Research Article

An Assessment of In-service Training Needs for Agricultural Extension Field Staff in the Scenario of Climate Change using Borich Needs Assessment Model

Ejaz Ashraf[1]*, Anam Sarwar[2], Muhammad Junaid[1], Mirza B. Baig[3], Hafiz Khurram Shurjeel[4] and R. Kirby Barrick[5]

[1]Department of Agricultural Extension, College of Agriculture, University of Sargodha, Sargodha, Punjab, Pakistan; [2]Department of English, The Women University Multan, Multan, Punjab Pakistan; [3]Department of Agricultural Extension and Rural Society, College of Food and Agriculture Sciences, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia; [4]Department of Agricultural Entomology, College of Agriculture, University of Sargodha, Sargodha, Punjab-Pakistan; [5]College of Agricultural and Life Sciences, University of Florida, Gainesville, Florida, USA.

Abstract | Climate change is recognized as the most conspicuous and leading threat to the global agricultural system, particularly for developing countries. Pre-service and in-service training becomes extremely important for Extension Field Staff (EFS) to develop skills and abilities to assist them in identifying and addressing the impacts and challenges of climate change. This study was designed to utilize the Borich Needs Assessment Model for assessing the existing competencies and the training needs of EFS in the scenario of climate change. A descriptive survey research method was employed in this census study. There were 147 working EFS and 130 of them participated in the study. A well-defined structured interview schedule was designed for data collection. The Borich Needs Assessment Model was applied on Microsoft Excel sheets to identify the training needs of EFS, and Statistical Package for Social Sciences (SPSS) version 20.0 used for additional analyses. The results indicated that humans are the chief representatives of alterations in climate systems. The extension field staff was incompetent in dealing with the threats of climate change due to their lack of knowledge regarding climate change adaptation, mitigation and strategies and the deficiency of climate-related skills or competencies. The extension field staff exhibited a confident attitude towards training in the arena of climate change adaptation and mitigation to help close the gap between potential crop yield and average crop yield and to update the living standards of rural societies. Therefore, in-service and pre-service training sessions should be arranged to develop and enhance the competencies of extension field staff in the area of climate change.

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***Correspondence** | Ejaz Ashraf, Department of Agricultural Extension, College of Agriculture, University of Sargodha, Sargodha, Punjab, Pakistan; **Email:** ejaz.ashraf@uos.edu.pk
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Introduction

Agriculture and livestock deal directly with the economy of nations. Almost 75% of rural food security can be improved with the help of agriculture, and it can also help reduce poverty and raise the living standard of the rural people. The Food and Agricultural organization (FAO, 2013) reported that nearly 60% of the world's starving population lives in rural areas of Asia and Pacific region and heavily depends on livestock income to buy their essential agricultural inputs. Agriculture is the engine for economic development. Agriculture is not only limited to crop production, animal rearing or fish farming but also linked to industrial growth and economic development of the country.

Pakistan is a very vibrant agricultural country. Agricultural experts entitled Pakistan as the 'gold sparrow' of Asia due to the potential production level and land quality of Pakistan. Agriculture is regarded as important for the redemption of the Pakistan economy. It controls principal sources of foreign exchange earnings and is the second largest economic sector that contributes over 21% in Gross Domestic Product (GDP) and employs 44% of the labor force (GoP, 2014). Approximately 64% of the entire population lives in rural areas, and most of the rural population directly or indirectly linked to agriculture sector (FAO, 2019).

Pakistan began as underprivileged economist country. After a few decades, due to the struggle of agricultural sector, the economy is much stronger, and Pakistan is a vital agricultural country in the world. However, the agriculture sector is lagging other economic sectors like textile mills, chemical manufacturing unit, food processing unit, and iron and steels mills in economic development. The gap between potential yield and actual yield of most of the crops reflects the inadequate access of rural communities to better farming knowledge and sporadic understanding about advanced and improved agricultural practices.

Overview of climate change

Before the end of the 20th century climate change had become a serious threat to worldwide human and animal life. In response to emerging regarding climate change, the Intergovernmental Panel for Climate Change (IPCC) was inaugurated in 1988 to distinguish the factors that cause long-term or short-term changes in the climate system and aimed to make possible the provision of most up-to-date, scientific, technical, socio-economic, comprehensive information about climate change (Parry et al., 2001). The extended periods of change that lasted for decades or millions of years in weather conditions could include uneven patterns of rainfall, unpredictable patterns of temperature variation, rise in sea levels, greenhouse gasses emission, relative humidity, windstorms, and the nature of the season. IPCC pronounced climate change as the change that follows the natural phenomena and human activities (anthropogenic factors) over long periods of time in a climate system.

In Asia, climate change became an established fact significantly affecting societies and economic growth pillars of the nations. Most of the Asian countries are suffering from food insecurity and low economic growth because they have low capacity of adaptation to climate change. The average agricultural yields continue to decline in developing Asian countries due to the variability in temperature and precipitation patterns and several climates induced diseases recorded due to global warming. IPCC already indicated that at the end of the 21st century the global average temperature possibly will be increased by 1.4 °C to 5.8 °C (Figure 1), and this terrific increase in temperature has tremendous effects on atmosphere, biosphere, hydrosphere, lithosphere, and ecosystem. Pakistan is one of the top ten countries most affected from the negative effects of the climate change (SDPI, 2018).

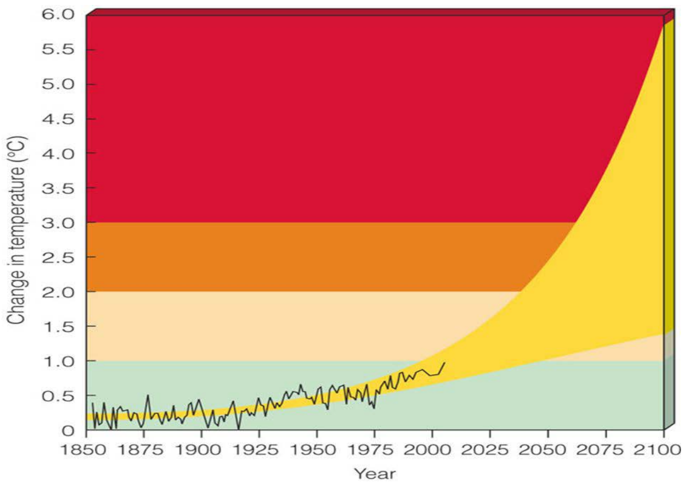

Figure 1: *Global average temperature changes since 1850 to 2100 year.*

Generally, the Islamic Republic of Pakistan has a warm climate, making it more vulnerable to the impacts of climate change. The global average temperature variation is not higher than the Pakistan's temperature variability. The northern parts of the country were covered up by the glaciers while the southern areas have heavy deserts. Pakistan has both tropical and subtropical climates and lies in the temperate zone. The climate of Pakistan varies from corner to corner and ranges from slight winter to hot (Figure 2).

The country continues to face several challenges such as overpopulation, poverty and food insecurity; however, in the beginning of the 21[st] century water scarcity turned out to be the major challenge for Pakistan. Currently Pakistan's water resources are unable to fulfill the needs of humans as well as for the growth of agricultural and economic sectors. According to water availability indicators, Pakistan is fast approaching the absolute water scarcity (Qureshi and Ashraf, 2019).

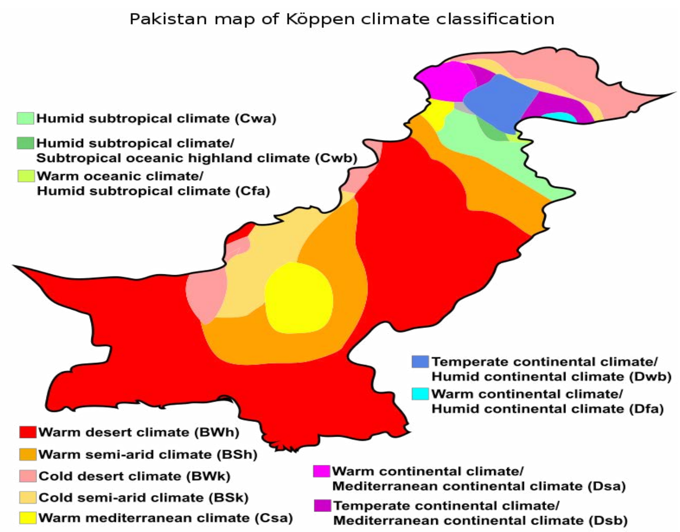

Figure 2: *Pakistan map according to Köppen Geiger Climate Classification.*

Driving forces of climate change

The greenhouse gases (GHGs) emission is surprisingly at the highest concentration over the last eighty thousands years (Figure 3). These gases hold the potential to create extreme events in temperature and rainfall fluctuations, heat waves, floods, droughts, water scarcity, and glacier melting. The earth's climate system over millions of years has been changing from "icehouse" or cold climate to warm climate or "warm house" with the change in the glacial and interglacial period to the general disappearance of glaciers in Northern hemisphere (Augustin et al., 2004). Heavy rainfall is also measured in South and North America and Northern Europe and in North and Central Asia as well.

The earth climate system together with GHGs concentration in the atmosphere is undulating due to the extent of severe human activities like deforestation, land use, intensive agricultural practices and most important fossil fuels burning which was associated with the industrial revolution (Figure 4). The history of geology indicates that past changes in climate are due to philosophical modifications in the earth system and life expectancy. Human advancements on reforming global climate system combine with short-term and long-term variations in weather patterns (Crutzen, 2006). IPCC reports also that the human-tempted aspects remained mostly answerable for the amazing upturns of surface air temperature around the globe along with severer influences on the agro-ecological system. The development of the industrial system or the industrial revolution since 1750 was perceived to be the main driver of change to the global climate system by increasing the GHGs concentration in the atmosphere. In addition to that widespread use of fossil fuel had begun since 1750 with the advent of industrial revolution. Moreover, many other human activities such as deforestation, agriculture, livestock and urbanization affecting the atmospheric part of the carbon cycle (Shepherd, 2011).

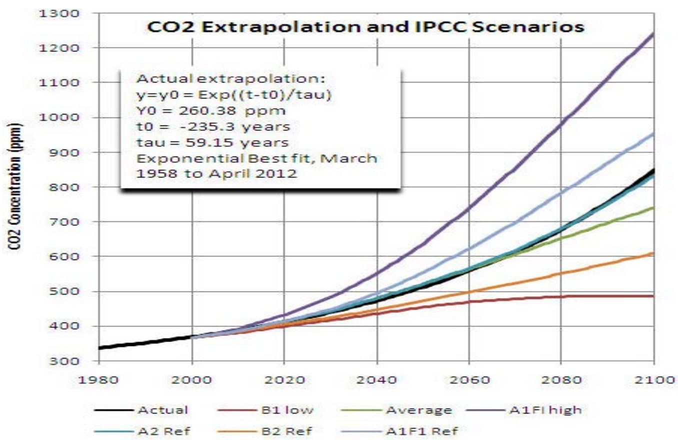

Figure 3: *CO_2 concentrations; IPCC scenarios vs. Actual extrapolations.*

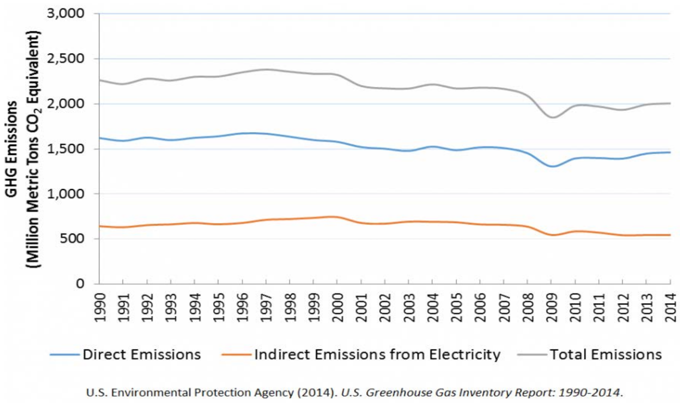

Figure 4: *Annual greenhouse gases emission concentration (ppm) by industrial sectors.*

The mean temperature of the atmosphere is estimated to increase 2°C to 4°C until the last half of the 21[st]century due to an increase in CO_2 concentration beyond the pre-industrial era (Figure 5). This global statistical figure may differ from region to region as high latitudinal regions are subjected to the largest increases in mean temperature while tropical and subtropical areas will experience smaller increases in mean temperature (Christensen et al., 2007). The intensity of temperature is regulated by an active hydrological cycle (Meehl et al., 2007). It means upturns and downturns in temperature ultimately cause change in overall rainfall amounts. As temperature fluctuations vary from region to region, seasonal precipitation rates also differ, and the same effects and changes or fluctuations could be measured locally. The temperature and rainfall fluctuations may not be well thought out as parameters of changing climate, but floods and drought conditions, storms, cyclones, land loss, biodiversity loss, water and food scarcity are also known as parameters of changes in the earth's climate system (Parry et al., 2007).

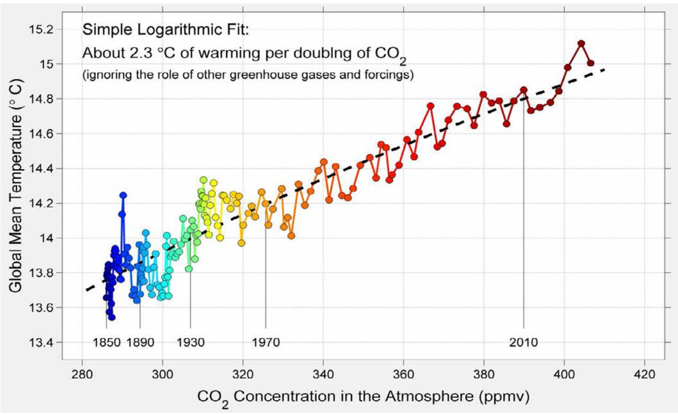

Figure 5: *Effect of CO_2 concentration in atmosphere on global average atmospheric temperature.*

Urbanization continues to expand to provide lodging for a massive density of population, thereby causing/forcing the transformation of cultivatable agricultural lands into the housing and or city development (McCarthy et al., 2010). These urban areas also contribute to the maximum heat expansion into the atmosphere due to burning of fossil fuels and excessive usage of motor engines/machinery causing global warming. The continuous increase in human population creates a hindrance in meeting the goals of food security, affecting the GHGs concentration in atmosphere from undue scorching of fuel (Khan, 2012). The urban areas, urbanization and energy sectors are also responsible for almost 75% of greenhouse gases emission (Figure 6) which has been acknowledged as the anthropogenic agents of climate change (Komeily and Srinvasan, 2015).

The natural drivers of the climate system such as variation in solar radiation, continental drift, volcanoes, earth orbital and axis deviation, and distance from ocean are very slow. They require millions of years to change the climate naturally. Humans have been influencing the climate system since they appeared on the earth. The industrial revolution propelled the concentration of carbon emissions, methane emissions, and large amounts of nitrous oxides. The excessive extent of these greenhouse gases struck the solar radiation and eventually warmed the earth (Figure 6) (Khan, 2012).

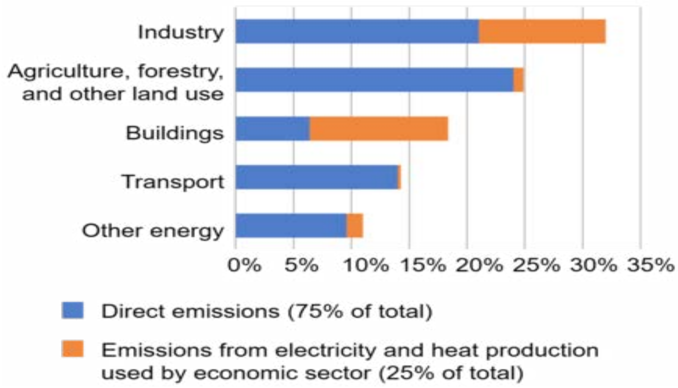

Figure 6: *Global greenhouse gases emissions by different sectors.*

Considerable concentration of oxides of sulfur and ash contents introduced into the earth's surface atmosphere (stratosphere) those undertake short-term effects to climate/weather components. Oxides of sulfur help to form sulfuric acid which increases the mass of previous particles to form new ones, and these particles increase the resistance in transmission of sunlight through the atmosphere and cause fluctuations in temperature (Myhre et al., 2013). The marine carbon matter increases and plankton production, either as phytoplankton or zooplankton, decreases due to considerable increases in iron contents from explosive volcanic eruptions. Volcanic eruptions also expel oxides of carbon into the atmosphere, but the estimated emitted carbon dioxides in the atmosphere from volcanic eruptions is less than or equal to 1% as compared to the emission of carbon oxides from exaggerated anthropogenic activities/actions (Myhre et al., 2013).

Impacts of climate change on the agriculture sector

In recent times agriculture has faced many problems, particularly climate change. Climate change has emerged as a global problem, especially for developing regions of the world including Pakistan, which is highly vulnerable to the consequences of climate change and issues like limited resources and lack of technological advancements (Ali et al., 2017). According to the Intergovernmental Panel for

Climate Change (IPCC, 2007) report, developing countries are more vulnerable to severe consequences of climate change as compared to developed countries.

Agricultural products are affected by the fluctuation in climate, such as precipitation rates, temperature variation, humidity rates, floods, droughts, cyclones and wind speed. Pakistan has a warm climate, and that is why it is susceptible to the consequences of climate change. The quality of agricultural crops and production yields are influenced by the climate variations including temperature and precipitation rate changes, water availability, type and method of land use, changes in dates of planting, maturity and harvesting (Shakoor et al., 2011). Climate change also impacts human and animal health, water depletion and pollution, biodiversity loss, and forests, and these impacts are noticeable. The climate fluctuations require abundant knowledge, experience and skills to predict because it is difficult to predict the climate fluctuations and their impacts. The climate variable increases the risk for farmers' and for the country's economic status.

Agriculture activities and production are highly sensitive and are threatened by the variables of climate change (Ghazala and Mahmood, 2009). Temperature variation, variation in precipitation patterns, water scarcity, floods and drought conditions, biodiversity loss, greenhouse gasses emission, burning fossil fuels, and change in planting and harvesting dates affect agriculture economically and physically. Kaiser and Drennen (1993) explained that the consequences of climate change are not limited to the production of crops; it also severely degrades the supply and demand balance, profit margin, and values of agricultural production. Pakistan is counted in the list of those 28 countries those are more vulnerable to the effects of climate change.

Increases in temperature could hinder the maturity of crops that adversely affects yield. It also has a negative impact on pollination process, fruit ripening, nutrient deficiency, increases in evapotranspiration, moisture in soil and others. The insignificant increase in sensational temperature dampens down the productivity of the crops (Schlenker and Roberts, 2006). The variation in temperature patterns affected the agricultural crop production and plant phenology over the previous two decades and ultimately caused the food insecurity or hunger conditions, particularly in least developed areas (Tao et al., 2006). The lack of irrigation water causes the death of plants, leading to the famine and food insecurity conditions, and floods obviously cause the destruction of cultivable lands, agricultural standing crops and other economic losses.

The irreversible loss to water bodies, production of agriculture and livestock sectors, and cultivatable lands are imposed by the extensive fluctuations in the climate system (Fischer et al., 2005). The water accessibility or availability affects the growth and growing seasons and is critical in determining the positive impacts of climate change on agriculture due to precipitation and dimensions of growing periods. Agronomic and livestock production are in danger because of variations in the rate and patterns of rainfall (Smith et al., 2000). Maize production in Bulgaria is reduced from 5% to 10% because of a decrease in growing periods of maize crop due to the consequences of the changing climate (Alexander and Hoogenboom, 2000).

The productivity of wheat, rice, maize and other cereal and cash crops is being affected by several climatic variations including an unexpected increase in temperature, stress of water and/or water scarcity, and other scenarios of climate change. Wheat production in arid, semi-arid, and sub-humid regions exhibit downward slope due to extended rate and patterns of temperature (Sultana et al., 2009). Overflow and water logging complications have the potential to influence maize crop productivity with the estimated value of above 18% of the total production in South and Southeast Asian belts and an annual estimate of loss of nearly 30% to the total production (Zaidi et al., 2010).

The agricultural production of tropical and subtropical regions in developing countries are subject to the higher vulnerability towards the impacts of climate change as compared the temperate region's crop production (Mendelsohn, 2008). Climate change threats are more surprising in developing nations and especially in South Asia which results in the loss of almost 30% of the production of cash and cereal crops. During the 21st century production loss will increase about 50% (UNFCC, 2007) if necessary actions and policies are not implemented. The food insecurity measures will increase because of the expansion of human population and the decreased crop production due to adverse effects of changing climate. South Africa is currently confronting severe droughts because of less rainfall and high temperature which significantly reduce agricultural and livestock production, and ultimately lack of water causes food insecurity, water scarcity and aridity (Masipa, 2017).

Training of extension field staff in the scenario of climate change

Rural people have limited sources of information and no right of entry directly into research-based knowledge and skills since they have limited opportunities for education. Because of their low level of education, they are unable to recognize and understand the emerging threats to agriculture, creating the need for extension field staff known as the front-line workers to be a source of facts and figures for farmers, and bring the appropriate change in farmers' behavior to adopt the latest technology and reliable information.

Nowadays farmers claim that agricultural extension workers are not very capable of fulfilling the facilitative needs of the farming community because extension personnel neither provide necessary information nor guide farmers about how to survive against the impacts of extreme events of weather and climate through the adoption of climate-resistant varieties of crops to endure production in extreme events of climate change. It becomes extremely important to adapt sufficient and suitable agricultural practices in contrast with the changing climate, tree plantation and deforestation through an active role of extension field staff through their intensive trainings in scenarios of weather/ climate change (Safdar et al., 2014).

In-service and pre-service training sessions for EFS should be offered to help staff become competent enough to offer training for farmers. The pre-service and in-service training becomes extremely important for extension field staff to incur skills and abilities that will assist them to identify and address the impacts and challenges of climate change on agriculture production.

To address the management issues of climate change, in-service training must ensure and arrange in subject areas of cultural practices, the use of agro-chemicals, statistical analyses of data for policy making related to climate change, and measurement of speed of air/ wind and intensity of sunlight, which are obligatory for the extension field staff in the mitigation of climate change. The implementation of early warning systems in tropical and subtropical regions to make them capable to bear and survive with the changes in climate or weather system is essential (Brown and Funk, 2008). The professional competencies, knowledge, and skills might be upgraded and strengthened through training and competency-based program with rapid changes in agricultural technologies and complications (Swanson et al., 1998).

The competent and trained extension field staff should be supportive for farmers in identifying and addressing the factors and impacts of climate change regarding agriculture which will help to improve the retention and endurance of advisory services provided by agriculture extension. Training needs should be assessed when there is a gap between "what should be" and "what is". "What should be" means the required professional and technical competencies and "what is" mean the existing professional and technical competencies. Training could be used to advance and empower the knowledge and skills or abilities of professional extension field staff (Qayyum et al., 2011). Therefore, a needs assessment model developed by Borich (1980) was found to be effective in the assessment of training needs of the EFS.

Borich needs assessment model

In 1980 Gary D. Borich developed a model of needs assessment aimed to improve the training programs of trainings institutions in the scenario of opportunities of professional development. The Borich Needs Assessment Model utilizes Mean Weighted Discrepancy Scores (MWDS) to identify the need priorities of participants of a program or company/organization. According to the Borich Needs Assessment Model, discrepancy between the goals of the program or organization and performance of participants of program or organization measured. In addition, the overall goal or aim or purpose were labeled "what should be", and "what is" stated the program participants' or employees' performance measured in terms of behavior, competencies, or skills (Borich, 1980).

Borich needs assessment model includes the following steps:

- Both desired and existing (Importance or Ability) competencies should be listed in the questionnaire
- Circulate the questionnaire among the participants /respondents

- Data tabulation on MS Excel
- Calculate the discrepancy score by subtracting Ability from Importance
- Calculate the WDS by multiplying the overall mean of Importance with the discrepancy score
- Find the mean of WDS to determine the MWDS
- Rank the competencies by employing the MWDS in numerical order to identify the prioritized training needs

Purpose and objectives

The purpose of the study was to assess the existing and desired competencies in climate change to identify the training needs of Extension Field Staff in district Sargodha, Punjab, Pakistan. The objectives included the following:

- To assess the demographic profiles of extension field staff;
- To identify the driving forces responsible for climate change as perceived by EFS;
- To assess the indicators of changing climate as perceived by EFS;
- To identify the desired competencies of EFS in the scenario of climate change;
- To assess the existing competencies possessed by EFS in the scenario of climate change;
- To identify the training needs of EFS using Borich needs assessment model; and
- To record the perceptions of EFS regarding problems facing in climate change adaptation and mitigation among farmers.

Materials and Methods

Study area

The district Sargodha, Punjab-Pakistan was the study area of investigation for the study. The Sargodha district is bounded by district Jhelum, districts of Mandi Bahauddin and Hafizabad, districts of Chiniot and Jhang, and Khushab with North, East, South and West borders, respectively (Figure 7).

There is mainly plain land in district Sargodha, but few hills also followed in the surroundings of Sargodha towards Faisalabad road. The city is also bounded by the River Chenab on the eastern side and the River Jhelum drifts along the western and northern edges of the city. The climate of Sargodha is a warm, semi-arid climate and is classified as BSh by the Kōppen-Geiger climate classification. The climate ranges from extremely hot in summer to reasonable cold in winter. The maximum temperature noted ever recorded is 50 °C (122 °F) in summer season and the lowest temperature has reached the freezing point in winter. The average temperature of the city is about 24 °C, and annual average rainfall is 410mm (Figure 8).

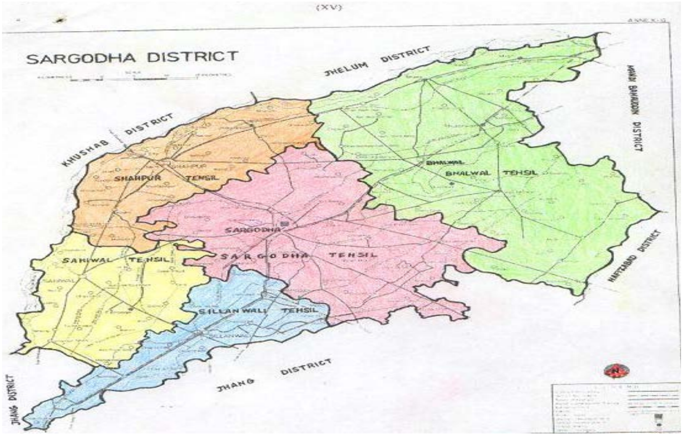

Figure 7: *Map of district Sargodha, Punjab-Pakistan.*

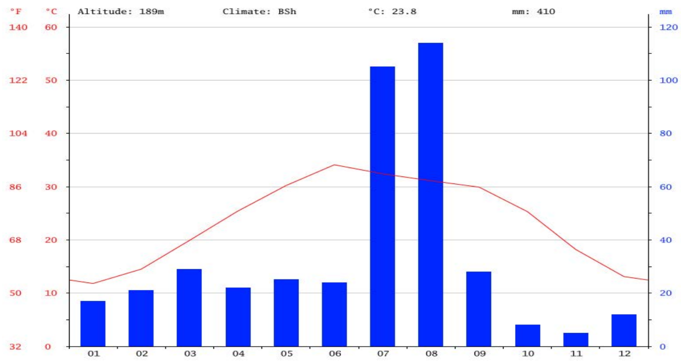

Figure 8: *Temperature and rainfall graph of district Sargodha.*

Research design

A descriptive survey method was employed in the present study to define and determine the attributes, attitudes, interests and competencies of the participants. The functional area of investigation was District Sargodha, which consists of seven tehsils: Sahiwal, Sargodha, Sillanwali, Shahpur, Kotmomin, Bhalwal and newly formed Bhera. The dependent variables of the study were desired competencies of the respondents. The independent variables included the demographic attributes, existing competencies, and driving forces or forcing factors of climate change.

Population and sample

The complete list of extension field staff within the study area was obtained from the Executive District Officer or Dy. Director of Agricultural Extension Sargodha. The total number of sanctioned posts of extension field staff was 201, but the number of filled posts or working extension field staff was 147. The working or filled posts were comprised of 1 Deputy Director of Agriculture Extension, 6 Assistant Directors of Agriculture Extension, 1 Assistant Horticulture

Officer, 17 Agriculture Officers, 1 Cotton Inspector, 10 Agriculture Inspectors, and 111 Field Assistants. The present study was a census study. The generalized results were valid for all the population of the study because it was census study.

Instrumentation

A well-defined interview schedule was designed according to the nature of the research study using five-point Likert-type scale. The validity (content and face) was determined by a panel of experts from Department of Agricultural Extension, Sargodha University along with the supervisor of the research study. Numbers of items on the interview schedule were revised after Cronbach's reliability test to enhance the validity and reliability of the research instrument.

Data collection

The data were collected through the research instrument (interview schedule) from extension field staff of all tehsils of district Sargodha, Punjab-Pakistan. All working extension field staff was the targeted respondents of the study. The supreme authority Deputy Director Agriculture (Ext) at district Sargodha was assessed and informed about the purpose and objectives of the study. The initial call was given in third week of March 2018 to every ADA (Ext), AO, AI, and FA through proper channels. A face-to-face meeting was organized with individuals and a group of respondents as per each situation due to the complex nature of the study. The participation rate of EFS in research study was 70%. Some of the EFS were approached after the next call which was given the first week of April 2018. Furthermore, the last reminder was given the second week of April 2018 and the participation rate was reached almost 88%. The remaining extension filed staff were again contacted but they refused to participate in the study. Therefore, the final participation rate was almost 88% (130 respondents) out of 100% (147 respondents).

Data analysis

The data were tabulated in a Microsoft Excel Sheet. The Borich Needs Assessment Model was applied in MS Excel (version 2010) to identify the training needs of EFS. In addition, the data were transferred to the Statistical Package for Social Sciences (version 20) for further analysis. The descriptive statistics of frequency distribution, percentages, means and standard deviations were used for general descriptions.

Results and Discussion

The demographic factors were analyzed for better pictorial view of the respondents' profiles and integrated in tabular form. The results presented in the following Table 1.

Table 1: *Frequency distribution of different demographic factors in the study.*

Factor	Frequency	Percentage
Age		
20 – 30 years	2	1.50
31 – 40 years	24	18.5
41 – 50 years	62	47.7
51 – 60 years	42	32.3
Education		
Ph.D.	1	0.80
M.sc (Hons)	23	17.7
Diploma of Agriculture	106	81.5
Specialization		
Basic Agriculture	106	81.5
Agronomy	12	9.20
Soil Science	4	3.10
Horticulture	2	1.50
Entomology	2	1.50
Agriculture Economics	2	1.50
Crop Physiology	1	0.80
Plant Breeding and Genetics	1	0.80
Job designation		
DDA(Ext.)	1	0.80
AHO	1	0.80
ADA(Ext.)	6	4.60
Cotton Inspector	1	0.80
Agriculture Officer	15	11.5
Agriculture Inspector	4	3.10
Field Assistant	102	78.5
Experience in extension services		
1 – 10 years	10	7.70
11 – 20 years	36	27.7
21 – 30 years	76	58.5
31 – 40 years	8	6.10
Dominant cause of climate change		
Human activities	94	72.3
Natural factors	36	27.7
Total	130	100.0

Age

Action and response of an individual to a process, subject, and an activity may be influenced by his/her age. There were just 1.5 % of respondents between the age group 20 to 30 years, which means that a small group of respondents were fresh or newly appointed. In addition, 18.5% of respondents were between 31 and 40 years of age, 47.7% of respondents were between 41 and 50 years of age, and the remaining 32.3% were in the group of 51 to 60 years of age (Table 1).

Education

Education enables an individual to develop his/her cognitive ability to act or react against an activity, phenomenon and statement. The educational profile of respondents revealed that most extension field staff (81.5%) had earned the degree of diploma in the field of agriculture, another 17.7% of respondents (Table 1) held the degree of Master of philosophy or M.Sc. (Hons.) in the specific fields of agriculture and were serving the agricultural extension department as officer in their field. One respondent held the degree of doctor of philosophy in a specialized field of agriculture.

Specialization

Most of the respondents (81.5%) recognized themselves as a basic agricultural specialist, 9.2% were specialized in the field of agronomy, 3.1% of respondents preferred soil sciences as specialized field of study, 1.5% of respondents hold specialization in the subjects of horticulture, entomology and agriculture economics and 0.8 % of respondents had chosen crop physiology and plant breeding and genetics as an area of specialization for themselves (Table 1). The most common area of specialization for extension field staff is basic agriculture.

Job designation

There was one deputy director of agriculture extension whose role is to be responsible activities and projects implemented and executed by extension personnel in the study area. Further, there were 0.8% of respondents designated as either Assistant Horticulture Officer or Cotton Inspector, and 4.6% of respondents were designated as Assistant Directors of Agriculture Extension for leading extension education activities and field work at the tehsils level.

Also, 11.5% of respondents were experts in their respective area of specialization, performing their responsibilities as Agriculture Officer, and 3.1% were Agriculture Inspectors. The dominant group of respondents (78.5%) was selected as Field Assistant (Table 1). The results elaborated that all the agricultural extension and education activities, actions and works are mostly done by subject specialists rather than agricultural extension experts; this could be considered as an important shortcoming in achievement of agricultural extension and education objectives (Figure 9).

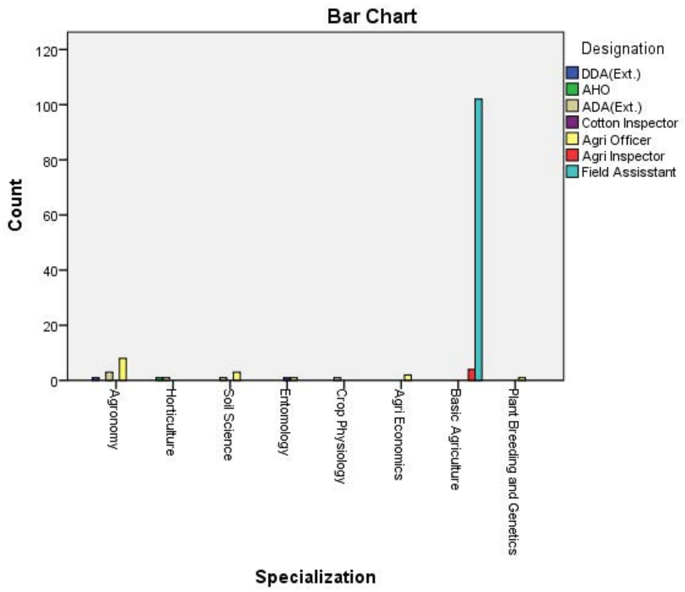

Figure 9: *Quantitative relationship between specializations and designations of EFS.*

Extension staff experience

Experience is counted as a significant factor in determining the existing competencies, skills, and expertise of an individual. The adoption or diffusion rate of any technology, skill, or knowledge is directly influenced by the experience of an individual. The results in Table 1 showed that 7.7% of respondents had acquired 1–10 years of experience, 27.7 % of respondents had 11–20 years of experience in agricultural extension, followed by the major group of respondents (58.5%) who had acquired 21–30 years of experience; 6.1% respondents had 31–40 years of experience in agricultural extension.

Dominating causes of climate change

A majority of the extension field staff (72.3%) thought that humans are more responsible for changes in climate system than the natural factors, and the remaining 27.7% of believed that natural factors are more prominent causes of climate change (Table 1). The results of study confirmed that human activities are viewed as the more severe and dominant causes of climate change.

Factors responsible for climate change

The radioactivity balance of earth influenced by human activities and the industrial revolution since 1750 has resulted in an increase in the volume of greenhouse gases (GHGs) in the atmosphere and changes in land use due to deforestation, desertification and urbanization (Fahey, 2017). Changes in the concentration of GHGs exert variations in temperature and rainfall patterns and other climatic variables. The results of Fahey's study revealed that industrial smoke was conceived to be the most critical factor in changing the climate of the earth as it increases the carbon contents in the atmosphere, which subsequently changes temperature and precipitation patterns (Table 2).

Table 2: *Mean and standard deviation of driving forces/ forcing factors responsible for climate change (N=130).*

Items	Mean	Std. Dev.	Rank
Windstorms	4.19	0.57	8
Uneven circulation of disasters	4.24	0.51	6
Variation in distance between earth and sun	3.09	0.82	14
Roughly scattered floods	4.33	0.49	4
Variation in intensity of solar radiation	4.43	0.51	2
Rise in sea level	3.89	0.61	11
Industrial smoke	4.46	0.56	1
Fossil fuels burning	4.40	0.57	3
Greenhouse gases emissions	4.24	0.67	7
Deforestation	4.32	0.58	5
Desertification	3.06	0.63	15
Water logging	2.44	0.74	17
Changes in land use	3.94	0.77	10
Urbanization	4.08	0.68	9
Non-recommended chemical applications	2.82	0.77	16
Intensive agricultural practices	3.89	0.80	12
Increase in population	3.84	0.75	13

Note: *1: Strongly disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly agree.*

Fahey (2017) also identified some prevailing forcing factors contributed much more in bringing about the fluctuations in weather or the climate system, like variations in the intensity of sunlight, extensive burning of fossil fuels, roughly scattered floods and droughts, deforestation, greenhouse gases emission, urbanization, a rise in sea level, intensive agricultural activities or practices, and an increase in population. The perceived factors of climate change indicated that humans, since their appearance on earth, have created changes to the climate with their aggravating activities and actions. The results further explored that there were also a few factors such as non-recommended chemical applications and water logging that served as trivial forces of bringing unwanted variations to the climate system (Table 2).

Indicators of climate change

Augustin et al. (2004) reported that the earth climate system has been changed from the interglacial period to the general disappearance of glaciers of the northern hemisphere. Pakistan suffers water scarcity and flooding challenges due to the inadequate management of water resources. The lack of irrigation water has caused the death of plants that ultimately lead to famine and food insecurity conditions, and uncontrolled floods causing the destruction of cultivated lands, agricultural standing crops and other economic losses. The intense heat also disturbs the hydrological cycle. The substantial precipitation rate projected during the drizzling seasons ultimately caused the flooding conditions and in contrast dry seasons suffer more droughts.

Table 3: *Mean and standard deviation of indicators of climate change (N=130).*

Items	Mean	Std. Dev.	Rank
Variation in temperature	3.92	0.65	9
Variation in rainfall patterns	3.93	0.64	8
Windstorms	3.97	0.65	7
Disasters	4.08	0.55	4
Rise in sea level	3.82	0.67	11
Glaciers melting	4.01	0.60	6
Floods	4.25	0.53	1
Droughts	4.09	0.63	3
Soil erosion	2.22	0.76	16
Variation in planting and harvesting timeline	3.70	0.77	12
Reduction in agricultural productivity	4.08	0.52	5
Plant diseases	3.16	0.70	13
Animal diseases	2.65	0.60	15
Human diseases	2.79	0.66	14
Food insecurity	4.09	0.60	2
Biodiversity loss	3.91	0.70	10

Note: *1: Not at all; 2; To some extent; 3: Moderate; 4: High; 5; Extremely High.*

The results of the present research study revealed that the conspicuous and extremely high indicator of changing climate considered by most extension field staff was floods (Table 3). This could be clearly specified that every year, Pakistan has suffered with severe flooding conditions due to lack of resources to store water. The results also indicated that soil erosion was thought to be a process which may be caused by human activities and may be due to excessive runoff of irrigation water or may be due to some other factors (Table 3). They thought that it could be slightly considered as an indicator of climate change in some situations, as it could be the results of imprecise agricultural practices or untilled land.

The results also tell that there were few noticeable indicators such as droughts, food insecurity, disasters, reduction in agricultural productivity and glaciers melting (Table 3). The findings of the study revealed a lot of indicators of a changing climate system, in which most were measured as drastically prevailing indicators of undesirable changes in our climate system.

Desired competencies of EFS in the scenario of climate change

Mainstream extension field professionals (extension field staff) were found to be incompetent in dealing with the threats of climate change. Most of the extension field staff showed their desires to attain skills and knowledge regarding mixed cropping and crop diversification to squeeze the yield gap followed by climate change, and to minimize the adverse effects of sensational changes in climatic conditions to agriculture and livestock units along with their allied branches. The mainstream of extension field staff also exhibited confidence towards top needed competencies for the welfare of farmers and the country, such as climate change adaptation and mitigation skills, forestation and agro-forestry skills, use of metrological information, integrated soil management skills, climate change risks management skills, and skills to minimize the adverse effects of greenhouse gases (Table 4).

The technological skills of producing and using biogas had the lowest desire for extension field staff in the scenario of climate change because the dominant group of rural communities has limited access to the livestock sector who desire low-cost efforts to boost up their living status (Table 4). The findings of the study pointed out that extension field staff needed much more skill in circumstances of changing climate because climate change is acknowledged as the most diversified and central issue to current and future agricultural setting and practices.

Table 4: *Mean and standard deviation of desired competencies of EFs in the scenario of climate change (N=130).*

Items	Mean	Std. Dev.	Rank
Mixed cropping skills	4.09	0.67	1
Crop diversification skills	4.08	0.68	2
Climate change adaptation and mitigation skills	4.00	1.03	3
Agro-forestry and forestation skills	3.99	0.87	4
Skills to use meteorological information	3.95	0.99	5
Skills for climate change risks management	3.89	0.99	6
Skills to minimize the adverse effects of greenhouse gasses	3.83	1.03	7
Ability to address the climate fluxes and its effects	3.79	1.01	8
Ability to comprehend early warning systems	3.68	1.06	9
Aquaculture skills	3.6	0.85	10
Diagnostic skills of land use	3.46	1.04	11
Improved irrigation and water management skills	3.35	0.84	12
Disaster management skills	3.18	1.10	13
Floods management skills	3.18	1.10	14
Technological skills of producing and using biogas to reduce greenhouse effect	2.76	0.90	15

Note: *1: No importance; 2: Below average importance; 3: average importance; 4: Above average importance; 5: Utmost importance.*

Existing competencies of EFS in the scenario of climate change

Extension field staff in the study area was not competent enough in comprehending early warning system, climate change adaptation and mitigation skills, management skills for disasters and floods, aquaculture skills, and skills to minimize the adverse effects of greenhouse gases. They were little competent in teaching of mixed cropping and crop diversification skills (Table 5). They were also unacquainted with climate fluxes and their effects on agricultural sector because they were incapable of using meteorological facts and figures.

The findings of the study determined that the respondents do not have climate change adaptation skills or competencies; a few were unacquainted with the reality of climate changes. The results portrayed that EFS were competent just in handling basic farming skills of irrigation and water management techniques, and they are not proficient in managing the prevailing and unpredictable climatic problems that are most harmful, especially for agriculture and the livestock sector.

Table 5: *Mean and standard deviation of existing competencies of EFS in the scenario of climate change (N=130).*

Items	Mean	Std. Dev.	Rank
Improved irrigation and water management skills	3.62	0.86	1
Mixed cropping skills	1.38	0.63	2
Crop diversification skills	1.21	0.43	3
Agro-forestry and forestation skills	1.10	0.30	4
Technological skills of producing and using biogas to reduce greenhouse effect	1.05	0.21	5
Skills to use meteorological information	1.02	0.15	6
Skills for climate change risks management	1.02	0.20	7
Ability to address the climate fluxes and its effects	1.01	0.09	8
Diagnostic skills of land use	1.01	0.30	9
Ability to comprehend early warning systems	1.00	0.00	10
Climate change adaptation and mitigation skills	1.00	0.00	11
Disaster management skills	1.00	0.00	12
Floods management skills	1.00	0.00	13
Aquaculture skills	1.00	0.00	14
Skills to minimize the adverse effects of greenhouse gasses	1.00	0.00	15

Note: *1: Not competent; 2: Little competent; 3: Somewhat competent; 4: Competent;5: Very competent.*

Extension field staff lack competence for farming societies to find out and solve the issues related to changes in the climate system through agro-forestry and forestation adaptation skills and the dynamic customization of agricultural lands because they did not learn about serious threats of climate change and its adaptation and mitigation skills.

Prioritized in-service training needs of EFS in the scenario of climate change

There is a great emphasize on training of Extension field staff in the scenario of climate change and need is to prioritize their training requirements and to identify where they need to be trained and technically competent enough in resolving various glitches and issues of farmers related to changes in the climatic system. The management of issues of unpredictable changes in climate requires demanding in-service trainings in the adaptation and mitigation to climate change (Anka, 2016). The sixth objective of the research study was to identify the training needs of extension filed staff using the Borich Needs Assessment Model. The model calculates mean weighted discrepancy scores to identify and prioritize the in-service training needs of Extension field staff to improve their existing skills and competencies for achieving the desired level in identified skills to teach advanced climatic changes or variations to growers for better crop production.

The results indicate the highest mean weighted discrepancy score of 12.00 for climate change adaptation and mitigation skills, meaning that it recognized as the foremost training need for the extension field staff in climate change (Table 6). The findings of the study revealed that most of the extension field staff also exhibited a confident attitude towards the attainment of trainings in mixed cropping and crop diversification skills, skills to use and implement the meteorological information, the ability to comprehend and use an early warning system for emergency situations, the ability to address climate fluxes and their effects on agriculture and livestock states and their associated branches, floods and disasters management skills to minimize the yield gap between potential yield and average yield (Table 6). Many of the respondents were already capable of satisfying the farming societies in the areas of insecticides and pesticides, irrigation and water management skills.

Problems in climate change adaptation and mitigation

The study determined that most of the extension filed staff contributed to the perceptions that lack of knowledge about climate change adaptation and mitigation awareness was the prevailing problematic element in communicating climate change adaptation and mitigation among farming societies (Table 7). The lack of awareness and understanding regarding climate change adaptation and mitigation courses among extension field staff creates an immense difficulty for extension field staff aimed at climate change adaptation and mitigation awareness skills among farming societies.

Table 6: *Mean, SDs of desired and existing competencies; and their mean weighted discrepancy scores (based on Borich Model) to prioritize in-service training needs of EFS in the scenario of climate change (N=130).*

	Desired *Comp.		Existing *Comp.			
Items	**M**	**SD**	**M**	**SD**	***MWDS**	**Rank**
Climate change adaptation and mitigation skills	4.00	1.03	1.00	0.00	12.00	1
Crop diversification skills	4.08	0.68	1.21	0.43	11.68	2
Skills to use meteorological information	3.95	0.99	1.02	0.15	11.58	3
Agro-forestry and forestation skills	3.99	0.87	1.10	0.30	11.54	4
Skills for climate change risks management	3.89	0.99	1.02	0.20	11.16	5
Mixed cropping skills	4.09	0.67	1.38	0.63	11.05	6
Skills to minimize the adverse effects of greenhouse gasses	3.83	1.03	1.00	0.00	10.84	7
Ability to address the climate fluxes and its effects	3.79	1.01	1.01	0.09	10.55	8
Ability to comprehend early warning systems	3.68	1.06	1.00	0.00	9.82	9
Aquaculture skills	3.60	0.85	1.00	0.00	9.36	10
Diagnostic skills of land use	3.46	1.04	1.01	0.30	8.25	11
Disaster management skills	3.18	1.10	1.00	0.00	6.90	12
Floods management skills	3.18	1.10	1.00	0.00	6.90	13
Technological skills of producing and using biogas to reduce greenhouse effect	2.76	0.90	1.05	0.21	4.74	14
Improved irrigation and water management skills	3.35	0.84	3.62	0.86	-0.90	15

**Comp: Competencies; *MWDS: Mean weighted discrepancy score.*

Table 7: *Mean and standard deviation for perceptions of EFS regarding problems facing in climate change adaptation and mitigation among farming communities (N=130).*

Items	**Mean**	**Std. Dev.**	**Rank**
Lack of knowledge about climate change	4.11	0.63	2
Lack of knowledge about adaptation and mitigation awareness	4.12	0.62	1
Lack of appropriate material for adaptation and mitigation	4.05	0.61	3
Lack of training facilities	4.00	0.78	4
Low level of income of Farmers	3.42	0.81	6
Self-reliance of farmers	3.25	0.80	7
Lack of access to information sources	2.34	0.60	8
Lack of coordination between meteorological unit and agri. extension unit	3.94	0.66	5
Major concern of the farmers to give satisfactory coverage	1.92	0.61	9

Note: *1: Strongly disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly agree.*

The extension field staff also considered that the lack of knowledge about climate change, absence of adequate material for climate change adaptation and mitigation, lack of training facilities, lack of coordination between meteorological unit, and the agriculture extension and unit are the forefront barriers in the implementation of adaptation and mitigation strategies of climate change among farming societies (Table 7). The results revealed that there were several problems and factors that created a hindrance for extension field staff in delivering services, especially in climate change.

Bivariate correlations of different factors in the study

The following table describes the bivariate correlations among different factors in the study area.

There were significant positive correlations of 0.968 and 0.218 associated between age and experience and age and education, respectively (Table 8). The strength of the relationships of age with experience and education with experience revealed that mostly educated, experienced were older extension field staff. The older EFS were conceived to be more educated and experienced in their relative area of interest in their jobs and duties as per terms of references (TORs). There was a significant positive correlation of .333 at α=0.01 between education and experience; highly educated EFS were more experienced in their relative senses of liabilities as a major period of their career has been devoted to prescribed branches of learning, practicing and training. The strength of relationship of specialization with experience and education measured significant positive correlation which means that extension field staff with master degree in their specialized field of study possessed more precise and relative experience and higher qualification in the respective field of specialized area of agriculture.

There was a small non-significant positive correlation of .169 between age and specialization, but there was insufficient indication to state a tangible correlation. This indicated that older or younger authoritative EFS at the tehsils and district levels acquired almost the same qualification with diversity of area of interest as the agricultural arena mainstream of EFS members who are field assistants in basic agricultural education. Age, experience, education and specialization have significant negative correlations of -.231, -.289, -.306 and -.277, respectively, at α=0.01 with the factor of driving forces responsible for climate change (Table 8). The strength of the relationship of driving forces of climate change with age and experience elaborated that older extension field staff were not assimilated sufficiently in analyzing and evaluating the forcing factors that stimulated the unpredictable changes in climate system. The strength of relationship of driving forces of climate change with education and specialization measured that EFS were not qualified and trained in measuring and evaluating the foundation factors that cause volatile and irregular changes in climatic variables.

The indicators of climate change showed significant negative correlations with age, experience, education and specialization which indicated that comprehension regarding climate change indications looked for sufficient climatological competencies with reference to agricultural accounts. The significant positive correlation between indicators of climate change and driving forces responsible for climate change means that volatile forces of climate change have many indications for the reality of climate change.

The factors of age, experience, education and specialization expressed significant positive correlations with existing competencies of EFS which further explained that older and more experienced EFS have diversified expertise and aptitudes in the agricultural spectrum. The strength of relationship also suggested that a broader sense of learning and gaining in-depth knowledge integrates maximum dynamic competencies in agronomic and plant diseases areas of learning and profession. There was a non-significant negative correlation of -.119 measured between existing competencies of EFS and driving forces responsible for climate change which exposed that EFS are unskilled, unacquainted and expressed unconfident attitude regarding the forces that brought volatile changes to the earth climate system and they were aware of the pitch of agriculture. The strength of relationship between existing competencies of EFS and indicators of climate change determined significant negative correlation of -.275, which means vibrant indicators of climate change demand diversified skills and knowledge to acknowledge the existence of unpredictable changes on climate system. In the current scenarios of climate change where dynamic indicators explained the reality and association of climate change with agriculture and the ecosystem, the EFS were unaware due to deficient competencies in measuring, analyzing and evaluating the climate change and their consequences on agriculture and the ecosystem.

The significant negative correlations measured between problems regarding climate change adaptation and mitigation with age and experience and the strength of relationship exposed that older and experienced EFS acquired expertise in an agricultural field of study regardless of climate change arena. The factors of education and specialization exhibited insignificant negative correlations with the factor of problems regarding climate change adaptation and mitigation which validated that most of the EFS were trained in agricultural and agricultural extension field of study. Nevertheless, identifying, analyzing and evaluating climate change adaptation and mitigation problems required abundant knowledge and skills in changing climate and its adaptation and mitigation. The driving forces of climate change and indicators of climate change revealed significant positive correlations with the problems regarding climate change adaptation and mitigation among farming societies, which specified that the higher the forcing factors of climate change and their indicators intensified the problems regarding climate change adaptation and mitigation among farming communities. The strength of relationship

Table 8: *Bivariate correlations of different factors of the study.*

		Age	Exp.	Edu.	Spec.	DFRCC	ICC	EC	PCCAM
Age	Pearson correlation	1							
	Sig. (2-tailed)								
	N	130							
Exp.	Pearson correlation	.968**	1						
	Sig. (2-tailed)	.000							
	N	130	130						
Edu.	Pearson correlation	.218*	.333**	1					
	Sig. (2-tailed)	.013	.000						
	N	130	130	130					
Spec.	Pearson correlation	.169	.285**	.883**	1				
	Sig. (2-tailed)	.055	.001	.000					
	N	130	130	130	130				
DFRCC	Pearson correlation	-.231**	-.289**	-.306**	-.277**	1			
	Sig. (2-tailed)	.008	.001	.000	.001				
	N	130	130	130	130	130			
ICC	Pearson correlation	-.337**	-.422**	-.461**	-.372**	.533**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000			
	N	130	130	130	130	130	130		
EC	Pearson correlation	.317**	.367**	.522**	.449**	-.119	-.275**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.178	.002		
	N	130	130	130	130	130	130	130	
PCCAM	Pearson correlation	-.366**	-.389**	-.079	-.037	.320**	.461**	-.192*	1
	Sig. (2-tailed)	.000	.000	.374	.675	.000	.000	.029	
	N	130	130	130	130	130	130	130	130

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Note: *Exp.: Experience; Edu.: Education; Spec.: Specialization; FFRCC: Driving forces responsible for climate change; ICC: Indicators of climate change; EC: Existing competencies; PCCAM: Problems regarding climate change adaptation and mitigation.*

between existing competencies of EFS and problems regarding climate change adaptation and mitigation measured significant negative correlation and there was enough evidence to state that EFS learned and trained in the field of agriculture and its allied branches but there was no specific medium and courses of action which embraced EFS with adequate skills and knowledge regarding climate change and its adaptation and mitigation.

Regression analysis to assess the change in desired competencies of EFS

The regression analysis predicted that 34% of variance within the dependent variable of desired climate change competencies of extension field staff was explained by independent variables such as indicators of climate change, existing competencies of EFS regarding climate change and the perceptions of EFS regarding problems in climate change adaptation and mitigation among farming societies (Table 9).

Hypotheses were formulated as:

H_0: There will be no significant prediction of change in Desired competencies of EFS in the scenario of climate change by Indicators of climate change, Existing competencies of EFS in the scenario of climate change, Perceptions of EFS regarding problem facing in climate change adaptation and mitigation among farming societies.

The two hypotheses in statistical notation are;

$$H_0: \beta 1 = \beta 2 = \beta_3 = \beta_4 = 0;$$
$$H_1: \beta_j \neq 0 \text{ for at least one } j \neq 0$$

The significance level (p-value) was measured at F (3, 126) = 21.624, p = .000. (Table 9).

Table 9: *Regression analysis for dependent variable (Desired competencies of EFS in the scenario of climate change), and independent variables (Indicators of climate change, existing competencies of EFS in the scenario of climate change and perception of EFS regarding problems facing in climate change adaptation and mitigation).*

Model Summary.

Model	R	R square	Adjusted R square	Std. error of the estimate
	.583	.340	.324	16.54734

Predictors: (Constant), Indicators of climate change, Existing competencies of EFS in the scenario of climate change, Perceptions of EFS regarding problem facing in climate change adaptation and mitigation among farming societies.

ANOVA

Model	Sum of squares	df	Mean square	F	Sig.
Regression	17763.099	3	5921.033	21.624	.000
Residual	34500.632	126	273.815		
Total	52263.731	129			

Dependent variable: Desired competencies of EFS in the scenario of climate change. Predictors: (Constant), Indicators of climate change, Existing competencies of EFS in the scenario of climate change, Perceptions of EFS regarding problem facing in climate change adaptation and mitigation among farming societies.

Regression analysis.

Variables	Unstandardized Coefficients	S.E.	Standardized Coefficients	t	Sig.
	(β)		Beta (β)		
Constant	61.945	23.457		2.641	.009
Perceptions of EFS regarding problems in climate change adaptation and mitigation among farming societies	.739	.236	.257	3.139	.002
Existing competencies of EFS in the scenario of climate change	-1.198	.386	-.235	-3.106	.002
Indicators of climate change	.563	.159	.296	3.540	.001

The calculated significance level determined that the model was statistically significant, which means there were significant relationships among the means of desired climate change competencies of EFS and predictors which were existing climate change competencies of EFS, indicators of climate change, and perceptions of EFS regarding problems facing climate change adaptation and mitigation among farming societies. The results further specified that there was a substantial relationship between desired competencies and exiting climate change competencies, skills, and knowledge of extension field staff, which highlighted the importance of training for desired climate change competencies.

The un-standardized coefficients explored showed one-unit increase in climate change adaptation and mitigation perceptions of EFS and the residual predictive variables remains constant, the desired competencies of EFS would be increased by .739. With a one-unit increase in indicators of climate change, the desired climate change competencies of EFS increased by .563, and a one-unit increase in existing climate change competencies of EFS decreased the desired climate change competencies of EFS of -1.198 units.

Similarly, for standardized Beta coefficients, a one-unit standard deviation change in any predictive variable such as perceptions of EFS regarding problems faced in climate change adaptation and mitigation among farming societies, existing competencies of EFS in the scenario of climate change and indicators of climate change, the desired competencies of EFS in the scenario of climate change changed to 0.257, -0.235 and 0.296, in that order (Table 9).

Conclusions and Recommendations

At present time, the production in agriculture sector entirely depends on climate change or variation. The main reason behind the gap between potential and average yields of major agricultural crops is farmers' lack of awareness regarding unexpected impacts due to climate change on agro-ecosystem. It is further concluded from the results that this study leads the farmers' education system through Extension field staff (EFS) which act as educators and knowledge providers. However, unfortunately EFS found unfamiliar with the imminent needs of the farmers in 21st century. It is also concluded that only aware, well trained and competent EFS could bring the change in the mindset of the farmers regarding learning of new trends in climate system which creates diversified impact on farmers' training and education for the development of agriculture and livestock sectors in Pakistan. Similar conclusion has been drawn by Ashraf et al. (2012) in their study in which they assessed the in-service training needs of Agricultural officers for adaptation of remote sensing technology for applications of precision agriculture in 21st century and emphasized that the goal of development of agriculture sector in future could only be achieved by accomplishing the desired level of competencies and skills of Agricultural officers or Extension educators to address the future needs of the farming community in the country.

A majority of the extension field staff seek in-service training in subject areas of climate change including: 1) the climate change adaptation and mitigation process and strategies to minimize the adverse effects of climate change on agriculture and livestock, 2) active collaboration with the meteorological unit and use of meteorological information for efficient use of the early warning system in abrupt situations, 3) use of agroforestry theme to stimulate active and a strong agro-ecosystem, and 4) mixed and diversified cropping in the management of changing climate risks and minimizing the consequences of climate changes.

The existing competencies and training of EFS are not up to the mark for tackling natural and anthropogenic factors of climate, and their consequences on agriculture and rural population. The consequences of climate change towards agriculture and rural communities could be addressed and managed via continuous training sessions for EFS in climate change and its adaptation and mitigation in consort with diversified forces of climate and their indicators.

Since the trained and competent extension personnel surely assess farmers' learning in better way and to identify problems through appropriate mode, either it is associated with climate or it is related to crop sustainability or better yield. Therefore, the needs of extension field staff should be continuously assessed to make EFS competent enough with up-to-date knowledge, skills and competencies that support farmers' learning to whom they are intended to serve.

Anka (2016) conducted a study on analysis of training needs of extension agents on climate change and concluded that training on elements of weather is significant for extension personnel in forecasting weather status on regular basis. Extension agents preferred to incorporate skills in agro-chemical practices to educate farming societies in minimizing the weeds. They also desired for training on statistical data analysis to teach farmers and EFS on cultural practices to support climate change adaptation and mitigation among rural societies.

- The needs of extension field staff should be assessing thoroughly and sporadically.
- Awareness and training sessions should be arranged on immediate basis for EFS to comprehend the changes in climate system and its effects on agriculture and livestock sectors.
- Pre-service and in-service training needs in the state of climate change adaptation and mitigation should be arranged continuously.
- There should be a close collaboration between farmer education system and meteorological system to predict perilous fluctuations in climate and to find possible adaptation and mitigation strategies in dealing climate changes towards agriculture and livestock system.

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Novelty Statement

The Borich needs assessment model was used first time in Pakistani agricultural extension survey research to assess the needs of Extension field staff. Borich needs assessment model focuses on the existing competencies possessed by the respondents and the significance of the required need as perceived by the respondents. According to the Borich Needs Assessment Model, discrepancy between the goals of the program and performance of participants of the program could be measured. Borich model tells the readers the real prioritized needs of the respondents in terms of significance.

Author's Contribution

Ejaz Ashraf conceived the idea of the study, supervised overall research process and finalized the write up of the manuscript. Anam Sarwar helped in write up of the manuscript. Muhammad Junaid and Hafiz Khurram Shurjeel, helped in the preparation of the instrument, data collection, analysis and in corrections of the final write up. Prof. Dr. Mirza Barjees Baig and Dr. Kirby Barrick reviewed and corrected the document for final submission.

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