CAPABILITIES OF AGRICULTURAL EXTENSION PERSONNEL TO TRANSFER CLIMATE CHANGE ADAPTATION TECHNOLOGIES TO FARMERS IN IMO STATE, NIGERIA

[1]UMUNAKWE, P.C., [2]MADUKWE, M.C. AND [1]AJA, O.O.

1: Department of Agricultural Extension, Federal University of Technology, Owerri, Nigeria

2: Department of Agricultural Extension, University of Nigeria, Nsukka

polycarpchika@yahoo.com, +2347064896882

ABSTRACT

The increasing spate of climate change and its impacts on the economies of developing countries necessitate the undertaking of actions to reduce the adverse effects. This is particularly important for agriculture which is the major source of livelihood for many people in those areas. Hence, the study investigated the capabilities of agricultural extension personnel to transfer climate change adaptation technologies to farmers in Imo State, Nigeria. A sample of 130 agricultural extension personnel drawn from Imo State Agricultural Development Programme, using simple random sampling technique participated in the study. Data were collected using structured questionnaire and were analysed using mean scores and percentage. Results showed that the extension personnel were capable of transferring technologies on improved livestock breed/crop varieties ($\bar{X}$ = 3.4), SPAT ($\bar{X}$ = 3.4), promotion of environmentally-friendly agricultural practices ($\bar{X}$ = 3.2), training of farmers on weed/pest management ($\bar{X}$ = 3.2), and delivering instructions on application of agrochemicals ($\bar{X}$ = 3.2). The personnel acquired capability for transfer of technologies through local seminars/workshops/conferences (95.7%), pre-service training (80.0%), routine in-house training (85.2%), internet (80.0%), journals and magazines (79.1%), training by non-governmental organizations (79.1%), and personal interaction with professional colleagues (79.1%). However, poor funding, ($\bar{X}$ = 3.5), inadequate manpower ($\bar{X}$ = 3.4), poor agricultural policies ($\bar{X}$ = 3.3), and inadequacy of required equipment ($\bar{X}$ = 3.3) constrained the acquisition of capabilities to transfer climate change technologies by the extension personnel. It was recommended, among others, that extension personnel should be equipped with the necessary skills required for effective transfer of climate change adaptation technologies.

Keywords: Adaptation capabilities, climate change, technology transfer, extension personnel, farmers

INTRODUCTION

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period, typically decades or longer. Climate change may be due to natural processes, external force, or persistent anthropogenic changes in the composition of the atmosphere or land-use (Adhikari, 2011). The wide-ranging impacts, current and predicted, of climate change on agriculture and food security are well documented (Intergovernmental Panel on Climate Change, IPCC, 2014). Inconsistencies in rainfall patterns, higher mean temperatures, increased variability in rainfall and temperature, changes in water availability, rise in sea levels, increased salinization, changes in the frequency and intensity of extreme weather events among other changes will have and are already having adverse effects on farming, fishery and forestry sub-sectors (Sala, Rossi & David, 2016). Food and Agriculture

Organization, FAO (2019) stated that these impacts reduce the capacity of natural resources to sustain global food demand. This will decrease agricultural production in the tropical and sub-tropical areas which are homes to most of the poorest populations and farming communities in the world (IPCC, 2014).

Nigeria has been identified as a climate change hotspot with expected rise in extreme weather events (Aaron, 2011). According to Ezeagwu (2014), the increasing drought, sea level rise, flood and continued irregularities of rainfall exacerbate the vulnerability of Nigeria. Werz and Conley (2015) reported that expanding desertification has led to the disappearance of over 200 villages in northern Nigeria. Ajibola (2014) reported the susceptibility of the savannah areas to a continuous reduction in rainfall. Chikezie *et al.* (2016) reported instability in the patterns of rainfall and temperature in South-eastern Nigeria. Consequently, this has left adverse effects on agriculture and pose serious threats to food security and livelihoods (FAO, 2016).

The foregoing necessitates the undertaking of actions to check the devastating impacts of climate change on agriculture. Climate change adaptation refers to changes in processes, practices or structures to moderate or offset potential damages or to take advantages of opportunities associated with changes in climate (Bosselo *et al.*, 2012). Adaptation implies capacity building (including skills, technologies, building stronger institutions and promoting social equity). Dejene *et al.* (2011) observed that farmers in many parts of Africa are not doing much and claim to have a few options for adapting to shocks posed by climate change. Thus, adaptation has become a process that would enable communities gain access to skills, resources and information to help them adapt to the changing climate. Sala *et al*. (2016) stated that achieving this requires improving farmers' access to climate–resilient technologies and practices, knowledge and information.

According to Maponya and Mpandeli (2013), achieved successful adaptation for climate in agriculture requires that agricultural extension service regularly accesses and disseminates new knowledge/technologies to farmers in an adequate and timely manner. Studies have shown that extension providers in developed countries have recorded great achievements in the facilitation and dissemination of innovations on climate adaptation (Takoustsing *et al.*, 2015; Kipot and Franzel, 2014; Simpson *et al.*, 2014). However, Sala *et al*. (2016) observed that the dissemination and uptake of these technologies and tools are still challenging processes in developing countries and stressed the need for a raise in capacity.

The increasing vulnerability of farmers in Imo State, Nigeria to climate change shocks have been reported (Ozor *et al.*, 2015; Chikezie *et al*., 2019), thus making enhancement of capabilities of extension personnel necessary for effective adaptation to climate change. However, not much has been done to investigate this in Imo State as to know the existing capabilities vis a vis inadequacy, thus creating a knowledge gap.

The findings of this study are expected to identify the climate change adaptation technologies transferred by extension personnel in Imo State. It will also catalyse extension capacity building programmes and policies on climate change adaptation in agriculture. Based on this, the study sought to investigate the capability of

extension personnel to transfer climate change adaptation technologies to farmers in Imo State, Nigeria.

OBJECTIVES OF THE STUDY

The major objective of the study was to investigate the capabilities for transfer of climate change adaptation technologies to farmers among agricultural extension personnel in Imo State, Nigeria.

The specific objectives of the study were to:

1. ascertain climate change adaptation technologies transferred by extension personnel;
2. identify climate change adaptation capabilities possessed by extension personnel;
3. ascertain how the capabilities were acquired; and
4. identify constraints to extension personnel's their acquisition of the capabilities

METHODOLOGY

The study was carried out in Imo State. It lies within latitude 4°45` and 7°15` N and longitude 6°50` and 7°25` E with an area of about 510km^2 and a population of 3,934,899 (National Population Commission, NPC, 2006). The State lies in the rainforest zone and has two distinct seasons – rainy which begins in April and lasts until October with an annual rainfall varying between 1,500mm and 2,200mm and the dry season which begins in November and lasts until March with an annual average temperature of about 28°C that creates a relative humidity of 75% (Okoro, 2014). Korie (2011) reported a change in the rainfall patterns of the State, with temperature varying between 27 and 30°C and rainfall between 1,500mm and 3209.1mm. Agriculture is the major occupation of the people and the common crops grown include maize, rice, yam, cocoyam, cassava and maize whereas the livestock reared are sheep, goat and fowls. Extension activities in the State are overseen by the Agricultural Development Programme (ADP), an arm of the State Ministry of Agriculture and Natural Resources with zonal setups in Orlu, Okigwe and Owerri and demarcated into 39 blocks and 326 circles (Chukwu *et al*., 2016).

The population for the study comprised all the staff of the Agricultural Development Programme in Imo State, Nigeria. The total number of extension personnel in the State was 166 distributed as follows – headquarters (5); Chief Subject Matter Specialists (6), Okigwe (24), Orlu (27) and Owerri (62) extension agents (EAs); subject matter specialists (SMSs) 4 per zone i.e., 12 in total; block extension supervisors (BESs) 27; zonal extension managers (ZEMs) 6; and zonal extension officers (ZEOs) 3.

Multistage sampling procedure was used to select the respondents for the study. The first stage of sampling involved the selection of all the personnel at the headquarters. At the second stage, 2 SMSs, 1 ZEM and 1 ZEO were selected from each of the three zones in the State using simple random sampling technique. At the third stage, 22 out of the 27 BESs were selected using simple random sampling technique. At the fourth stage, 80% of the EAs were selected from each of the three zones using proportional sampling technique to correspond to 50, 22 and 19 from Owerri, Orlu and Okigwe agricultural zones respectively. Thus, a total of 130 extension personnel constitute the sample for the study. Data collection instrument was structured questionnaire. Data were analysed using percentages and mean scores.

RESULTS AND DISCUSSION

Climate change adaptation technologies transferred by extension personnel

Results in Table 1 show that the extension personnel in the State disseminated many technologies for climate change adaptation but concentrated more on technologies pertaining to crop and livestock production. Prominent among these were technologies on crop diversification and new crop varieties (95.8%), livestock disease management (95.0%), disease tolerant crop varieties/livestock breeds (90.8%), and use of organic manure (90.8%). This finding could be a reflection of the major agricultural activities of the people. It could also imply the adaptation technologies the organization is capable of disseminating. The Organization for Economic Cooperation and Development and the Food and Agriculture Organization (OECD-FAO) (2016) noted that agriculture represents the single most important sector in the economy of many low-income countries, contributing about 15% of the total gross domestic product (GDP), employs half of the total labour force, and within the rural communities provides a livelihood for multitudes of small-scale producers. The IPCC (2014) added that developing countries tend to prioritize agricultural adaptation as a result of the growing vulnerability of the agricultural sector to climate change.

TABLE 1: AGRICULTURAL ADAPTATION TECHNOLOGIES DISSEMINATED BY EXTENSION PERSONNEL

Technologies transferred	Frequency	Percentage
Crop diversification and new crop varieties	115	95.8
Livestock disease management	114	95.0
Crop rotation	110	91.7
Use of organic manure	109	90.8
Use of disease-tolerant crop varieties	109	90.8
Integrated nutrient management	107	89.1
Use of drought-tolerant crop varieties and livestock breeds	105	87.5
Agroforestry	102	85.0
Conservation tillage	101	84.2
Mixed farming	100	83.3
Planting of early maturing crop varieties	100	83.3
Ecological pest management	99	82.5
Use of mulching/cover crops	98	81.7
New crop varieties from biotechnology	98	81.7
Seed and grain storage technologies	97	80.8
Changes in planting dates	97	80.8
Sprinkler and dripping irrigation	90	75.0
Slow-forming terraces	87	72.5
Off-farm income activities	87	72.5
Early warning system	71	59.1
Rainwater harvesting	71	59.1
Seasonal to inter-annual prediction	60	50.0
Construction of drainage system	65	54.2
Selective breeding via controlled mating	58	48.3
Climate insurance	11	9.2

Source: Field Survey Data, 2021

Capabilities for climate change adaptation

Results in Table 2 reveal that the extension personnel were capable of disseminating some climate change adaptation technologies to farmers. Out of the 29 capability areas listed, they were found capable in 19. The finding thus suggests that extension capability in the area has barely gone beyond the traditional roles of agricultural innovation dissemination. According to Sala *et al*. (2014) extension personnel should be encouraged while the organization undergoes institutional changes in order to accommodate new challenges posed by climate change. Dimelu *et al.* (2014) noted that antecedents of climate change leave new/and or additional roles for extension professionals in the country. Mustapha *et al.* (2012) opined that extension personnel need to acquire new skills so that they can help farmers manage emerging climate change issues. Afful (2016) confirmed the inadequacy of capability for climate change adaptation among agricultural extension personnel in Africa. Thus, for effective adaptation to climate change to occur, the capability of extension personnel should be adequate in order to address the emerging challenges.

TABLE 2: CAPABILITIES TO TRANSFER CLIMATE CHANGE ADAPTATION TECHNOLOGIES AMONG EXTENSION PERSONNEL

Capabilities	$\overline{X}$	S. D
Use of weather forecasting equipment	3.08*	0.79
Understanding and communicating weather forecast	3.21*	0.67
Dissemination of information on improved livestock breeds/crop varieties	3.42*	0.68
Conducting of SPAT	3.35*	0.77
Promoting environmentally friendly agricultural practices	3.24*	0.77
Using ICTs in climate change adaptation	3.06*	0.88
Pro-poor options for carbon development	2.92	0.83
Translating climate change information into practical guidance	3.01*	0.84
Employing disaster risk reduction strategies	3.11*	0.84
Building linkages among relevant stakeholders	2.10	0.87
Conducting vulnerability risk assessment	2.87	0.87
Water and soil conservation	3.05*	0.88
Planning climate resilient programmes	3.06*	0.84
Promoting rearing of improved livestock breeds	3.17*	0.83
Promoting cultivation of improved crop varieties	3.23*	0.82
Adapting foreign technologies to local conditions	3.15*	0.82
Enterprise diversification	3.14*	0.87
Routine training on climate change related issues	3.07*	0.76
Dissemination of soil fertility management technologies	3.08*	0.81
Training of farmers on pest/weed control methods	3.23*	0.82
Warning on impending climate change disaster	3.19*	0.78
Instruction on the application of agrochemicals	3.23*	0.82
Routine sensitization of farmers on climate change related issues	3.10*	0.80
Evaluating adaptation options	2.90	0.85
Improved sanitation	2.80	0.65
Urban farming	2.89	0.90
Dryland cultivation	2.00	0.57
Forage conservation	1.98	0.65
Mobilizing resources for adaptation	2.87	0.82
Awareness raising	2.91	0.90
Market intelligence	2.98	0.86
Network brokerage	2.83	0.82
Conflict management	2.81	0.82
Process facilitation	2.88	0.81
Lobbying and advocacy	2.84	0.79

Source: Field Survey Data, 2021 * Existing Climate change adaptation Capabilities

Ways of acquiring capabilities

Results in Figure 1 reveal that agricultural extension personnel in the state acquired capability to transfer climate change adaptation technologies to farmers through local seminars/workshops/conferences (95.7%), routine in-house training (80.0%), internet (83.50%), pre-service training (8.00%), and journal/magazines and newspapers (80.00%). This result suggests that the extension personnel had diversified avenues for acquiring capability for climate change adaptation. This is normal as every source has its strengths and weaknesses and thus combination of methods creates opportunity for improvement. However, the low score by international conferences/workshops (32.60%) underscores the declining funding of extension service in the country.

Conferences/workshops promote interaction among stakeholders and

professionals on issues of interest. They enhance exchange of information, knowledge and experience and encourage co-creation of innovations. Aidah (2013) reported that in-service training improves employees' performance through the enhancement of skills thus promoting efficiency, job satisfaction, and morale. Umar *et al.* (2017) opined that extension personnel require in-service training in order to communicate climate change information effectively. Similarly, Burbi and Rose (2016) noted that internet promotes interaction among climate change stakeholders irrespective of location.

Training promotes and facilitates learning when used appropriately and hinder learning when used otherwise (Aremu*et al.*, 2019). Training enables extension personnel to acquire the necessary skills, specialized knowledge and attitude for effective performance of their jobs. Training helps extension personnel to be proficient in doing their jobs. Usually, an organization facilitates the employees' learning through training so that their modified behaviour contributes to the attainment of the organization's goals and objectives.

The internet has become a very important tool in the communication of climate change information. It allows the transfer of information without requiring physical contacts. It can also be used to deliver information to mass audience within a short period of time. The internet can be used for video-conferencing, tele-working and e-commerce. According to International Telecommunication Union (ITU, 2018) more than half the world's population is using the internet and by 2020, more than half of the world's households will have access to the internet. According to ITU (2019) the increasing connectivity and affordability of digital devices; and with internet speeds becoming faster and usage limits declining, the world is becoming more connected than ever before. These increasing levels of connectivity and the increasing use of information communication technologies could offer some potential to help address some of the world's pressing climate concerns. The internet can be used to disseminate information that shapes responsible discourse and practices.

Personal interaction with professional colleagues allows for the clarification of confounding issues, sharing of information and knowledge. Face-to-face interaction is beneficial especially during emergency conditions or when the task is complex. It makes it easier to convince people, builds stronger connection, improves non-verbal connections and is quicker and more effective. It also encourages team participation. Ean (2010) explains that face-to-face communication allows people to hear and see messages being conveyed by the sender via body language and facial expressions. He maintained that face-to-face interaction helps to build relationships and distribute information with ease. However, it is cost-intensive and takes a longer period of time.

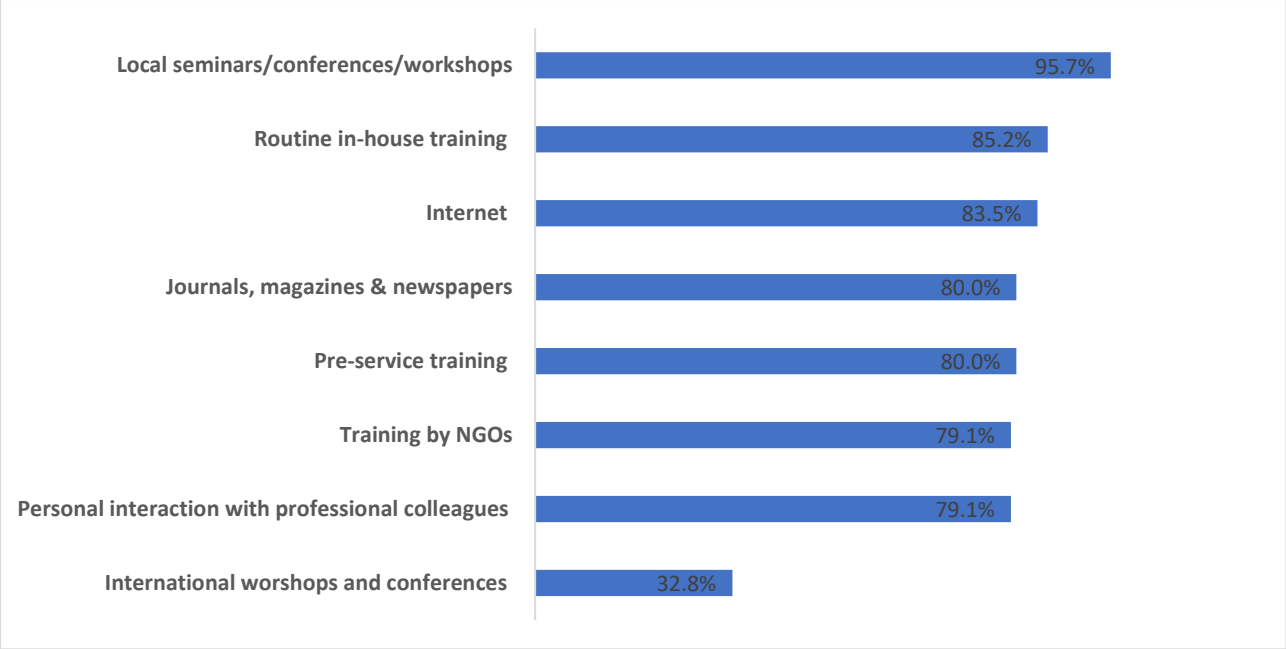

Figure 1: Extension personnel's sources of capability for to transfer climate change adaptation information

Constraints to acquisition of capabilities to transfer climate change adaptation technologies

Results in Table 3 show that the constraint of poor funding (X = 3.52), inadequate manpower (X = 3.35), inadequate agricultural policies (X = 3.34), inadequacy of required equipment (X = 3.33), difficulty of adaptation technologies to local conditions (X = 3.24), and corruption-related constraints (X = 3.23) were the major constraints to transfer of agricultural technologies. However, the constraints were mainly institutional and financial factors. Poor funding has been identified as one of the most serious challenges to effective extension service delivery in Nigeria. Olaniyi and Farinde (2017) reported that funding of extension services in Nigeria drastically reduced following the withdrawal of World Bank assistance in 1996 which resulted in a significant fall in extension service performance. According to Madukwe (2008), many State governments have proven incapable of funding extension service in Nigeria and this might prolong and worsen the situation. Olaniyi and Farinde (2017) pointed out that the poor funding resulted in lack of logistics like motorcycles needed to reach out to farmers. Dimelu *et al*. (2014) noted that the continued decline of government spending on extension activities will hinder the implementation of climate change adaptation programmes in Nigeria.

Agbamu (2011) highlighted policy instabilities and inconsistencies and bureaucratic bottlenecks as serious challenges to agricultural extension service delivery in Nigeria. Dimelu *et al*. (2014) noted that the Nigerian governments have initiated several agricultural and ecological policies and programmes but they have not endured due to political instabilities. Obiora (2012) observed that most agricultural policy documents in Nigeria focused on

increasing food production but failed to accommodate climate change issues. Antwi-Agyei and Stringer (2022) also observed that Nigerian government in recent times has accelerated efforts to address the adverse impacts of climate change especially in the agricultural sector but improving the capability of extension personnel for climate change adaptation remains elusive since the service lacks policy framework.

Poor linkages among stakeholders in the agricultural innovation system has also been identified as a challenge to building capability of extension personnel for climate change adaptation in Nigeria. Agwu *et al.* (2011) found that farmers studied in Nigeria, Sierra Leone, and Liberia indicated that the information on climate change adaptation provided to them by extension personnel were not relevant. This is not unconnected with the weak linkage in the innovation system. It suggests poor involvement of farmers in innovation creation resulting in the development of innovations that do not meet their needs.

Job satisfaction is another factor that could make or mar extension capability for transfer of technologies. A worker that is not satisfied with his/her job shows less commitment. This is common in the Nigeria extension service where the personnel are barely satisfied with their jobs especially the field staff who deal directly with farmers. Olatunji *et al.* (2015) reported that extension agents in Rivers State ADP indicated non-satisfaction with their jobs and cited issues like poor and irregular salaries, poor office conditions and lack of incentives as the causes. This might make the personnel seek alternative or supplementary economic activities, thus reducing dedication to their duties.

Weak collaboration among stakeholders in the agricultural innovation system could impact agricultural innovation generation and dissemination negatively. Weak linkages between farmers and extension agents could impair the transfer of technologies. For instance, poor understanding of instructions on the application of agrochemicals could lead to their misuse. Mordiwa and Oladele (2017) found that strong collaboration among agricultural stakeholders would improve agricultural production.

TABLE 3: CONSTRAINTS TO ACQUIRING CAPABILITIES FOR CLIMATE CHANGE ADAPTATION

Constraints	X	S.D
Poor funding	3.52*	0.74
Inadequate manpower	3.35*	0.73
Poor agricultural policies	3.34*	0.75
Inadequacy of required equipment	3.31*	0.83
Difficulty in adapting technologies to local conditions	3.24*	0.82
Corruption-related factors	3.23*	0.79
Poor attendance to workshops/seminars	3.23*	0.88
Poor sponsorship of programmes on climate change	3.22*	0.87
Paucity of field-level extension staff	3.22*	0.85
Unfavourable attitude towards climate change	3.21*	0.82
Inadequate logistics	3.19*	0.81
Lack of incentives	3.19*	0.78
Weak collaboration among other stakeholders	3.16*	0.85
Poor communication network	3.14*	0.84
Bureaucratic bottlenecks	3.13*	0.79
Low level of education	3.13*	0.95
Poor linkages with farmers	3.11*	0.92
Lack of information on farm-level adaptation	3.10*	0.85
Complexity of technologies	3.04*	0.86
Technical incompetence	3.03*	0.86
Poor remuneration	3.02*	0.81
Difficulty in analysing farmers' farm situation	3.01*	0.91

Source: Field Survey Data 2021

*** PerceivedConstraints to transfer of climate change adaptation technologies by agricultural extension personnel**

CONCLUSION

Climate change has remained an important challenge to agricultural production especially in developing countries because of limited ability to adapt. The findings of the study would guide policymakers towards formulating sound policies and programmes aimed at reducing the impacts of climate change. They will also enable the agricultural extension organizations know the agricultural adaptation technologies that can be transferred to farmers especially in Imo State, Nigeria. This is expected to create room for improvement. The findings can concentrate research efforts on the adaptation technologies transferred by extension personnel to farmers and this can scale-up the adoption of such technologies.

RECOMMENDATIONS

1. Alternative and sustainable funding strategies for the agricultural extension service should be identified and developed. This can be achieved by identifying and partnering relevant stakeholders than living it totally in the hands of the government. Strategies working in other countries can be adapted and tried. Also, the service should be demand-driven to enhance end-users' willingness to pay.
2. A robust policy framework should be developed and implemented for extension service. Also, agricultural policies and

programmes in the country should integrate climate change adaptation.

3. Capacity building programmes on agricultural adaptation to climate change should be regularly mounted for extension personnel and emerging issues should as well be integrated in the programmes. Also, linkages between extension organization and research institutes should be promoted to encourage exchange of information.

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