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TECHNOLOGY ADOPTION PROCESS IN THE NIGERIAN SUBSISTENCE AGRICULTURE: A CASE STUDY OF USE OF FARMER-TO-FARMER APPROACH IN COCOYAM MINISETT

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Abstract

This study analyzes the use of the farmer-to-farmer approach in cocoyam minisett technologies dissemination among rural women farmers in Imo State, Nigeria. The study specifically examined rural women farmers' awareness of cocoyam minisett technologies, the channels used to transfer the technologies, the rural women's knowledge of the farmer-to-farmer approach, and the utilization and extent of utilization of the farmer-to-farmer approach in transferring cocoyam minisett technologies. Data were collected using a structured and validated questionnaire from 120 randomly selected rural women farmers. Data were analyzed using descriptive statistics such as percentages, frequency distribution and mean score. Results of the study show that cocoyam minisett technologies were actually introduced to the farmers and different channels were used to transfer the technologies, but the utilization of the farmer-to-farmer approach was low, with the use of farmers/friends and neighbours being the dominant channel for transferring innovations among farmers. The study recommends, among others, the creation of adequate awareness on the need and benefit of using the farmer-to-farmer approach, and that the modalities involved in using the approach need to be properly streamlined so that farmers understand the difference between this approach and other channels of information dissemination. The study finally concludes that the farmer-to-farmer approach was relatively unknown among farmers, hence the need to popularize it to help fill the gap in the farmer-extension ratio.

1.1 Introduction

Agriculture, before the advent of oil, had been described as the main stay of Nigeria's economy. It made significant contributions to the development of the country, building up to the GDP (Gross Domestic Product) of the nation. However, this contribution has continued to dwindle, and the status of agriculture has not been encouraging, irrespective of the various programmes and projects aimed at improving the agricultural outlook in the country. Statistics have shown that agricultural production and productivity have remained thresholds in the country, leading to food and fibre insufficiency and nutrition-related negativities. Despite potentialities and prospects of producing food for home consumption and export, achieving a balance between food and population growth remains the most serious problem facing Nigeria today (Onyeukwu 2015; Anaeto 2010; Onu 2008).

Agriculture in Nigeria is still predominantly traditional and based on traditional technology. It is based on the factors of production that have been used by farmers for generations (land and labour) and is part of the cultural heritage and an integral part of the socio-economic structure of the country. Nigerian agriculture is still characterized by small-sized farms scattered in different locations, far away from home,

using very simple hand tools like hoes and cutlass, with drudgery, sap human energy, and high susceptibility to vagaries of climate and other natural disasters. It follows seasonal patterns (busy planting and harvest seasons followed by slack periods), resulting in seasonal unemployment. Despite all these hindrances facing Nigeria's small-scale farmers and agricultural development organizations like extension services and research institutes, one serious problem yet to be tackled properly is how to persuade subsistence farmers to adopt agricultural innovations (Agbamu, 2016).

Onyeukwu (2015) observed that the adoption and use of improved farm technologies by subsistence farmers in Nigeria has been received with mixed feelings by many researchers and experts. Anaeto (2010) and Onu (2006) explain that despite the potential economic benefits expected from adoption, available evidence shows low and differential rates between large-scale and resource-poor farmers, as well as vulnerable groups, mostly women and youths. Women's contribution to agricultural growth and development in Africa has been well documented in the literature, and the situation regarding the contribution of rural women to agricultural production in Nigeria is no different. In Nigeria's rural sector, women contribute to agricultural production, food processing, marketing, family stability, as well as farm and non-farm labour (Onyeukwu 2015). Despite these significant contributions, literature on women's access to and adoption of improved agricultural technologies is replete with views of severe restriction (Anaeto 2010; Onu 2008).

The Transfer of Technologies (ToT) model assumes that the transfer of technology and knowledge from scientists will trigger development (Asiabaka 2002; Agbamu, 2016). Agbamu maintained that the role of agricultural extension agents in the ToT model is to assist farmers in putting blueprints or ready-made technologies into practice, despite the fact that they may not be appropriate. Unfortunately, agricultural organizations often assumed that as progressive farmers adopt innovations, they are observed by other less innovative farmers who get influenced and later adopt the innovations, which then spread to the majority of farmers. In real-life situations, this assumption may not prove correct, because, according to Agbamu (2016) and Hagmann et al. (1999), the ToT approach has resulted in poor adoption rates of technologies, poor performance of researchers' technologies under farmers' management, neglect of the stumbling blocks for successful development (socio-cultural, organizational and political issues at community level), as well as neglect of people's indigenous knowledge. Experts and development patterns agree that the ToT approach has failed to address the problem of dissemination of innovations to farmers, and thus there is a need for a rethink of this model in order to develop more effective approaches for stimulating farmers to adopt technologies for the development of themselves and their communities.

Cocoyam (*Xanthosoma sagitifolium*) is a stem tuber that is widely cultivated in both tropical regions of the world. Nigeria is the largest producer of cocoyam in the world, accounting for about 40 percent of total world output (Eze and Okorji, 2023). Cocoyam ranks third in importance after cassava and yam among root and tuber crops cultivated and consumed in Nigeria. According to Obi (2020), it is an important staple food commonly grown by women in Nigeria, hence it is often regarded as a women's crop, falsely.

Nutritionally, cocoyam is superior to cassava and yam in protein, mineral and vitamin content, as well as easily digestible starch (Onyenweaku and Okoye, 2016). It is highly recommended for diabetic patients, the aged, children with allergies, and persons with intestinal disorders (Ohajianya, 2016). Cocoyam can be used as an industrial raw material in the manufacture of alcohol and drugs, and its food energy yield per unit land area is high. Cocoyam production in Nigeria is labour intensive, with most operations carried out manually at the traditional level.

In order to increase the production of cocoyam in large quantities, cocoyam minisett technologies were introduced throughout the country, including Imo State. Cocoyam minisett technologies involve methods of rapid seed multiplication, which involve cutting the whole tuber into minisetts, treating the cut surface with appropriate dressing chemicals, weeding, proper spacing, timely application of fertilizers, etc. At the end of the harvest, some of the harvest is saved to produce the new season's planting materials.

This cocoyam minisett technique of rapid multiplication of root and tuber crops was developed after years of research at the National Root Crop Research Institute, Umudike, Nigeria, and the International Institute of Tropical Agriculture (IITA), Ibadan. These improved techniques have been widely used in overcoming cocoyam seed problems by rural women, through the help of extension agents acting as the information source, and more recently used in the production of marketable cocoyam, among others. Cocoyam minisett techniques possess the following advantages:

- Reducing the cost of planting material
- Reduction in the cost of farm operation
- Fourfold increase in crop production per unit area as a result of reduced spacing of minisett
- Suppression of weeds as a result of increased crop population per hectare
- Substantial increase in seed crop supply, and
- The amount of edible crop usually planted is reduced to one quarter, thereby reserving more food for human consumption (Obi 2020).

One approach that readily comes to mind in this direction is the participatory technology development and participatory extension approach, which ensures the development of technologies together with farmers, farmer experimentation, and sharing of experiences and farmer-to-farmer innovation dissemination, with extension workers as facilitators (Agbamu 2016; Hagmann et al. 1999). No doubt, it is expected that the main shift in orientation will occur when the development of farmers' capacity to develop and diffuse technologies substantially changes the role of farmers and outsiders in the diffusion of innovations. The farmer-to-farmer approach has been successfully practiced in most countries like Senegal (Amination rural), Kenya, Ethiopia and Uganda. In Nigeria, especially in rural settings like Imo State, it is not clear which innovation dissemination approaches are available to farmers, especially rural farmers in the field. The use of extension contact farmers, farmers' field schools, Fadama user groups, OFAR farmers, contract farming, radio/TV farmer programmes, cooperative associations, demonstrations, meetings, training and visits, telephone, face-to-face contact and, to some extent, farmer-to-farmer approaches have been used to reach farmers in the state. Little and scanty information exists concerning the use of the farmer-to-farmer approach in disseminating innovations such as cocoyam minisett technologies to rural women farmers in Imo State. It is against this backdrop that this study proposes an empirical analysis of the use of the farmer-to-farmer approach in spreading cocoyam minisett technologies among rural women farmers in Imo State. The study therefore seeks to provide answers to the following research questions:

- Do the rural women farmers know about cocoyam minisett technologies in Imo State? What channels are used in transferring cocoyam minisett technologies to the rural women farmers?
- Do the rural women farmers know about the farmer-to-farmer approach as an extension method for innovation dissemination?
- If they do, do they utilize it?

- What are the constraints that affect/limit the rural women farmers' use of the farmer-to-farmer approach?

Answers to these issues and questions raised are the main focus of this study.

1.2 Objective of the Study

The study specifically addressed the following objectives:

- Identify the rural women farmers' awareness of cocoyam minisett technologies.
- Determine the channels used in the transfer of cocoyam minisett technologies to rural women farmers.
- Describe the knowledge of rural women farmers on the use of the farmer-to-farmer approach.
- Discuss rural women farmers' utilization of the farmer-to-farmer approach in spreading technologies among rural women farmers.
- Assess the extent of utilization of the farmer-to-farmer approach among rural women farmers, and
- Ascertain the constraints likely to militate against the use of the farmer-to-farmer approach in disseminating innovation among rural women.

2.1 Methodology

This study was conducted in Imo State, Nigeria. Imo State is one of the five states in the South-East. The state is divided into 3 agricultural zones to aid agricultural planning, based on the diversity of environmental and ecological factors. The estimated population of Imo State, according to the National Population Commission (2023), is 4,453,889 people and covers an area of 5,530 sq km. The state is bordered by Rivers State to the south and Cross River to the north, and is to the west of...

Two main sources of data were used, namely primary data from field survey and secondary data from literature reviewed. Structured and validated questionnaires were used to collect data from 120 rural women farmers selected using multistage random sampling techniques. The list of local government communities, villages and farmers, as supplied by the agricultural officers as well as community development officers in the Local Government Area headquarters, was used for the study and constituted the sampling frame. Data were collected by researchers based on the objectives of the study and analyzed using appropriate statistical tools.

Examples: Objectives III, IV, I and II were analyzed using frequency distribution and percentages. Objectives V and VI were determined using frequency distribution, percentages and mean score obtained using a 3-point Likert-type measuring scale.

The Likert-type measuring scale was established using the formula:

$$\mathbf{X\ (mean)\ =\ \Sigma X\ /\ n}$$

where: X = mean of the scaling statement; Σ = summation of the nominal values; X = normal value assigned to each statement; n = number of nominal values.

The difference in scaling statement used for serious, serious and not serious, and also very serious and not serious, was found using the mean of the scaling statement, calculated thus: (3+2+1) / 3 = 6/3 = 2.0. An interval of 0.5 was taken, thus giving an upper limit of 2 + 0.5 = 2.5, and a lower limit of 2 – 0.5 = 1.5.

Decision Rule:

Any mean score above and equal to 2.5 is very high and very serious, while below 1.5 is not high/not serious, and between 1.5 and 2.4 is just high or serious.

3.0 Results and Discussion

Table 1: Distribution of Rural Women Farmers According to Their Knowledge of Cocoyam Minisett Technologies

Response	Frequency	Percentage
Yes	80	66.67
No	40	33.33
Total	120	100

Source: Field survey

The result in Table 1 shows that about 67 percent of the rural women knew about cocoyam minisett technologies, while 33 percent did not. This thus implies that cocoyam minisett technologies were actually introduced in the study area.

Table 2: Distribution of Rural Women Farmers According to Channel/Methods of Transfer of Cocoyam Minisett Technologies

Channels used to disseminate cocoyam minisett technologies	Frequency*	Percentage	Ordinal ranking
Research institute	20	16.67	10th
Extension agent	58	48.33	2nd
Fellow farmers/friends	72	60.00	1st
Cooperative societies	40	33.33	4th
TV/Radio farmer programme	25	20.83	7th
Church organization	30	25.00	5th
Contact farmer	52	43.33	3rd
OFAR farmer	25	20.83	7th
Farmer-to-farmer	05	4.17	16th
Fadama users	18	15.00	11th
Contract farming	27	22.5	6th
Telephone	15	12.5	14th
Extension poster/newsletters	17	14.17	13th
Excursion tours	18	15.00	11th
Field days/Agricultural show	22	18.33	9th
Print media (newspaper, magazines)	15	12.5	14th

*Multiple responses were recorded. Source: Field survey Data 2023

Table 2 shows the channels often used to transfer cocoyam minisett technologies among rural women farmers in Imo State. The results show that farmers were exposed to different channels, but from ordinal ranking of channels by the rural women farmers in the study area, fellow farmers and friends ranked first, followed by extension agents, contact farmers, and cooperative societies, in that order. However, the farmer-to-farmer approach took the last position (16th), thus still showing that the approach is not well known, appreciated and understood by the farmers. The fact that fellow farmers and friends were rated 1st and high shows that if proper education of farmers on what constitutes the farmer-to-farmer approach is done, the approach would most likely be embraced and used well by farmers.

Table 3: Distribution of Rural Women Farmers According to Knowledge of Farmer-to-Farmer Approach

Response	Frequency	Percentage
Yes (know about it)	25	20.83
No (do not know about it)	95	79.17
Total	120	100

Source: Field survey data 2023

Table 3 shows that the utilization of the farmer-to-farmer approach in transferring cocoyam minisett technologies to rural women farmers is very low. The result shows that out of the 25 percent of farmers who felt they knew about the farmer-to-farmer approach, 80 percent of them have not used it. Only 20 percent that utilized it may have confused it with the mere obtaining of information from other farmers and neighbours. The implication of this therefore is that the approach is still very much unknown among rural farmers in Imo State. It is also likely that those who utilized it may have confused it with the mere obtaining of information from other farmers and neighbours, and this calls for service in area awareness creation on the operations and benefits of the approach.

Table 6: Distribution of Rural Women Farmers According to Their Extent of Utilization of Farmer-to-Farmer Approach

Extent of Utilization	Frequency	Percentage	Mean Score
Highly Utilized	0	0	
Moderately Utilized	05	20	
Lowly Utilized	20	80	

Source: Field survey Data 2023

Rural women farmers were asked to rate their extent of utilization of the farmer-to-farmer approach based on a 3-point Likert-type measuring scale of highly utilized, moderately utilized and lowly utilized, and analyzed using mean score. The result (mean = 1.2) thus reconfirms earlier findings that the extent of utilization of the farmer-to-farmer approach was very low, showing that the approach is very much unknown among the rural women farmers in the study.

Table: Distribution of Rural Women Farmers According to Constraints Likely to Militate Against the Effective Use of the Farmer-to-Farmer Approach (Extent of Seriousness)

Socio-economic factor	Very Serious	%	Serious	%	Not Serious	%	Mean	Remark
Age of farmer	10	8.33	20	16.67	90	75	1.33	Not serious
Sex of farmer	05	4.17	15	12.5	100	83.33	1.21	Not serious
Level of education	55	45.83	45	37.5	20	16.67	2.29	Serious
Marital status	30	25	25	20.83	65	54.17	1.70	Serious
Farming experience	45	37.5	60	50	15	12.5	2.25	Serious
Farming size	40	33.33	65	54.17	15	12.5	2.25	Serious
Farm income	70	58.33	50	41.67	0	0	2.58	Very serious
Culture of the people	20	16.67	30	25	70	58.33	1.58	Serious
Religious influence	08	6.67	15	12.5	97	80.83	1.25	Not serious
Peer group influence	25	20.83	37	29.16	50	41.67	1.70	Serious
Traditional/custom of the people	35	29.16	40	33.33	48	40	1.70	Serious
Group influence	38	31.67	40	33.33	42	35	1.96	Serious
Political interference	40	31.67	40	33.33	42	35	1.96	Serious
Ignorance	58	48.33	50	41.67	12	10	2.38	Serious
Lack of adequate awareness/information	50	41.67	60	50	10	8.33	2.53	Very serious
Lack of extension visit / follow-up	60	50	50	41.67	10	8.33	2.51	Very serious
Climate change effects	65	54.16	40	33.33	15	12.5	2.41	Serious
Fertility depletion	70	58.33	45	37.5	05	4.17	2.54	Very serious
Declining crop yield	80	66.66	35	27.16	05	4.17	2.62	Very serious
Location specific	50	41.66	60	50	10	8.33	2.33	Serious
Yield stability	70	58.33	45	33.33	10	8.33	2.50	Very serious
Sustainability of the approach	85	70.83	25	20.83	10	8.33	2.63	Very serious
Availability of training for farmers	92	76.67	20	16.67	08	6.67	2.70	Very serious
Time and convenience	48	40	55	37.5	27	22.5	2.34	Serious
Complexity	62	51.67	50	41.67	08	6.67	2.25	Serious
Reliability	74	61.67	36	30	10	8.33	2.53	Very serious
Compatibility	60	50	50	41.67	10	8.33	2.41	Serious
Friability	54	45	60	50	06	5	2.40	Serious
Acceptability/relative advantage	70	58.33	45	37.5	05	4.17	2.54	Very serious

Source: Field survey Data 2023

A list of likely factors that might militate against the use of the farmer-to-farmer approach was presented, and farmers were asked to rate the factors as they could affect the use of the approach, based on a 3-point Likert-type measuring scale of very serious, serious and not serious. Most farmers rated farm income, lack of awareness/information creation, lack of extension visit/contact, the yield stability and sustainability of the approach, availability of farmers' proper training on the approach, and relative advantage of the approach over what they use in the past as the very serious problems that might work against use of the approach. However, the age of the farmers, sex and religious belief were not seen as problems, and other factors listed on the table were seen as problems but not too serious enough to work strongly against the use of the farmer-to-farmer approach in technology transfer. However, efforts need to be put in place to make the approach workable and appreciated by the farmers.

Conclusion

This study dwelt on the use of the farmer-to-farmer approach in technology transfer, and focused on the use of the farmer-to-farmer approach in transferring cocoyam minisett technologies to rural women farmers. The study showed very low utilization of the farmer-to-farmer approach in the study area, thus showing that the approach is still relatively unknown in the area, irrespective of the fact that cocoyam minisett technologies were known by the women in the study area. The study concludes that the inadequate knowledge of the farmer-extension ratio has resulted in the need to form a farmer-to-farmer extension approach to help argument the shortage of extension personnel across the country, and this thus justifies the need to popularize the farmer-to-farmer approach in the country, as done in other countries like Senegal, Kenya and Uganda.

Recommendations

Based on the findings of this study, the following recommendations are made:

- The level of awareness and utilization of the farmer-to-farmer approach was very low, thus there is need for improvement in the propensity and intensity with which farmers respond to the use of the approach, through creation of increased awareness of the need for the approach and its associated benefits.
- Since the majority of the farmers did not understand the workings of the approach and were misunderstanding it as normal interaction with their fellow farmers, neighbours and friends, there is need for proper explanation of the modalities of operation of the approach, such as identifying the key players in the approach, their required attributes, the training needed, and the characteristics of the supposed farmers to be used.
- There is also need for close monitoring of the key players involved in the approach so that the aim of shortening the gap in the farmer-extension ratio will be achieved.
- The factors that will militate against the effective use of the farmer-to-farmer approach should be carefully studied and taken into consideration in the development and use of the approach.
- Since this approach is not meant to replace the service of extension agents but to complement them because of the shortage of extension personnel, capacity building in the form of adequate training, workshops, seminars, conferences, etc., must be provided for the selected farmers involved in the approach.
- Since what is best needed for the country's agricultural growth is honesty and merit to guide the selection and use of farmers to be involved in the approach, the idea of favoritism, quota systems and

nepotism should be jettisoned, since knowledgeable and credible farmers who command influence and acceptability would assist in the approach.

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