frontiers | Frontiers in Climate

TYPE Original Research
PUBLISHED 26 August 2024
DOI 10.3389/fclim.2024.1297225

OPEN ACCESS

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RECEIVED 19 September 2023
ACCEPTED 24 July 2024
PUBLISHED 26 August 2024

CITATION
Ojo IE, Akangbe JA, Kolawole EA, Owolabi AO, Obaniyi KS, Ayeni MD, Adeniyi VA and Awe TE (2024) Constraints limiting the effectiveness of extension agents in disseminating climate-smart agricultural practices among rice farmers in north-Central Nigeria.
Front. Clim. 6:1297225.
doi: 10.3389/fclim.2024.1297225

Constraints limiting the effectiveness of extension agents in disseminating climate-smart agricultural practices among rice farmers in north-Central Nigeria

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Climate-smart agricultural practices play a crucial role in achieving national food security and development goals, and the significance of extension agents in this endeavor is invaluable. In view of this, this study investigated the constraints limiting the effectiveness of extension agents in disseminating climate-smart agricultural practices to rice farmers in North-central, Nigeria. The study specifically examined the socioeconomic characteristics of the extension agents, the dissemination pathways employed by them, constraints limiting the extension agents from effectively disseminating climate-smart agricultural practices, and the factors that influence their constraints. Data for the study were collected using a well-structured questionnaire administered to a total of 88 respondents selected through a multistage sampling procedure. Data analysis was done using descriptive statistics and Pearson product–moment correlation. The result showed that the respondents had a mean age of 48 years, the majority were males (93.2%), married (95.5%), and (85.2%) had tertiary education. Dissemination pathway/ method mostly used by the extension were; farm and home visits ($\bar{x}$ = 1.73), result demonstration ($\bar{x}$ = 1.66), and methods demonstration ($\bar{x}$ = 1.58). The constraints impeding the extension agents in disseminating CSA practices were; insufficient number of extension workers to provide services for a large number of farmers ($\bar{x}$ = 1.87), lack of incentives for staff motivation ($\bar{x}$ = 1.83), inadequate means of transportation ($\bar{x}$ = 1.83), were ranked 1st,2nd, and 3rd, respectively. There was a negative significant correlation (p = 0.05) between the number of training and personal constraints, as well as institutional constraints (p = 0.017) in the dissemination of climate-smart agricultural practices. Therefore, it is recommended that extension agents receive periodic training and incentives such as awards, cash rewards, promotions, and staff recognition from government bodies to enhance their performance.

KEYWORDS

constraints, dissemination pathways, climate-smart agricultural practices, rice farmers, extension agents

Introduction

Agriculture is significant in driving economic advancement, bolstering food security, alleviating poverty, and fostering the progress of rural areas. It serves as the primary livelihood source for approximately 2.5 billion individuals residing in developing nations, underlining its pivotal contribution to livelihoods and prosperity. Despite its significant contribution to livelihoods, it faces the threat of climate change.

Climate change's sharp and significant effect on agriculture has created a serious and immediate threat to food security in developing countries, especially in Sub-Saharan Africa (SSA). This is because agricultural practices in Nigeria are predominantly rain-fed and, therefore making it vulnerable to climate change. Rice is one of the staple foods in various African countries that accounts for a significant amount of the diet regularly Merem et al. (2017). Rice is deeply ingrained in Nigerian culture and cuisine. It plays a central role in various traditional dishes, celebrations, and ceremonies, making it culturally significant and an integral part of daily life. However, Nigeria is recognized as the world's top rice importer, with 3.4 million tonnes of expected imports (Bello et al., 2020). This is because Nigerians prefer imported rice brands to native rice kinds. This could be as a result of the poor processing technology used by the rice processors (Ajala and Gana, 2015).

There are different rice production methods practiced in Nigeria, this includes rainfed lowland, rainfed upland, mangrove swamp and deep inland water, irrigated lowland (Van Oort and Zwart, 2018; Anyaoha et al., 2019). However, the most common method used in Nigeria is rainfed upland rice farming, which is prominent in areas such as Ado-Ekiti, Abakiliki, Abeokuta, Gombe, Zamfara, and Yola in the north, and Ogoja in the south (Nwaobiala and Adesope, 2013; Olanrewaju et al., 2017). The rainfed upland rice production method is mostly practiced by small-scale farmers and it is mostly attributed to low yield as a result of some climate change factors such as drought, and stress related to irregular rainfall as the primary water supply (Kumar et al., 2014). Also as reported by Ajetomobi et al. (2011), Ali and Erenstein (2017), and Anyaoha et al. (2019) rice-growing communities in Nigeria are mostly challenged with drought stress caused by increased variation in rainfall patterns within rice growing seasons. An increase in drought stress has an adverse effect on the rice crop physiology, morphology, and molecular trait, which might result in reduced grain production and quality (Bernier et al., 2008; Kumar et al., 2014). One of the ways to increase rice production is to expand the adoption of climate-smart practices such as the use of improved rice variety, and integrated pest management as Ayeni et al. (2023) confirm that Climate-Smart Agriculture strategies increase crop productivity.The Climate-Smart Agriculture (CSA) definition was created with a strong emphasis on food security and climate change adaptation both for now and in the future. CSA is an "agricultural practice that increases output in a sustainable manner, builds resilience (adaptation), lessens GHGs (mitigation) whenever possible, as well as contributes to the achievement of national food security and development goals.

Some examples of CSA practices include soil and water conservation measures (such as minimum or zero tillage, construction of water-retention structures, planting crops that enhance ground cover quickly and use minimal water), diversification of farm enterprise, proper timing and application of farm operations, crop rotation and intercropping by incorporating legumes to promote soil fertility, farmyard composting and adopting farmyard manure management through biogas production, and minimize release of methane amongst others (Food Agriculture Organization, 2018). Research indicates that global rice consumption is projected to increase significantly by 2030, going from 586 million metric tons in 2001 to 756 million metric tons (Udemezue, 2014). This underscores the urgency of the situation, especially considering that by 2050, an extra 2.4 billion individuals are anticipated to reside in developing nations, with a concentration in sub-Saharan Africa and South Asia, To adequately address the burgeoning demand for rice in the coming years, it is imperative for farmers to embrace Climate-Smart Agriculture (CSA) practices.

Although CSA practices have a lot of advantages, the uptake of the practices is frequently low and this has been ascertained by several researchers who have observed limited climate adaptation practices uptake and utilization (Akinnagbe, and Andirohibe, 2014; Ali and Erenstein, 2017; Tripathi and Mishra, 2017; Tiamiyu et al., 2018). One of the reasons attributed to this was inadequate information communicated to the farmers through the extension agents. Hence, this study aimed to investigate the obstacles that restrict extension agents from effectively conveying Climate-Smart Agriculture (CSA) practices to farmers.

The broad objective of the study was to ascertain the constraints limiting the effectiveness of extension agents in disseminating CSAP. The specific objectives were to describe the socio-economic characteristics of the respondents, determine the dissemination pathway used by respondents, and determine the constraints to disseminating CSA practices to the farmers in the study area.

Hypothesis

> *H1*: There is no significant relationship between the socio-economic characteristics of extension agents and constraints/challenges in disseminating CSA practices.

Methodology

This study was conducted within Nigeria's North Central zone, which stands as one of the nation's six geopolitical regions. This geographical region encompasses Benue, Plateau, Niger, Kogi, Kwara, Nasarawa, and the Federal Capital Territory (Abuja), commonly recognized as constituents of the North Central. Geographically, it extends from latitude 7^0 00'to 11^0 30' North of the equator and from longitude 4^0 00'to 11^0 000′ of the Greenwich meridian. The primary economic activity prevalent in this region is agriculture, featuring the cultivation of crops such as rice, maize, beans, and tomatoes, as well as the rearing of livestock, including sheep, goats, and cattle (Tsado et al., 2018). The average annual rainfall in this area varies between 1,200 mm and 1,500 mm, while the temperature remains consistently high throughout most of the year, except the harmattan period, which typically spans from November to February. Furthermore, there is a projected increase of 0.58 mm of rainfall per year from 2013 to 2042 in this region.

Sampling procedure

The research employed a three-stage sampling process. Stage one involved a purposive selection of Kwara, Kogi, and Niger states given their significant involvement in rice production. The second stage also followed a purposive selection of Zone A in Niger State, Zone B in Kwara State, and Zone D in Kogi State, respectively, as these zones are prominent in rice cultivation. For the third stage, all the extension agents within these selected zones were selected which comprise fifty-three (53) extension agents (E.A's) in Niger state, twenty (20) E.A's in Kwara and fifteen (15) E.A's in Kogi state, as their numbers were relatively small (Figure 1).

Methods of data analysis

The independent variable comprised the socio-economic characteristics of the respondents and dissemination pathways used by the respondents. The scale used to determine the dissemination pathways wasoften used (2), rarely used (1), and never (0) while the scale used to determine the dependent variable (constraints to disseminating CSAPs) were major Constraints (2), minor constraints (1) and not a constraint (0). Data were analyzed using descriptive statistics such as percentage, frequency, and mean while Pearson Product Moment Correlation (PPMC) was used to test the relationship between socio-economic characteristics and the constraints to disseminating CSAPs.

Results and discussion

Socio-economic characteristics of extension personnel

Results in Table 1 revealed that majority of the extension personnel were males (95.5%) with an average of 48 years and a mean years of experience of 20.50 years. This implies that the majority of the extension workers in the study area were young, active, and economically productive. Also,the majority of the respondents had tertiary education (85.2%),this finding underscores the high level of education among extension agents, aligning with previous research by Owolabi and Yekinni (2022), which found that the majority of public extension agents held a Higher National Diploma (HND) as their highest educational attainment. On average the household size of the respondents was 10 members and the mean monthly income was N74,370. This implies that althoughthe majority of the extension workers had a moderate remuneration, many of themstruggled to meet their households' financial needs, as evidenced by the income-to-household-size ratio. This disparity may undermine their motivation to carry out their responsibilities effectively, potentially impeding the spread of Climate-Smart Agriculture (CSA) practices to farmers. This finding resonates with the implication drawn by Obabire et al. (2019) that with the current economic reality of the country, the level of income of extension workers with an average family size of five people may be deemed insufficient, this therefore results in job dissatisfaction. The mean number of in-service training attended on CSA practices in the last 5 years was 5. The number of in-service trainings attended was significantly low which could restrict them from effectively communicating the CSA practices to the farmers. Additionally, the table revealed that the mean number of farmers/farm families per extension worker was 1935.6 ± 6690.1. This is relatively high compared to the 1:1000 number of extension agents to farm families ratio recommended by FAO. This result is high enough to de-motivate and impede the extension agent from disseminating climate-smart agricultural practices to the farmers across the study. This finding aligns with Haruna (2013) who reported that extension to farm family's ratio in Kwara and Kogi and Niger state was relatively higher than the FAO standard. Furthermore, the mean number of contacts with agencies in the study area was 2.3 ± 1.3. This limited interaction with agencies limits extension agents' access to CSA training and financial support for implementing these practices. As a result, extension agents' effectiveness in promoting CSA practices to farmers is compromised.

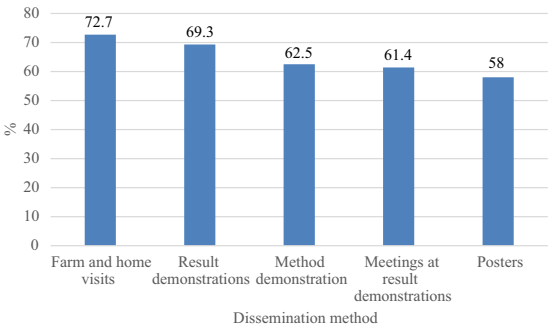

FIGURE 1
Extension dissemination method.

> *Result from the focus group discussion: one of the discussants at Kwara State ADP indicated that they had contacts with agencies like USAID and ABC (Agricultural Business Concepts). Another discussant in Kogi state ADP mentioned that they receive training from FMARD, International Institute of Tropical Agriculture (IITA), ARMTI, and SASAKAWA Global (SG), which is the one that is going on currently. We receive training periodically (once in 2-year intervals).*

Dissemination pathways used by the extension agents

Table 2 shows that teaching methods mostly used by the respondents in disseminating climate-smart agricultural practices to the rice farmers include; individual contact methods: farm and home visits ($\bar{x} = 1.73$), group contact methods: result demonstration ($\bar{x} = 1.66$), methods demonstration ($\bar{x} = 1.58$), meetings at results demonstrations ($\bar{x} = 1.57$) and leaders training meetings ($\bar{x} = 1.48$) and mass media methods: posters ($\bar{x} = 1.50$).

This implies that farmers in the study mostly have physical contact with the extension agents which may motivate them to adopt the CSA practices being disseminated to them, thereby making the extension agents effective in performing their roles. This aligns with the findings of Ahmed and Adisa (2017) who reported that rice farmers in Kogi State perceived field demonstration and individual contact methods

TABLE 1 Socio-economic characteristics of extension agents.

Characteristics	Levels	Percentage	Mean (S.D)
Sex	Male	95.5	
	Female	4.5	
Age (Years)	30–37	4.5	48 (6.9)
	38–45	34.1	
	46–53	37.5	
Level of education	Primary	2.2	
	Secondary	12.5	
	Tertiary	85.2	
Household size	3–7	39.8	
	8–12	38.6	
	13–17	14.8	
	>17	6.8	
Monthly income (N)	30,000 – 82,000	78.4	74,370
	82,000 – 134,000	15.9	
	134,001 – 186,000	1.1	
	>186,000	4.5	
Number of in-service training on CSA practice	1–6	78.4	4.8 (4.7)
	7–12	13.6	
	13–18	5.7	
	19–25	2.3	
Number of farm families per extension agents	1–6,700	93.18	1935.6 (6690.1)
	6,701–13,401	5.68	
	>13,401	1.14	
Number of contacts with the agency	1–2	51.13	2.3 (1.3)
	3–4	45.45	
	5–6	1.13	
	>6	2.27	

Source: Field survey, 2021.

(result demonstration, farm and home visits) as the most effective teaching methods used by the extension agents. Abdulshakur et al. (2020) ranked group discussion and demonstration 1st and 2nd as the most effective methods used by extension agents in Niger State. However, the teaching methods rarely used by the extension agents include newspaper ($\bar{x} = 0.68$), personal letter ($\bar{x} = 0.78$), slide shows ($\bar{x} = 0.78$), flip charts ($\bar{x} = 0.82$), radio ($\bar{x} = 0.85$), drama ($\bar{x} = 0.85$) and circular letters ($\bar{x} = 0.86$). This could be due to the high cost of disseminating information through these media. Therefore, extension organizations should seek private sponsorship of Radio and TV programs by corporate organizations and NGOs (non-governmental organizations).

Process flow of method or pathways employed in disseminating CSAPs

Figure 2 reflects the various methods employed in dissemination of Climate-Smart Agricultural Practices (CSAP). In the dissemination process, farm and home visits are important methods of dissemination because they allow for personalized interaction with farmers. When dealing with larger farming households that exceed an extension agent's capacity, the group method proves invaluable. This includes techniques such as method and result demonstrations, which provide step-by-step instructions while effectively capturing farmers' attention. For audiences spread across multiple regions, mass media channels such as posters, radio, and television are effective. However, certain limitations prevent the full use of these methods.

Constraints limiting the extension agents to effectively disseminate CSA practices

Results in Table 3 show the constraints/challenges in three categories; Personal constraints faced by the extension agents in order of ranking were: Lack of incentives for staff motivation ($\bar{x} = 1.83$), Non-payment of allowance to field staff ($\bar{x} = 1.75$) and Non availability of inputs ($\bar{x} = 1.66$).This implies that there is a need for the extension agents to be motivated through incentives in order

TABLE 2 Distribution of respondents by teaching/dissemination pathways used.

Dissemination pathways	Often used Freq (%)	Rarely used Freq (%)	Never used Freq (%)	Mean	Std. Deviation	Rank
a. Individual contact methods						
Farm and home visits	64 (72.7)	24 (27.3)	0 (0)	**1.73**	0.448	1st
Telephone Calls	40 (45.5)	41 (46.6)	7 (8.0)	1.38	0.631	
Office calls	38 (43.2)	41 (46.6)	9 (10.2)	1.33	0.656	
Personal letter	14 (15.9)	41 (46.6)	33 (37.5)	0.78	0.702	
b. Group contact methods						
Result demonstrations	61 (69.3)	24 (27.3)	3 (3.4)	**1.66**	0.544	2nd
Method demonstration	55 (62.5)	29 (33.0)	4 (4.5)	**1.58**	0.582	3rd
Meetings at result demonstrations	54 (61.4)	30 (34.1)	4 (4.5)	**1.57**	0.583	4th
Lecture meetings	24 (27.3)	57 (64.8)	7 (8.0)	1.19	0.564	
Conferences	12 (13.6)	66 (75.0)	10 (11.4)	1.02	0.502	
Leader training meetings	45 (51.1)	40 (45.5)	3 (3.4)	1.48	0.567	
Discussion meetings	41 (46.6)	41 (46.6)	6 (6.8)	1.40	0.617	
Tours (field trips)	27 (30.7)	50 (56.6)	11 (12.5)	1.18	0.635	
Schools	9 (10.2)	44 (50.0)	35 (39.8)	0.70	0.646	
Flip chart	11 (12.5)	50 (56.8)	27 (30.7)	0.82	0.635	
c. Mass contact methods						
Posters	51 (58.0)	30 (34.1)	7 (8.0)	1.50	0.643	5th
New stories	25 (28.4)	41 (46.6)	22 (25.0)	1.03	0.734	
Circular letters	21 (23.9)	34 (38.6)	33 (37.5)	0.86	0.776	
Radio	15 (17.0)	45 (51.1)	28 (31.8)	0.85	0.687	
Television	28 (31.8)	32 (36.4)	28 (31.8)	1.00	0.802	
Exhibits	24 (27.3)	52 (59.1)	12 (13.6)	1.14	0.628	
Leaflets	28 (31.8)	41 (46.6)	19 (21.6)	1.10	0.728	
Bulletin	29 (33.0)	33 (37.5)	26 (29.5)	1.03	0.794	
Campaign	22 (25.0)	39 (44.3)	27 (30.7)	0.94	0.748	
Newspaper	11 (12.5)	38 (43.2)	39 (44.3)	0.68	0.687	
Extension journals	38 (43.2)	37 (42.0)	13 (14.8)	1.28	0.710	
Newsletter	22 (25.0)	40 (45.5)	26 (29.5)	0.95	0.741	
Pamphlet	27 (30.7)	43 (48.9)	18 (20.5)	1.10	0.712	
Folders	21 (23.9)	45 (51.1)	22 (25.0)	0.99	0.703	
Drama	16 (18.2)	43 (48.9)	29 (33.0)	0.85	0.704	

Source: Field survey, 2021.

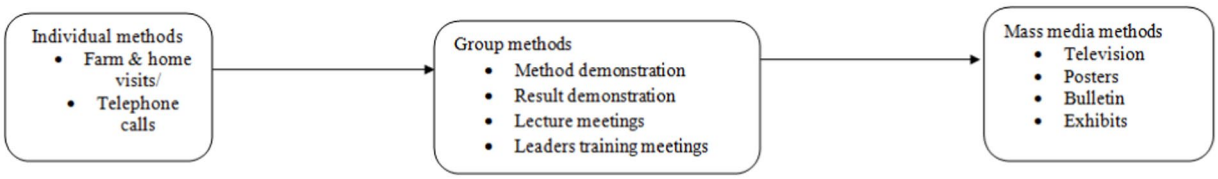

FIGURE 2
Process flow chart of method in disseminating climate-smart agricultural practices.

to ameliorate the extension service delivery. This is corroborated by Ndem et al. (2020) who discovered that the provision of incentives to the extension agents is one of the major strategies to improve extension service delivery. Also, according to Okwoche et al. (2015), extension agents are motivated by increases in salary and welfare package.

The institutional challenges faced by the extension agents were: Insufficient number of extension workers to provide services for large

TABLE 3 Challenges limiting the effective dissemination of CSA practices.

Challenges associated with the effective dissemination of CSA practices	Mean	Std. Deviation	Rank
a. Personal challenges			
Lack of incentives for staff motivation	1.83	0.460	1st
Non-payment of allowance to field staff	1.75	0.572	2nd
Non availability of some inputs/ Delay in providing working material for field demonstration	1.66	0.565	3rd
Limited capacity to implement the techniques	1.55	0.623	4th
Inability to flow with the target population	1.51	0.695	5th
lack of regular promotion	1.49	0.711	6th
Gender imbalance between farmers and extension agents	1.15	0.720	7th
Complexity of extension messages	1.08	0.665	8th
Low interest in CSA practices among extension agents	0.90	0.831	9th
b. Institutional challenges			
Insufficient number of extension workers to provide services for a large number of farmers (E.A: farm families)	1.87	0.366	1st
Inadequate means of transportation	1.83	0.407	2nd
Inadequate training programs for extension agents in CSA	1.76	0.455	3rd
Low institutional/government support for agricultural extension.	1.70	0.550	4th
Lack/ inadequate information from research institute	1.49	0.661	5th
The dearth of subject matter specialist	1.41	0.753	6th
c. External challenges			
Poor funding of CSA practices	1.59	0.517	1st
Certain techniques associated with sustainable land management can be incompatible with traditional practices (cultural beliefs)	1.28	0.566	2nd
Deep religion beliefs by the farmers	0.83	0.820	3rd

Source: Field survey, 2021.

number of farmers (E.A: farm families) ($\bar{x} = 1.87$) ranked 1st, followed by Inadequate means of transportation ($\bar{x} = 1.83$), Inadequate training programs for extension agents in CSA ($\bar{x} = 1.76$), Low institutional/government support for agricultural extension ($\bar{x} = 1.70$), Lack/ inadequate information from research institute ($\bar{x} = 1.49$) were ranked 2nd, 3rd, 4th and 5th, respectively. This implies that more hands are needed in the extension organization to augment the imbalance ratio and to be able to cover a large number of farmers in a short period as insight from this study revealed that an extension agent per farm family was 1: 2000.

Furthermore, this result suggests that extension agents may lack the requisite knowledge and skills necessary to effectively disseminate information to rice farmers, owing to insufficient training in Climate-Smart Agriculture (CSA) practices. This finding is consistent with the conclusions drawn by Ojo et al. (2023), who observed a similar trend of low competence among extension agents in North-Central Nigeria regarding certain CSA practices required by rice farmers. Therefore extension organization should organize adequate training for extension agents so that farmers can also be trained adequately. This result is in line with the findings of Sennuga and Fadiji (2020) who reported inadequate government support, low/inadequate number of extension personnel, and insufficient agricultural technologies to farmers, as factors that influence extension agents' effectiveness models in Nigeria. The same authors also identified bad roads and language barriers as factors that affect effective communication. In another study (Ragasa et al., 2016), reported a lack of mobility and lack of interaction of agents with key actors as one of the major factors that limit the performance of extension agents. Finally, the table reveals that the external challenges faced by farmers include: Poor funding of CSA practices ($\bar{x} = 1.59$) and certain techniques associated with sustainable land management can be incompatible with traditional practices (cultural beliefs) ($\bar{x} = 1.28$). This implies that farmers in the study area are not adequately funded, which may discourage the farmers from adopting CSA practices or even discontinuous adoption, if the technology is capital-intensive and time consuming. Therefore funds and support should be given to farmers by government and NGOs to increase adoption of CSA practices. This is in line with the findings of Nyasimi et al. (2017) in Tanzania who reported that most farmers are willing to use CSA practices, but are constrained by some factors such as cultural practices.

Constraints limiting effective dissemination of CSA practices and theory of change

Personal constraints limiting effective dissemination of CSA practices

As depicted in Figure 3 several prerequisites must be fulfilled in order to successfully disseminate Climate-Smart Agriculture (CSA)

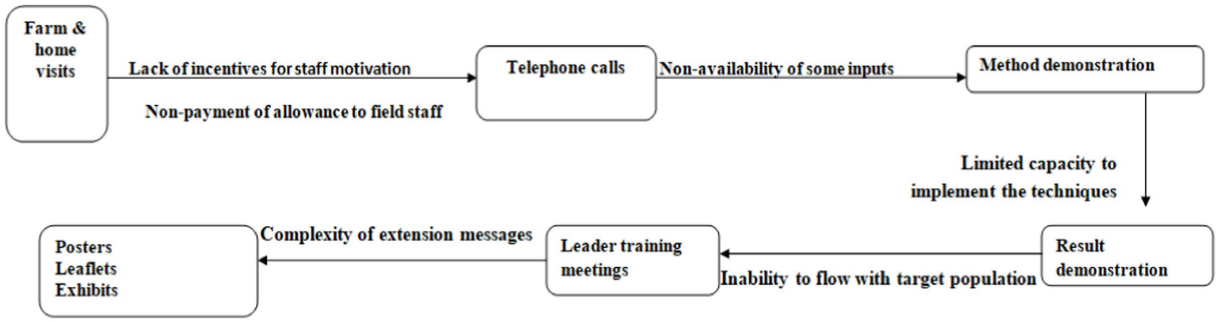

FIGURE 3
Personal constraints limiting effective dissemination of CSA practices.

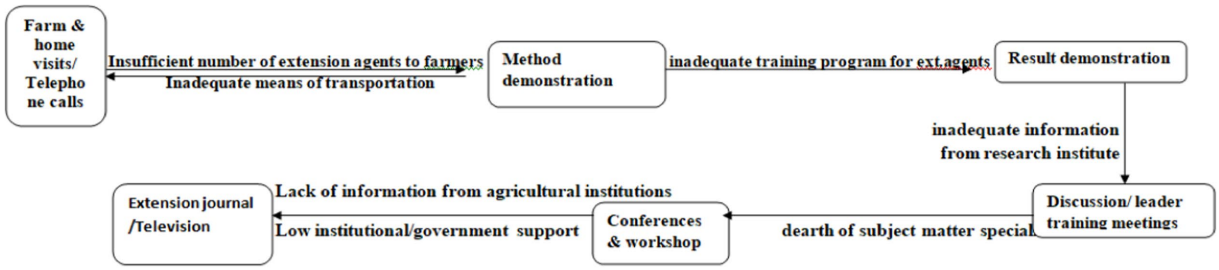

FIGURE 4
Institutional constraints limiting effective dissemination of CSA practices.

practices to the farmers. These include driven field personnel, prompt procurement of essential resources and supplies, simplified extension messages, efficient leadership training, and enhanced execution competency.

To tackle the issue of insufficient motivation and ensure satisfactory remuneration for field staff, a scheme of incentives should be implemented by offering both monetary and non-monetary rewards as this will bolster the drive and efficacy of field personnel. Additionally, ensuring prompt access to resources will heighten efficiency. Also, comprehensibility of extension messages can be improve by creating approachable posters, pamphlets, as well as streamlining extension messages will increase farmer's understanding. Alongside this effort, frequent leadership training sessions should also be arranged to augment their ability to communicate proficiently with the intended audience. Finally, practical demonstrations will reveal the outcomes of CSA techniques and then incentivize farmers to embrace CSA methods.

Institutional constraints limiting effective dissemination of CSA practices

As shown in Figure 4, numerous institutional limitations hinder the successful dissemination of Climate-Smart Agriculture (CSA) practices. Primarily, a dearth of extension agents and inadequate means of transportation impede their ability to aid farmers. Insufficient training programs for extension agents hinder their capability to effectively demonstrate the CSA practices. Inadequate information from the research and agricultural institutions, further exacerbated by dearth of subject-matter specialist capable of conducting conferences and workshops culminate into inadequate dissemination of CSA practices. Thus hindering vital information from reaching farmers through extension journals, television broadcasts, and leader training assemblies. Accordingly, the Theory of Change proposes that remedying these constraints--via augmenting the number of extension agents, optimizing transportation methods, establishing more comprehensive training programs, ensuring unfettered flow of data from research institutions, bolstering institutional and governmental backing, and expanding the ranks of subject matter specialists — will ultimately foster optimal diffusion and incorporation of CSA techniques.

External constraints limiting effective dissemination of CSA practices

The theory of change aims to promote the use of Climate-Smart Agriculture (CSA) techniques to enhance agricultural sustainability and resilience to climate change. To achieve this, it is important to align CSA practices with indigenous cultural and spiritual beliefs, ensuring community acceptance and collaboration. Adequate financial support is crucial, requiring the government to implement policies that provide funding for CSA initiatives and prioritize capacity building for farmers. To increase the adoption of CSA techniques, key strategies include training extension agents to effectively disseminate CSA knowledge, engaging community leaders to address cultural and religious concerns, and providing farmers with necessary resources such as seeds, tools, and technologies. The

expected outcomes include increased adoption of CSA practices, improved agricultural productivity and sustainability, and enhanced resilience of farming communities to climate change. Success will be measured by the number of farmers adopting CSA practices, improvements in crop yields and farm incomes, positive feedback from community engagement efforts, and measurable reductions in greenhouse gas emissions from farming activities.

Relationship between the socio-economic characteristics of extension agents and constraints/ challenges in disseminating CSA practices

Table 4 showed that there was no significant relationship between the age of the extension agent and personal, institutional and external constraints in disseminating CSA practices ($p = 0.767$, 0.211 and 0.303). In the same vein, educational attainments ($p = 0.914$, 0.441 and 0.551), and years of experience ($p = 0.470$, 0.143 and 0.311), were not statistically significant.

The number of training was found to have statistical significantinfluence on personal ($p = 0.05$) and institutional constraints ($p = 0.017$) to dissemination of CSA practices. However, the correlation coefficient r shows a negative linear relationship, thus the implication of this is that as the number of training increases, the lower the personal and institutional constraints faced in the dissemination of CSA practices. This further implies that an increase in the number of training will enhance the effectiveness of the extension agents in disseminating CSA practices to the farmers. This study agrees with Nwosu et al. (2015) who concluded that training and level of education significantly influence the job performance of the extension workers. Likewise (Ogunremi and Olatunji, 2017), reported the number of in-service training as one of the main determinants of job satisfaction.

The table also revealed that the number of farmers/ farm families per extension agent was statistically significant and related to personal and institutional constraints in disseminating CSA practices ($p = 0.02$, 0.08), with a negative correlation coefficient. This suggests that as the number of farm families increases, the lower the likelihood of having constrained in disseminating CSA practices to the rice farmers and vice versa. This is surprising because increase in number of farm families is expected to increase the constraints in disseminating CSA practices. However, in a situation where the increase experienced is still from the same set of families, constraints in disseminating CSA might be reduced. This result negates the findings of Nwosu et al. (2015) reported that an increase in the number of farm families covered significantly reduces the performance of extension agents.

Furthermore, the table shows that contact with agency was statistically significant and negatively related to personal and institutional constraints constraint in disseminating CSA practices ($p = 0.01$, 0.00). This suggests that the higher the number of contact with agency, the lesser the constraints faced in disseminating CSA practices to the rice farmers. Therefore, extension organization can improve the effectiveness of extension agents by increasing the number of trainings of the extension agents as well as increasing their contact with agencies so as to get more familiar with the practice which aids convenient dissemination of information.

Conclusion and recommendation

Dissemination methods commonly used by the extension agents were farm & home visits, result demonstration, method demonstrations and posters. Lack of incentives for staff motivation, non-payment of allowance to field staff and non- availability of input were the most significant constraints that limited extension agents' ability to effectively disseminate CSA practices.Furthermore, the study highlights that the number of training sessions conducted, the ratio of farmer families to each extension agent, and the extent of interaction with research agencies significantly influence the constraints faced by extension agents in effectively disseminating CSA practices. The study therefore recommends that incentives (awards, cash rewards, promotion, staff recognition) should be given to the extension agents so as to enhance their performance. Government should ensure adequate linkage between international agencies, researchers and extension organization in order to keep the extension agents abreast of new CSA practices that can help the rice farmers to increase their production.

TABLE 4 Relationship between selected socio-economic characteristics of extension agents and constraints to dissemination of CSA practices.

Variable	*r*-value personal constraints	*r*-value institutional constraints	*r*-value external constraints	*p*-value personal constraints	p-value institutional constraints	*p*-value external constraints	Decision
Age	−0.032	0.135	−0.111	0.767	0.211	0.303	Not significant
Educational attainment	0.012	0.083	0.064	0.914	0.441	0.551	Not significant
Years of experience	0.078	0.158	−0.109	0.470	0.143	0.311	Not significant
Numbers of training	−0.299	−0.253	−0.055	0.05	0.017	0.612	Significant
Numbers of farmers	−0.244	−0.184	−0.080	0.02	0.08	0.460	Significant
Contact with Agency	−0.363	−0.447	−0.036	0.01	0.00	0.741	Significant

***, **, * Variable is significant at 1, 5, 10%, respectively.

Data availability statement

Original datasets are available in a publicly accessible repository: The original contributions presented in the study are publicly available. This data can be found here: 10.6084/m9.figshare.26503696.

Ethics statement

The studies involving humans were approved by the Agricultural Development Programme Zones in Kwara, Kogi, and Niger State. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because this is because they are aware it is research that will benefit them and the populace. Written informed consent was not obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article because this is because they are aware that the result of the research will inform policy that will change their status.

Author contributions

IO: Investigation, Methodology, Writing – original draft. JA: Conceptualization, Supervision, Writing – review & editing. EK: Investigation, Writing – review & editing. AO: Investigation, Validation, Writing – review & editing. KO: Investigation, Validation, Writing – review & editing. MA: Methodology, Software, Validation, Writing – review & editing. VA: Investigation, Validation, Writing – review & editing. TA: Data curation, Investigation, Methodology, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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