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AN ANALYSIS OF PROFESSIONAL AND TECHNICAL IN-SERVICE TRAINING NEEDS ASSESSMENT OF EXTENSION FIELD STAFF OF SOUTHERN PUNJAB, PAKISTAN

Muhammad Hamid Nawaz Khan[1*], Dr. Muhammad Ismail Kumbhar[2], Dr. Aijaz Ali Khooharo[3], Dr. Habibullah Magsi[4], Dr. Zaheeruddin Mirani[5], Dr. Aamir Riaz[6].

1. PhD Scholar , Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan. Email: hamid.nawaz@iub.edu.pk (Corresponding author)
2. Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences , Sind Agriculture University, Tandojam, Pakistan. Email: mikumbhar@sau.edu.pk
3. Professor and Dean, Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan. Email: draijaz@sau.edu.pk
4. Professor & Chairman, Department of Agricultural Economics , Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan. Email: hmagsi@sau.edu.pk
5. Professor and Chairman, Department of Agricultural Education Extension & Short Courses, Faculty of Agricultural Social Sciences, Sind Agriculture University, TandoJam, Pakistan. Email: zamirani@sau.edu.pk
6. Assistant Professor, Department of Agricultural Extension Education Faculty of Agriculture & Environment, The Islamia University of Bahawalpur, Pakistan. Email: aamir.riaz@iub.edu.pk

Abstract

Global development agencies, particularly in Pakistan, are focusing on agricultural development. However, Pakistan's extension services' effectiveness is under scrutiny. Assessing training requirements for extension personnel is crucial. This study aims to analyzes the in-service training needs of extension field staff in Southern Punjab, Pakistan. The research collected data from 300 respondents from five districts, focusing on current versus required competence levels. Data was collected using a questionnaire, tabulated in excel and analyzed using SPSS, descriptive and inferential statistics were used to study the relationship between variables. The study found that the most urgent professional competencies required in-service training are the planning and development of Extension programs and use of Extension Methods. Technical competencies agronomic, plant protection and soil fertility. Professional competencies showed smaller training gaps compared to technical ones. Demographic factors significantly influence EFs' in-service training needs, but other factors may also impact these requirements.

Key words: In-service training, Competency, Training needs assessment, Extension Field Staff

1. Introduction

Pakistan is an agriculturally based economy country. According to Chandio et al. (2022) and Bint Zaman et al. (2021), agriculture accounts for around 19% of Pakistan's GDP and has an annual growth rate of 2.77%. In addition, the COVID-19 outbreak disrupted crop production and supply in countries such as Bangladesh, India, and Pakistan, highlighting how subject the industry is to external factors (Ahmed et al., 2021). According to previous information, Pakistan's agricultural production has been declining during the past ten years, in accordance with other quickly expanding countries; in 1960, the agriculture sector contributed 29% of GDP, but that figure fell to 18.9% in 2020 (Gul et al., 2022). Food-related global greenhouse gas (GHG) emissions account for approximately 26 percent of total pollutants (Tariq et al., 2023). Carbon emissions from the use of petroleum and natural gas provide an issue to the agricultural sector in Pakistan business, affecting both food production and climate change. To address these issues, modernization and sustainable agriculture practices must be implemented, including the use of energy sources that are renewable along with successful techniques for farming. Strengthening crop yields as well as sustainability is critical to Pakistan's economic prosperity and ecological well-being.

A variety of political as well as economic variables influence agricultural product demand in South Asian countries. Population growth, import and export dynamics, and shifting dietary habits are all major variables in determining consumption. According to investigations, the agricultural business in South Asia has seen major shifts in structure, with the cultivation of a broader range of crops prompted by variables like as per capita GDP, pesticide usage, and food crop yields (Singh et al.,2022).

Pakistan has two agricultural seasons: Rabi and Kharif, with Kharif running from April 16 to October 15 and producing rice, sugarcane, sorghum, millet, and maize. Rabi, which runs from November to April, produces wheat, barley, mustard, and peas in the spring. Pakistan's four regions are Sindh, Baluchistan, KPK, and Punjab. Punjab, comprising 55% of the population, is the most industrialized and contributes significantly to agricultural output. Despite its dry climate, the province's thriving agricultural sector, facilitated by irrigation, is vital. The agriculture industry in Pakistan experienced a remarkable growth rate of 4.40 percent in 2021-22, surpassing both the target and the previous year's growth rate of 3.48 percent. Key drivers include high yields, favorable output prices, government policies, access to certified seeds, pesticides, and agricultural credit. Important crops like cotton, rice, sugarcane, and maize also saw significant growth. Pakistan's livestock and fishing industries experienced growth in 2021-22, with livestock experiencing a 3.26

percent increase compared to the previous year. The fishing industry saw a 0.35 percent increase, while the forestry sector saw a 6.13 percent increase, indicating positive growth.

Yield gap analysis measures the difference between current food yields and ideal agricultural conditions, identifying causes like poor soil quality, insufficient irrigation, pests, and diseases. It helps understand agricultural productivity potential and potential for increased crop yields. Research shows improved management techniques and soil fertility can increase maize and wheat yields by 50-100% . Yield gap analysis is crucial in agribusiness for guiding investment and policy decisions. Studies show that reducing yield gaps in crops can boost agricultural production, rural income, and food security. Closing these gaps can boost output by 45% and positively impact the economy and environment (Van Wart *et al.,* 2019 and Zhang *et al.,* 2017).

Through study, several potential reasons for yield gaps in Pakistan have been found. Low yields and bad crop quality may be the outcome of restricted access to high-quality inputs like seeds, fertilizer, and pesticides (Qasim *et al.,* 2021). In Pakistan's semi-arid and arid areas, inadequate irrigation infrastructure can also cause water stress, which lowers yields (Hussain *et al.,* 2020). Another important factor in production gaps is poor soil quality brought on by erosion, nutrient depletion, and soil degradation (Rafiq *et al.,* 2019). If not properly controlled, pests and diseases can considerably lower crop yields. Another element causing yield gaps is the non-adoption of contemporary farming techniques and technologies. Crop rotation, resistant crop varieties, and precision agriculture methods like satellite imagery and remote sensing can all help reduce pest and disease problems. Another element causing yield gaps is the non-adoption of contemporary farming techniques and technologies. Crop rotation, the use of resistant crop varieties, and precision agriculture methods like satellite imaging and remote sensing can all help reduce pest and disease issues and enhance soil quality. By addressing these issues, sustainable and creative farming methods can help Pakistani farmers close yield gaps and boost crop growth (Khan *et al.,* 2021; Sher *et al.,* 2020; Hussain *et al.,* 2021; Rehman *et al.,* 2021).

By provision of information and skills to farmers which the they need to increase their output and income, extension services are essential in closing the yield gap in agriculture. Through extension services, farmers can access information on market opportunities, adopt more advanced technologies, and engage in sustainable farming practices. Numerous studies have emphasized the usefulness of extension services in closing the agricultural yield disparity. For instance, Gebremedhin *et al.,* (2021) discovered that by supplying farmers with better technologies and

management techniques, extension services greatly increased the yield of maize and wheat crops. Similar to this, Akrobortu *et al.,* (2021) discovered that extension services greatly increased tomato crop yields by educating farmers on pest control and better production methods. Numerous studies have shown how effective extension services are at closing the yield disparity in Pakistani agriculture. According to a study by Ahmad *et al.,* (2021), for instance, the yield of wheat and maize crops in Pakistan was considerably increased by the provision of extension services, which included training and field demonstrations. The use of input subsidies and extension services increased the adoption of improved rice varieties and greatly increased rice yields in Pakistan, according to a study by (Shahzad *et al.,* 2020).

The accomplishment of an extension program is revealed by the capacity of extension agents who are qualified, extremely responsible in their work, and capable in the extension process. Many extension techniques and tactics rely on peasant approval of technology transfer with thorough development (Omeh *et al*., 2014). The extension agent must establish credibility with clients by displaying the degree of proficiency necessary to motivate others (Noe, 2017).). With issues like poverty, food insecurity, and climate change, among others, the need for skill in agriculture is currently more important than ever (Rivera *et al.,* 2002). Providing an efficient connection service relies on how well extension agents communicate with farmers about their various agricultural innovations (Umeh *et al*., 2018). It also demonstrates the need for extension agents to learn more in order to be able to meet the demands of customers who are becoming more sophisticated and varied. Extension agents who are successful at disseminating information that can improve life need to know more. The need for routine evaluation and analysis of the technical capacity and ability was verified by the role of extension agents as conduits connecting the various stakeholders (Umeh *et al*., 2018). The extension officers who are among agriculture extension agents must improve their professional competencies, such as competencies in organization and social community, in addition to their knowledge of agriculture (Smith *et al*., 2016).

The level of agricultural output can be significantly impacted by extension workers' professional incompetence. Extension personnel are people who work closely with farmers to give them knowledge, instruction, and professional assistance to enhance their agricultural practices. These employees may unintentionally give farmers inaccurate or out-of-date information if they lack the required knowledge and abilities, which would lower agricultural productivity. According to a study by Rana and Singh (2017), farmers in India were less likely to adopt new practices and technologies as a result of the extension workers' professional incompetence. Farmers' incomes

also suffered as a consequence of the decreased agricultural productivity. Similar to this, in a study in Nigeria by Omoregie and Isitor (2015) found that farmers adopted unsustainable practices like monoculture and excessive fertilizer use due to extension workers' lack of knowledge and expertise in managing soil fertility and crop production, which in turn caused a decline in soil fertility and agricultural productivity. Furthermore, farmers may implement environmentally harmful practices as a result of the extension employees' professional incompetence. For instance, Yaro and Akinnifesi's (2016) research in Ghana found that farmers adopted unsustainable Agro- forestry practices, which led to deforestation and soil erosion, because extension workers lacked the necessary knowledge and expertise.

Finally, the incompetence of extension workers can impact agricultural production in negative significantly resulting in decreased productivity, lower farmer incomes, and environmental degradation. In order to give farmers accurate and current information and support, it is crucial to make sure extension agents have received the proper training and possess the required knowledge and skills.

Research on the effects of extension workers' professional incompetence on Pakistani agricultural output is scarce. In Punjab, Pakistan, Hussain *et al.,* (2021) evaluated the skill of agricultural extension employees and its effect on farmers' adoption of suggested practices. The research discovered that farmers did not implement recommended practices because extension workers' competence was low, which caused a decline in agricultural productivity. The efficacy of agricultural extension services in Pakistan in promoting sustainable farming practices was assessed in a different study by Arshad *et al.,* (2020). According to the research, extension agents were unable to effectively support farmers with technical assistance because they lacked the required knowledge and skills. Farmers did not adopt sustainable practices as a result, which decreased agricultural output. Additionally, Ullah *et al.,* , study (2019) found that Pakistani extension workers lacked the skills and knowledge necessary to effectively promote modern agricultural practices among farmers, which resulted in low adoption rates and decreased agricultural output. In conclusion, the professional incompetence of Pakistani extension employees can significantly affect agricultural production, resulting in decreased productivity and lower incomes for farmers. It is crucial to ensure that extension agents have received the appropriate training in order to ensure that they can provide farmers with accurate and up-to-date information and assistance.

Training need Assessment is the procedure for determining, prioritizing, and implementing concrete measures to address training requirements as part of a training program. (TNA). Particularly in the beginning stages, it is regarded as being a crucial element of the planning process. TNA is used to improve, modify, and adapt current programs to suit a client's unique needs. Although the overall goal is to close the performance gap between current and intended performance, TNA can take many different forms depending on the program. It is an essential component of the training cycle and overall planning process. The crucial value of TNA in determining the training requirements of extension workers was emphasized by a study conducted by Ali *et al.,* (2021) in the Pakistani province of Khyber Pakhtunkhwa. The research emphasized the necessity of ongoing TNA in order to maintain the applicability and efficacy of the training programs provided to extension workers. Similar research was done by Ahmad *et al.,* (2019) in Punjab province, where they discovered that training programs based on TNA greatly increased the knowledge and abilities of agricultural extension workers. Mahmood *et al.,* (2018) highlighted the importance of TNA in creating tailored training programs for extension workers in Pakistan in another research. According to the study's findings, TNA was useful in identifying the knowledge gaps that extension employees had, and training programs created using TNA were more successful in boosting their performance. In summary, TNA is an indispensable tool for developing effective training programs for extension workers in Pakistan. Regular TNA can identify knowledge and skill gaps, leading to relevant and effective training programs.

Table 1 : Review of studies relevant to current research

Location	Author(s)	Year	Title
Punjab province	Hussain, A., & Padder, M. A.	2012	Capacity building of agricultural extension staff in Pakistan: An analysis of training need
Punjab province	Hassan, Z. U., Khalid, M. A., & Mahmood, A.	2016	Assessment of training needs and preferences of agricultural extension workers in Punjab, Pakistan.
Punjab province	Mahmood, A., Aslam, M., Khalid, M. A., & Haq, M.	2018	Developing customized training programs for extension workers in Pakistan: The role of training needs assessment.
Punjab province	Ahmad, M., Azeem, M. M., Saleem, M. A., & Farooq, A.	2019	Effectiveness of training program for agricultural extension workers in Pakistan: An analysis based on training needs assessment.
Khyber Pakhtunkhwa province	Ali, A., Khan, M. A., Ahmad, N., & Ahmad, N.	2021	Identification of training needs of extension workers in Khyber Pakhtunkhwa, Pakistan.
Sindh province	Iqbal, M. S., & Hassan, S.	2019	Training needs assessment of agricultural extension workers in Sindh province of Pakistan.

Employee skills possess an essential function in defining an organization's immediate and long-term success, as they are its most asset (Al-Mzary *et al.,* 2015). The effect of training on employee job performance is the domain of Human resource management research. Research studies by (Iqbal *et al.,* 2014; Padamanaban and Shakeel-Ul-Rehman, 2013; Elnaga and Imran, 2013) suggest that an organization's training practices might impact performance. Using multiple training

approaches may boost employee work performance, thereby benefiting the organization. Effective training techniques are crucial for a company's performance, making them worthy of study examination. The latest research area in this context has focused on how human resource management and training techniques affect organizational performance (Manning, 2015; Jayakumar and Sulthan, 2014; Treven *et al.,* 2015). Training can improve employee happiness, dedication, and empowerment (Voegtlin *et al.,* 2015; Ajibade and Ayinla, 2014; Sung and Choi, 2014).

Taking advantage of contemporary techniques and concepts of learning has become an essential aspect of training. Effective training requires effective ways that capture employees' attention and enhance learning (Teck-Hua and Catherine, 2015; Mishra and Smyth, 2015; Alwekaisi, 2015). Captivating the focus of participants in training is crucial for a successful outcome, since it relies on their mindsets concerning training procedures along with consequences. Positive attitudes towards training procedures maximize learners' advantages (Nu'man, 2006).

Extension services now concentrate on socioeconomic and environmental issues in addition to technical ones, meeting the comprehensive needs of farmers and rural communities. In Pakistan, agricultural extension has recently placed a greater emphasis on participatory methods. Farmers have been encouraged to actively participate in extension efforts and be included in decision-making processes. As venues for knowledge exchange and hands-on learning, farmer field schools (FFS) and farmer interest groups (FIGs) have been developed (Bakht *et al.,* 2020). In order to improve farmer capacity, encourage sustainable agricultural practices, and handle the changing problems encountered by the agricultural sector, the Pakistani government continues to engage in agricultural extension in partnership with international organizations and development partners. By facilitating the transmission of appropriate technology and knowledge to enhance agricultural productivity and rural lives, Pakistan's extension services are aiming to close the knowledge gap between researchers and farmers.

Agricultural extension agents' knowledge, abilities, and skills must be improved through training if they are to help farmers and rural people in the agricultural sector successfully. Agricultural extension agents work as a bridge between farmers and agricultural research, offering useful knowledge, support, and training to enhance agricultural practices and boost productivity (Rivera *et al.,* 2018). Training is essential for providing extension agents with the knowledge and resources they need to carry out their duties and advance agricultural development. Agronomy, livestock

management, pest and disease control, soil conservation, sustainable farming methods, market analysis, and rural development strategies are among the topics included in training for agricultural extension agents (Swanson and Rajalahti, 2010). Extension agents learn the most recent information about cutting-edge farming practices, new technologies, and best practices in agricultural management through extensive training programs. With this expertise, they are better equipped to give farmers accurate and timely information that will encourage them to adopt more productive farming practices and reduce hazards.

Pakistan's agriculture extension service is under criticism for its shortcomings. A study is being conducted to understand the responsibilities and skills of extension staff, identify areas of weakness, and prioritize training requirements. This research aims to develop efficient training programs and policy recommendations for capacity building, enhancing the extension system.

However, a quick online review of different research shows that there is limited research available on the training needs assessment of extension workers specifically in Southern Punjab. However, there are studies available on the training needs assessment of extension workers in Punjab province, which Bahawalpur is a part of. One such study is "Assessment of Training Needs of Agricultural Extension Workers in Punjab, Pakistan" conducted by Mohammad *et al.,* (2020). The study highlights the importance of TNA in identifying the training needs of extension workers and suggests that regular TNA can help improve their performance. Therefore, this study was designed to analyze the professional and technical in-service training needs assessment of Extension Field Staff of Southern Punjab, Pakistan.

2. MATERIAL AND METHODS

2.1 Study Area

Punjab, a South Asian region, is a vital agricultural hub with vast agricultural fields that contribute to regional and national economies. The region is influenced by the Jhelum, Chenab, Ravi, and Sutlej rivers and has a rich agricultural landscape. South Punjab, comprising three distinct regions, occupies 45% of Punjab's 91,998 km2 and is home to 32.7 million people. The region's agricultural landscape has evolved during the 1960s and 1970s Green Revolution, with the introduction of novel wheat and rice varieties, substantial farming inputs, and the growth of the water supply system. The study focused on five districts: Bahawalpur, Bahawalnagar, Rahim Yar Khan, Lodhran, and Muzaffargarh. A cross-sectional survey was used to gather data from a sample at one time.

2.2 Study population

The population of the study was all Extension Field staff (EFs) from Southern Punjab's agriculture department.

2.3 Sample selection

A sample size of 300 respondents was chosen using the Fitzgibbon Table (1980).

2.4 Instrument development

A structured interview schedule was developed for obtaining quantitative data from respondents, based on literature review, specialist discussions, peer reviews, and field interviews. Data was collected through semi-structured interviews, with each participant assured of privacy. Data quality was maintained through a critical phase of examining completed questionnaires and interview schedules for errors, missing information, and discrepancies.

2.5 Data analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 20 computer program, with calculations for both descriptive and inferential statistics. The results were tabulated, evaluated, discussed, and utilized to provide suggestions. The relationship between hindering and supportive factors was investigated using Chi Square Correlation Analysis.

3. RESULTS AND DISCUSSION

The findings of this study were comprised of the socioeconomic characteristics of all respondents.

Demographic information of respondents

The respondents' demographics are thought to have a significant role in determining whether or not they are aware of and embrace current manufacturing practices (Hassan 2015; Ali *et al.,*2021; Jones, and Garcia (2021); Thompson and Smith (2016).Similarly, Rehman *et al.,* (2013) found a substantial correlation between farmers' socioeconomic characteristics and their ability to obtain agricultural knowledge in order to embrace new technologies. It is believed that a person's attitude and behavior can be influenced by their demographic characteristics. Given the significance of these variables, data has been supplied on the respondents' age, area of jurisdiction, professional education, duration of

service, family history, agricultural experience, and attendance at in-service training courses and refresher courses.

Table 2: Demographics of Agricultural Extension Field Staff (N=300)

Category	Frequency (f)	Percentage (%)
Age (in years)		
20-30	78	26.00
31-40	84	28.00
41-50	120	40.00
50 and above	18	6.00
Education		
3 Years diploma	71	23.66
B.Sc. (Hons.) Agri	125	41.66
M.Sc. (Hons.) Agri	92	30.66
Ph.D. (Agri)	12	4.02
Service Length (No. of years spent in job)		
1-5	95	31.67
6-10	110	36.67
11-15	73	24.33
16 and above	22	7.33
Family Background		
Farming	195	65
Non-Farming	105	35
Training (Attended)		
On job training	227	75.67
Refresher course	191	63.67
No. of trainings		
No	11	3.67

1-5	171	57.00
6-10	86	28.67
11or above	32	10.66

Table 2, summarizes results of the information gathered from EFs, demonstrate that 26% respondents were primarily from the 20–30 age group, (28 %) from 31-40 years and just 6.0% were older than 50 years old. Regarding the education of respondents, 41.66% were B.Sc. (Hons) Agri 30.66% M.Sc. (Hons) Agri. whereas 23.66 % were with 3 years diploma and only 4.02% were those having Ph. D Agri. Above table also clarifies the distribution of respondents according to their period of service showing 36.67% with 6 to 10 years of service, 31.67% with 1-5 , 24.33% 11-15 years and only 22% of respondents fall in category 16 and above years length of service. Further, table also shows 65 % of respondents had farming family background, 75.67% participated in on-the-job training programs, 63.67% attended refresher courses ,96.33% participants completed one or more training and refresher courses and only 3.67% respondents were who never attended such training or refresher courses.

The demographic analysis of the agricultural extension field workers reveals an experienced workforce, with a significant percentage having completed professional training programs and come from farming backgrounds. These characteristics indicate that the field personnel are well-positioned to conduct effective agricultural extension services. However, there is still an opportunity to increase access to training opportunities, particularly for people with little or no prior training, in order to maintain continuous skill development across the workforce.

Perceptions of Extension Field staff regarding need of In-service Training Needs

In-service training enhances the professional abilities and competencies of extension workers and specialists. Research indicates that the in-service training requirements for agricultural extension professionals fluctuate with time (Jayakumar and Sulthan (2014).). According to JICA and ICARDA (2016), training enhances staff knowledge, skills, and attitudes, ultimately leading to better services. Training has become essential to improving efficiency, motivating employees, and providing necessary information to do their job effectively. EFS were asked what they perceive about the need of in-service trainings and to what extent they agree with statement that are in-service trainings are Essential for, and response is given in Table follows.

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Table 3: Mean ± STD of opinions / extent of agreement to In-service Training needs in study domain

Inservice training is essential for	Mean	±STD
Enhancing professional skills and knowledge.	4.21	0.93
Job effectiveness and productivity	4.22	1.00
Updating industry advancements in addition to standard practices.	4.30	0.90
Professional advancement and accomplishment.	4.17	1.01
Fostering an excellent atmosphere in the workplace.	4.12	0.91
Increasing satisfaction with work favorably.	4.22	0.84
Aggregate score	4.21	0.93

Mean and ±STD values were calculated from responses were measured on 5-Point Likert scale from (1=Strongly disagree 2= Disagree 3= Neutral 4=Agree 5= Strongly Agree)

Table 3 shows the extent to which participants agreed on the value of in-service training in key elements of professional and workplace development. The responses were gathered on a 5-point Likert scale (1=Strongly Disagree to 5 = Strongly Agree), and the mean and standard deviation (±STD) values were computed to illustrate the central tendency and variability of the opinions.

The findings demonstrate a strong consensus among participants regarding the importance of in-service training across various dimensions of professional and organizational development. The highest mean score (4.30 ± 0.90) was observed for the role of in-service training in "updating industry advancements in addition to standard practices," highlighting its critical importance in enabling employees to stay current with technological and industry changes. This was closely followed by the agreement on the importance of in-service training for "job effectiveness and productivity" (4.22 ± 1.00) and "increasing satisfaction with work favorably" (4.22 ± 0.84), emphasizing its dual role in improving performance and boosting employee morale. Similarly, in-service training was widely recognized for its role in "enhancing professional skills and

knowledge" (4.21 ± 0.93), fostering employees' growth and capability in their roles. The mean score for "professional advancement and accomplishment" (4.17 ± 1.01) further indicates that participants view such training as a means to achieve career growth and remain competitive in their field. Additionally, the role of in-service training in "fostering an excellent atmosphere in the workplace" (4.12 ± 0.91) reflects its contribution to improving collaboration and workplace dynamics. The aggregate score (4.21 ± 0.93) reflects positive agreement in all categories, with low standard deviations indicating consistent replies across individuals. These findings highlight the relevance of in-service training as a critical tool for developing employees' professional and technical competencies for staying current with industry innovations, increasing efficiency, boosting workplace happiness, and promoting career progression. Regular and focused training programs customized to employees' changing requirements are critical for sustaining these advantages over time.

Categories of Competences

Two categories of competences that EFs must possess were identified by a number of researchers: i) Professional competencies ii) Technical proficiencies (Lakai *et al.*, 2014; Graham, 2009; Stone and Coppernoll, 2004).

Professional competencies: These refer to the knowledge, attitudes, skills, and behaviors required to perform at the highest standards of the profession (Kazi *et al.,* (2019).). These competencies require base-level knowledge or awareness as well as application, synthesis, and critique (Khan, and Masrek (2017). Public extension agents, for example, regarded four (4) professional abilities as extremely crucial for their professional efficiency, according to Khan's (2003) research. The skills involved included human behavior/public relations, program design, extended teaching techniques, and supervision/administration. Agri-extension professional abilities continue to be one of the key deficiencies in developing nations, Priya and Sirvanaryana, (2013) contended that a professional competency in communication, program planning and execution, teaching and extension methodologies, adult behavior comprehension, along with other related areas ought to be possessed by extension agents working in developing nations. According to Issahaku (2014), the majority of extension workers lacked the necessary

competences, and the researcher asserted that professional competencies are a crucial component of persuading farmers to accept the recent advances in technology.

The following key professional skills were identified and determined to be necessary for employees to be successful as these contribute to the comprehensive growth of extension specialists: Planning an Agriculture Extension Program; Using Extension Methods; Communication and Presentation Skills; Supervision and Administration; Evaluation; Participatory Extension Techniques; Computer Skills and Knowledge; and Public Relations Techniques. The respondents were asked about their possessed and required levels in Planning and development of Extension programs and Using Extension Methods related skills as professional ones, summary is as in table 3, below.

Table 4: Mean ± STD of Competencies possessed and required level in Planning and development of Extension programs as professional competency in study domain

S#	**Planning and development of Extension programs related Skills**	**Required Competency level (RCL)**		**Possessed Competency level (PCL)**		**Training Need (DV=RCL-PCL)**	**Rank Order**
		Mean	±STD	Mean	±STD		
1	Develop short and long duration extension programs	4.39	0.48	3.23	0.55	2.20	1
2	Skills and ability to develop an action plan	4.33	0.49	2.32	0.87	1.90	2
3	Ability to analyze the current situation	4.32	0.49	2.32	0.66	1.88	3
4	Gaining the participation of opinion leaders and professional groups in program planning	4.29	0.45	2.78	0.88	1.51	4
5	Ability to identify specific and general objectives	4.28	0.54	2.83	0.82	1.49	5
6	Using personnel resources in program planning and extension programs	4.28	0.52	2.88	0.78	1.40	6
7	Giving people satisfaction from the extension program	4.28	0.48	3.02	0.68	1.38	7
8	Organizing and working with program planning committees	4.22	0.57	3.09	0.66	1.24	8
9	Knowledge about involving people in the program planning process	4.22	0.49	3.10	0.67	1.18	9
10	Identifying people's needs, interests and priorities	4.20	0.53	3.02	0.68	1.18	10
11	Ability to use census data and other resources	4.22	0.53	3.23	0.55	0.99	11

Mean and ±STD values were calculated from responses were measured on 5-Point Likert **Scale: (1=Very low 2= Low 3= Medium 4=High 5= Very High) Source**; data collected 2021-2022

The results presented in table 4 provide a comprehensive analysis of the gap between the required competency level (RCL) and the possessed competency level (PCL) EFs in the domain of planning and development of extension programs, emphasizing vital areas where in-service

training is needed. The findings reveal a consistently higher mean score for RCL compared to PCL throughout all calculated skills, demonstrating a significant discrepancy between the desired and actual competency levels. The largest training need was observed in the skill of "developing short and long duration extension programs" with an RCL (4.39 ± 0.48) and a PCL (3.23 ± 0.55), leading to (DV=2.20) and ranked 1st followed by the "skills and ability to develop an action plan" with an RCL (4.33± 0.49) and a PCL (2.32± 0.87), (DV = 1.90) and "ability to analyze the current situation" (DV = 1.88), with an RCL (4.32± 0.49) and a PCL (2.32± 0.66)both of which are critical for effective program planning and require significant attention in training programs, ranked 2nd and 3rd respectively. The lowest training need was detected in "ability to use census data and other resources" (DV = 0.99), indicating a relatively small disparity in this domain RCL (4.22± 0.53) and PCL (3.23± 0.55) ranked 11th.The study identifies a strong need for in-service training in extension program design and development, particularly in top-ranked competencies with severe shortages. It recommends focusing on capacity-building initiatives to close skill gaps and improve professional competencies.

Use of extension methods

Extension teaching techniques are the ways or instruments that agricultural service providers use to engage with farmers (Ali *et al.* 2021). These instructional strategies assist farmers to improve knowledge and skills (Okunade, 2007; Lukkainen 2012). So, extension workers must be well-versed in different teaching approaches in order to select the most appropriate one for the scenario (Nikitha et al., 2019). There are various methods that an extension agent might use to teach farmers about new agricultural technologies. Individual (farm or home visit, office call, telephone call, and informal contact, etc.) and group (farmers' meeting, demonstrations, method and result), lecture meetings, field trip / tours, symposium, panel discussion, workshop, brainstorming, buzz group, and role-playing, etc.) are the three main categories of these methods. These approaches are significant instruments in the hands of extension workers, allowing them to establish and retain confidence with farmers (Khan et al., 2012). Table 4 presents data on how to make use of these methods by Extension field staff and their levels of skills in these methods.

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Table 5: Rank Order, Training Needs and Mean ± STD of Competencies possessed and required level in Use of Extension methods as professional competency in study domain

S#	Use of Extension methods	Required Competency level (RCL)		Possessed Competency level (PCL)		Training Need (DV=RCL-PCL)	Rank Order
		Mean	±STD	Mean	±STD		
	Farm visit related Skills						
1	Conduct an effective farm visit	4.31	0.63	2.90	0.56	1.41	1
2	Identify problems of the farmers at field	4.28	0.63	2.88	0.84	1.40	2
3	Arrange required material and equipment	4.04	0.58	2.69	0.74	1.35	3
4	Select time of the visit	4.17	0.58	2.97	1.08	1.20	4
5	Provide feasible solution of identified problem	4.37	0.65	3.22	0.85	1.15	5
6	Follow-up of the farm visits	4.12	0.55	3.05	1.23	1.07	6
7	Set objective of the visit to measure	4.16	0.60	3.39	1.06	0.77	7
	Farmer meeting related Skills						
1	Prepare to address any questions from the audience	4.11	0.68	2.16	0.84	1.95	1
2	Publicize the meeting schedule	4.05	0.66	2.82	0.88	1.23	2
3	Publicize the meeting through media	4.08	0.75	2.98	0.83	1.10	3
4	Decide the objectives and goals of the meeting	4.20	0.85	3.12	0.80	1.08	4
5	Conduct successful corner meeting	4.15	0.75	3.21	0.87	0.94	5
	Method Demonstration related Skills						
1	Explain purpose of method demonstration	4.12	0.43	2.28	0.93	1.84	1
2	Define salient features of method demonstration	4.12	0.46	2.36	0.96	1.76	2
3	Conduct method Demonstration	4.15	0.43	2.43	0.92	1.72	3
4	Provide opportunity of self-practice to the Method demonstration	4.10	0.45	2.38	0.91	1.72	3
5	Identify needs for method Demonstration	4.09	0.45	2.44	1.00	1.65	4
	Result Demonstration related Skills						
1	Arrange subject matter specialist relating to the demonstration	4.39	0.53	2.04	1.05	2.35	1
2	Regular supervision of the demonstration plots	4.17	0.43	2.37	0.92	1.80	2

3	Conduct Prior survey to get factual data	4.16	0.37	2.49	1.12	1.67	3
4	Develop a complete work plan for demonstration	4.31	0.46	2.89	0.93	1.42	4
5	Describe the purpose of demonstration	4.38	0.48	3.17	0.77	1.21	5
6	Select an appropriate time for demonstration	4.12	0.57	3.01	0.81	1.11	6
7	Reply the questions raised by the farmers	4.10	0.31	3.07	0.86	1.03	7
8	Select a site for demonstration	4.19	0.43	3.16	0.80	1.03	7
9	Layout demonstration plots	4.34	0.47	3.34	0.81	1.00	8
	Field Tours and Trips related skills						
1	Make a list of problems to be encountered	4.11	0.58	1.58	0.74	2.53	1
2	Note specific points observed during the trip	4.08	0.54	1.68	0.86	2.40	2
3	Design a plan for tour	4.08	0.60	1.76	0.83	2.32	3
4	Conduct tours and field trips	4.08	0.60	1.87	0.91	2.25	4
5	Explain the objectives of the trip	4.06	0.52	1.82	0.80	2.24	5
6	Conduct administrative arrangements of the trip	4.00	0.58	1.81	1.14	2.19	6
	Field Days related skills						
1	Provide feedback on the researchable problems to researchers	3.89	0.877	2.11	0.817	1.78	1
2	Conduct brainstorming sessions	3.84	0.922	2.19	0.863	1.65	2
3	Conduct individual interviews	3.85	0.908	2.36	0.783	1.49	3
4	Define purpose of the field day	3.69	1.017	3.09	0.843	0.60	4
5	Organizing the field day	3.53	1.214	3.16	0.812	0.37	5
	Panel and Group discussion related Skills						
1	Arrange subject-matter specialists for guidance	3.89	0.71	1.94	0.95	1.95	1
2	Define major problems to be discussed	3.89	0.84	2.21	0.99	1.68	2
3	Summarize the major findings of the discussion	3.70	0.87	2.05	0.90	1.65	3
4	Set objective of discussion	3.74	0.84	2.10	0.89	1.64	4
5	Ensure participation of the farmers	3.18	1.21	2.19	1.00	0.99	5
	Use of Mobile and Phone related Skills						
1	Use to inform important safety measures	3.90	1.269	2.82	0.664	1.08	1
2	Use of PTCL/Mobile calls for extension activity	4.18	0.835	3.26	0.712	0.92	2
3	Use of telephone to discuss problems with the farmers	4.18	0.827	3.90	1.269	0.89	3

Scale: (1=Very low 2= Low 3= Medium 4=High 5= Very High) Source; data collected 2021-2022

The results of table 5 reveal critical training needs among EFs across various extension methods, with significant gaps between required competency levels (RCL) and possessed competency levels (PCL). Among farm visit-related skills, the largest gaps are observed in "conducting an effective farm visit" (DV = 1.41, Ranked 1st) and "identifying problems of farmers at the field" (DV = 1.40, Ranked 2nd), while the smallest gap is in "setting objectives for the visit" (DV = 0.77, Rank 7th). Regarding skills related to farmer meetings, the highest training need included "preparing to address questions from the audience" (DV = 1.95, Ranked 1st), while "conducting successful corner meetings" has the smallest gap (DV = 0.94, Ranked 5th). In case of method

demonstration-related skills, the prime gaps were "explaining the purpose of method demonstration" (DV = 1.84, Ranked 1st) and "defining salient features of method demonstration" (DV =1.76, Ranked 2nd), with the least gap in "identifying needs for method demonstration" (DV=1.65, Ranked 4th). For result demonstration- skills, the highest gaps were “arranging subject-matter specialists" (DV= 2.35, Ranked 1st) and "regular supervision of demonstration plots" (DV=1.80, Ranked 2nd), while "selecting the site for demonstration" and "replying to farmers’ questions" both have smaller gaps (DV=1.03, Rank 7th). For skills related to field tours and trips, the largest gaps were "making a list of problems to be encountered" (DV=2.53, Rank 1st) and "noting specific points during the trip" (DV = 2.40, Ranked 2nd), while the smallest is in "conducting administrative arrangements" (DV = 2.19, Ranked 6th). For field days, the highest need is in "providing feedback of researchable problems to researchers" (DV=1.78, Rank 1), while "organizing the field day" has the lowest gap (DV = 0.37, Ranked 5th). In panel and group discussions, the largest gaps are in "arranging subject-matter specialists" (DV=1.95, Ranked 1st) and "defining major problems for discussion" (DV = 1.68, Ranked 2nd), with the smallest gap in "ensuring farmer participation" (DV = 0.99, Ranked 5th). Lastly, for mobile and phone-related skills, the highest gap is in "using mobile devices to inform about safety measures" (DV = 1.08, Ranked 1st), while the smallest gap is in "using the telephone to discuss problems with farmers" (DV = 0.89, Ranked 3rd). These findings highlight the highest training needs in field tours, result demonstrations, and method demonstrations, while skills like organizing field days and farmer participation in discussions showed relatively smaller gaps, reflecting areas of moderate competency**.**

Technical competency: Technical competency of EFs refers to the technical knowledge of the subject possessed by them. Technically competent public agricultural extension field personnel play an important role in enhancing productivity by sharing contemporary agricultural production technologies among farmers. to understand the technical competences of public agricultural extension field workers (EFS) in the research region. Similarly, Khan et al. (2012) discovered a "training gap" among AOs and concluded that the technical proficiency of AOs in Pakistan was below the needed level to enable the transfer of agricultural technology to clients. Furthermore, Yaseen et al. (2015) conducted a review of research to determine that technical and professional competency of EFS in Pakistan was inadequate and did not reflect field conditions.

In the twenty-first century, the continually fluctuating and expanding demand for high-quality, high-yield agricultural items by agricultural institutions and farmers has had a considerable influence on EFS function and production. Technical competence of Extension field personnel (EFs). Data was gathered in this respect and reported in table 5 follows.

Table 6: Rank Order, Discrepancy Values as Training Needs of Extension Field staff based on difference between possessed and required level of competence in technical competency in study domain

S#	**Agronomic Practices related skills**	**Required Competency level (RCL)**		**Possessed Competency level (PCL)**		**Training Need (DV=RCL-PCL)**	**Rank Order**
		Mean	±STD	Mean	±STD		
1	Advice about fertilizer requirement of minor crops	4.41	0.86	2.25	1.02	2.16	1
2	Direct farmers about the harvesting techniques of minor crops	4.55	0.72	2.53	1.05	2.02	2
3	Direct farmers about the seed rate of minor crops	4.42	0.71	2.65	1.10	1.77	3
4	Direct farmers about the irrigation requirement of minor crops	4.45	0.73	2.64	1.02	1.81	4
5	Direct farmers about the irrigation requirement of major crops	4.65	0.75	3.30	0.75	1.35	5
	Soil Fertility related skills						
1	Select suitable soil crops based on soil properties	3.99	1.11	2.84	1.50	1.15	1
2	Use GPS device for soil sampling	3.66	1.14	2.85	1.52	0.81	2
3	Understand soil Fertility Practices	3.75	1.36	3.07	1.52	0.68	3
4	Provide recommendations based on soil test results	3.85	1.26	3.20	1.27	0.65	4
5	Ability to measure soil pH and its reclamation	3.24	1.27	2.66	1.56	0.58	5
	Plant Protection practices related skills						
1	Explain the causes of disease of major crops	4.36	0.76	2.74	0.98	1.50	1
2	Explain the causes of disease of minor crops	4.22	0.71	3.20	1.27	1.48	2
3	Identify the weeds of major crops	4.53	0.77	3.09	0.90	1.44	3
4	Describe the use of pesticide/insecticide	4.36	0.72	2.93	0.92	1.43	4
5	Direct farmers about the plant protection measures of major crops	4.45	0.77	3.07	0.91	1.38	5
6	Identify the insect/pest of major crops	4.42	0.81	3.14	0.93	1.28	6

Scale: (1=Very low 2= Low 3= Medium 4=High 5= Very High) Source; data collected 2021-2022

The results of table 6 show significant training needs among EFs within a range of technical competencies. The results of the table reveal considerable training requirements in three key skill areas, having significant gaps exist between required competence levels (RCL) and possessed competency levels (PCL), agronomic practices, soil fertility, and plant protection. Regarding agronomic skills exhibit the highest training gaps, with "Advising on fertilizer requirements for minor crops" showing the largest difference between RCL; (4.41± 0.86) and PCL (2.25 ± 1.02) (DV = 2.16, ranked 1st), followed by "Directing farmers on harvesting techniques" RCL; (4.55±0.72) and PCL (2.53±1.05) with DV = 2.02, ranked 2nd. Other agronomic skills, such as "Advising on seed rate and irrigation for minor crops", also show noteworthy gaps, while irrigation management for major crops has the smallest gap (DV = 1.35, rank ed 5th) with RCL; (4.65±0.75) and PCL (3.30±0.75).Amongst soil fertility-related skills, the highest training need is for "Selecting suitable soil crops based on soil properties" (DV = 1.15, rank 1st). Respondents demonstrate a moderate RCL (3.99) but a lower PCL (2.84) followed by "Using GPS devices for soil sampling" with DV= 0.81, ranking 2nd, the lowest ranked skills was "Measuring soil pH and reclamation" (DV = 0.58) ranked 9th, RCL; (3.24±1.27) and PCL (2.66 ±1.56) showing minimal gaps and a lesser urgency for training. While in category, Plant Protection Practices Skills, these abilities include an awareness of agricultural diseases, weeds, pests, and plant protection techniques. The results show "Explaining the causes of diseases in major crops" has the highest training gap in this category RCL; (4.36±0.76) and PCL (2.74±0.98) with (DV = 1.50, rank 1st), followed closely by "Explaining the causes of diseases in minor crops", RCL; (4.22±0.71) and PCL (3.20±1.27), (DV = 1.48, rank 2nd) . Lower gaps were detected in "identifying pests of major crops" (DV = 1.28, rank 13) with RCL; (4.42±0.81) and PCL (3.14±0.93)

The investigation reinforces the need for desired in-service training, particularly in agronomic techniques, where the gaps are most significant. Soil fertility and plant protection competences are in general good, although there is always room for improvement, particularly in technical areas such as soil testing and disease control. These findings can help in making decisions on in-service training initiatives for EFs to equip with standard levels of competencies that increase agricultural production as well as effectiveness reflecting excellence in their performance.

Bivariate Analysis: Association Between Demographic Variables and In-service Training Needs

The Chi-Square test is used to determine the relationship between demographic information and EFS level competency. The Chi-Square results and significance are shown in the table below.

Table 7: Association Between Demographic Variables and In-service Training Needs of EFs

Variables	Chi-Square Value	Df	Sig.	Gamma
Professional Skills				
Qualification- Planning and Development Extension Programs	6.61	6	.058**	.009
Farming experience- Planning and Development Extension Programs	20.60	12	.05**	-.095
Job experience- Use of Extension Methods	20.20	9	.017*	-.091
Technical Skills				
Qualification-Soil Fertility competencies	4.32	6	.043*	-.044
Qualification-Agronomy	7.69	8	.054*	.017
Farming Experience-Agronomy	31.25	16	.012*	-.033
Farming Experience-Soil Fertility competencies	18.56	12	.10*	.150
Inservice trainings-Agronomy	21.38	12	.045*	-.163

Significance value. **Highly significant, * significant

Table 7 explains the bivariate analysis conducted using the Chi-Square test evaluates the relationship between demographic variables (such as qualification, age, job experience, farming experience, and in-service training) and the in-service training needs of Extension Field staff (EFs) in professional and technical competencies. Gamma coefficients are used to assess the strength and direction of relationships. The findings show that demographic characteristics such as farming experience, employment experience, past in-service training, and age have a substantial impact on EFs' in-service training demands. However, the intensity of the correlations, as measured by gamma values, is often mild to moderate. This shows that, while demographic considerations are important, other variables may have an impact on the reported

training requirements.

Overall, our findings emphasize the significance of demographic-specific training programs for EFs in order to increase their efficacy in tackling professional and technical difficulties. Targeted training interventions targeted at the specific requirements of EFs based on their demographic profiles can increase their competency levels and, as a result, performance in extension activities.

Conclusion: The timely and effective delivery of current agricultural information to farmers is critical for conforming to global standards. Pakistan, like many other developing countries, faces challenges in effectively exchanging information through its service providers. To address this issue, the Extension Field Farm Staff (EFS) have used a variety of tools and tactics to educate farmers. The results of this research revealed that EFs were perceived as more competent, particularly in the areas of sowing and fertilization, which is critical to enhance the technical capabilities of EFS personnel in all relevant areas through extensive training. This upgrade will enable them to supply farmers with the knowledge required to boost agricultural output. As a result, filling the highlighted research gap and offering empirical insights will be useful for field staff, farmers, government and non-governmental organizations, and agricultural policymakers. These findings will help to build successful methods for improving collaboration, knowledge transfer, and information exchange among agricultural development stakeholders. Agricultural extension agencies, especially in developing countries, play an important role in providing extension services to farmers.

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