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An Evaluation of the Extent of National Agricultural Research Institutes' Communication Strategies Regarding Farmers' Awareness of Agricultural Technologies in South-West Nigeria

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Abstract

One of the National Agricultural Research Institutes' key responsibilities is information sharing to farmers. This study investigated selected NARIs' deployed communication strategies in disseminating agricultural technologies information to farmers and evaluated farmers' awareness level of agricultural technologies in adopted villages in southwest Nigeria. Based on perception theory, this study used an embedded mixed-methods research design with 575 farmers from three selected NARIs in southwest Nigeria: The Cocoa Research Institute of Nigeria, the Institute of Agricultural Research and Training, and the Nigerian Institute for Oceanography and Marine Research. Data were collected through key informant interviews and validated questionnaires. Qualitative data were analyzed thematically, whereas quantitative data were analyzed using descriptive statistics. The study found that NARIs in southwest Nigeria used various communication strategies to disseminate agricultural technologies to farmers. The study highlighted the impressive level of awareness regarding agricultural technologies. CRIN ($\bar{x} = 3.68$), IAR&T ($\bar{x} = 3.73$), and NIOMR ($\bar{x} = 4.49$). It concluded that the understanding of agricultural technologies, as conveyed by the NARIs' communication strategies, is effective, and recommended increasing awareness of agricultural technologies to promote effective use.

Keywords: Agricultural research institutes, agricultural technology awareness, communication strategies, development communication, farmers

Introduction

Effective communication is critical for transferring research technologies to end users. However, obstacles, such as poor feedback from end users and inadequate links among agricultural stakeholders, hinder the widespread use of practical technology (Babu et al., 2017). Communication for development plays a critical role in enhancing agricultural practices and boosting farming output (Onagwa, 2016). It is essential to foster economic advancement and leverage agricultural innovations. The usual routes for creating effective communication are the extension communication methods. Diverse communication strategies include but not limited to farm visits (face-to-face), television, radio, field demonstration, joint workshops, empowerment training, posters/flipbooks, multimedia compact discs, mobile phones, teleconferencing, and bulletins (Akintayo, 2022; Fisher et al., 2018; Ismail et al., 2018; Kayode-Adedeji et al., 2017; Le et al., 2020; Mairiga et al., 2019; Mubofu & Malekani, 2020). These strategies can be deployed to develop skills to increase agricultural production and meet market needs.

Researchers, extension workers, and farmers must work together in a collaborative effort known as the "linkage" to improve agriculture. Farmers and other stakeholders need to plan a communication framework for disseminating agricultural technologies and gathering feedback to boost productivity (Ifeanyieze et al., 2017). Effective communication and collab-

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oration among agricultural stakeholders are essential for identifying research problems, adapting recommendations to local conditions, and improving agricultural technologies. Providing feedback to researchers is crucial for continuous improvement (Voh, 2017).

To succeed in technology uptake and utilization by farmers, all value-chain actors must appreciate farmers' perceptions of agricultural technology through their communication strategies to guarantee efficacious interventions (Onyeneho et al., 2016). In brevity, in order to promote the adoption of new agricultural technologies, it is crucial to establish systematic links between research and development. This approach can enhance farmers' awareness of and exposure to these technologies, as Yigezu et al. (2018) pointed out. However, becoming aware of and acquainted with new technologies does not necessarily result in their implementation due to various challenges, as Sennuga et al. (2020) noted. Hence, there is a need for this study to determine the extent of National Agricultural Research Institutes' communication strategies on farmers' awareness of agricultural technologies in southwest Nigeria.

Review of Literature

Development Communication in Agriculture

Agricultural communication, as a branch of study in agriculture, deals with the planning and management of agricultural information and methods of effectively communicating agricultural technology to bring about desired behavioral changes in farmers and their farming practices for improved production. It is a subset of all communication efforts applicable to development projects and issues to improve the lives of farmers and other farming stakeholders in every manner possible (Onagwa et al., 2017). Agricultural communication is exchanging information about agricultural and natural resource industries through effective and efficient media such as newspapers, magazines, television, radio, telephones, and the web to reach appropriate audiences (Badmus, 2023). It includes news writing, graphic design, video and radio reporting and production, special event planning, photography, web design, advertising, and public relations (Telg & Irani, 2012).

Sustainable development in the agricultural sector depends on the generation of appropriate technologies and creation of an effective communication strategy to disseminate recommended techniques to end users. Agricultural communication is not new, but has evolved over the years (Badmus, 2023). Communication is a building block of sustainable development that goes far beyond top-down information. A process that enables other functions such as communication is essential for initiating this (Food and Agriculture Organization, 2012). A system or an organization's communication may be internal or external. Voh (2017) maintained that "to achieve development effectively, communication actions should be research-based and planned. Effective communication is essential to achieving organizational research objectives and promoting performance" (p. 5).

The benefits of developing communication programs and policies on agricultural growth in Nigeria are considerable (Chukwu, 2015). Mubofu and Malekani (2020) posited that "the dissemination of agricultural research information is critical for facilitating farmers' application of reliable agricultural information. No matter how promising the agricultural information is, it must reach farmers for it to be meaningful" (p. 2). Information literacy in agriculture is for all stakeholders in the sector (Adeyemo, 2020), and because communication is associated with dissemination, it is fundamental for extension services. Farmers' behavior and the value of communication in extension cannot be quantified.

With varying degrees of effectiveness, development planners have utilized communication to support and promote agricultural development policies and programs in various contexts and conditions (Gadzama & Akinola,

2013). Communication experts worldwide have advised development-support communication to link all organizations involved in planned agricultural development programs (FAO, 2012; Onagwa, 2016). The communication path envisioned here is both vertical and horizontal, in other words, between institutions and individuals involved in agricultural growth. Political executives, agricultural policy managers, and rural farmers remain the ultimate delivery points of agricultural information.

According to Onagwa (2016), agricultural communication or agricultural extension "is development-support communication in the context of agricultural development planning and implementation, in which adequate action is taken of human behavioral factors in the design of development projects and their objectives" (p. 32). Communication for innovation requires numerous procedures, not only regarding the tactics deployed but also the overall planned goals.

Sustainable agricultural development requires a well-functioning and strong agricultural research system. Both non-governmental and governmental research institutions conduct research and create technologies that can be integrated into farming systems. These organizations create and disseminate technologies for improved output, information, and food security (Bitagi & Ozioko, 2015; Ifeanyieze et al., 2017; Ojesanmi et al., 2014). The National Agricultural Research Institutes (NARIs) in Nigeria, including the Cocoa Research Institute of Nigeria (CRIN), the Institute of Agricultural Research and Training (IAR&T), and the Nigerian Institute for Oceanography and Marine Research (NIOMR), have been tasked by the Federal Government with developing technology-driven solutions for various challenges facing the agricultural sector, including improving yield efficiency and ensuring environmental safety.

An Overview of Selected Nigerian Agricultural Research Institutes' Mandates

Cocoa Research Institute of Nigeria (CRIN) was founded on December 1, 1964, in Ibadan, Oyo State (CRIN, 2019). It took over from the West African Cocoa Research Institute (WACRI) substation established in Tafo, Ghana. CRIN was established to carry out research that would improve cocoa production by making it disease-free or resistant to it. The Nigerian Research Institutes Act No. 33 of 1964 expanded CRIN's mandate beyond WACRI, and it now conducts research on five crops across the country: cocoa, kola, coffee, cashews, and tea (Nigeria Statute, Act No. 6 of 1950). The CRIN mandate aims to improve crop production and socio-economic life by enhancing genetic potential, agronomic and husbandry practices, identifying and controlling pests and diseases, and studying the efficient use of crops and their by-products (CRIN, 2019).

The Institute of Agricultural Research and Training (IAR&T) is a national multi-commodity institute located in Ibadan, Oyo State, Nigeria, and is affiliated with the Obafemi Awolowo University. Its primary focus is to provide research, services, and training to support Nigeria's agricultural development. This institute is one of Nigeria's major agricultural research centers (IAR&T, 2020). It became one of Nigeria's four university-based agricultural research institutions in 1969 when it joined the present Obafemi Awolowo University, Ile-Ife, but was previously called the University of Ife (IAR&T, 2020). The Institute's missions are diverse and include soil and water management research. They also focus on improving the genetics of kenaf, jute, and maize for forest and humid savannah agroecology in Southern Nigeria. The institute also conducts research on farming systems and extensions in the south-western zone. Additionally, they serve as joint national coordinators for the Nationally Coordinated Research Project (NCRP) on soybeans and carry out livestock research with a particular focus on small ruminants (goats and sheep), pigs, and poultry (IAR&T, 2020).

The Nigerian Institute for Oceanography and Marine Research (NIOMR) is a marine Research Institute established in November 1975, through the Establishment Order of the

Research Institute (Federal Government of Nigeria, 1975). It is located on the Wilmot Point Road, off Ahmadu Bello Way, Victoria Island, Lagos, near the Atlantic Ocean. NIOMR has outstations in Buguma (Rivers State), Aluu (Rivers State), Sapele (Delta State), and Badore (Lagos) (NIOMR, 2023). NIOMR focuses on ocean and marine science research. This includes aquaculture, biological oceanography, biotechnology, fishery resources, fish technology and product development, marine geology and geophysics, and physical and chemical oceanography. Service departments and sections also handle administration, finance and supply, information and documentation, protocols, planning, technical services, and staff clinic units (NIOMR, 2023).

The Adopted Village and Concept

The adopted village concept was originally birthed by and practiced in India, but was first introduced to the NARIs in Nigeria through the recommendations of the National Agricultural Research Project (NARP) under the World Bank assisted program in 1996 to address the problem of widespread rural poverty (Issa et al., 2022). The adopted village model's primary objective is to promote the widespread adoption of enhanced technology to economically uplift resource-poor farmers, generate job opportunities, and secure food security (Akinola et al., 2013; Issa et al., 2022; Onagwa, 2016). In a subsequent response to the call by the African Union‘s (AU) New Partnership for Africa‘s Development (NEPAD) in 2009 that annual agricultural total productivity growth should reach at least 3% and agricultural GDP output to fulfill the targets of the MDGs by 2015, Onagwa (2016) reported that Agricultural Research Council of Nigeria (ARCN) requested the NARIs and colleges of agriculture in the country to embark on the initiative to revitalize the adopted village, which gained momentum and eventually led to the launch of the adopted village project to serve as field laboratories for research and extension and also as first impact villages for improved agricultural technologies (Onagwa, 2016; Othman, 2018).

Influence of Farmers' Exposure to Communication Strategies on Agricultural Technologies Awareness

Studies conducted in the field of agriculture have highlighted the significance of accessing information sources to increase the adoption of new technologies (Uwandu et al., 2018). Farmers who receive information from various sources such as media channels, social interactions, and agricultural extension systems are more likely to voluntarily adopt new practices. These sources of information can reinforce each other, leading to a higher agricultural productivity rate (Bello et al., 2021; Jiang et al., 2021). To reach specific groups of farmers, it is crucial to develop pluralistic research and extension systems that use information technologies, community-based organizations, and mass media outlets like radio to create awareness (Kaliba et al., 2018).

In addition, combining information from agricultural extensions, social networks, and peers is an effective way to promote environmentally friendly agricultural practices (Le et al., 2020; Okafor & Umebali, 2019). Farmers who have access to a communication network that eliminates language barriers and enables them to communicate with advisers are more likely to adopt agricultural technology, resulting in significant improvements in agricultural productivity (Gupta et al., 2020). Meanwhile, local and conventional communication strategies enhance participation in sustainable agricultural development, sending a vital message to encourage more farmers to pursue careers in agriculture (Mairiga et al., 2019).

Gaps in Literature

The researchers found two significant gaps in the previous research and reviewed literature. First, the researcher found an empirical or evaluation gap in previous studies. Previous research studies have not provided enough evidence to prove the effectiveness of agricultural technologies developed and disseminated by NARIs

based on the communication strategies deployed in selected villages.

Furthermore, to ascertain the reality of the submissions of Adesiji et al. Azumah et al (2017) (2018), Ifeanyieze et al. (2017), Onagwa (2016), and Voh (2017) as relating to the agricultural extension activities' working conditions (constraints) of NARIs without a functional and strategic communication guide, in connection with technological adoption and utilization by farmers in the Northern and Eastern regions of Nigeria, realized the need and significance of carrying out this research work in the South-West zone of Nigeria.

Few studies, such as those by Akintayo (2022), Alarima et al. (2020), Alhassan et al. (2021), Mubofu and Malekani (2020), and Uwandu et al. (2018) found that certain information sources significantly influenced the adoption of technology, with significant differences in agricultural information access and crop technology adoption among respondents. However, there is a need for further studies that examine other kinds of communication strategies, especially those different from those reviewed, and the role they play in technology utilization. That is why the current study is critical.

Second, the researchers identified a methodological gap. Many empirical studies reviewed leveraged quantitative analysis to process and review data obtained from respondents, except for a few that utilized mixed research methods. No study in Africa or Nigeria in particular has been carried out to conduct an exploratory analysis of the communication activities deployed by agricultural research institutes in disseminating agricultural technologies and how these affect farmers' technologies uptake and utilization in their adopted villages. In line with this, the study employed a mixed method approach by adopting an embedded mixed methods design of quantitative and qualitative methods of scientific inquiry to simultaneously collect data, combine it, and analyze the findings to gain insights for research purposes and measure the study variables more accurately than any other method.

Theoretical Framework

This study is anchored on the perception theory. Perception theory, developed in 1964 by B. Berelson and G. A. Steiner, explains the act of making sense of an experience (Berelson & Steiner, 1964). It involves a complex interplay between psychological dispositions, past experiences, cultural expectations, and social relationships (Ihebuzor, 2014). Perception involves organizing, recognizing, and understanding sensory inputs to comprehend the surroundings. This relates to our ability to detect, interpret, and grasp stimuli (Aleshinloye, 2018; Ihebuzor, 2014). Research on perception investigates the interaction between stimuli and our sense systems, which form representations of the world (Aleshinloye, 2018).

Perception extends beyond information and incorporates feelings, opinions, and various forms of cognition. Perception is an active process that extends beyond immediate sensory input. It involves immediate or intuitive recognition, insight, and discernment (Ihebuzor, 2014). Perception is influenced by prior experience and stored knowledge (Aleshinloye, 2018). Our interpretation of communication messages is based on previous experiences, current dispositions, needs, mood, beliefs, and messages (Aleshinloye, 2018). Sensation and perception are closely connected, as sensation involves receiving information and perception entails interpreting it. Sensation must precede perceptions (Aleshinloye, 2018).

Perceptions vary between individuals. Different people can perceive the same circumstances differently. Furthermore, we attach various meanings to what we see, which can change for individuals. One can alter one's perspectives or assign a variety of interpretations to things. Language constraints and limited experience also contribute to selective perceptions through selective exposure, attention, and retention. The assumptions of perception theory as they relate to this study are as follows: (a)

visual communicators aim to attract attention, facilitate learning, and elicit desired responses from audiences, and (b) perception is a complex process through which magazine readers select, organize, and interpret sensory stimulation to construct a meaningful understanding of the world (Ihebuzor, 2014).

The theory remains relevant to this study, considering the features of farmers' perceptions and exposure to both communication strategies and agricultural technologies. Two types of perception influence exist, structural and functional, as identified by Uzah and Nyiwo (2019). This theory suggests that farmers' values, beliefs, norms, and behaviors play an important role in the perception and interpretation of selected or identified communication strategies for dissemination. Communication strategies can help overcome adoption and utilization constraints by affecting farmers' perceptions of technology.

Objectives of the study

1. To investigate the communication strategies selected NARIs deploy in disseminating agricultural technologies information to farmers in adopted villages in Southwest Nigeria.
2. To determine farmers' awareness of agricultural technologies based on NARIs' communication strategies used in disseminating in adopted villages in southwest Nigeria.

Methodology

Research design

This study used an embedded mixed-methods research design that integrated qualitative and quantitative approaches. The mixed-method design was chosen because it allowed researchers to gain a deeper understanding of the topic of interest by triangulating different datasets, contributing to the credibility of the study findings (Zhai et al., 2022).

Scope of the Study

This study focused on the communication activities of selected NARIs and agricultural technologies among farmers in the southwest region of Nigeria. While the findings have potential applications for agricultural extension and development in Nigeria, the scope of the research is limited to three NARIs with adopted villages in southwest Nigeria. These institutes, namely the Cocoa Research Institute of Nigeria (CRIN), the Institute of Agricultural Research and Training (IAR&T), and the Nigerian Institute for Oceanography and Marine Research (NIOMR), are responsible for developing, evaluating, collating, and disseminating proven agricultural innovations under the Federal Ministry of Agriculture and Food Security's supervision. The study focuses on the Institutes' communication activities and the disseminated agricultural technologies between 2009 and 2023.

Population

Based on the adopted research methods, two separate population profiles were considered in this study. The first population of interest pertained to the qualitative aspect of this study, and the second pertained to the survey. The qualitative analysis of this study encompasses all six research institutes in South-West Nigeria, which include the Federal Institute of Industrial Research Oshodi (FIIRO), Lagos; Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos; National Institute of Horticulture (NIHORT); Ibadan; Cocoa Research Institute of Nigeria (CRIN); Ibadan; Institute of Agricultural Research and Training (IAR&T), Ibadan; and the Forestry Research Institute of Nigeria (FRIN), Ibadan. In addition, all NARIs under the supervision of the Federal Ministry of Agriculture and Food Security presently have 12 adopted villages.

The population of farmers in this study was 575 (CRIN - 70, IAR&T - 350, NIOMR – 60, NIHORT - 95), cutting across all the NARIs' adopted villages in South-West Nigeria. Likewise, 48 extension officers across the three selected NARIs (CRIN – 20, IAR&T – 11, and

NIOMR – 17) comprised the population of the subject-matter specialists to be interviewed.

Sample Size

Out of the six NARIs in the Southwest, the study was carried out on three purposively selected NARIs' adopted villages (CRIN - Aba Agbo, Ibadan, IAR&T - Oniyo, Ogbomoso, and NIOMR – Magbon Alade, Lagos) in the Southwest, based on their influence on the agricultural technology uptake and utilization of farmers in their adopted villages between 2009 and 2023. The selected research institutes are under the supervision of the Federal Ministry of Agriculture and Food Security and have different and unique mandates. However, the adopted villages are similar in terms of agro-climatic, ethnic group, religion, and cultural settings. There is no climatic or agronomic difference between these communities; they are located in the same region. The communities (adopted villages) are similar and have virtually everything in common. The three communities had access to the extension agents.

Meanwhile, this study focused on farmers in the selected villages who participated in NARI's technology transfer programs from 2009 to 2023. They constitute the sample size for this study, which includes 132 adopted village farmers based on the inclusion criteria

Sampling Techniques

A multistage sampling technique was adopted to obtain the sample for this study. Maximum variability sampling was used to select the sample for the qualitative analysis. Maximum variation, or heterogeneous sampling, is a purposive sampling method that aims to gather diverse viewpoints on the subject of interest. In other words, maximum variation sampling seeks to identify variations in perspectives. From the sample size of 48 extension officers across the three selected NARIs (CRIN – 20, IAR&T – 11, and NIOMR – 17), convenience sampling was used to select two personnel from each of the selected NARIs based on their agricultural technology transfer participation, years of working experience, availability, and responses, making six altogether for the key informant interview.

These subjects – coordinators of the adopted villages–were considered appropriate for this study because of the highly specialized nature of the subject matter. The responses of these unique respondents are crucial for putting the study into context because they can better respond with pertinent information to the questions posed by the study objectives, as they are people who have specialized knowledge of the administration of the adopted villages and engage in extension communication.

In the selection of samples for the quantitative analysis aspect of this study, random probability sampling was used to select one adopted village from each of the selected NARIs. The reason for the principle of randomization was to give each NARI in the sample size a chance (greater than zero) to be carefully chosen. Based on the expert or judgmental non-probability sampling technique, only adopted villages with proven agricultural technology transferred to the farmers per sampled population were selected for this study. Thus, a maximum of three villages were selected for this study.

To determine the farmers' samples from the 575 population to execute the quantitative research technique of this study through a survey, total population sampling and snowball sampling approaches were used. Total population sampling also referred to as census sampling or complete enumeration technique, is described by Anggraini and Melinda (2018) and Mufidah (2020). This means that only farmers in the selected NARIs' adopted villages who took part in the adopted village programs between 2009 and 2023 made up the sample size of this study. To this end, the sample size of the village farmers adopted for this study was 132.

Reliability, Validity and Trustworthiness of the Instrument

The reliability test ensures that the research instrument can produce the same result when administered to similar respondents. The reli-

ability of the survey instrument was determined using Cronbach's alpha. Using a total population sampling approach, the instrument was administered to fifty-one (51) respondents who met the pretest selection criteria of the study. All constructs had Cronbach's alpha scores greater than 0.7, which implies that they had good internal consistency.

The instruments were subjected to face, content, and construct validity tests. To ascertain face validity, the instruments were examined and vetted by the researcher's supervisor and co-supervisor in the Mass Communication Department of Babcock University, along with two agricultural extension subject matter specialists from the National Agricultural Extension and Research Liaison Services, Ahmadu Bello University (NAERLS/ABU), Zaria, Kaduna State, and National Cereals Research Institutes (NCRI), Badeggi, Niger State.

Before finalizing the questions in the questionnaire, a pilot study was conducted on Saturday on May 20, 2023. A questionnaire was created and given to 51 farmers who participated in the adopted village programs from 2009 to 2023 in the adopted village of the National Institute of Horticulture (NIHORT) in the Awaye Community, Egbeda Local Government Area, Oyo State, Nigeria. A pilot study was carried out to determine whether the questions were clearly understood within the context of the research and to ensure that they addressed the research objectives and measured the intended variables. Additionally, a thorough literature review was conducted to confirm construct validity, which means that the instrument accurately assesses the intended construct.

Efforts were made by researchers to ensure the trustworthiness of the qualitative section. Following the key informant interview conducted on May 25, 2023, with one of the desk officers for NIHORT's adopted village and school programme under the West African Agricultural Productivity Programme (WAAPP) and currently the Assistant Director and Head of Extension Programme in the institute in her office, a KII guide pre-test was conducted to evaluate the relevance and understanding of the KII items and determine the instrument's credibility.

Data Collection

For key informant interviews, letters of introduction were first sent to the selected management of NARIs. After approval was given, the researchers personally met the respondents and discussed the research and its proposed outcomes, followed by a suitable period, time, and venue chosen by the respondents to conduct the interview. The interviews were then recorded and transcribed. For the survey data collection, besides using the Farmers' Questionnaire (FQ) in the adopted villages, letters of introduction were submitted to the institutes' management, while the adopted village coordinators introduced the researchers to the adopted villages' respondents, who then interacted with them. At a time convenient for the farmers, the researchers and at least two research assistants then administered copies of the questionnaire.

This process was repeated from one adopted village to another for the selected NARIs. To ensure an adequate sample size, the snowball sampling technique was adopted, where farmers could not complete questionnaires during the scheduled time owing to their busy schedules. This led to some questionnaires being administered individually to the farmers at their respective houses at night. The fieldwork lasted seven weeks, between October 23, 2023, and December 15, 2023. The researchers conducted six key informant interviews that lasted between 45 minutes and one hour each and administered questionnaires across all the selected NARIs' adopted villages in Ibadan, Ogbomoso, and Lagos in Nigeria.

Data Analysis

The data obtained from the interview sessions were examined thematically, in accordance with the research objectives. Thematic analysis is suitable when the research aims to comprehend experiences, thoughts,

and emotions (Kiger & Varpio, 2020), and the analysis process comprises various steps (Busetto et al., 2020). The initial step involved transcribing the recorded interviews to compile the data. Although transcribing was time-consuming, it was beneficial as it familiarized the researchers with the data (Castleberry & Nolen, 2018). The next phase entailed organizing the data into meaningful groups/codes based on their relevance to the objectives of the study. The interview data were transferred from a Word document to an Excel spreadsheet. The third stage was to identify patterns in the codes and classify them based on existing findings from the literature, making adjustments in which new categories emerged. The last step in theme identification required analyzing category patterns and confirming them with established themes from previous literature.

For the quantitative aspect of the study, the data were analyzed and presented using descriptive statistical tools. Tables were constructed to present and depict the results of the data analysis. Frequency counts, simple percentages, mean scores, and standard deviations were used to address the study objectives.

Ethical Consideration

The researcher ensured that ethical guidelines addressed the disclosure of research purposes, participant consent, and study benefits. Also, the Babcock University Health Research Ethics Committee (BUHREC) in Nigeria reviewed and approved this study, ensuring it remained within the standards of ethically acceptable research

Results

What are the communication strategies used by NARIs to disseminate agricultural technologies to farmers in adopted villages in Southwest Nigeria?

In the course of analyzing the communication strategies selected by NARIs deployed in disseminating agricultural technologies to farmers in adopted villages in South-West Nigeria, different communication strategies were identified. However, they are categorized into four dominant themes: interpersonal communication, extension publications, leaflets and training manuals, media (audio-visual aids, radio programs, television, and farmers' helpline centers), and empowerment and training.

Interpersonal Communication

All the selected agricultural institutes disseminated technologies to farmers in the adopted villages basically through interpersonal communication. They use face-to-face interactions, training, field demonstrations, and workshops. For instance, one of the interviewees from the NIOMR mentioned that the institute organizes focus group discussions among farmers as an interpersonal communication strategy for disseminating agricultural technologies. In a related development, another interviewee from CRIN spoke about various methods used for technology transfer, including the exhibition, where different technologies developed by the institute are showcased with an explanation of the banner:

> *"Yes, the first thing that we use is the exhibition, which showcases different technologies that the institute has developed. All these will be on a stand; we will show them, explain to them, and put a banner there to illustrate the idea of developing each of these technologies" (CKI 1).*

NIOMR KI1 explained that one-on-one visits are used for illiterate farmers:

> *"We use a few strategies; like I said, we approach and visit them one-on-one. Yes, that is what we do most of the time because we have a large percentage of illiterate farmers in the adopted villages, so we cannot give out pamphlets or posters" (NKI 1).*

The institutes also have demonstration plots where research trials of technologies are displayed to farmers. For example, one of the extension specialists stated: "We have demonstration plots where we showcase these technologies so that the farmers can compare them with their methods and results" (IKI 2). This was also confirmed by CRIN: "We go to their

farms, tell them how things are done. How to plant cocoa, how to maintain cocoa and how to perform many other activities. So, we demonstrate by using a participatory approach. Everybody comes together and fits in with the idea" (CKI 1).

Extension Publications, Leaflets and Training Manuals

The NARIs are dedicated to providing farmers with useful information in their native languages. This was confirmed by both CRIN and NIOMR interviewees. According to an interviewee from NIOMR, they use various media communication channels and distribute extension bulletins to share information with the farmers. "We have the media communication … and the use of extension bulletins" (NKI 2). Similarly, the CRIN interviewee also mentioned that they distribute leaflets during the technology transfer journeys to guide farmers. Additionally, they have produced a comprehensive training manual at CRIN, which is distributed to farmers even after the training.

> *"When we are going on the journey of technology transfer, we go with lots of leaflets that people can see and read to guide them. Apart from that one, we have a training manual that we produced at CRIN; we just give it to them, even after the training" (CKI 1).*

Media (Audio-Visual Aids, Radio Programmes, Television and Farmers' Helpline Centres)

Media services are also utilized as IKII1 said radio programs are created with interactive quizzes and dramas to engage farmers and obtain feedback. "Then, they are so attached to our radio programs … to make sure that the program is interactive, we now have quizzes and drama on the program each week. So farmers respond to our quiz program in terms of feedback" (IKI 1). This was confirmed by IKI 2, "… we use media services. The institute pays radio stations to teach on the radio". The institutes use media gadgets to cover their activities as NKI 1 revealed that media gadgets are used for coverage, and NKI 2 corroborated that NIOMR "have the media communication through the radio".

Additionally, IAR&T has helpline centers where farmers can call and ask for information or report their problems, which are then resolved through telephone interactions.

> *"Apart from radio, we also give information on television and we use ICT, and GSM to communicate to farmers. I will tell you that … now, all farmers have telephones, and some of them can read messages. I am not talking about WhatsApp. You can read SMS messages so that they can read. And there's one thing that we have now, the Helpline Center. The Helpline Center is a form of a digital extension, where farmers can call anywhere in the region to ask for information or to give us his or her problems and we solve the problem through telephone interaction" (IKI 1).*

Empowerment and Training

The NARIs empower farmers by providing them with tools and equipment. They also organize stakeholder meetings to facilitate financial assistance for farmers.

> *"One of them is also empowerment based on feedback from the field. Our institute is used to empower farmers, both in cash and in kind. For instance, there are some villages where our institute has established gari processing facilities; there is one at Aborisade. There are some villages where they have established fishponds for farmers; there are some villages where livestock farmers have been empowered by giving them day-old chicks and some other things. We have situations where farmers have been given fertilizers, seeds, and harvesters" (IKI 2).*

NIOMR KI1 stated that stakeholder meetings are held to discuss loans and how financial institutions can assist farmers. He stated that:

> *"Once in a while, too, we organize stakeholders' meetings. The stakeholder meetings involve all the stakeholders—fish farmers,*

processors, and even financial institutions—to discuss loans and how they can assist the farmers in facilitating loans" (NKI 1).

"Another method is training. We go with experts in different disciplines to train them on each of these technologies. For example, maybe somebody will train them to manage a cocoa farm and give them training manuals. When we are going on the journey of technology transfer, we go with lots of leaflets that people can see and read to guide them" (CKI 1).

Presentation of Quantitative Survey Analysis

Table 1

Demographic Characteristics of CRIN's Farmers

Variable		Frequency (n)	Percentage (%)
Gender	Male	31	68.9
	Female	14	31.1
	Total	**45**	**100.0**
Category of Farmers	Crop farmer	29	64.4
	Mixed farming farmer	16	35.6
	Total	**45**	**100.0**
Age	25-34 years	3	6.7
	35-44 years	9	20.0
	45-54 years	12	26.7
	55-64 years	16	35.6
	65 years and above	5	11.1
	Total	**45**	**100.0**
Length of experience in agricultural activities	10 years	1	2.2
	11-20 years	13	28.9
	21-30 years	11	24.4
	31-40 years	12	26.7
	41 years and above	8	17.8
	Total	**45**	**100.0**
Highest Educational Qualification	Primary	33	73.3
	Secondary	6	13.3
	Tertiary	1	2.2
	None	5	11.1
	Total	**45**	**100.0**

Note. From Field Survey by Researchers, 2024

Table 1 shows that the majority of CRIN farmers were male (68.9%). Of these, crop farmers (64.4%) dominated this study. Many of the CRIN farmers were between the ages of 55 and 45 years (62.3%). In addition, many farmers had 11 to 20 years of experience, followed by those aged 31 to 40 years. The majority of CRIN farmers had only a primary education (73.3%).

Table 2

Demographic Characteristics of IAR&T's Farmers

Variable		Frequency (n)	Percentage (%)
Gender	Male	41	78.8
	Female	11	21.2
	Total	**52**	**100.0**
Category of Farmers	Crop farmer	16	30.8
	Livestock farmer	1	1.9
	Mixed farming farmer	35	67.3
	Total	**52**	**100.0**
Age	25-34 years	2	3.8
	35-44 years	18	34.6
	45-54 years	27	51.9
	55-64 years	3	5.8
	65 years and above	2	3.8
	Total	**52**	**100.0**
Length of experience in agricultural activities	10 years	2	3.8
	11-20 years	13	25.0
	21-30 years	30	57.7
	31-40 years	4	7.7
	41 years and above	3	5.8
	Total	**52**	**100.0**
Highest Educational Qualification	Primary	9	17.3
	Secondary	17	32.7
	Tertiary	8	15.4
	None	18	34.6
	Total	**52**	**100.0**

Note. From Field Survey by Researchers, 2024

Table 2 indicates that the majority of IAR&T farmers were males (78.8%), and out of these, mixed farming farmers (67.3%) dominated the study. The IAR&T farmers were between 35 and 54 years of age (86.2%). In addition, most farmers had 21–30 years of experience (57.7%). Lastly, many IAR&T farmers had no education (34.6%), and a third had only a secondary education (32.7%).

Table 3

Demographic Characteristics of NIOMR's Farmers

Variable		Frequency (n)	Percentage (%)
Gender	Male	21	60.0
	Female	14	40.0
	Total	**35**	**100.0**
Category of Farmers	Fishery farmer	20	57.1
	Mixed farming farmer	15	42.9
	Total	**35**	**100.0**
Age	15-24 years	2	5.7
	25-34 years	2	5.7
	35-44 years	11	31.4
	45-54 years	9	25.7
	55-64 years	9	25.7
	65 years and above	2	5.7
	Total	**35**	**100.0**
Length of experience in agricultural activities	10 years	5	14.3
	11-20 years	20	57.1
	21-30 years	10	28.6
	Total	**35**	**100.0**
Highest Educational Qualification	Primary	9	25.7
	Secondary	9	25.7
	Tertiary	17	48.6
	Total	**35**	**100.0**

Note. From Field Survey by Researchers, 2024

Table 3 indicates that the majority of NIOMR farmers were male (60%) and the majority were fishery farmers (57.1%). Most NIOMR farmers were between the ages of 35 and 54 (57.1%). In addition, most of them had between 11 and 20 years of experience (57.1%). Interestingly, 48.6% of NIOMR farmers had tertiary education.

What is the farmers' level of awareness of agricultural technologies disseminated through the communication strategies of selected NARIs in adopted villages in South-West Nigeria?

Table 4

Farmers' Level of Awareness of CRIN's Existing Technologies

Statements	Mean $\bar{x}$	Standard Deviation (SD)	Verbal Interpretation
Establishment of hybrid cocoa plot	3.84	0.37	High level of awareness
Inclusion of cocoa pod husk in layer feeds	3.84	0.42	High level of awareness
Production of liquid soap detergents	3.69	0.73	High level of awareness
Production of composted manure	3.33	0.74	Moderate level of awareness
Average Overall Mean	3.68	0.57	High level of awareness

Note. From Field Survey by Researcher, 2023; Freq. = Frequency
****Decision Rule if mean is 1 to 1.79=Not at all; 1.80 to 2.59 = Poorly Aware; 2.60 to 3.39 =Moderately Aware; 3.40 to 4.19= Highly Aware; 4.20 to 5= Totally Aware*

Table 4 shows that CRIN farmers generally have a high level of awareness of the agricultural technologies disseminated by CRIN ($\bar{x}$ = 3.68). They have a high level of awareness of the agricultural technologies in terms of the establishment of hybrid cocoa plots ($\bar{x}$ = 3.84), inclusion of cocoa pod husk in layer feeds ($\bar{x}$ = 3.84) and production of liquid soap detergents ($\bar{x}$ = 3.69). This suggests that CRIN farmers generally have a high level of awareness of the agricultural technologies disseminated by CRIN. This high level of awareness was related to the establishment of hybrid cocoa plots, including cocoa pod husk in layer feeds and the production of liquid soap detergents.

Table 5

Farmers' Level of Awareness of IAR&T's Existing Technologies

Statements	Mean $\bar{x}$	Standard Deviation (SD)	Verbal Interpretation
Ife 98 – 12 Cowpea (White) variety	3.92	0.65	High level of awareness
Ife Branch Peduncle Cowpea (BPC) variety	3.92	0.65	High level of awareness
Ife brown cowpea variety	3.92	0.65	High level of awareness
Improved Soybean Production	3.92	0.65	Moderate level of awareness
Provitamin A cassava variety	3.48	0.75	High level of awareness
Provitamin A potato variety	3.48	0.75	Verbal Interpretation
Provitamin A maize variety	3.48	0.75	High level of awareness
Average Overall Mean	3.73	0.70	High level of awareness

Note. From Field Survey by Researcher, 2023; Freq. = Frequency
****Decision Rule if mean is 1 to 1.79=Not at all; 1.80 to 2.59 = Poorly Aware; 2.60 to 3.39 =Moderately Aware; 3.40 to 4.19= Highly Aware; 4.20 to 5= Totally Aware*

Table 5 depicts that generally, IAR&T's farmers had high level of awareness of agricultural technologies disseminated ($\bar{x}$ = 3.73). Specifically, farmers were highly aware of the following existing technologies: Ife 98 – 12 Cowpea (White) variety ($\bar{x}$ = 3.92), Ife Branch Peduncle Cowpea (BPC) variety ($\bar{x}$ = 3.92) and provitamin A maize variety ($\bar{x}$= 3.48). This implies that the level of awareness of agricultural technologies disseminated among farmers through IAR&T was high. This was high concerning Ife 98 – 12 Cowpea (White) variety, Ife Branch Peduncle Cowpea (BPC) variety and provitamin A maize variety.

Table 6

Farmers' Level of Awareness of NIOMR's Existing Technologies

Statements	Mean $\bar{x}$	Standard Deviation (SD)	Verbal Interpretation
Plastic Tank Fishpond Management	4.60	0.50	Total level of awareness
NIOMR's Smoking Kiln	4.37	0.49	Total level of awareness
Average Overall Mean	4.49	0.49	Total level of awareness

Note. From Field Survey by Researcher, 2023; Freq. = Frequency
****Decision Rule if mean is 1 to 1.79=Not at all; 1.80 to 2.59 = Poorly Aware; 2.60 to 3.39 =Moderately Aware; 3.40 to 4.19= Highly Aware; 4.20 to 5= Totally Aware*

Table 6 shows that NIOMR's farmers were totally aware of the agricultural technologies disseminated by NIOMR ($\bar{x}$ = 4.49). Detailed analysis indicates that NIOMR's farmers were totally aware of plastic tank fish pond management ($\bar{x}$ = 4.60) and NIOMR's smoking kiln ($\bar{x}$ = 4.37). This analysis implies that NIOMR's farmers were totally aware of the agricultural technologies disseminated by NIOMR. This result aligns with the testament of one of the key informant interviewees from NIOMR, who rated the overall assessment of NIOMR's communication strategies or approaches - interpersonal communication and field demonstrations–as impacting farmers' utilization of disseminated agricultural technologies as excellent.

Discussions

Communication strategies used by NARIs to deploy and disseminating agricultural technologies to farmers in adopted villages in South-West Nigeria.

Based on the responses received during the KII sessions, the NARIs deployed different communication strategies to disseminate agricultural technologies to farmers in southwest Nigeria. These strategies include exhibitions, field demonstrations, training, manuals, farmers' field days, workshops, face-to-face interpersonal contact, radio programs, empowerment, audio-visual aids, and farmers' helpline centers. These findings are consistent with previous studies showing that different communication strategies can be used to effectively deliver agricultural information to farmers (Akintayo, 2022; Alarima et al., 2020; Azumah et al., 2018; Fisher et al., 2018; Ifeanyieze et al., 2017; Ismail et al., 2018; Kayode-Adedeji et al., 2017; Le et al., 2020; Mairiga et al., 2019; Mtega, 2018; Mubofu & Malekani, 2020; Nyasimi et al., 2017; Oluyi & Adetola, 2021; Omisope, 2020; Onagwa, 2016; Onagwa et al., 2017).

In addition, the findings affirm the submission of Kaliba et al. (2018) that it is essential to establish diverse research and extension systems that use information technologies, community-based organizations, and mass media outlets, such as radio, to effectively connect with specific groups and farmers to create awareness.

Farmers' level of awareness of agricultural technologies is disseminated through communication strategies in adopted villages in Southwest Nigeria

Further to the study, the research highlights the impressive level of awareness among farmers regarding the agricultural technologies disseminated by CRIN, IAR&T, and NIOMR. Specifically, CRIN farmers were highly aware of the establishment of a hybrid cocoa plot, inclusion of cocoa pod husk in layer feeds, and production of liquid soap detergents. Similarly, IAR&T's farmers exhibited remarkable knowledge of the Ife 98-12 Cowpea (White) variety, Ife Branch Peduncle Cowpea (BPC) variety, and provitamin A maize variety. Meanwhile, the NIOMR farmers demonstrated a keen understanding of the agricultural technologies disseminated by the institute.

These findings indicate that the dissemination of agricultural technologies by these institutions has proven effective in allowing farmers to adopt and benefit from these advancements. The results are consistent with various studies in agriculture, emphasizing the importance of accessible information sources in fostering the adoption of new technologies. According to Uwandu et al. (2018), farmers who receive information from diverse sources, such as media channels, social interactions, and agricultural extension systems, are more inclined to adopt new practices. These information sources can complement each other, leading to enhanced agricultural productivity (Bello et al., 2021; Jiang et al., 2021).

To effectively reach specific groups of farmers, it is essential to develop comprehensive research and extension systems that utilize information technologies, engage community-based organizations, and leverage mass media outlets such as radio to raise awareness (Kaliba et al., 2018). Additionally, several studies including those by Akintayo (2022), Alarima et al. (2020),

Alhassan et al. (2021), Mubofu and Malekani (2020), and Uwandu et al. (2018) identified certain information sources that have significantly influenced technology adoption among respondents. Moreover, integrating information from agricultural extension services, social networks, and peer interactions has proven effective in promoting environmentally sustainable agricultural practices (Le et al., 2020; Okafor & Umebali, 2019).

Farmers with access to communication networks that transcend language barriers and facilitate communication with advisors are more likely to adopt agricultural technology, resulting in notable improvements in agricultural productivity (Gupta et al., 2020). Furthermore, local and conventional communication strategies play a vital role in enhancing participation in sustainable agricultural development by delivering crucial messages that encourage more farmers to pursue careers in agriculture (Mairiga et al., 2019).

According to Ifeanyieze et al. (2017) and Voh (2017), collaboration among researchers, extension workers, and farmers, known as "linkage," is vital for enhancing agriculture. This is supported by Yigezu et al. (2018), who found that it is crucial to establish systematic links between research and development to promote the adoption of new agricultural technologies. This approach can enhance farmers' awareness and exposure to these technologies. According to Onyeneho et al. (2016), understanding farmers' perceptions through effective communication is essential for successful technology adoption and productivity improvement. Stakeholders must engage in communication planning to disseminate agricultural technologies and gather feedback. However, Sennuga et al. (2020) maintained that becoming aware of and acquainted with new technologies does not necessarily result in their implementation owing to various challenges.

Conclusion and Recommendation

This study evaluated farmers' awareness of agricultural technologies based on NARIs' communication strategies in southwest Nigeria. From the study results, it is concluded that the awareness of agricultural technologies, as communicated and shared by CRIN, IAR&T and NIOMR is crucial for the development of the farming industry. Based on this, it is recommended that boosting the awareness of agricultural technologies is critical for promoting their use. By raising awareness of NARI's agricultural technologies through diverse communication strategies, their utilization among farmers can be increased. Hence, the study recommended that NARIs across different regions in Nigeria should continue using multiple communication strategies to enhance farmers' awareness of agricultural technologies and their subsequent adoption.

Limitations of the Study

The first limitation was the paucity of research in the area of NARI's deployment of communication strategies to disseminate technologies and farmers' awareness of agricultural technologies. Consequently, researchers were constrained to a narrow frame of reference when developing the methodological direction for the study. In addition, this study was limited to NARIs in southwest Nigeria and did not extend to other NARIs in other geopolitical zones of the country. This limitation means that the implications of the findings need to be used with caution and can only be generalized to samples of the same nature. Further studies should be conducted in other areas to establish similarities and differences.

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