Research Article

Climate Change Competencies Assessment of Field Assistants in Khyber Pakhtunkhwa, Pakistan

Asif Nawaz* and Muhammad Zafarullah Khan

Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan.

Abstract | The present research study was conducted in order to assess possessed and required level of climate change competencies, their training needs and influence of demographic characteristics on the climate change competencies of Field Assistants of the Agriculture Extension Department, Khyber Pakhtunkhwa. A sample of 234 out of total 543 Field Assistants were selected with the help of Sekaran Sampling Technique and the respondents were distributed in four Agro-ecological zones of the province with the help of proportional allocation sampling method. Data from the respondents were collected through pretested and validated interview schedule. Data was analyzed using SPSS Ver.20. Mean, standard deviation, chi-square test and paired sample t-tests were calculated to achieve the study objectives. Results of the study revealed that Field Assistants were incompetent in competencies regarding record keeping on climate change issues, recording and reporting climate change impacts, use of cultural practices to mitigate climate change impacts, promoting cultivation of improved crop varieties regarding climate change and evaluating adaptation options. Highly significant difference at 1% level of probability between the possessed and required level of these competencies revealed that Field Assistants required trainings in these climate change competencies. Therefore, it is suggested that immediate in-service training should be provided to them in the identified competencies and also it might be included in the curriculum of the Field Assistants diploma course.

Received | June 01, 2018; **Accepted** | November 01, 2018; **Published** | November 26, 2018
***Correspondence** | Asif Nawaz, Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan; **Email:** asif.nawaz38300@gmail.com
Citation | Nawaz, A. and M.Z. Khan. 2018. Climate Change Competencies Assessment of Field Assistants in Khyber Pakhtunkhwa, Pakistan. *Sarhad Journal of Agriculture,* 34(4): 924-931.
DOI | http://dx.doi.org/10.17582/journal.sja/2018/34.4.924.931
Keywords | Climate Change, Competencies, Demographic Characteristics, Field Assistants, Khyber Pakhtunkhwa

Introduction

One of the foremost challenges to agricultural development these days is the climate change. Augmented body of evidences showed that natural resources like water, land, vegetation and forests are unfavorably affected by the deviations in climatic conditions. Extreme weather conditions and irregular changes in rainfall have threatened food security to a larger extent (Ogunlade et al., 2014). Global warming which refers to increasing of average temperature worldwide is the most apparent indicator of climate change. An increase of above 0.6˚C in pre-industrial era of 1990 to 2000 indicates the best estimate for warming in the coming years. Changes in rainfall and snowfall pattern, alteration in incidence and intensity of storm, rising of sea level, melting down of glacier and increase in plant diseases are further noticeable impacts of climate change (Sarkar and Padaria, 2015).

Change in climate is principally attributed to the persistent increase in greenhouse gases, like carbon dioxide, fluorinated gases, nitrous oxide and methane which are responsible for changes in temperature and

rainfall pattern and it also has negative effects on land resources, water, droughts and floods. Due to change in these climatic factors, the most affected countries are those which are agriculture based. Pakistan too is highly affected by the climate change because of being an agricultural country and its economy most rely on agricultural sector directly and indirectly (Mendelsohn, 2014; Kurukulasuriya et al., 2006). Due to these contrasting climatic situations, Pakistan has high vulnerability index of climate change as compared to other countries of the globe. In recent times, the country has confronted climatic changes like enhanced temperature, weather shift, disparities in precipitation pattern, earthquakes, floods and many more. Pakistan needs to be adapted to new changes due to its high vulnerability index towards climate change (Yousuf et al., 2014).

The role of extension system as a means of providing information and new technologies to the farmers in order to assist them combat the threat of climatic change is however recognized and unanimously accepted. Leeuwis and Aarts (2011) stated that agricultural extension is a series of embedded communicative interventions that are meant to induce innovations that should help to resolve problematic situations. A good extension service should be able to provide information about new and better technologies that can solve particular constraints from research institutions to farmers, and back to researchers and policy makers (Dimelu, 2016). To achieve the said purpose, the Agriculture Extension Agents must be competent enough regarding the various indicators of climate change issues and its possible solutions whereas competencies refers to the knowledge, skills and attitudes that extension workers should possess in order to effectively perform their roles as educators, along with technical subject/matter competency.

Field Assistant stands at important position in agricultural extension activities and acts as a link between the farmers and researchers. He carries problems of the farmers to the researchers as an input and brings back their solution to the farming community. Field Assistants are the qualified diploma holders from Agriculture Services Academy (ASA) and after joining the Agriculture Extension Department, he is the incharge of all the extension activities at Union Council level. Field Assistants provides advice to the farming community about latest information regarding crop production (Anaeto et al., 2012; Memon et al., 2013; Ullah et al., 2017). In this regard, there is dire need that the Field Assistants should be competent and dynamic enough to provide extension services that will enable farmers respond quickly to climate change and adeptly manage the associated risks. The increasing intolerance of farmers towards climate change effects coupled with its adverse impacts on agricultural productivity indeed call for competent Field Assistant staff regarding climate change. Therefore, this study was carried out to find the possessed and required level of climate change competencies of Field Assistants regarding their task performance, their training needs and influence of their demographic characteristics of climate change competencies in Khyber Pakhtunkhwa province of Pakistan.

Materials and Methods

Study area

The present study was conducted in all four Agro-ecological zones of the Khyber Pakhtunkhwa province in year 2018. Khyber Pakhtunkhwa province is located between 31 to 37° N and 70 to 74° E. The geographic area of this province is 74,521 Km^2 that accounts for 9.36% of total geographical area of Pakistan (Khan, 2012). All the Field Assistants working in Khyber Pakhtunkhwa Department of Agriculture Extension constituted population of the study.

Research design

Cross-sectional descriptive survey design was employed in this study because it allows data to be collected at one point in time and survey allows data to be collected from a large population (Mugenda and Mugenda, 2003). Moreover, Kothari (2004) points out that descriptive study are those studies that are concerned with describing the characteristics of the particular individual or a group. This design was also appropriate as it allowed for the use of both qualitative and quantitative data.

Sampling design

List of In-service Field Assistants were obtained from the Directorate General Office of Agriculture Extension Office. A total of 543 Field Assistants were working among which 234 were selected as a sample for the present study using Sekaran Sampling Technique (Sekaran, 2006). Furthermore, proportional allocation sampling technique was used for the distribution of the respondents regarding agro-ecological zones of the Khyber Pakhtunkhwa province. Hence the distri-

bution of respondents from each agro-ecological zone was 88 from Central Plain Valley, 55 from Southern Piedmont Plain, 42 from Eastern Mountainous Zone and 49 from Northern Mountainous Zone. Convenient Sampling technique was applied to interview the respondents from the selected agro-ecological zone.

Development of research instrument and data collection

The respondents of the study was personally interviewed through a well-structured and pretested (20 Field Assistants) interview schedule designed for them in the light of study objectives based on literature review and agricultural expert consultation. Five point likert scale was used to measure the perception of the respondents about their possessed and required climate change competencies and the weight assumed for each number was 1 for very low, 2 for low, 3 for medium, 4 for high and 5 for very high. Cronbach's Alpha test was calculated to check the reliability of the interview schedule by using Statistical Package for Social Sciences (SPSS) software and the Cronbach's alpha was 0.763 which comes in the acceptable range. Ashraf et al. (2018) quoted that Cronbach's alpha is the most appropriate statistic for the measurement of reliability index for the parameters which is measured on likert scale.

Data analysis

Data collected was punched into the SPSS Ver. 20 whereas mean, standard deviation, paired t-test and chi-square test were calculated. The paired t-test and chi-square test are explained in Equation 1 and 2 respectively.

$$t = \frac{\bar{d}}{Sd/\sqrt{n}} \quad \text{.....(Eq. 1)}$$

Where; d = difference between two sample observations (possessed and required level of competencies); n = number of pairs; Sd = standard deviation.

$$Sd = \sqrt{\frac{\Sigma(d_i - \bar{d})^2}{n-1}} \text{ and } \bar{d} = \frac{\Sigma d_i}{n}$$ the mean of d values.

$$x^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(Oij - e\,ij)^2}{eij} \quad \text{.....(Eq. 2)}$$

This test under the null hypothesis (H_o) follows a χ^2 distribution with *(r-1)(c-1)* degrees of freedom, in equation (II), O_{ij} indicates the observed frequency and e_{ij} shows the expected frequency.

Results and Discussion

Demographic characteristics of the respondents

The results pertaining to demographic characteristics of the respondents are shown in Table 1 which showed that majority (32%) of the total sampled respondents were from the age category of above 50 years followed by the respondents (29%) from the age category of 31-40 years. Similarly, 20% of the respondents were from the age category of 41-50 years whereas only 19% of the respondents were up to 30 years of age. These results indicated that majority of the Field Assistants were in their active years of life and has the ability to cope with the extension work. These results are in somewhat agreement with the findings of Demenongu et al. (2015) who reported that 37.6% of the extension workers were in the age bracket 31 to 40 years.

Table 1: *Demographic characteristic of the respondents.*

Demographic Characteristics	Categories	Counts	Percentages
Age (in Years)	Up to 30	45	19
	31 to 40	68	29
	41 to 50	47	20
	Above 50	74	32
Educational Level	Basic Qualification (BQ)	101	43
	BQ + Intermediate	60	26
	BQ + Graduation	50	21
	BQ + Master	23	10
Family Background	Farming	182	78
	Non-Farming	52	22
Domicile	Rural	178	76
	Urban	56	24
Job Experience (in Years)	Up to 5	33	14
	6 to 15	92	39
	16 to 25	22	10
	Above 25	87	37
Farming Experience (in Years)	Not Involved in Farming	69	29
	1 to 10	51	22
	11 to 20	55	24
	Above 20	59	25

Source: *Field Survey, 2018.*

Results regarding educational level in Table 1 depicted that maximum number (43%) of the total respondents had basic qualification for serving as a Field Assistant and that basic qualifications includes Matriculations/ SSC plus three year field assistant diploma offered by

the ATI (Agricultural Training Institute) presently known as ASA (Agriculture Services Academy). The results showed that in addition to basic qualification, 26% of the respondents had acquired an intermediate education, 21% of the respondents had acquired graduation and merely 10% of the respondents reported master education. Our results are also in line with that of Farooq et al. (2010) who also reported that 59% of the Field Assistants were educated up to Matric plus two years' extension training certificate.

Moreover, 78% of the respondents were from farming family background which might be attributed to the fact that majority (76%) of the respondents were holding rural domicile. The larger portion of the Field Assistants from farming background is due to the fact that they have been involved in the farming and is familiar with the farming practices; therefore, joined career of Field Assistant by acquiring basic qualification. Our results are at par with that of Khan (2003) who reported that 70% of the respondents belonged to farming background.

Findings regarding job experience in Table 1 depicted that majority (39%) of the respondents had job experience of 6 to 15 years followed by 37% of the respondents that had above 25 years of experience whereas only 10% of the total respondents had 16 to 25 years of job experience. It can be concluded from the instant results that Field Assistants of the Agriculture Extension Department had enough job experience to offer their services to the farming community for development of agriculture. Agunga and Manda (2014) reported opposite results which stated that 43% of the extension workers had been on the job since five years whereas the rest of the respondents had higher job experience.

The data given in Table 1 showed that 29% of the sampled respondents were not currently involved in the farming because majority of these respondents were the residents of the urban areas where they lack resources to carry out farming activities. About 71% of the respondents were currently involved in the farming among which 25% of the respondents had above 20 years of experience followed by 24% of the respondents that had 11 to 20 years of experience. About 22% of the respondents reported one to ten years of farming experience. The instant results revealed that majority of the Field Assistants were involved in the farming activities which is also a good sign to learn many farming practices through their personal experience.

Required and possessed level of climate change competencies

Data given in Table 2 showed the possessed and required level of climate change competencies of Field Assistants which revealed that their mean possessed competencies in climate change was 3.43 whereas the required level was 4.20 at five point likert scale. The top most possessed competency recorded was familiarity with the climate change issues (4.33) whereas the required level reported for the said competency was 4.44. Similarly, the second highest possessed competency recorded was ability to communicate climate information effectively (4.27) followed by the understanding basic agro-meteorological parameters (3.94). The required levels reported for the two aforementioned competencies were 4.52 and 4.41 respectively. This showed that sampled Field Assistants were highly competent in these three competencies which can be attributed to their greater job experience as shown in Table 1.

Competencies regarding understanding and communicating weather forecast stood at 4th position with mean value of 3.37 and the required mean value was 4.35 and indicates that the greater portion of the Field Assistants were competent to understand the weather forecast and also has ability to properly communicate it. The fifth ranked competencies on possessed level were in soil and water conservation techniques with mean value of 3.33 and required mean value of 4.27. The competencies in measurement of agro-meteorological parameters were at 6th rank order with mean possessed level of 3.32 and mean required level of 3.88. Majority of the respondents responded during an informal discussion that they are capable to measure the agro-meteorological parameters but they do not have enough facilities to measure these parameters.

The competencies on possessed level at rank 7th and 8th were record keeping on climate change issues and recording and reporting climate change impacts and the mean values were 3.31 and 3.08 respectively. The competencies on lowest ranked order of possessed level were use of cultural practices to mitigate climate change impacts (mean=3.03, rank=9), promoting cultivation of improved crop varieties regarding climate change (mean=2.96, rank=10) and evaluating adaptation

Table 2: *Mean, SD and rank of the required and possessed level of climate change competencies.*

Sr. #	Items	Required level			Possessed level		
		Mean	SD	Rank	Mean	SD	Rank
1.	Communicating climate information effectively	4.52	0.71	1	4.27	0.87	2
2.	Familiar with climate Change	4.44	0.74	2	4.33	0.86	1
3.	Understanding basic agro-meteorological parameters	4.41	0.69	3	3.94	0.84	3
4.	Understanding and communicating weather forecast	4.35	0.79	4	3.37	0.85	4
5.	Soil and water conservation techniques	4.27	0.62	5	3.33	0.78	5
6.	Promoting cultivation of improved crop varieties regarding climate change	4.14	0.80	6	2.96	0.75	10
7.	Use of cultural practices to mitigate climate change impacts	4.11	0.94	7	3.03	0.72	9
8.	Evaluating adaptation options	4.07	0.74	8	2.84	0.69	11
9.	Record keeping on climate change issues	4.03	0.68	9	3.31	0.63	7
10.	Recording and reporting climate change impacts	3.94	0.68	10	3.08	0.71	8
11.	Measurement of agro-meteorological parameters	3.88	0.82	11	3.32	0.94	6
Overall Mean		4.20			3.43		

Table 3: *Rank order of training needs based on mean required and possessed level of climate change competencies.*

Sr. #	Items	Possessed level	Required level	Training need/ mean difference	Rank	t-value
1.	Evaluating adaptation options	2.84	4.07	-1.24	1	-17.23**
2.	Promoting cultivation of improved crop varieties regarding climate change	2.96	4.14	-1.18	2	-17.07**
3.	Use of cultural practices to mitigate climate change impacts	3.03	4.11	-1.08	3	-14.21**
4.	Understanding and communicating weather forecast	3.37	4.35	-0.98	4	-15.04**
5.	Soil and water conservation techniques	3.33	4.27	-0.93	5	-15.91**
6.	Recording and reporting climate change impacts	3.08	3.94	-0.87	6	-13.45**
7.	Record keeping on climate change issues	3.31	4.03	-0.72	7	-12.18**
8.	Measurement of agro-meteorological parameters	3.32	3.88	-0.56	8	-10.84**
9.	Understanding basic agro-meteorological parameters	3.94	4.41	-0.47	9	-8.84**
10.	Communicating climate information effectively	4.27	4.52	-0.24	10	-6.09**
11.	Familiar with climate Change	4.33	4.44	-0.11	11	-1.75NS

NS: *represents Non Significant whereas; ** represents significance at 1% level of probability.*

options (mean=2.84, rank=11). Tripathi and Mishra (2017) reported similar results that respondents were incapable in use of cultural practices to mitigate climate change impacts and promoting cultivation of improved crop varieties regarding climate change. These results conclude that Field Assistants had medium level competencies regarding mitigation of the climate change strategies and promotion of climate related cultivation of crops and vegetables varieties. Our results are slightly in contrast with Ogunlade et al. (2014) who reported that extension agents have high knowledge about climate change impact, its causes, effects and mitigation/adaptation methods which might be due to the training provided to them regarding these aspects.

Training needs in climate change competencies

Table 3 showed the training needs of Field Assistants regarding climate change competencies. The mean difference denotes their training needs which were based on the difference between the possessed level and the required level of the Field Assistant's competencies regarding climate change. The top most training need reported was evaluation of adaptation options followed by promoting cultivation of improved crop varieties regarding climate change with mean difference of -1.24 and -1.18 and t-values of -17.23 and -17.07 respectively. Highly significant (P≤0.01) difference was found between the possessed and required level regarding competencies of evaluation of adaptation options and promoting

cultivation of improved crop varieties regarding climate change. Significant (P≤0.01) difference between possessed and required level of cultural practices to mitigate climate change impacts competency was observed with t-value of -14.21 and mean difference of -1.08. Adisa and Balogun (2012) also stated that extension agents needed to be provided training use of cultural practices to mitigate climate change impacts in Nigeria.

Understanding and communicating weather forecast was ranked at 4th order regarding training needs with the highly significant (P≤0.01) mean difference of -0.98 and t-value of -15.04. The 5th ranked training need was found in competencies of soil and water conservation techniques (mean difference=-0.93, -15.91). Training needs in recording and reporting climate change impacts was ranked at 6th order with mean difference of -0.87 and t-value of -13.45. The training needs in competencies regarding record keeping on climate change issues, measurement of agro-meteorological parameters and understanding basic agro-meteorological parameters stood at 7th, 8th and 9th rank with mean difference of -0.72, -0.56 and -0.47 and t-values of -12.18, -10.84 and -8.84 respectively. Significant difference (P≤0.05) was reported between the possessed and required level in competencies of understanding and communicating weather forecast, soil and water conservation techniques, recording and reporting climate change impacts, record keeping on climate change issues, measurement and understanding of agro-meteorological parameters.

Training needs in competencies of the Field Assistants regarding communicating climate information effectively was ranked at 10th order with mean difference of -0.24 and t-value of -6.09 and with significant difference at 1% level of probability. Non-significant difference was reported in possessed and required level of competencies in familiar with climate change and ranked at 11th order of training needs. These results are partial in line with Anka (2016) who recommended that extension staff of Zamfara state of Nigeria must be provided with intensive training on the use of ICTs, measurement of agro-meteorological parameters (speed of wind and intensity of sunshine), properly collecting data and its analysis to help them in handling climate change related issues. The findings regarding training needs are also shown in Figure 1 on radar graph in order to understand it easily.

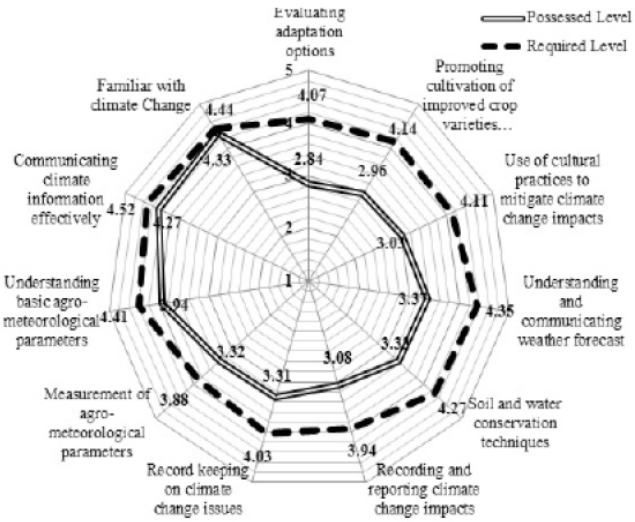

Figure 1: *Radar graph showing training needs of field assistants*

Association among demographic characteristics and climate change competencies

To find association among demographic attributes of the Field Assistants with their climate change competencies, chi-square test was applied and the results are shown in Table 4. The results showed that there exists highly significant association (P<0.05) among family background, domicile and length of farming experience with field assistant's climate change competencies. The negative value of gamma test i.e. -0.512 and -0.475 for family background and domicile of the Field Assistants respectively indicates the inverse association with their climate change competencies. This showed that Field Assistants from farming background with rural domicile had higher climate change competencies as compared to Field Assistants of non-farming background with urban domicile. This might be due to the fact that these Field Assistants had acquired these climate change competencies while personally engaged in the farming during their residency in rural areas. The positive value of gamma for length of farming experience (0.213) indicated that with increase in farming experience of the Field Assistants their climate change competencies also increased that could be due to their personal experience and mitigation strategies that they adopted to minimize the harmful effects of climate change in their daily farming activities. The results in Table 4 also indicated that there exists non-significant association among the three demographic characteristics i.e. age, job experience and educational level of the Field Assistants with their climate change competencies as P>0.05. The instant results are almost opposite to that of Dimelu (2016) who reported that year of

experience in extension organization had significantly related to the knowledge of climate change.

Table 4: *Association among demographic characteristics and climate change competencies.*

Demographic characteristics	Possessed level competency		
	χ^2	P-value	Gamma value
Age	6.441	0.695	0.010
Family Background	10.551	0.014	-0.512
Domicile	8.524	0.036	-0.475
Job Experience	6.042	0.736	-0.042
Education Level	9.580	0.386	0.030
Length of Farming Experience	21.780	0.010	0.213

Family background: *1 for Farming and 2 for Non-Farming;* **Domicile:** *1 for Rural and 2 for Urban*

Conclusions and Recommendations

It can be concluded from the present study that despite of the enough job experience and educational qualification, the sampled respondents were not competent in most of the climate change competencies. The competencies in which Field Assistants lacks competence were; record keeping on climate change issues, recording and reporting climate change impacts, use of cultural practices to mitigate climate change impacts, promoting cultivation of improved crop varieties and evaluating adaptation practices. Also wide range of training needs was observed in the above competencies which significantly affected their task performance. The results further conclude that family background, domicile and farming experience has considerably improved their climate change competencies. Due to their esteem importance in the transfer of improved technologies the Field Assistants need to be equipped with the proper knowledge along with gadgets so that they can perform their duties efficiently. It is suggested that the proper in-service trainings should be arranged for the Field Assistants along with the inclusions of this very important emerging challenge in the basic curriculum of Field Assistant Diploma Courses.

Author's Contribution

The present research article is a part of PhD research work of Asif Nawaz which was supervised by Prof. Dr. Muhammad Zafarullah Khan.

References

Adisa, R.S. and K.S. Balogun. 2012. Analysis of Training Needs of Extension Agents on Climate Change Issues in Ekiti State Agricultural Development Project (EKSADP), Nigeria. J. Agric. Ext. 16(2): 24-33.

Agunga, R. and L.Z. Manda. 2014. Communication for strengthening agricultural extension and rural development in Malawi. J.Dev. Commun. Stud. 3(1): 1-16.

Anaeto, F.C., C.C. Asiabaka, F.N. Nnadi, J.O. Ajaero, O.O. Aja, F.O. Ugwoke, M.U. Ukpongson and A.E. Onweagba. 2012. The Role of Extension Officers and Extension Services in the Development of Agriculture in Nigeria. Wudpecker J. Agric. Res. 1(6): 180-185.

Anka, L.M. 2016. Analysis of training needs of extension agents on climate change issues in Zamfara Agricultural Development Project (ZADP), Nigeria. Pak. J. Agric. Agric. Eng. Vet. Sci. 32(1): 66-74.

Ashraf, E., H.K. Sharjeel, R. Babar, M. Junaid, Q. Iqbal, R. Rasheed and N. Fatima. 2018. Perceptions of Extension Field Staff regarding Technology Transfer through Different Extension Approaches. Sarhad J. Agric. 34(2): 291-300. https://doi.org/10.17582/journal.sja/2018/34.2.291.300

Demenongu, T.S., O.J. Okwu and V.A. Okwoche. 2015. Assessment of communication competence of agricultural extension workers in Benue state, Nigeria. J. Agric. Food Inf. 16(2): 163-173. https://doi.org/10.1080/10496505.2015.1016612

Dimelu, M.U. 2016. Determinants of knowledge and attitude of extension professionals to climate change in Anambra State, Nigeria: A Multivariate Logistic Analysis. Asian J. Agric. Ext. Econ. Soc. 14(4): 1-16. https://doi.org/10.9734/AJAEES/2016/30701

Farooq, A., M. Ishaq, N.A. Shah and R. Karim. 2010. Agriculture extension agents and challenges for sustainable development. Sarhad J. Agric. 26(3): 419-426.

Husain, N. 2004. Analysis of the competency levels of extension administration in the Punjab, Pakistan. Unpublished PhD thesis Dep. Agric. Ext. Univ. Agric. Faisalabad, Pak.

Khan, M.A. 2012. Agricultural development in Khyber Pakhtunkhwa: prospects, challenges

and policy options. Pakistaniaat: J. Pak. Stud. 4(1): 49-68.

Khan, M.A.J. 2003. Identification and rank order development of self-perceived competencies possessed by agriculture extension agents in the Punjab, Pakistan. Ph.D Dissertation. Dep. Agric. Ext. Educ. Univ. Agric. Faisalabad, Pak. p. 173.

Kothari, C.R. 2004. Research Methodology Methods and Techniques (2nd Ed., Reprint: 2011). New Delhi: New Age. p. 187.

Kurukulasuriya, P., R. Mendelsohn, R. Hassan, J. Benin, T. Deressa, M. Diop, H.M. Eid, K.Y. Fosu, G. Gbetibuo and S. Jain. 2006. Will African Agriculture Survive Climate Change? World Bank Econ. Rev. 20(1): 367–388. https://doi.org/10.1093/wber/lhl004

Leeuwis, C. and N. Aarts. 2011. Rethinking communication in innovation processes: creating space for change in complex systems. J. Agric. Educ. Ext. 17(1): 21-36. https://doi.org/10.1080/1389224X.2011.536344

Memon, R.A., E. Bashir, H.U.R. Mian and A.R. Nasimullah. 2013. Extension Methods. Nat. Book Found. Pak. 54-56.

Mendelsohn, R. 2014. The impact of climate change on agriculture in Asia. J. Integr. Agric. 13(1): 660–665. https://doi.org/10.1016/S2095-3119(13)60701-7

Mugenda, O.M. and A.G. Mugenda. 2003. Research Methods: Quantitive and Qualitative Approaches. Nairobi: Acts Press. 87.

Ogunlade, I., S.A.A. Wahab and A.O. Mensah. 2014. Knowledge levels of extension agents and their perceived impact of climate change on extension service Provision in Ghana. Ethiop. J. Environ. Stud. Manage. 7(1): 96-103. https://doi.org/10.4314/ejesm.v7i1.12

Sarkar, S. and R.N. Padaria. 2015. Measuring farmers' awareness and knowledge level about climate change and formulating future extension strategies. India. Res. J. Ext. Educ. 15(1): 107-111.

Sekaran, U. 2006. Research Methods for Business. USA, Harnitage Publishing Services. p. 468.

Tripathi, A. and A.K. Mishra. 2017. Knowledge and passive adaptation to climate change: an example from indian farmers. Clim. Risk Manage.16(1):195-207. https://doi.org/10.1016/j.crm.2016.11.002

Ullah, R., K. Ullah, I. Ullah, M.Z. Khan and A. Nawaz. 2017. Field assistants impact on agricultural extension activities: A Case Study of District Dera Ismail Khan, Khyber Pakhtunkhwa Pakistan. Pak. J. Agric. Res. 30(3): 287-293. https://doi.org/10.17582/journal.pjar/2017.30.3.287.293

Yousuf, I., A.R. Ghumman, H.N. Hashmi and M.A. Kamal. 2014. Carbon emissions from power sector in pakistan and opportunities to mitigate those. Renewable and Sustainable Energy Rev. 34(1): 71–77. https://doi.org/10.1016/j.rser.2014.03.003