their importance in global and regional food production. Hence this group of farmers remain the engine driving agribusiness production in virtually all the developing countries. In Nigeria for instance, over 80% of the food produced and consumed, come from smallholder farmers' farms (Kekonmen, 2017). According to Dawson et al. (2016), more than 57 million farms worldwide are being operated on a small scale with land access of fewer than two hectares representing 75 percent of world agricultural land (Maertens & Vande Velde, 2017). Across the globe generally, about one billion people who live in rural areas depend majorly on agriculture as their main source of livelihood (Anderson, 2016). In view of the green revolution that facilitated the effort of developing countries in the 1960s and 70s to an increased agricultural production as well as reduced poverty, the productive gains to farmer's family were supported through research and extension services (Ayanew et al., 2020).

The sustainability of rural economy has potential of increasing employment opportunities, stemming rural-urban migration and ultimately reducing poverty (Bellemare & Novak, 2017). They further buttressed that curbing the looming hunger and heightened poverty in developing countries will require government's deliberate and conscious effort to provide the needed incentives to this group of farmers who for many decades continue to sustain food supply in the world.

Sadly, despite the relevance of these smallholder farmers in global and regional food production, they comprise majority of the world's undernourished population and those living in abject poverty, according to the Food and Agricultural Organization of the United Nations (FAO, 2021). This is because not all studies linking agricultural development and poverty address the role of smallholder farmers specifically, but their importance as food producers, and the fact that they comprise such a large proportion of the world's poor indicate that their development significantly helps reduce poverty and hunger. The relevance of this group of farmers may be noticeable in terms of positive impact in sub-Saharan Africa and south Asia

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(Challa, 2023). Smallholders manage over 80% of the world's estimated 500 million small farms and provide over 80% of the food consumed in large part of the developing world, contributing significantly to poverty reduction and food security (FAO, 2018).

According to Maertens and Vande Velde (2017), increased fragmentation of landholding, lack of access to credit facilities, lack of technical support coupled with reduced investment support and marginalization of small farms in economic and development policy, threaten this contribution, leaving many smallholder farmers vulnerable to poverty, which in turn deprived them of adopting new and improved technologies. In Nigeria, for example, this group of farmers constitute 95% of Nigerian farmers, while the corporate and government supported large-scale farms account for just 5% (FAO, 2021). However, effort in promoting agriculture prioritizes the 5%, possibly due to their alliance and proximity to government agencies thereby given less attention to the greater percentage of the farming population. With this sharp disparity and ugly scenario, over 72% of this category of farmers lives below the poverty line of $1.9per day (FAO, 2018).

As noted by Agbarevo (2014), different studies on the constraints and problems faced by smallholder farmers in the country, and indeed Ogoja Agricultural Zone of Cross River State have revealed lack of access to market information, poor access to credit facilities, little or no support and high cost of farm inputs as major hindrances to their profitability and productivity (Raballion & Chen, 2014). According to Khan et al. (2019), smallholder farmers are those farmers owning small-based plots of land on which they grow subsistence crops, one or two cash crops and a few domestic animals, and relying almost exclusively on family labour. They are equally predominantly located in the rural area and cultivate a piece of land usually less than two hectares (Anderson, 2016). More than 80% of farmers in Nigeria are smallholder farmers. They are also a major contribution to GDP (Gross Domestic Product) in Nigeria. A smallholder farmer depends on his efficiency in the utilization of basic production resources available to him. He makes significant and important contribution to the national production, as about 99 percent of total crops output is produced by smallholder farmers in Nigeria. They are the main producers of an estimated 98% of food produced and consumed in Nigeria (Udry, 2018).

Although for a couple of decades, considerable, deliberate and concerted efforts have been made to improve agricultural production by the Nigerian government, non-governmental organizations and international agencies, but these sustained efforts have not always been possible to meet the growing food and nutritional demand of Nigerian teeming population. It falls short of what is needed, hence low productivity (Anderson, 2016). Indeed, the government and some foreign bodies' efforts have failed to yield expected results. Even though the Nigerian economy has what it takes to be food-secured given the enormous natural resources she is endowed with, the fact remains that smallholder agriculture is not given the priority attention it deserves.

It is on this note that Agbarevo (2014) seeks for a re-orientation of the agricultural sector in Nigeria generally, and in Ogoja Agricultural Zone of Cross River State, by properly repositioning the smallholder farmers who in the strict sense are the providers and engine driving food production in Nigeria. With the immense collective experience of this group of

farmers coupled with their intimate knowledge of local conditions, smallholder farmers would no doubt provide practical solution that can help place agriculture on a more sustainable and equitable footing (Challa, 2023). To do this, they need support from the government and non-governmental agencies/organizations to enable them function effectively (Ngango & Hong, 2021).

Generally, in Nigeria, smallholder agriculture is constrained by numerous setbacks that ranged from weak institutional support, marginalization, lack of capital, insecure land tenure, high transportation costs, high cost of farm incentives, lack of access to credit facilities or even motivation. Given these conditions, it becomes difficult, if not impossible, to adopt emerging agricultural technologies (Kekonmen, 2017). But it is believed that with higher rate of adoption and utilization of modern agricultural technologies by smallholder farmers, both crop and animal yield could increase which will consequently lead to increased income (Keelan et al., 2014; Ayanew et al., 2020). In other words, sustainable crop and animal production cannot be achieved without adequate adoption and application of emerging agricultural technologies.

In view of the above, adoption of improved agricultural technologies by smallholder farmers is a necessary condition, if better yield must be achieved. This is because technology plays a crucial role in both plant and animal husbandry. However, studies have shown that despite the relevance of technology in agricultural development, many rural farmers do not embrace and adopt these modern methods/techniques of agricultural production. This, as noted by Akudugu et al. (2020), is due to multifarious variables which are both institutional, and household oriented. Institutional factor, according to Akudugu et al. (2020), refers to the organizational, social and regulatory structures that influence the adoption of technology by rural farmers. Example of institutional factor may include farmers' organization, associations, farmers club, research and development institution, and others; they exert profound influence on smallholder farmers' adoption of agricultural technologies. For instance, a farmer who is a member of farmer's association, farmers club, organization or linked to research institution, has more access to information than a farmer who is not linked to these groups. And through interaction and association, a farmer will be convinced to adopt a particular agricultural technology.

Studies have also shown that household factor influence smallholder farmers' adoption of agricultural technologies. Household factor as defined by Adewale and Serifat (2015), Okuniola et al. (2019) refers to the characteristics and dynamics within a rural farm household that influence the adoption and use of agricultural technology. They listed some examples of household factor to include age, family size, education, household labour and others. In a similar view, Arndt et al. (2009) opined that household factor, especially risk tolerance and farm size, strongly influences farmers' readiness to adopt new technology.

Unfortunately, most of the new agricultural technologies introduced by relevant agencies are not fully adopted by these farmers because majority of the farmers are conservative, and so hold very tenaciously to cultural practices passed down to them by their forefathers, besides the fact that, most of the smallholder farmers are not buoyant to key into such technologies so introduced. Therefore, it is practically difficult to convince them on the adoption of new technologies (Mendola, 2017). As noted by Agbarevo (2014), agricultural production is predominantly carried out in the study area; however, up till date there is insufficiency of

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empirical evidence showing the extent to which farmers have adopted new technologies, or indeed where they are on the adoption continuum. It is against this background that the present study on determinants of technologies adoption by smallholder farmers in Ogoja Agricultural Zone of Cross was conceived and executed.

Research questions

i. What is the influence of institutional factor on smallholder farmers' adoption of agricultural technologies?
ii. What is the influence of household-specific factor on smallholder farmers' adoption of agricultural technologies?

Methodology

The study employed survey research design. Survey research, according to Kerlinger (1986), is that which is geared towards determining the nature of a situation as it exists at the time of investigation. He further describes it as a type of research that studies large and small population by selecting and studying samples chosen from the population to discover the relative incidence, distribution, and interrelations of sociological and psychological variables. This agrees with Isangedighi (2012) who described survey research as a design which is specifically intended to systematically collect data about a group of individuals who have some characteristics through the use of written or oral data collection instrument, interview, questionnaire, telephone, mails and internet, concerning particular responses on fact, opinion, attitude, among others.

The study area was Ogoja agricultural zone, Cross River State. It is one of the three agricultural zones in Cross River State. Ogoja Agricultural Zone comprises Obudu, Ogoja, Obanlikwu, Yala and Bekwara Local Government Areas. A total sample of 200 respondents from a target population of 497 registered farmers was selected. The sampling technique adopted for the study was the simple random sampling. The heart and draw method of simple random sampling was used to select the sample of 200 registered smallholder farmers from the entire population.

The instrument for data collection was a structured questionnaire designed by the researchers titled Determinants of Technologies Adoption by Smallholder-Farmers Questionnaire (DTASFQ). It was made up of two sections. Section A elicits information based on the respondents' demographic data, while section B elicits information based on the sub-variables under study. The questionnaire response options include Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The Questionnaire was validated by one expert in Measurement and Evaluation and one lecturer in the Department of Agricultural Education, University of Calabar. The responses which were assigned nominal values were scored as follows: Strongly Agree (SA)- 4points, Agree (A)- 3points, Disagree (D)- 2points and Strongly Disagree (SD)- 1point. The data collected was analyzed using mean and standard deviation.

To determine the reliability of the instrument, Cronbach Alpha reliability method was adopted. The researchers administered twenty (20) copies of the instrument to the respondents in two farming communities in Ikom Agricultural Zone that were not part of the study sample. This was to ascertain if the instrument was internally consistent. The reliability coefficient obtained from

the analyses of data was 0.79 which was a clear indication that the instrument was reliable for gathering data for the study.

Presentation of results.

Research question 1: What is the influence of institutional factor on smallholder farmers' adoption of agricultural technologies?

Table 1: Mean and standard deviation analyses of respondents' rating on influence of institutional factor on smallholder farmers' adoption of agricultural technologies

S/N	Item	SA	A	D	SD	Mean	Remarks
1	Giving incentives to farmers motivates them to adopt agricultural technologies.	135	60	5	-	3.65	A
2	Information help farmers welcome and adopt agricultural technologies.	90	60	40	10	3.15	A
3	Access to credit, loans and financial services motivate farmers to adopt technology.	105	75	-	20	3.33	A
4	Availability of effective farmers association in a community influence farmer to adopt agricultural technology	87	83	17	13	3.32	A
5	Farmers organizations enhance farmers adoption of agricultural technologies.	100	78	20	2	3.38	A

Table 1 shows mean responses of respondents on the influence of institutional factor on smallholder farmers adoption of agricultural technologies. Since all the items 1-5 recorded mean score above the cut-off mark of 2.50. This implies that the respondents agreed that institutional factor exerts influence on smallholder farmers' adoption of agricultural technologies.

Research question 2: What is the influence of household-specific factor on smallholder-farmers' adoption of agricultural technologies?

Table 2: Mean and standard deviation analyses of respondents' opinion on household-specific factor on smallholder farmers' adoption of agricultural technologies.

S/N	Items	SA	A	D	SD	Mean	Remarks
1	Farmers' education level enhances adoption of agricultural technology.	1oo	57	33	10	3.24	A
2	The size of a farmers' family influences his adoption of agricultural technologies.	50	32	90	28	2.52	A
3	Farmers with low income hardly adopt agricultural technology.	90	25	105	60	1.93	D
4	Household labour influence adoption of agricultural technologies.	90	70	-	40	3.03	A
5	Willingness to take risk enhances adoption of agricultural technologies by farmer.	120	60	20	-	3.5	A

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Table 2 shows the mean rating of respondents on the influence of household factor on smallholder farmers' adoption of agricultural technologies. All the items 1-5 recorded cut-off mean of above 2.50, except item number 3 with cut-off mark of 1.93. This implies that respondents agreed that household has influence on smallholder farmer's adoption of agricultural technologies.

Discussion of the findings

Based on the analysis of data obtained from the study, the following findings and corresponding discussions are made. Institutional-factor influences smallholder-farmers' adoption of agricultural technologies. The findings are consistent with those of Akudugu et al. (2020). The researchers found that institutional factor has influence on smallholder-farmers' adoption of agricultural technologies. The finding is also in consensus with the work of Adewale and Serifat (2015) that farmers within a social group learn from each other, the benefit and usage of new agricultural technologies. Although many researchers have reported a positive influence of social group on agricultural technologies adoption, Kekonmen (2017) differs in his opinion that despite the relevance of social groups in farmers' technologies adoption, social group may also have negative impact on technology adoption especially where free-riding behaviours exist.

According to research question two, the results revealed that household factor influences farmers' adoption of agricultural technologies. These findings thus confirm the findings of research conducted by Okuniola et al. (2019) on the influence of household factor and rural farmer's adoption of agricultural technologies. The finding is also in line with that of Arndt et al. (2009) on the effect of farmers' educational level and their interest/readiness to adopt agricultural technologies. The study also aligns with that of Kekonmen (2017) on the influence of household factor and the productivity of smallholder farmers, where he held that household factor influences fish farmers' adoption of technology. It also supports Anderson (2016) findings on influence of household factor on adoption of organic fertilizer by smallholder-farmers.

Conclusion

The main purpose of this study was to investigate the determinants of agricultural technologies adoption by smallholder farmers in Ogoja Agricultural Zone of Cross River State. Findings from the study revealed that institutional and household factors have influences on smallholder farmers' adoption of agricultural technologies. It is therefore concluded that institutional and household factors influence the adoption of agricultural technologies by smallholder farmers.

Recommendations

i. Based on the findings of the study and discussion thereof, the following recommendations were made:
ii. Agricultural policies and programmes that favour smallholder-farmers should be formulated and implemented judiciously by government.
iii. Government at all levels (federal, state and local) should encourage and motivate smallholder-farmers by provision of needed incentives.
iv. Smallholdings agriculture should be prioritized more than large scale farming. Since over 90% of the food produced and consumed come from smallholder farmers.

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