SOCIAL SCIENCE REVIEW ARCHIVES
ISSN Online: 3006-4708
ISSN Print: 3006-4694
https://policyjournalofms.com

Building Extension Agents' Capacity for Sustainable Development to Promote Climate Resilience in Pakistani Agriculture: A case study of South Punjab

Muhammad Ismail Kumbhar[1], Muhammad Hamid Nawaz Khan[2], Aijaz Ali Khooharo[3], Fateh Muhammad Mari[4], Habibullah Magsi[5], Zaheeruddin Mirani[6], Aamir Riaz[7], Arif Masood[8], Afia Naseem[9], Syed Taimoor shah[10]

DOI:https://doi.org/10.70670/sra.v3i1.448

[1,] Professor, Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences , Sind Agriculture University, Tandojam, Pakistan mikumbhar@sau.edu.pk
[2,] Lecturer, Department of Agricultural Extension Education, Faculty of Agriculture & Environment, The Islamia University of Bahawalpur, Pakistan hamid.nawaz@iub.edu.pk
[3,] Professor and Dean, Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan draijaz@sau.edu.pk
[4,] Professor, Department of Agricultural Economics , Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan fateh.marri@gmail.com
[5,] Professor & Chairman, Department of Agricultural Economics , Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan hmagsi@sau.edu.pk
[6,]Professor and Chairman, Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan zamirani@sau.edu.pk
[7,] Assistant Professor, Department of Agricultural Extension Education Faculty of Agriculture & Environment, The Islamia University of Bahawalpur, Pakistan aamir.riaz@iub.edu.pk
[8,] Deputy Registrar, The Islamia University of Bahawalpur, Pakistan arifmasood@gmail.com
[9,] PhD (Scholar), Department of Pakistan Studies, The Islamia University of Bahawalpur, Pakistan afianaseem1@gmail.com
[10,] Lecturer Agriculture Extension, Baluchistan Agriculture college QuettaTaimoor.shahbac@gmail.com

Abstract
Achieving the Sustainable Development Goals (SDGs) of ending hunger and poverty requires Pakistan's agriculture industry to adapt to climate change. Agricultural productivity is greatly impacted by climate change due to unpredictable weather patterns, high temperatures, and altered rainfall cycles. Food security is impacted, and poverty is made worse, especially for smallholder farmers who are less equipped to adjust. To lessen these effects and increase farmers' climate change resilience, agricultural extension agents' skills and abilities must be strengthened.When it comes to sharing information, expertise, and technologies that support farmers in implementing climate-smart farming practices, agricultural extension services are essential. However, extension agents' proficiency, education, and capacity to convey creative solutions determine how effective they are. The purpose of this study is to evaluate the socioeconomic characteristics, climate change awareness, responsibilities, and skill gaps of extension agents in Punjab, Pakistan, in order to determine their training needs. Ninety extension workers from three districts—Bahawalpur, Lodhran, and Rahim Yar Khan—were asked to complete a standardized questionnaire. Descriptive statistics and mean scoring techniques were used to analyze the

data.The results indicate that extension agents need specialized training in current agricultural practices, policy implementation, and climate resilience methods. By filling in these gaps through ongoing professional development, extension services will be better equipped to assist farmers with climate adaptation. In Pakistan's agrarian economy, bolstering agricultural extension initiatives can result in increased productivity, better climate adaptability, and general economic growth. This study emphasizes the necessity of taking a methodical approach to giving extension agents the tools they need to successfully address the difficulties posed by climate change.

Introduction

Adapting the Pakistan agricultural system effectively to the effects of climate change will significantly aid the country's efforts to achieve the sustainable development goals of hunger and poverty eradication. This may be possible if agricultural extension agents and farmers' capacities and competencies are strengthened to deal effectively with the vagaries of climate change. Climate change refers to persistent changes in average weather conditions or shifts in global climatic patterns (Beaugrand et al., 2019). It refers to statistically significant changes in weather over an extended period of time, typically a decade or more (IPCC, 2007). CC manifests itself through variations in the intensity of unpredictable meteorological occurrences such as temperature, rainfall, and wind. C is responsible for temperature increases besides the commencement, consistency, and severity of rainfall, all of which have an impact on agricultural output. Climate change is a significant environmental and development issue worldwide (Skogen et al., 2018). It refers to an emerging paradigm that threatens to fundamentally transform both human geography and the physical environment, with disastrous repercussions for humanity. Climate change is having a more obvious impact on the agricultural business. Communities with high levels of poverty have fewer options for adapting, trapping them in the climate change cycle. C reduces crop yields and hence food security (Gitz et al., 2016). According to Birthal et al. (2014), yield losses caused by severe environmental conditions have a direct influence on food security, as do changes in agricultural pest population dynamics and regional dispersal. Ngoma et al. (2021) discovered that C had a detrimental impact on agriculture and gross domestic products. This is because climate change affects agricultural productivity because of extreme temperatures and drought, resulting in a high poverty rate (Aragón et al., 2021; Gezie, 2019). On the other hand, lower output from agriculture might be attributed to a lack of adoption of new agricultural methods proposed by agricultural extension workers (Farooq et al., 2007). Agriculture extension is an ongoing method of gathering important data for producers and assisting their interests in developing the skills, expertise, and mindsets necessary to successfully apply this technological infrastructure in order to achieve high productivity and adapt to changing needs (Ortiz-Crespo et al., 2020; Kuehne et al., 2017; Shah et al., 2013) and Khan (2024) Agriculture extension services encompass complicated and dynamic processes that change the understanding of individuals, how they react to events, and what they can do. The majority of these instances occur in countries that are developing, and many of them are people from impoverished households and rural areas. Extension agents should target this group in order to assist them and boost their production. Agriculture extension is intended to be a structure that facilitates agricultural workers' utilization of expertise, data, and technological devices by connecting them with education partners, farming businesses, research, markets, and other agricultural-related resources, as well as assisting them in growing their own organizational and executives, procedure, and technical capacities (Raidimi et al., 2017) and Khan et al., (2024). Furthermore, the ability of extension workers to meet the established goals for the program is proportional to the quality of their skills, knowledge, and status. It has been stated that professional and personal characteristics contribute to success or high performance in tasks. Mitchell (2002) recommended all extension professionals to develop their own unique abilities, knowledge, informational proficiency, appropriate technological knowledge, as well as workplace skills. Furthermore, the most important factor determining success or failure in the agricultural extension

program is the extension worker, who is the most useful and critical professional throughout the extension program. Skills should receive the most priority in all training activities (Nawaz et al., 2020). The effectiveness of an extension project is determined on the competency of extension agents who are qualified, highly accountable for their work, and capable of handling the entire extension procedure. The farmers' endorsement of the transfer of technologies with entire growth is a prerequisite for many extension's approaches and strategies (Axinn, 1988). By showcasing their degree of expertise, the extension agent can motivate clients and gain their trust (Oakley & Garforth, 1997). With the problems of poverty, food insecurity, and climate change, among others, there is a greater demand than ever for agricultural professionals (Rivera et al., 2002). Extension agents must be efficient in disseminating a variety of farming technologies to producers in order to provide an efficient connecting operation (Umar et al., 2018). It also demonstrates that extension agents who have been successful in sharing knowledge which can enhance people's lives must learn more in order to satisfy the needs of their increasingly varied and knowledgeable clientele. The necessity of routinely assessing and analyzing technical capability and ability was validated by the extension agents' function as intermediaries between the many stakeholders (Oakley & Garforth, 1997). Among agriculture extension agents, extension officers must develop their technical skills, including organizational and social community abilities, in addition to their agricultural expertise (Shah et al., 2013). Appropriately modifying Pakistan's farming industry to the consequences of climate change is going to be crucial to the nation's attempts to eradicate extreme hunger and poverty as part of the Sustainable Development Goals. If growers' and agricultural extension agents' skills and abilities are improved to better handle the whims of climate change, this would be feasible. Agriculture is critical to achieving the Sustainable Development Goals (SDGs) of eliminating malnutrition, decreasing disparities, and enhancing incomes and livelihoods in low-income countries (Blesh et al., 2019; Mollier et al., 2017). Agriculture is an extremely significant sector in Pakistan's budget, and it is regarded as the foundation of all economies. Our country is agrarian, contributing 19.3% of GDP, employing almost 42.3% of the labor force, and accounting for a sizable amount of export revenue. Agriculture employs over 68% of the rural population, with minor and major agricultural goods being grown, refined, and traded. It is their biggest source of revenue and support, meeting the population's dietary requirements and providing raw materials to industry (GoP, 2019-2020). According to Borlaug's 2007 prediction, an additional 3.5 billion people will require more food than the world's current population over the next fifty years. Only the three major cereal crops, wheat, rice, and maize, will need to be increased by 70% by 2050 to meet the needs of the expanding populations in both cities and rural areas. Changes in climate as well as variation still pose an issue to the agricultural sector survival and significance in most developing countries (Lemi and Hailu, 2019). For a consequence, climate change (CC) has garnered a lot of attention in recent years since it is thought to have a negative impact on a range of industries, particularly agriculture. Climate change appears to have a more negative impact on smallholder farmers who lack the resources and experience to face the problems posed by C to their production operations and the threat to their livelihoods (Acquah and Onumah, 2011). According to Onokala, Enete, et al. (2010), farmers' capacity to adapt to climate change successfully depends on the reliability and availability of the knowledge that they are given access to. Regretfully, most Pakistani farmers lack the resources, expertise, along with knowledge needed to adjust to climate change. The result points to a weakness in the function of agricultural extension agents, who are charged with responding to the urgent need to improve the welfare and standard of life of farmers as well as with the duty of distributing agricultural information across the nation. This is achieved by educating farm families about new developments in agriculture technology and better farming methods, as well as by enhancing their ability to deal with new concerns that arise in the modern world and have an impact on their farming operations, such climate change. Information technology and information management, skill building, and the facilitation and execution of policies and programs targeted at enhancing local capacity for adaptation are all areas in which Extension should be crucial, according to Davis (2009).

Extension is anticipated to support the creation of expertise, awareness-building, the dissemination of information and technological advances, and the execution of successful initiatives to manage risks (FAO, 2008). According to **Duncan (1957),** the recently hired extension agent needs to receive training on the duties of his position. He also mentioned that extension work involves ongoing training, which needs to be coordinated and organized irrespective of how it is put into practice. The skills needed by extension workers in Zamfara State, Nigeria, were also identified by **Anka (2000),** who suggested that extension agents focus more on technical skills like agronomy, crop protection, horticulture, agricultural economics, and marketing in order to carry out what they are supposed to do. Examining the professional skills required of extension agents who act as a liaison between small-scale farmers and research stations for farm-related matters is crucial **(Anka, 2014a).** According to **Richardson and Eckard (1972),** extension professionals must fulfil three responsibilities. These positions include administration of team development and training, acquiring expertise, and educator. They claim that in order to meet the requirements of these positions, extension agents need to be professionally prepared and acquire the various skills and abilities that those jobs need (Anka 2016). Extension work in Pakistan is perceived to perform below expectations. This resulted from inadequate extension program development, collaboration, evaluation, monitoring, and execution. Because of this, numerous extension programs lacked a clear connection to the climate of their growers as well as to the agricultural field locations. Climate change poses significant hazards to societies, making it crucial for extension workers to receive training in varied abilities to solve associated difficulties. The study aimed to assess the climate change training needs of extension workers in the study area. The study aimed to identify workers' responsibilities regarding climate change, identify skills gaps, and recommend techniques for dealing with the issues identified.

Objectives of study

The broad objective of the study was to assess climate change training needs of agricultural extension agents in the study area.

The specific objectives were to:

1. Describe the socio-economic characteristics of agricultural extension agents in the study area.
2. Determine the climate change knowledge level of agricultural extension agents in the study area.
3. Determine tasks performed by agricultural extension agents in climate change issues in the study area.
4. Determine the climate change training needs of extension agents in research area and
5. Identify ways to improve agricultural extension agent’s knowledge and skill in climate change issues in the study area.

Methodology

The function of extension workers includes disseminating data, enhancing farmer ability using multiple communication means, while assisting farmers in making intelligent choices. The study focused on job analysis. This involves determining the tasks of technical people to properly bring contemporary technologies to farmers.

Population for the study

The population for the study consists of selected extension workers in the agriculture department of province Punjab, Pakistan.

Sample selection

The method of random sampling was used to cover the entire extension department as described below:

Table1

District	No of respondents
Bahawalpur	30
Lodhran	30
Rahim Yar Khan	30
Total	**90**

,

Data collection and analysis

The study gathered information on subjects' socioeconomic statuses, including age, occupational status, and education level of attainment. Data was collected using a well-structured questionnaire.

Data was analyzed using applicable statistical approaches, including descriptive statistics, frequency percentages, and means. The data was used to assess extension workers' readiness for climate change training as well as determine areas where the staff do not require it. A mean score of 3 or higher indicates places in need of training, while a score below 3 indicates areas that do not require training.

Results and Discussion

Demographic characteristics of the respondents

The primary demographic characteristics assumed for this research study were age and literacy status along with level of education. These characteristics are quite useful for collecting data and obtaining essential information from respondents. Demographic traits always have an impact on other characteristics. For these reasons, data collecting in these areas is important (Ekanem et al., 2006; Fawole, 2006; Agwu et al., 2008; Saadi et al., 2008; Jensen et al., 2009). The respondents' demographics are thought to have a significant role in determining whether or not they are aware of and embrace current manufacturing practices (Hussain et al., (2015); Ali et al.,(2021); Jones, and Garcia (2021); Thompson and Smith (2016).Similarly, Rehman et al., (2018) and Khan et al., (2024) found a substantial correlation between farmers' socioeconomic characteristics and their ability to obtain agricultural knowledge in order to embrace new technologies. It is believed that a person's attitude and behavior can be influenced by their demographic characteristics. Given the significance of these variables, data has been supplied on the respondents' age, area of jurisdiction, professional education, duration of service, family history, agricultural experience, and attendance at in-service training courses and refresher courses.

Table 2: Demographics of Agricultural Extension Field Staff (N=90)

Category	Frequency (f)	Percentage (%)
Age (in years)		
20-30	23	25.56
31-40	25	27.78
41-50	36	40.00
50 and above	6	6.67

Education		
3 Years diploma	21	23.33
B.Sc. (Hons.) Agri	38	42.22
M.Sc. (Hons.) Agri	28	31.11
Ph.D. (Agri)	3	3.33
Service Length (No. of years spent in job)		
1-5	30	33.33
6-10	33	36.67
11-15	22	24.44
16 and above	5	5.56
Family Background		
Farming	59	65.56
Non-Farming	31	34.44
Training (Attended)		
On-job training	68	75.56
Refresher course	59	65.56
No. of Trainings		
No	1	1.11
1-5	56	62.22
6-10	26	28.89
11 or above	7	7.78

Results presented in table 2 show the analysis of demographics. The distribution of age of respondents is as follows with 27.78% and 40%, respectively, more than half of extension agents are in the 31–40 and 41–50 age ranges. This suggests that the workforce is comparatively seasoned, with many people remaining in their prime working years. There appears to be a moderate input of younger professionals into the industry, as the younger age group (20–30 years old) accounts for 25.56%. Ages 50 and over make up a smaller fraction (6.67%), which can be a reflection of retirement trends or the low rate of elderly workers entering the field. Results for educational background: 42.22% of extension agents have a B.Sc. (Hons.) in Agriculture, which is the most common degree. Those with an M.Sc. (Hons.) in Agriculture make up the second-largest group (31.11%), suggesting a highly educated workforce with a focus on agricultural sciences. Higher education levels beyond a master's degree appear to be less common in this sector, as only 3.33% of respondents have a Ph.D and the majority of extension agents (36.67%) have 6-10 years of experience, while 33.33% have 1-5 years. This points to a moderately

experienced and comparatively stable workforce. Only 5.56% of agents have been in their current roles for more than 16 years, suggesting that there is movement or churn in the sector. Data also shows that the majority (65.56%) of extension agents come from farming families, providing them with practical agricultural experience and knowledge. Although the remaining 34.44% come from non-farming households, this could suggest that their backgrounds are diverse, but they might also need more assistance or training in practical agricultural skills and the significance of ongoing professional development is underscored by the fact that a significant majority of agents (75.56%) have participated in on-the-job training. Furthermore, 65.56% have taken refresher courses, highlighting the dedication to keeping expertise and abilities current. In order to adjust to evolving agricultural innovations and procedures, these training opportunities are essential. Table further indicates that the majority of extension agents (62.22%) have participated in one to five training sessions, indicating that training is regular but not excessively comprehensive. The fact that a lower percentage (7.78%) have participated in 11 or more training courses may suggest that the agents are very dedicated to continuous improvement. The information points to a workforce that is, on the whole, knowledgeable, experienced, and dedicated to continuing their professional growth through refresher courses and on-the-job training. Nonetheless, there might be chances to expand the pool of highly qualified individuals and help agents from non-farming backgrounds get more hands-on agricultural knowledge.

Table 3: Awareness and Knowledge of Climate Change of Agricultural Extension Agents

Variables	**Frequency (n=90)**	**Percentage (%)**
climate change Awareness		
Yes	83	92.0
No	7	8.0
Self-reported knowledge in climate change issues		
Yes	69	77.0
No	21	23.0
Level of knowledge on climate change		
Limited knowledge	10	11.0
Moderate knowledge	48	53.0
Extensive knowledge	11	36.0
Perceived relevance of climate change to extension work		
Yes	85	95.0
No	5	5.0
Extent of relevance to extension work		
Low relevance	4	7.0

Moderate relevance	24	35.0
High relevance	57	58.0
Perception of climate change impact on agriculture		
Yes	82	91.0
No	8	9.0
Perceived severity of climate change effects on agriculture		
Mild impact	6	7.0
Severe impact	18	21.0
Very severe impact	56	72.0

Table 3 shows the results of the response of extension workers regarding Awareness and Knowledge of Climate Change. The data show that 92% of agricultural extension agents were aware of climate change, but only 77% believed themself informed about the problem. It also means that, whereas the notion of climate change is well understood, there are gaps in extension agents' knowledge. The majority (53%) claimed to have moderate knowledge, whereas only 36% had substantial knowledge. This highlights the necessity for ongoing professional development and specialized training programs to improve extension workers' understanding in climate-related topics. Addressing relevance, 95% of respondents agreed that climate change is important to their extension work. However, the level of perceived significance varied, with just 58% rating it as highly relevant. This shows that, while extension agents recognise climate change as an issue, not all actively incorporate it into their advisory jobs. When assessing the impact of climate change on agriculture, 91% of agents recognized the consequences, but their assessments of severity varied. While 72% claimed the effects were extremely severe, 21% saw them as severe, and 7% noticed just minor consequences. This variety reflects probable disparities in experience, training, or direct exposure to climate-related difficulties in agriculture. According to Iwuchuku and Onyeme (2013), the results support the idea that extension agents were aware of how climate change was affecting natural resources including agricultural products.

Table 4: Agricultural Extension Agents' Knowledge Levels in Climate Change Areas

Statements	Knowledgeable N (%)	Moderately Knowledgeable N (%)	Highly Knowledgeable N (%)	Mean	Interpretation (knowledge level)
Basic concepts of climate change	56 (62.2)	24 (26.7)	10 (11.1)	1.5*	Moderate
Climate change effects on agricultural activities	36 (40.0)	44 (48.9)	10 (11.1)	1.7*	Moderate

Climate change effects on farmers' livelihood	30 (33.3)	52 (57.8)	8 (8.9)	1.7*	Moderate
Climate change mitigation options	60 (66.7)	18 (20.0)	12 (13.3)	1.4*	High
Adaptation strategies to climate change	52 (57.8)	27 (30.0)	11 (12.2)	1.5*	Moderate
Constraints to climate change adaptation among farmers	38 (42.2)	34 (37.8)	18 (20.0)	1.8*	Lower

Source: field survey 2022 Midpoint = 2.0; * low knowledge level, ** high knowledge level

Table4
shows the overall awareness, understanding, and perceived importance of climate change among agricultural extension agents. Agricultural extension agents were generally (95.6%) aware of climate change, and 86.7% said they were informed about climate-related concerns. The majority (52.2%) were moderately informed, while 23.3% were very knowledgeable. 64.4% of respondents ranked climate change's relevance as high, and nearly all (97.8%) said it was relevant to their work. Furthermore, 96.7% of respondents agreed that climate change has a significant impact on agriculture, with 76.7% believing the consequences are highly serious. The findings indicate: Climate Change Awareness: 95.6% of agents were aware of climate change, showing that it is a well-recognized phenomenon in the area; Climate Change Issues Knowledge: Although 86.7% of respondents indicated they knew a lot about the topic, just 23.3% thought they knew a lot, indicating that more knowledge is required. Relevance to Extension Work: 64.4% of agents rated climate change as having a strong relevance to their position, while nearly all agents (97.8%) agreed. Perceived Impact of Climate Change on Agriculture: 76.7% of respondents rated climate change's impact as extremely severe, while 96.7% acknowledged its impact on agriculture. This table further evaluates how well-versed extension agents are in particular areas of climate change. Higher knowledge levels are indicated by a lower mean value, which ranges from 1.4 to 1.8. Results in the table explain that a mean score of 1.4 for climate change mitigation alternatives suggests that extension agents are knowledgeable about climate change mitigation strategies. The overall mean values indicate that although extension agents possess an adequate comprehension of climate change concepts, there are still knowledge gaps regarding adaptation constraints and specific consequences for agricultural livelihoods and a mean of 1.8 for constraints to climate change adaptation demonstrates lower knowledge, which indicates that agents may not fully understand the barriers farmers face in adapting to climate change. The results are consistent with Yanfika, Listiana, Mutolib, and Rahmat's (2019) conclusions that the lack of knowledge among agricultural extension staff has resulted in insufficient efforts to mitigate climate change.

Table 5: Major Tasks Performed by Agricultural Extension Agents in Climate Change Issues

Climate Change Tasks	Task Not Performed N (%)	Task Performed N (%)	Task Frequently Performed N (%)	Mean	Interpretation of Tasks Performed
Creating climate change awareness among farmers	40 (44.4)	28 (31.1)	22 (24.5)	1.8*	Moderately
Rendering technical advice to farmers on climate change	18 (20.0)	45 (50.0)	27 (30.0)	2.1**	Frequently
Establishment of SPAT to monitor climate change impacts	25 (27.8)	28 (31.1)	37 (41.1)	2.1**	Frequently
Educating farmers on agrochemical use for climate adaptation (weed/pest control)	25 (27.8)	34 (37.8)	31 (34.4)	2.1**	Frequently
Linkage to credit facilities for climate change adaptation	42 (46.7)	35 (38.9)	13 (14.4)	1.7*	Moderately
Statistical analysis of field data on climate change	45 (50.0)	27 (30.0)	18 (20.0)	1.7*	Moderately
Record keeping on climate change effects/impacts	38 (42.2)	42 (46.7)	10 (11.1)	1.7*	Moderately
Assisting subject matter specialists on climate change issues	30 (33.3)	48 (53.3)	12 (13.3)	1.8*	Moderately
Organizing climate change training/workshops for farmers	36 (40.0)	32 (35.6)	22 (24.4)	1.8*	Moderately
Conducting demonstrations for farmers on climate change	30 (33.3)	36 (40.0)	24 (26.7)	1.9*	Moderately
Weather forecasting on climate change	40 (44.4)	35 (38.9)	15 (16.7)	1.7*	Moderately
Analyzing farmers' problems related to climate change	55 (61.1)	20 (22.2)	15 (16.7)	1.6*	Less frequently
Educating farmers on soil conservation methods	36 (40.0)	25 (27.8)	29 (32.2)	1.9*	Moderately
Using ICTs for effective climate change communication	37 (41.1)	35 (38.9)	18 (20.0)	1.7*	Moderately

Preparation/use of audio-visual instructional materials in teaching climate change	38 (42.2)	23 (25.6)	29 (32.2)	1.8*	Moderately
Indigenous technology development to mitigate climate change	42 (46.7)	28 (31.1)	20 (22.2)	1.8*	Moderately
Improving farmers' knowledge using multimedia projectors for climate change training	50 (55.6)	32 (35.6)	8 (8.9)	1.5*	Less frequently
Program planning on climate change issues	54 (60.0)	26 (28.9)	10 (11.1)	1.5*	Less frequently

Source: Field Survey, 2022 Midpoint = 2.0; *Task not performed; ** Task performed

The information in table 5 demonstrates the range of climate change related activities carried out by agricultural extension agents. It was found that raising farmers' awareness of climate change was a moderately performed task; 44.4% of agents said they did not execute it, 31.1% did so, and 24.5% did so regularly (Mean = 1.8). The frequency of farmers giving technical advice on climate change was higher, with 50.0% of respondents doing so and 30.0% doing so frequently (Mean = 2.1), suggesting that this task is frequently completed. With 41.1% regularly using SPAT (Spatial Planning and Analysis Tool) to track the effects of climate change, this job was also completed frequently (Mean = 2.1). Similar to this, a substantial percentage of farmers, 34.4%, frequently used agrochemicals for climate adaptation (weed/pest management) (Mean = 2.1). However, only a small amount of linkage to finance facilities for climate change adaptation was completed (Mean = 1.7), with 46.7% failing to complete this job. Another job with moderate performance (Mean = 1.7) was statistical analysis of field data on climate change; half of the agents (50.0%) reported non-performance. With means ranging from 1.7 to 1.9, records on the consequences of climate change, helping specialists, planning training workshops, and putting on demonstrations were all completed at moderate levels. It is noteworthy that the least common activities were evaluating farmers' climate change-related issues (Mean = 1.6), enhancing farmers' understanding through multimedia projectors (Mean = 1.5), and developing climate change-related programs (Mean = 1.5). This result is in line with earlier studies (Adisa & Balogun, 2012; Anka, 2016), which found that agricultural extension agents needed a lot of training in climate change-related skills, including weather forecasting, using cultural practices to lessen the effects of climate change, pest control to prevent infestations, conserving soil to prevent evapo-transpiration, and development of programs.

Table 6: Training Needs of Agricultural Extension Agents on Climate Change Issues

Training Needs	**Strongly Agree N (%)**	**Agree N (%)**	**Disagree N (%)**	**Strongly Disagree N (%)**	**Mean**	**Priority Training Needs**
Understanding basic concepts of climate change	72 (80.0)	12(13.3)	2 (2.2)	4 (4.4)	3.7**	Highest
Soil fertility management to reduce climate change impact	60 (66.7)	20 (22.2)	5 (5.6)	5 (5.6)	3.5**	Highest

Agro-chemical skills to reduce weed growth	42 (46.7)	34(37.8)	8 (8.9)	6 (6.7)	3.2**	Moderate
Indigenous technology development for climate adaptation	55 (61.1)	15(16.7)	15 (16.7)	5 (5.6)	3.3**	Moderate
Use of cultural practices to mitigate and adapt to climate change impacts	54 (60.0)	23 (25.6)	9 (10.0)	4 (4.4)	3.4**	Moderate
Application of ICTs for enhanced climate change communication	38 (42.2)	38(42.2)	8 (8.9)	6 (6.7)	3.2**	Moderate
Environmentally friendly management practices to reduce climate change	54 (60.0)	22(24.4)	7 (7.8)	7 (7.8)	3.4**	Moderate
Recording and reporting on climate change impacts	30 (33.3)	40(44.4)	13(14.4)	7 (7.8)	3.0*	Lower
Weather forecasting on climate change	26 (28.9)	46(51.1)	14(15.6)	4 (4.4)	3.0*	Lower
Soil conservation methods skills	47 (52.2)	27(30.0)	13(14.4)	3 (3.3)	3.3**	Moderate
Multilateral decisions and agreements on climate change	20 (22.2)	54(60.0)	12(13.3)	4 (4.4)	2.9*	Lower
Statistical analysis of field data on climate change issues	18 (20.0)	43(47.8)	20(22.2)	9 (10.0)	2.7*	Lower
Evaluation of trials on climate change-related technology	58 (64.4)	22(24.4)	3 (3.3)	4 (4.4)	3.5**	Highest
Effective access and procurement of credit facilities for climate change adaptation	31 (34.4)	38(42.2)	18(20.0)	3 (3.3)	3.1*	Lower
Causes of climate change	43 (47.8)	32(35.6)	12(13.3)	3 (3.3)	3.3**	Moderate
Pest control skills to reduce pest attack	47 (52.2)	32(35.6)	8 (8.9)	3 (3.3)	3.4**	Moderate
Overcoming constraints to climate change adaptation	39 (43.3)	34(37.8)	12(13.3)	5 (5.6)	3.2**	Moderate
Program planning for climate change issues	36 (40.0)	32(35.6)	13(14.4)	9 (10.0)	3.0*	Lower

Source: Field Survey, 2022 Midpoint = 2.5, *Disagreement, **Agreement

The findings in Table 6 show that agricultural extension agents have a severe need for climate change related training. The highest requirement was to understand the fundamentals of climate change, with a

mean score of 3.7 and 80.0% strongly agreeing. With measures of 3.5, soil fertility management to lessen the effects of climate change and the assessment of technological trials connected to climate change were also ranked as high-priority needs. The development of indigenous technology (Mean = 3.3), the use of ICTs for communicating about climate change (Mean = 3.2), and pest control techniques to lessen pest attacks (Mean = 3.4) were among the moderately important training needs. The application of cultural practices (Mean = 3.4) and ecologically friendly management techniques (Mean = 3.4) were two more demands that were fairly valued. Effective access to financing facilities for adaptation (Mean = 3.1), multilateral climate change decisions (Mean = 2.9), and statistical analysis of field data (Mean = 2.7) were lower priority training needs. Additionally, program planning for climate change challenges received a lower ranking (Mean = 3.0), indicating that planning capacities need to be improved.

TABLE 7: Constraints to attend training in climate change

Statements	**Strongly Agree N (%)**	**Agree N (%)**	**Disagree N (%)**	**Strongly Disagree N (%)**	**Mean**	**Constraints**
Insufficient funds to support myself for training	60(66.7)	18 (20.0)	2 (2.2)	10 (11.1)	3.4**	Major
Lack of financial support from my organization	42 (46.7)	38 (42.2)	4 (4.4)	6 (6.7)	3.3**	Major
Inability to access financial support from other sources	42 (46.7)	38 (42.2)	5 (5.6)	5 (5.6)	3.3**	Major
Inability to identify the right training to address my needs	9 (10.0)	27 (30.0)	39 (43.3)	15 (16.7)	2.3*	Moderate
Lack of information on relevant training opportunities	5 (5.6)	30 (33.3)	35 (38.9)	20 (22.2)	2.2*	Moderate
Organization's rejection of my application for training travel	7 (7.8)	34 (37.8)	36 (40.0)	13 (14.4)	2.3*	Moderate
Excessive workload and limited time for training	9 (10.0)	18 (20.0)	18 (20.0)	45 (50.0)	1.8*	Least

Source: Field Survey, 2022 Midpoint = 2.5, *Disagreement, **Agreement

Table 7 lists the obstacles that prevent extension agents from taking part in training programs on climate change. Insufficient money for self-sponsorship (Mean = 3.4), a lack of organizational financial assistance (Mean = 3.3), and an inability to obtain financial aid from other sources (Mean = 3.3) were the main obstacles found. These results imply that access to training is significantly hampered by budgetary limitations. Lack of knowledge about pertinent training possibilities (Mean = 2.2), trouble finding appropriate training programs (Mean = 2.3), and organizational rejection of training applications (Mean = 2.3) were examples of moderate restrictions. With a mean score of 1.8, excessive workload and

little training time were the least restrictive factors, suggesting that financial obstacles were more important than workload.

Conclusion

The results show that although agricultural extension agents are essential in tackling climate change challenges, their involvement in many important jobs is still only moderate. Some responsibilities, such linking to credit, program planning, and multimedia-based training, are less common than others, like providing technical advice and educating people about the use of agrochemicals. According to the training needs analysis, there is a high demand for understanding basic climate change concepts, managing soil fertility, and assessing climate-related technologies. The greatest obstacle to stopping agents from attending required training, however, continues to be budgetary limitations.

Recommendations

1. Increase Financial Support: To make it easier for extension agents to receive training on climate change problems, government organizations and non-profits could offer financial aid or scholarships.
2. Raise Awareness and Information about Training Opportunities: Using technological resources and organizational methods of communication, attempts have to be undertaken to spread knowledge about the training programs that are offered.
3. Strengthening Program Planning and Credit Linkage Initiatives: To effectively assist farmers in adapting to climate change, extension agents should undergo specialized training in program planning and financial access facilitation.
4. Encourage the Use of ICTs and Multimedia for Training: To increase the effectiveness of educating farmers about climate change, training should include digital tools and multimedia resources.
5. Promote Policy Support for Climate Change Training: It is important to implement policy changes that guarantee agricultural extension agents are required to attend recurring training sessions on climate change.

Conflict of interest: All the authors showed no conflict of interest among each other on any of the aspect of research work.

Acknowledgement: The contribution of each of the mentioned author is acknowledged. Their collective efforts helped in completing this research work.

References

Adeola, R. G., & Ayoade, A. R. (2011). Extension personnel's perception of the information needs of women farmers in Oyo State, Nigeria. Global Journal of Human Social Science, 11(10), 33–36.

Adisa, R., & Balogun, S. (2012). Analysis of training needs of extension agents on climate change issues in Ekiti State Agricultural Development Project (ADP). Journal of Agricultural Extension, 16(2), 24–33.

Agbamu, J. U. (2005). Problems and prospects of agricultural extension service in developing countries. In S. F. Adedoyin (Ed.), Agricultural Extension in Nigeria (pp. 52–62). ARMTI, Ilorin: Agricultural Extension Society of Nigeria.

Airemen, S. A. (2005). Training needs of extension staff in agriculture: A case study of Edo State Agricultural Development Programme (Unpublished B.Sc thesis). University of Benin, Benin-City, Nigeria.

Ali, M., Hussain, I., Ullah, R., & Ullah, S. (2021). Training needs assessment of extension workers for agricultural development in Khyber Pakhtunkhwa province of Pakistan.

Journal of Agriculture and Rural Development in the Tropics and Subtropics, 122(1), 1–13.
Anka, L. M. (2000). Identification of skills and professional competencies needed by agriculture extension agents in Zamfara State of Nigeria. The Legacy (Agriculture), Zamfara State Government Newspaper, 6.
Anka, L. M. (2014a). Crop farmers' perception and adaptation strategies to climate change in Faskari Local Government Area, Katsina State of Nigeria (Unpublished research paper).
Anka, L. M. (2016). Analysis of training needs of extension agents on climate change issues in Zamfara Agricultural Development Project (ZADP), Nigeria. Pakistan Journal of Agricultural, Agricultural Engineering & Environmental Sciences, 32(1), 66–74.
Antwi-Agyei, P., & Stringer, L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from Northeastern Ghana. Climate Risk Management, 32, 100304.
Beyioku, J. (2016). Climate change in Nigeria: A brief review of causes, effects, and solution. Federal Ministry of Information and Culture, Federal Republic of Nigeria. Retrieved from https://fmic.gov.ng/climate-change-nigeria-brief-review-causes-effects-solution/.
Duncan, J. A. (1957). Training cooperative extension workers. Cooperative Extension Service, University of Wisconsin, Madison, USA.
Ejembi, E. P., Omoregbee, F. E., & Ejembi, S. A. (2006). Farmers' assessment of the training and visit extension system in central Nigeria: Evidence from Barkin Ladi, Plateau State. Journal of Social Sciences, 12(3), 207–212.
Enete, A. A., & Amusa, T. A. (2010). Challenges of agricultural adaptation to climate change in Nigeria: A synthesis from the literature. Field Actions Science Reports. Retrieved from http://journals.openedition.org/factsreports/678.
FAO & ECOWAS Commission. (2018). National gender profile of agriculture and rural livelihoods – Nigeria. Country Gender Assessment Series, Abuja.
Godson Ibeji, C. C., Chikaire, J. U., Anaeto, F. C., & Oparaojiaku, J. O. (2020). Capability competence of agricultural extension staff for helping rural farming communities adapt/mitigate to climate change variability in Imo State, Nigeria. Journal of Biology and Today's World, 9(7), 232–237.
Government of Pakistan. (2022). Economic survey of Pakistan 2021-22. Ministry of Finance. Retrieved from https://www.scribd.com/document/577666138/Economic-Survey-2021-22.
Haider, H. (2019). Climate change in Nigeria: Impacts and responses. Knowledge, Evidence and Learning for Development Helpdesk.
Hassan, M. (2010). Gender mainstreaming in agricultural extension: Analysis and obstacles to gender mainstreaming in agriculture extension: A case study of district Muzaffargarh, Pakistan. Germany: VDM-Verlag Dr. Müller GmbH & Co. KG.
Hussain, I., Ahmad, T., Hussain, M., & Ahmad, W. (2021). Evaluation of agricultural extension workers' competence in Punjab, Pakistan. Sarhad Journal of Agriculture, 37(1), 276–282.
Ifeanyi-Obi, C. C., Etuk, U. R., & Jike-Wai, O. (2012). Climate change, effects and adaptation strategies: Implication for agricultural extension system in Nigeria. Greener Journal of Agricultural Sciences, 2(2), 53–60.
Ifeanyi-Obi, C. C., Togun, A. O., Lamboll, R., Adesope, O. M., & Arokoyu, S. B. (2017). Challenges faced by cocoyam farmers in adapting to climate change in Southeast Nigeria. Climate Risk Management, 17, 155–164. https://doi.org/10.1016/j.crm.2017.04.002
Iwuchukwu, J., & Onyeme, F. (2013). Awareness and perceptions of climate change among

extension workers of Agricultural Development Programme (ADP) in Anambra State, Nigeria. Journal of Agricultural Extension, 16(1), 104–118.

Jones, M., & Garcia, A. (2021). Exploring the relationship between farming experience and skill acquisition in agricultural extension workers. Agricultural Education Research Journal, 36(2), 89–104.

Khan, M. H. N. (2024). An analysis of professional and technical in-service training needs assessment of extension field staff of Southern Punjab, Pakistan (Doctoral dissertation). Sindh Agriculture University, Tando Jam, Pakistan.

Khan, M. H. N., Kumbhar, M. I., Khooharo, A. A., & Magsi, H. (2024). A SWOT analysis of in-service training programs for agricultural extension workers in Southern Punjab, Pakistan. Traditional Journal of Law and Social Sciences, 3(2), 84–98.

Khan, M. H. N., et al. (2024). An analysis of professional and technical in-service training needs assessment of extension field staff of Southern Punjab, Pakistan. Remittances Review, 9(S4), 1055–1082. https://doi.org/10.33282/rr.vx9i2.60

Mustapha, S. B., Undiandeye, U. C., & Gwary, M. M. (2012). The role of extension in agricultural adaptation to climate change in the Sahelian zone of Nigeria. Journal of Environment and Earth Science, 2(6), 48–59.

Rivera, W. M., Gustafson, D. J., & Leeuwis, C. (Eds.). (2018). Agricultural extension: Worldwide institutional evolution and forces for change. Cambridge University Press.

Zafezeka, M. Z., Paramu, L. M., Maxwell, M., & Obert, J. (2019). Climate change mainstreaming in extension agents' training curricula: A case of Mopani and Vhembe District, Limpopo Province, South Africa. Journal of Asian & African Studies, 55(1), 44–57. https://doi.org/10.1177/0021909619857098