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Building Climate Resilience: Competency-Based Training Needs Assessment of Extension Workers in Pakistan

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ABSTRACT

Extension field staff is the group of people who are responsible for managing activities related to agricultural information dissemination and farming community is the recipient or audience of that knowledge by implementing this knowledge on farm, farming community may enhance their farm productivity and uplift socio-economic situation. The Present study was based on primary data, collected from agricultural extension field staff (EFS) using interview schedule in cotton belt of Punjab province. Three hundred and fifty-nine (359) extension field staff workers were selected from population of five hundred and forty (540) by using Cochran sampling technique. Moreover, Borich needs assessment model was implied to prioritize the training needs of EFS about climate adaptation. Study found that majority of the EFS seek trainings in specific areas regarding climate variability including; skills to use meteorological instrument, ability to comprehend early warning system, serving and mapping of climatic variability areas, management of ICT tools for weather forecasting, disaster management skills, and integrated soil management skills by acquiring these competencies they can effectively and efficiently work for minimizing the consequences of climate variability on cotton crop. There was significant positive correlation of 0.608 between specialization and possessed competencies regarding climate adaptation which shows that specialized extension staff possessed competencies regarding climate adaptation. On the basis of findings study suggests that the training needs of the extension field workers should be assessed regularly regarding various latest techniques and technologies. Training sessions regarding climate variability adaptation should be arranged for extension workers of cotton belt.

Key Words: Borich Need Assessment Model, Cotton Belt, Climate Variability, Correlation Analysis, Extension Field Staff, Pakistan.

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INTRODUCTION

Agriculture contributes a large share in Pakistan's development, as it is a mainstream portion of the country's economy, with 22.9 % to the Grass Domestic Product (GDP) having growth rate of 1.55% and provides livelihood to 37.4% of the labor force (GoP, 2023). The improvement and sustainable growth in agriculture sector will enhance the farm income, reduce the prices for consumers and increase the diverse food supplies that generate export surplus.

Agriculture production of Pakistan is much lower than many other countries of the world due to various factors, like traditional cultivation methods, non-adaptation of latest agricultural technologies, lower level of education and poor farm management (GoP, 2024). Rural development and investment in the agriculture sector is still below potential. The farming community of the country faces various problems such as unstable situation of market that is manipulated by intermediaries, marketing decisions and suitable information. The poor transportation system, no store houses in rural areas and non-participation in market decisions by the farming community has restricted/forced them to sell their output at low profit (FAO, 2016). **The changing climate is one of the biggest problems faced by agriculture sector of region. The production of crops in the Pakistan is significantly drop due to unexpected climate pattern. The cotton which is major cash crop of country is highly damaged in 2023 by the hazardous effects of climatic variability. Severe heat waves during the germination period burns the seedlings. Floods wipes out the fields that overall affects the production of crops (GoP, 2023).**

Intergovernmental Panel on Climate Change (IPCC) defines Climate change or climate variability is a transformation over time in the climate whether due to individual' activity or result of any natural changeability. The definition of IPCC is dissimilar from the definition given by Climate Change Framework Convention (CCFC), climate change or variability is directly or indirectly due to human activities that disturb the atmosphere these changes add to natural variability which we observe with time period.

The rise of industrialization and industrial revolution in 18^{th} and 19^{th} century many changes in climate and weather were observed with passage of time that leads toward climatic change/ variability and enhance the climate modeling and research (IPCC, 2000; Afsar, 2019). Scientists nowadays, has views that these changes in climate are due to the anthropogenic origin and it is main reason behind changes. The associated emission of Carbon dioxide (CO_2), Nitrogen (N_2O), Methane (CH_4) and massive burning of fossil fuel causes disturbances and pollution in

environment (IPCC, 2013; Afsar, 2019). The major reason behind warmness of climate is changes in greenhouse gases concentration that has the ability to observe the earth surface infrared radiations (IPCC, 2013; Afsar, 2019). **Climate variability completely effects the agricultural productivity so agricultural crop relay on climatic situation. Lack of awareness about unexpected threats and adverse effects of climatic variability among farming community generally and cotton producers specially is major reason between the gap of potential and average yield. EFS act as agricultural educators and knowledge providers so it is need that they should be well competent about tackling and solving the problems of 21st century such as unexpected occurring of climatic variability and problems faced by cotton growers due to these threats. However, EFS found unfamiliar and less equipped with the competencies regarding climate change adaptation.**

Pakistan has not exception of global warming and climatic variability because both these not follow any boundary of geographic or politics. Unexpected rise in temperature and irregular changing pattern of precipitation are observed in last two decades. Pakistan has diverse climatic pattern as extreme cold observed in northern areas and burning temperature in the southern areas of country. World's highest mountainous ranges available in country protect the cold waves in south and extreme monsoon rains in north Pakistan. Hydrological changes have been seen due to rise in temperature as water availability periods, cropping pattern, droughts, heat wave intensity, weather induced disasters and changes in precipitation pattern (Bosshard, 2006; Rasul et al., 2012).

Extension field staff is the group of people who are responsible for managing activities related to agricultural information dissemination and farming community is the recipient or audience of that knowledge by implementing this knowledge on farm, farming community may enhance their farm productivity and uplift socio-economic situation. For achieving the sustainable agriculture development, it is necessary to have efficient extension co-ordination among farming community, EFS and research (Shalaby *et al.,* 2010).

Extension field workers are important mediators among research stations and farmers, play a vital role in promoting agricultural practices. However, effectiveness of their duties depends on competency including skills, knowledge regarding adaptation of climate variability. In spite of this important role, a gap exists in assessment of competency required by extension field staff for building climate resilience in farming community. Present studies rarely identified the specific training needs of extension field staff regarding climate

adaptation. In results, different initiatives of capacity building remain misaligned with the problems faced by extension staff regarding climate adaptation that reduced their efficiency and impact in the field. The present study addresses persistent needs of the extension field staff for in Pakistan regarding climate variability adaptation. Furthermore, identify the gap in knowledge and skills, aims to deliver actionable insights which helps in designing specialized capacity building trainings. The study will help in strengthening the extension field staff role in promoting climate variability adaptation and sustainable development.

RESEARCH METHODOLOGY:

The Present study was based on primary data, collected from agricultural extension field staff (EFS) using interview schedule in cotton belt of Punjab province of Pakistan. Five districts (Bahawalnagar, Bahawalpur, Multan, Rahimyar Khan and Rajanpur) form cotton belt of Punjab province were selected from different agro-ecological zones. Bahawalnagar, Bahawalpur, Multan, Rahimyar Khan and Rajanpur are selected from cotton mix cropping, cholistan desert, mix cropping, arid irrigated and cotton-sugarcane zones respectively. **The Cochran sampling technique is effective in selecting statistically reliable and valid sample size. It helps in determining the minimum sample size required to make precise inferences of the population and it controls sampling error. This is especially beneficial in research where characteristics of the population may vary, and accurate representation is critical for obtaining consistent conclusions.** Three hundred and fifty-nine (359) extension field staff workers were selected from population of five hundred and forty (540) by using cochran sampling technique at 95% level of confidence and 3% of confidence interval.

Formula for obtaining the sample size used by cochran sampling technique is presented below

$$S.S = \frac{Z^2 * (p) * (1-p)}{C^2}$$

Where, Z= Z value (value of confidence interval), P= Percentage picking a choice, and C= Confidence interval.

Well-structured interview schedule was designed for data collection. Pre-testing was performed on 15 respondents for evaluating the validity of instrument. The interview schedule was furnished after making necessary changes according to results of pre-testing. After collection, data coded in Microsoft excel. Data was analyzed by using Statistical Package for the Social Sciences (SPSS)

version 27.0. Descriptive as well as inferential statistics were implied to analyze the data and draw results from obtained data. Frequency, percentages and means are calculated for drawing results regarding socio-economic factors. Bivariate correlation analysis was performed to check the relationship between different variables such as social economic factors and competencies regarding climate adaptation.

Moreover, Borich needs assessment model was implied to prioritize the training needs of extension field staff (EFS) about climate adaptation. The aim of this model is to measure "what is" and "what should be" the performance and competencies of extension workers. Mean weighted discrepancy score (MWDS) was calculated in Borich needs assessment model to prioritizing the training needs. For 5-Point Likert scale value of MWDS should be between 4 and 20 (Borich, 1980; **Ashraf et al., 2020**). **The Borich Needs Assessment Model is a significantly improved model that prioritized training needs by analyzing the gap between possessed and require competency and skills level. This model ensures the efforts are focused on critical skill set by generating mean weighted discrepancy score (MWDS). Its flexibility allows to tailor the competency statements to the precise needs of agricultural extension staff. The model ensures the acceptance of the training programs by directly involving stakeholders in the process. It provides proven, data driven framework that aligns with study' objective to develop focused, impactful and evidence-based training programs (Lee et al., 2023).**

Following five (05) steps were followed to apply Borich need assessment model;

- Use MS Excel for data tabulation obtained through interviewing respondents by using well-structured interview schedule
- Subtract possessed from required for measuring discrepancy score (DS) **(DS= required – possessed)**
- Multiply overall mean of required with discrepancy score for calculating weighted discrepancy score (WDS) **(WDS = DS × $\bar{x}$ required)**
- Find the mean of WDS for measuring MWDS
- Rank competencies on the basis of MWDS for prioritizing training needs of the extension field staff.

RESULTS AND DISCUSSION:

Demographic Factors

Demographic factors are used to define or examine the characteristics of a population or sampled group. Some commonly used demographic factor are variables such as age, experience, education, income etc.

Age of the Respondents

Age is referred to the numbers of years a person spends in his life span from birth to death (Naqvi et al., 2020). It directly affects the individuals' way of thinking, observation, attitude toward things, ideas of a person and way of performing activities (ibid). The results of study indicate that most (43.5%) of the respondents lied in the category of young having age between 20 to 35 years while slightly more than one-third (38.2%) of the respondents are middle-aged lied in the age group of 36-50 (Fig. 01). The results further showed that about one-fifth (18.4%) of the respondents are in the age group of above 50. Results are slightly different from Ashraf et al., 2020 who conducted a study regarding in-service training needs of EFS about climate change in District Sargodha and reported that most (47.7%) of the respondents are lied in the age group of 41-50. This difference is due to the areas difference and new induction in the Department of Agriculture Punjab.

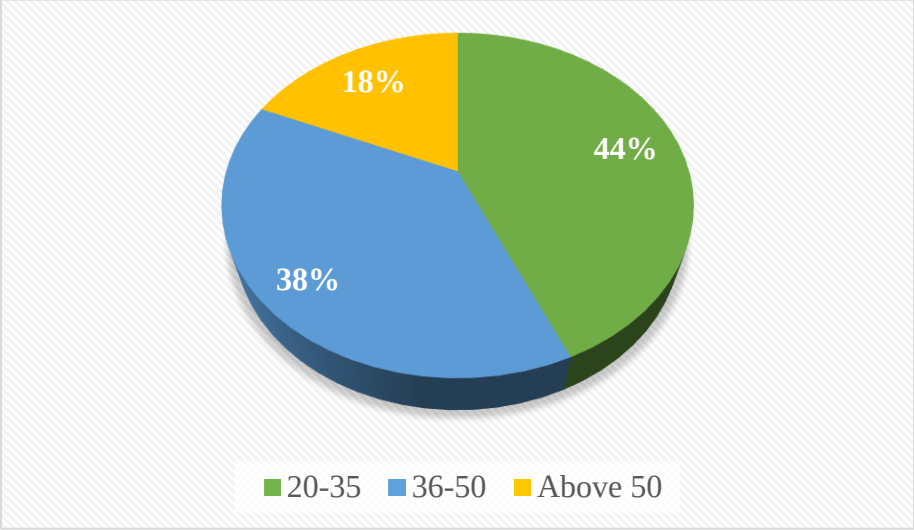

Fig 01. Age of the Respondents.

Education of the Respondents

Education enhances the ability of a person to act or react against any phenomenon, activity or any statement. The results of study disclosed that Majority (82.2%) of the respondents earned diploma in agriculture while one-eighth (12.5%) of the respondents have M.Sc. (Hons.) Degree in

the specialized field of agriculture and serve the Department of Agriculture, Punjab as officer (Fig. 02). The present study also revealed very small number (2.8%) and (2.5%) had the education of B.Sc. (Hons.) and Ph.D. respectively in the specialized fields of agriculture.

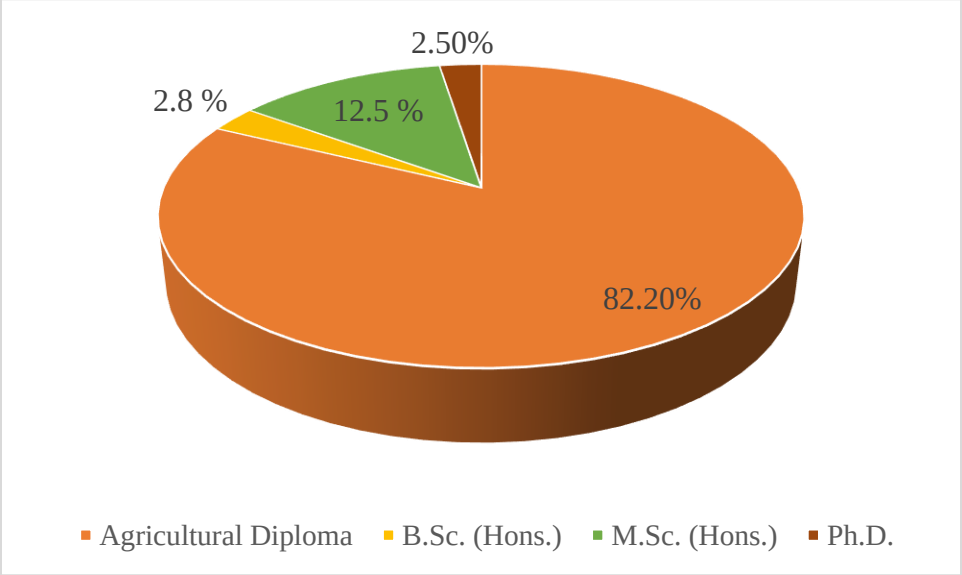

Fig. 02. Educational Level of the Respondents.

Specialization of the Respondents

The results of study revealed that Majority (82.2%) of the respondents recognized themselves as basic agriculture specialist while 7.5% of the respondents were specialized in the field of Agronomy, 3.1% were specialized in the field of Entomology and 2.2% of the respondents were specialized in the field of Soil Science (Table 1). The study further disclosed that 1.4% of the respondents had specialization in the field of Plant Pathology and Horticulture. Furthermore, 0.8% of the respondents had chosen PBG (Plant Breeding & Genetics) and Agriculture Extension as area of specialization for themselves. Study found that for the extension and education activities there are small number of agriculture extension specialists, that is one of the reasons behind slow growth rate of agriculture sector.

Table 1. Subject Specialization of the Respondents.

Specialization	Frequency	Percent
General Agriculture	295	82.2
Agriculture Extension	3	0.8
Agronomy	27	7.5
Plant Pathology	5	1.4
PBG (Plant Breeding & Genetics)	3	0.8
Entomology	11	3.1
Horticulture	5	1.4
Food Technology	1	0.3
Soil Science	8	2.2
Agricultural Economics	1	0.3
Total	359	100.0

Source: Field Survey, 2024.

Portfolio Held

The results of study revealed that Majority (82.7%) of the respondents are working as Field Assistant (FA) they are responsible for field extension and education activities at village level almost one village was allotted to one FA and sometimes there are more than one village allotted to FA, while one-seventh (14.2%) of the respondents are Agriculture Officers (AOs), they are responsible for the extension education activities at Markaz level (Fig 03). Markaz is consisting of 10-13 villages. The study further found that little number (3.1%) of the respondents are working as Cotton Inspectors (CI). They are specialist in cotton cultivation and responsible for extension activities regarding cotton sometimes.

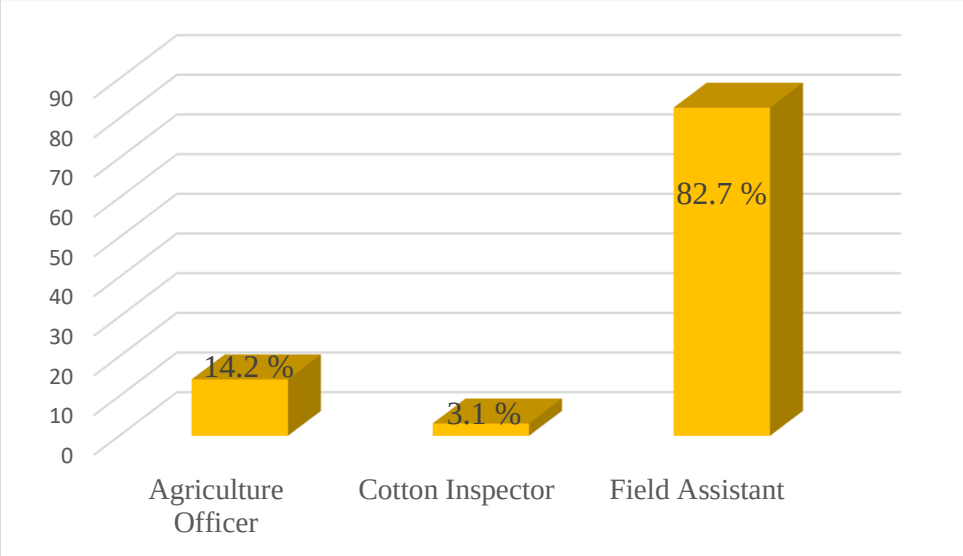

Fig 03. Designation of the Respondents.

Job Experience of the Respondents

Experience of a person counted as an important factor in analyzing skills, competencies and expertise. The diffusion or adoption of any skill, knowledge and technology is directly related to experience of an individual. The results of study disclosed that two-third (61.8%) of the respondents having experience up-to 15 years while slightly less than one-third (30.9%) of the respondents having experience of 15-30 year (Fig 04). The study also disclosed that 7.2% of the respondents had experience above 30 years.

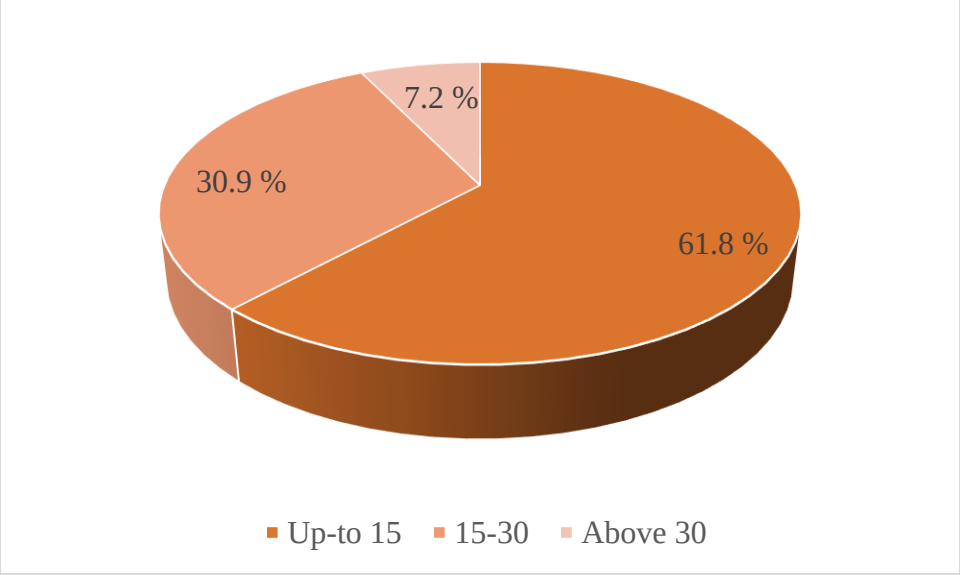

Fig 04. Job Experience of the Respondents.

Possessed Competencies about Climate variability

Extension field staff (EFS) in the study area was not competent enough in comprehending early warning system about climatic situation and not having skills to use meteorological instruments. They are less competent in management of ICT tools for weather forecasting (Table 2). They were unable to advice cotton growers abut latest innovations and adaptation strategies about climate variability because they are less competent in reading and understanding climate related Publications.

Results of the study found that extension field staff (EFS) possessed competencies about inform cotton producers about market information, educate cotton producers about climate variability, prepare cotton producers about natural disaster in advance, ability to educate farmer on IPM (Integrated pest management) and knowledge about climate variability and ranked 1st, 2nd, 3rd, 4th and 5th respectively (Table 6).

EFS are less competent about disaster management skill, climate change adaptation strategies, weather change forecasting.

Table 2. Possessed Competencies of Respondents about Climate Variability.

Possessed Attributes	Mean	Standard Deviation	Rank
Inform cotton producers about market information.	1.529	1.037	01
Educate cotton producers about climate variability.	1.523	1.021	02
Prepare cotton producers about natural disaster in advance.	1.518	1.002	03
Ability to educate farmers on IPM.	1.515	1.118	04
Knowledge about climate variability	1.509	1.037	05
Improve irrigation management.	1.509	1.056	06
Climate change adaptation strategies.	1.484	0.941	07
Climate change mitigation management skills.	1.481	1.002	08
Ability to address the climate effect(s)	1.473	1.004	09
Weather change forecasting.	1.467	1.048	10
Skills for climate variability risk management.	1.448	0.943	11
Integrated soil management skills.	1.431	1.033	12
Read and refer climate variability related publication.	1.428	0.968	13
Disaster management skills.	1.423	0.974	14
Management of ICT tools for weather forecasting.	1.370	0.939	15
Serving and mapping of climate variability areas.	1.367	0.944	16
Ability to comprehend early warning system.	1.345	0.883	17
Skills to use meteorological instruments.	1.323	0.928	18

Scale: 1= very Low, 2= Low, 3= Moderate, 4= High, 5= very High.

Required Competencies about Climate Variability

Agricultural extension field staff (EFS) found to be less competent in dealing with threats and effects of climate variability. Majority of the extension field workers showed interest in attaining skills to use meteorological instruments and ability to comprehend early warning system by this they can measure climatic situation early and plan accordingly to overcome the adverse effects of climate variability. The extension field workers also showed interest in obtaining top needed competencies that are required for welfare of country as well as farmers, such as, serving and mapping of climate variability areas, management of ICT tools for weather forecasting, disaster management skills, integrated soil management skills, read and refer climate variability publication and skills for climate variability risk management (Table 3).

Inform cotton producers about market information was the lowest requirement for the extension field workers in the scenario of climate variability and adaptation (Table 3). Furthermore, the finding of study found that extension field workers required much more skills in climate change adaptation strategies, climate change mitigation management skills, knowledge about climate variability and ability to educate cotton producers on IPM.

Table 3. Required Competencies of the respondents about Climate Variability.

Required Attributes	Mean	Standard Deviation	Rank
Skills to use meteorological instruments.	4.033	0.893	01
Ability to comprehend early warning system.	3.991	0.857	02
Serving and mapping of climate variability areas.	3.974	0.898	03
Management of ICT tools for weather forecasting.	3.972	0.887	04
Disaster management skills.	3.919	0.891	05
Integrated soil management skills.	3.913	0.939	06
Read and refer climate variability related publication.	3.902	0.896	07
Skills for climate variability risk management.	3.888	0.854	08
Weather change forecasting.	3.871	0.945	09
Ability to address the climate effect(s)	3.871	0.884	10
Climate change mitigation management skills.	3.866	0.880	11
Climate change adaptation strategies.	3.857	0.814	12
Improve irrigation management.	3.849	0.906	13
Knowledge about climate variability	3.830	0.901	14
Ability to educate farmers on IPM.	3.830	0.981	15
Educate cotton producers about climate variability.	3.818	0.876	16
Prepare cotton producers about natural disaster in advance.	3.816	0.874	17
Inform cotton producers about market information.	3.813	0.888	18

Scale: 1= very Low, 2= Low, 3= Moderate, 4= High, 5= very High.

Prioritized Competencies regarding Climate Variability

There is a major emphasis on trainings of extension field workers regarding climate variability and need is to prioritize the areas of training requirement and to categorize the areas where training is required to make them technically competent in resolving the various problem and issues faced by cotton growers related to adverse effects of climatic variability. There is a need for trainings during service for extension workers to tackle hurdles faced by farming community regarding adaptation and mitigation of climatic variability (Anka, 2016). The basic objective of the present study was to identify the training needs of extension field staff regarding climate variability adaptation by using Borich needs assessment model. The model calculates mean weighted discrepancy score (MWDS) to prioritize the training needs of EFS for improving their possessed skills, competencies and achieve the required level of competency in identified areas of climatic variability adaptation by that they can effectively and efficiently play role in agriculture improvement specially for the better cotton production.

The results of study revealed highest mean weighted discrepancy score of 10.54 for skills to use meteorological instruments, which mean it is foremost training need for the EFS in scenario of climate variability adaptation (Table 4). Furthermore, study found ability to comprehend early warning system, serving and mapping of climate variability areas, management of ICT tools for

weather forecasting, disaster management skill and integrated soil management skills as the much-needed training need ranked 2nd ,3rd ,4th ,5th and 6th respectively.

Moreover, study disclosed that read and refer climate related publication ranked at 7th most needed training with MWDS of 9.62 while skills for climate variability risk management ranked at 8th most needed training with MWDS of 9.492.

Many of the respondents are already capable of informing cotton producers about market information and satisfied about educating cotton growers regarding climate variability.

Table 4. Prioritized Competencies by the Respondents about Climate Variability.

Attributes	Required		Possessed		Prioritized	
	Mean	SD	Mean	SD	MWDS*	Rank
Skills to use meteorological instruments.	4.033	0.893	1.323	0.928	10.543	01
Ability to comprehend early warning system.	3.991	0.857	1.345	0.883	10.294	02
Serving and mapping of climate variability areas.	3.974	0.898	1.367	0.944	10.142	03
Management of ICT tools for weather forecasting.	3.972	0.887	1.370	0.939	10.120	04
Disaster management skills.	3.919	0.891	1.423	0.974	9.709	05
Integrated soil management skills.	3.913	0.939	1.431	1.033	9.654	06
Read and refer climate variability related publication.	3.902	0.896	1.428	0.968	9.622	07
Skills for climate variability risk management.	3.888	0.854	1.448	0.943	9.492	08
Weather change forecasting.	3.871	0.945	1.467	1.048	9.351	09
Ability to address the climate effect(s)	3.871	0.884	1.473	1.004	9.329	10
Climate change mitigation management skills.	3.866	0.880	1.481	1.002	9.275	11
Climate change adaptation strategies.	3.857	0.814	1.484	0.941	9.232	12
Improve irrigation management.	3.849	0.906	1.509	1.056	9.102	13
Knowledge about climate variability	3.830	0.901	1.509	1.037	9.026	14
Ability to educate farmers on IPM.	3.830	0.981	1.515	1.118	9.004	15
Prepare cotton producers about natural disaster in advance.	3.816	0.874	1.518	1.002	8.939	16
Educate cotton producers about climate variability.	3.818	0.876	1.523	1.021	8.928	17
Inform cotton producers about market information.	3.813	0.888	1.529	1.037	8.885	18

*MWDS= Mean Weighted Discrepancy Score.

Correlation analysis of different variables

Correlation analysis performed for evaluating the relationship between different variables of the study such as socio-economics including age, education, experience and Possessed competencies

of EFS regarding climate variability and adaptation. The results of the Bivariate correlation are presented in Table 5.

There was highly significant but negative correlation of -0.187 and -0.176 between age and education and age and specialization respectively (Table 5). The relationship between age with education and age with specialization disclosed that older extension staff had lower education level as study found that most of the older staff were FAs and their education is agricultural diploma. There was a significant positive correlation of 0.168 and 0.964 between age and portfolio held and age and experience. The strength of relationship between age and experience revealed that the older staff had more experience in the field. While the study found non-significant correlation between age and possessed competencies regarding climate adaptation.

There was significant positive correlation of 0.810, 0.929 and 0.744 between education and specialization, education and portfolio held and education and possessed competencies regarding climate adaptation. The strength between relationship of education with specialization and education with possessed competencies found that educated staff possess the competencies regarding climate adaptation and they are specialized in their field of work. Study further revealed significant but negative correlation between education and experience in the Department of Agriculture.

There was significant positive correlation of 0.608 between specialization and possessed competencies regarding climate adaptation which shows that specialized extension staff possessed competencies regarding climate adaptation. Study further disclosed that there is significant but negative correlation of -0.759 and -0.213 between specialization and portfolio held and specialization and experience.

There was significant positive correlation of 0.133 between experience and possessed competencies regarding climate adaptation. The relationship of experience with PCCA (Possessed Competencies of Climate adaptation) disclosed that extension staff having more experience possessed higher competencies regarding climate adaptation.

Table 5. Bivariate Correlation analysis of different variables.

	Age	Edu.	Spec.	JT	Exp.	PCCA
Age	1					
Edu.	-0.187**	1				
Spec.	-0.176**	0.81**	1			
JT	0.168**	0.929**	-0.759**	1		
Exp.	0.964**	-0.229**	-0.213**	0.219**	1	
PCCA	-0.09	0.744**	0.608**	-0.752**	0.133*	1
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						
PCCA= Possessed Competencies of Climate adaptation, Edu. = Education, Spec. = Specialization, JT= Job Title, Exp. = Experience						

CONCLUSIONS AND RECOMMENDATIONS

The present study concluded that most of the EFS were young and their experience is low that is one of reason for their less competency about climatic variability adaptation. Experience in the field had direct effect on competencies possessed by EFS the strong correlation was found in the study between these variables. It is concluded that majority of the EFS seek trainings in specific areas regarding climate variability including; skills to use meteorological instrument, ability to comprehend early warning system, serving and mapping of climatic variability areas, 4) management of ICT tools for weather forecasting, disaster management skill, integrated soil management skills by acquiring these competencies they can effectively and efficiently work for minimizing the consequences of climate variability on cotton crop. The possessed competencies and training of the extension field staff are not up to the mark for tackling the adverse effects and consequences of climate variability. The consequences of climate variability on cotton crop could be managed and addressed properly by continuous trainings to the extension field workers regarding climate variability and its adaptation.

On the basis of findings, study recommend that;

- **Department of Agriculture should organize competency-based training sessions regarding usage of meteorological tools, disaster management and early warning systems for the extension field staff regularly.**

- **Department of Agriculture should start a mentorship program for the younger extension staff to enhance their practical knowledge regarding climate adaptation by pairing them with experienced workers.**

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