Physical Education, Health and Social Sciences

https://journal-of-social-education.org

E-ISSN: 2958-5996

P-ISSN: 2958-5988

Impact of Agricultural Extension Services on Melon (Cucumis melo L.) Yield: An Analysis of Farmer Engagement and Technical Support Stages

Abdul Haseeb Khan[1], Urooba Pervaiz[1], Mahmood Iqbal[1], Romana Bibi[2], Abdul Wadood[3] Naseer Ullah[4]

[1] Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar
[2] Department of Political Science, University of Peshawar
[3] Department of Human Nutrition and Dietetics, The University of Agriculture, Peshawar
[4] University of Agriculture, Peshawar

***DOI:* https://doi.org/10.63163/jpehss.v4i1.1042**

Abstract

Agricultural extension services are essential for eliminating the productivity gap in horticulture crops. However, socioeconomic disparities sometimes limit their effectiveness. This study evaluated the impact of extension services on melon cultivation among 102 farmers from district Lakki Marwat, focusing on the influence of education, tenancy status, and visit frequency on yield outcomes. Using a non-parametric approach, data were analyzed through Pearson Chi-square tests and Spearman's Rank Correlation (r_s). Descriptive results showed that while 76.47% of farmers were literate, the majority (33%) had only primary education. Furthermore, 56.9% were landowners, while 17.6% were tenants. Regarding service delivery, 72.5% of farmers received extension visits, but the frequency was inconsistent, with 48.6% reporting only "Off & On" contact. Results revealed a significant "service gap," as land owners enjoyed substantially higher access to extension (49%) compared to tenant farmers (5.9%, Chi $x^2 = 18.42$, $p < 0.001$). Furthermore, a strong, positive correlation was found between the frequency of extension visits and yield improvement (r_s= 0.684**, $p < 0.001$), indicating that regular technical support is a primary driver of productivity. While agents were effective in transferring pest management knowledge, significant gaps remain in irrigation and sowing support. The study concludes that while extension services are highly effective when delivered, current outreach is skewed toward educated landowners. It is recommended that extension policies be restructured to include mandatory registration of tenant farmers and the implementation of visual-based training to overcome literacy barriers, ensuring equitable agricultural development.

Keywords: Agricultural Extension, Field Visits, Melon Cultivation and Yield Enhancement

Introduction

Melons are highly profitable horticultural crops compared to rice, maize, and other local mainstays (Yekti et al., 2017; Saediman et al., 2020). According to Onyemekonwu et al., (2019) and Ibironke and Oyeleke (2014), small-scale melon farmers in Nigeria generated mean annual revenues of ₦28,640–₦74,508 per farmer or per hectare, and production was evidently profitable based on cost-return analysis. Despite climate risk, contract-farmed melons in Indonesia can generate returns "up to 100% of capital," with the majority of farmers (78%) making up to >40 million IDR each season. Because of the significant profits, sponsors are willing to give input credit (Prasetyo et al., 2022). Similarly in horticulture industry Melon contributes around 11% of the agricultural value addition, with an estimated output of 398,987 metric tons from an area of approximately 64,950 hectares in Pakistan (Government of Pakistan, 2024). The 'other crops' category, which includes melons, saw a growth of 4.78% during the 2023–2024 cropping season, indicating a notable recovery in the post-flood agricultural landscape (MNFSR, 2024). Khyber Pakhtunkhwa continues to play a crucial role in the sector, contributing about 10% of the national volume. Melons, a major Kharif cash crop, are grown in a variety of ecological zones in Khyber Pakhtunkhwa, which retains a crucial fruit production niche (CRS KP, 2024).

Yield Gap in Melon Cultivation

Melon is extremely susceptible to water deprivation, particularly from flowering to fruit growth; even brief droughts drastically impair fruit output and quantity (Yavuz et al., (2021). Insufficient or improperly timed irrigation reduces photosynthesis and fruit set in semi-arid areas and results in significant output losses (Melo et al., (2020). Similarly, many farmers apply significantly more N, P, and K than is necessary due to imbalanced and excessive fertilizer application, which reduces nutrient-use efficiency and can affect yield and quality (Yue et al., 2023; Wen et al., 2022). Furthermore, melon development is restricted globally by salinity and drought, particularly in arid and semi-arid regions, which results in smaller fruits and lower yields (Adıgüzel et al., 2022; Akrami et al., 2019; Melo et al., 2020). Soil-borne diseases, viruses, and insect pests can reduce melon yields by over 50% in organic or low-input settings, particularly when accompanied with salt stress. (Flores-León et al.,2021). Yields also remain below potential due to ignorance of intercropping, mulching, grafting, and pollination control (Cuartero et al., 2022 and Adamczewska-Sowińska, 2024).

Agricultural extension as a Solution

Agricultural extension agents play a crucial role in resolving the unique technical and environmental challenges faced by melon growers since they are the main conduit between research and field implementation. In order to manage irrigation and fertilization inefficiencies that would otherwise result in resource depletion, these advisors serve as frontline facilitators by teaching farmers the best water-nutrient schedules (Raji et al., 2024; Wen et al., 2022; Yavuz et al., 2021; Yue et al., 2023; Yitayew et al., 2021). By encouraging stress-tolerant cultivars, grafting methods, and soil conservation strategies to lessen the effects of salinity and drought, extension helps in areas vulnerable to environmental extremes (Raji et al., 2024; Adıgüzel et al., 2022). Additionally, by teaching farmers about Integrated Pest Management (IPM), extension agents improve crop protection by empowering them to keep an eye out for illnesses and use pesticides responsibly to avoid yield loss (Eze et al., 2023; Argaw et al., 2023). Additionally, they close a significant knowledge gap in pollination by emphasizing how important pollinator habitats are to cucurbit fruit set success (Sawe, 2020). Lastly, ICT tools, field schools, and demonstrations speed up the adoption of contemporary technologies by giving farmers the real-world proof they need to switch from conventional to better farming methods (Raj, 2024; Yitayew et al., 2021).

Research Gap

Pakistan's current national agricultural evaluations highlight systemic inefficiencies in technology transfer and stress brought on by climate change, but they frequently lack detailed information about particular horticultural value chains, including melon cultivation (Kamal et al., 2020). According to existing research, the extension system is structurally biased, with advising services often favoring large-scale landholders while providing little technical assistance to smallholder farmers (Alzahrani et al., 2023). Localized needs assessments tailored to Pakistani melon growers are conspicuously lacking, despite international research attributing low melon yields to a lack of specialized knowledge in agronomy, insect management, and fertigation (Nor et al., 2022). Additionally, studies have not yet examined the effects of technologies unique to melon, such as protected culture, drip irrigation, and Integrated Pest Management (IPM).

Need of the Study

The essential interplay of institutional support and human capital in agricultural growth makes this research necessary (Ullah et al., 2025). Research shows that a farmer's ability to accept contemporary seed types and management techniques is greatly improved by better education levels, which raises total output (Paltasingh & Goyari, 2018). Additionally, literacy is required to understand complex extension directions and use ICT-based services efficiently (Khan et al., 2022). However, complicated land tenure rules sometimes inhibit long-term investment in capital-intensive technologies; even when technical guidance is provided, adoption rates are often hindered (Antwi-Agyei & Stringer, 2021). The successful adoption of adaptive strategies, such as the use of drought-tolerant cultivars and modified planting schedules, requires both regular extension contact and formal education (Ullah and Haq, 2025), as evidenced by international precedents like those in Nigeria (Aroyehun et al., 2024). This study is crucial, because there is currently a dearth of empirical data on the impact of these socioeconomic determinants on melon growers' production in the local context.

Objectives

1. To assess how socioeconomic characteristics affect farmers' access to extension services.
2. To determine the relationship of extension visit frequency, socioeconomic characteristics and yield outcomes for melon production.

Methodology

The aim of the current study was to investigate the Impact of Agricultural Extension Services on Melon (Cucumis melo L.) Yield in District Lakki Marwat, Khyber Pakhtunkhawa. The respondents were selected by adopting a multi-stage sampling method. Among the four tehsils in the district there was a deliberate choice of Tehsil Serai Naurang due to the prevalence of melon farming in that area. Three union councils (Kot Kashmir, Shakh Quli Khan, and Nar Abu Samand Begu Khel) and two villages from each union coucils were selected. Using a list of melon growers provided by the Extension Department, 30% of farmers were selected through proportional sampling technique, making a sample of 102 melon growers out of 340 in total.

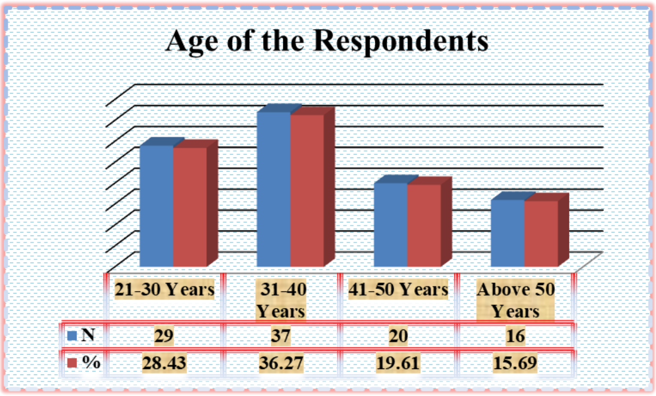
Formula of proportionate allocation technique is as follow in equation 1.

$$ni = \frac{Ni}{N} \text{ X } n \ldots\ldots\ldots\ldots\ldots 1$$

The variables (Education level, Tenancy status, Extension visits to Farmers, and Yield Improvement of water Melon) were measured on an ordinal scale, so non-parametric statistical approaches were used to evaluate the data. The Pearson Chi-square (Chi x^2 test was used to investigate the relationship between categorical variables. Additionally, Spearman's Rank Correlation Coefficient (r_s) was computed to measure the degree and direction of the association between agricultural productivity and the frequency of extension services. This strategy was used because it does not presume a normal distribution of the data and is robust against tied ranks, which were present due to the categorical character of the survey replies. All calculations were performed using SPSS (Version 26.0) and Microsoft Excel for Chart making.

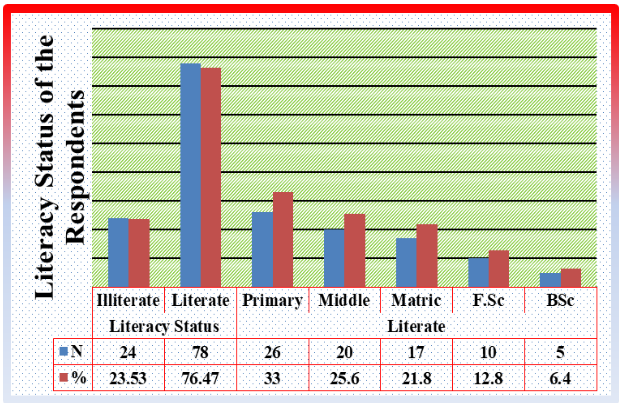
Results and Discussions

Figure1 N= Number of Respondents



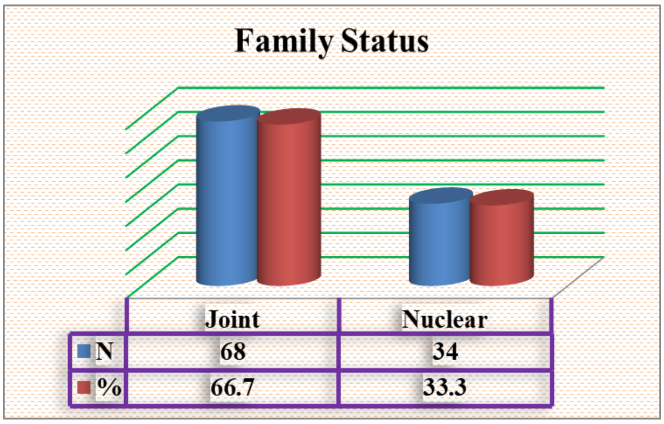
Source: Data Survey 2025

Figure2: N= Number of Respondents



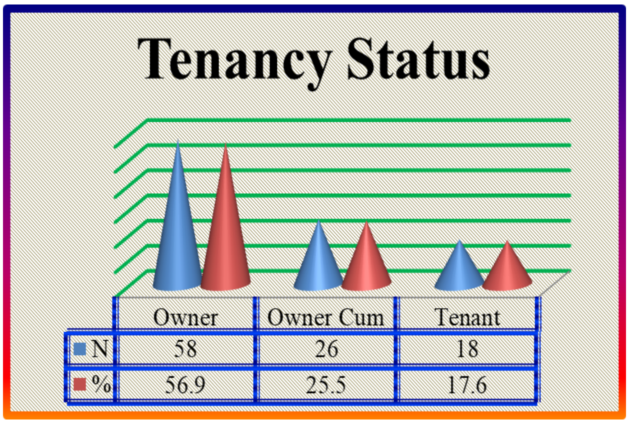
Source: Data Survey 2025

Figure 3 N= Number of Respondents



Source: Data Survey 2025

Figure 4 N= Number of Respondents



Source: Data Survey 2025

Figure 5 N=Number of Respondents

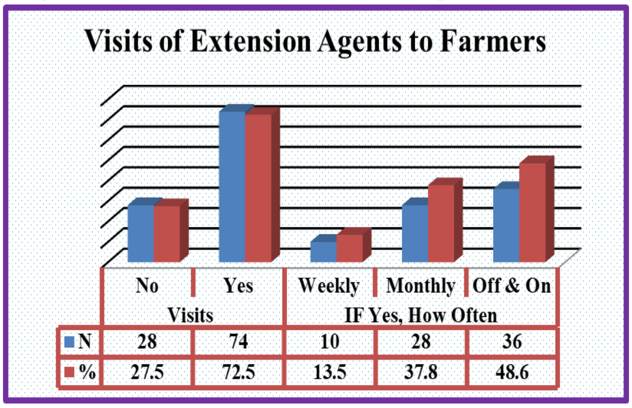


Figure 6 N=Number of Respondents

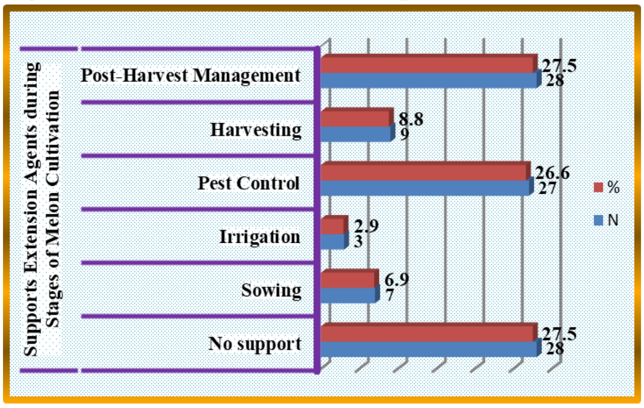
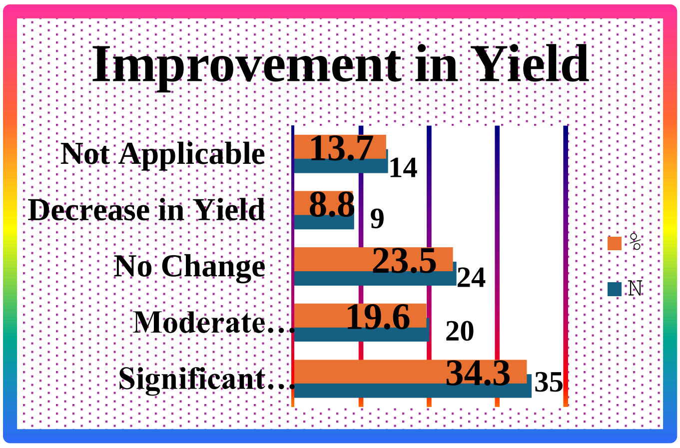


Figure 7 N=Number of Respondents



Sources: Data Survey 2025

The data given in figures provide a very solid foundation for the "Socio-Demographic Profile" of the area with a sample size of N=102

In **Figure 1** the data indicates that a majority of the respondents (36.27%) are in the age category of 41-50 years with the majority of respondents placed in this category were young. This means that the farming of melons in the region of study is largely controlled by a work force that is energetic as well as physically active and is a good sign that modern agricultural farming that is labor intensive can be adopted in the region. Although in **Figure 2** the respondents with respect to education status indicate that a large number of growers are literate (76.47%), most of the literates (33%) are only primary and (25.6%) middle-school educated. This observation is invaluable to the Extension Department; it implies that as much as texts (brochures, posters) can be employed, the information should be simplified and represented in a heavy manner in order to accommodate the limited literacy levels of most people. Moreover in **Figure 3** the data show that the predominance of joint family system (66.67%) of the respondent demonstrates that farmers probably could enjoy the availability of bigger pool of the unpaid family labour that is vital during the labour intensive period of melon production like planting and harvesting. Furthermore the results in **Figure 4** show that a greater number of the respondents (56.9%) are owner. The agricultural extension theory has a general rule: The owner is more likely to invest in the long-term soil health and costly technologies than the Tenant, since the farmer has the security of permanent land. The data in **Figure 5** regarding extension agents shows that there is a strong availability of agricultural extension services in the study region, of which 72.5 percent of the melon growers stated that they had direct field access with extension agents. Such an engagement rate indicates proper operation of dissemination network, and a favorable desire by farmers to communicate with formal advisory services. This rate of high penetration offers a desperate background of conveying the contemporary farming methods and enhanced crop control measures to most members of the agricultural community. Nevertheless, there is still room to improve the consistency of such interactions. Although the reach is extensive, almost half (48.6) of the farmers visited described these meetings as only being carried out “on an off” on basis, which suggests a rather reactionary support system. The respondents who acquired the benefits of the weekly visits were only 13.5% as such visits are perfect in controlling the high growth cycles and vulnerability of melons to pests. Moving to regular visits (monthly or weekly) in addition to occasional visits might be an additional benefit to the effect of such services on the general crop productivity.

The extension support as seen in the distribution of support between various stages of cultivation in **Figure 6** indicates that there is a very specific approach towards service delivery. The statistics indicate that the key focus areas are Pest Control and Post-Harvest Management whereby 26.6 and 27.5 percent of farmers were provided with assistance during Pest Control and Post-Harvest Management respectively. The fact that the pest control has been highly supported is especially important concerning the fact that melons are highly susceptible to numerous insects and diseases, and the focus on post-harvest management indicates that the losses would be minimized once the fruit has left the field. However, as compared to the later phases of the cultivation cycle, e.g., Sowing (6.9%) and Irrigation (2.9%), the extension agents pay very minimal attention. Such an imbalance suggests the type of crisis-management model, in which support is focused at the end of the season or during the outbreaks of pests of a high risk, instead of the basic planning and planting stage. Additionally, 27.5 percent of the respondents stated that they did not receive any technical support at any point and this is the same percentage of farmers who earlier reported no field visit. To achieve a more comprehensive enhancement in yield, the extension services might be required to redistribute their effort towards providing more information on water management and general establishment of crops. In **Figure 7** more than half of respondents (34.3%) indicated that their production significantly or moderately improved after the extension intervention. However, the fact that nearly 9% report a decline in yield and 23.5% report no change suggests that technical advice may not always apply to external factors like market or climatic shifts. In order to support the values of the gains obtained by the more successful groups, the 13.7% in the "Not Applicable category" would typically be the group that received no extension services and has not applied for any.

Table 1: Association between Visit of Extension Agents and Improvement of Yield

Visits of Extension Field Staff to Farmers	Improvement in Melon Yield					Total
	Significant Improvement	Moderate Improvement	No Change	Decrease in Yield	Not Applicable	
No Visit	2(2.0)	0	7(6.9)	5(4.9)	14(14.7)	28(27.5)
Weekly	8(7.8)	2(2.0)	0	0	0	10(9.8)
Monthly	15(14.7)	10(9.8)	2(2.0)	1(1.0)	0	28(27.5)
Off & On	10(9.8)	8(7.8)	15(14.7)	3(2.9)	0	36(35.3)
Total	35(34.3)	20(19.6)	24(23.5)	9(8.8)	14(14.7)	102
Chi x^2= 76.87 P-Value=0.000						

Sources: Data Survey 2025

According to the Chi-square test in table 1, there is a highly significant correlation (Chi x^2= 76.87, $p < 0.001$) between the number of extension visits and yield results. As the data suggest, consistent weekly and monthly support is directly associated to Significant Improvement in yield and the absence of visits is primarily linked to stagnating outcomes or the category of “non-applicable”. The aforementioned results provide statistical proof that more field visits are necessary to guarantee optimal melon production efficiency.

Table 2: Association between Education level and Improvement of Yield

Education level	Extension workers led to an improvement in melon yield					Total
	Significant Improvement	Moderate Improvement	No Change	Decrease in Yield	Not Applicable	
Illiterate	2(2.0)	4(3.9)	8(7.8)	10(9.8)	0	24(23.5)
Primary	12(11.8)	10(9.8)	12(11.8)	12(11.8)	0	46(45.1)
Matric and Above	21(20.6)	6(5.9)	4(3.9)	1(1.0)	0	32(31.4)
Total	35(34.3)	20(19.6)	24(23.5)	23(8.8)	0	102

Chi x^2= 29.45 P-Value=0.000

Source: Data Survey 2025

Higher literacy levels boost a farmer's ability to apply technical advice successfully, according to the analysis in table 2, which shows a highly significant association between educational attainment and production enhancement (Chi x^2= 29.45, $p < 0.001$). The necessity for extension services to use more visual and practical teaching approaches for less-educated groups is highlighted by the fact that illiterate growers had more stagnant results, whereas farmers with Matric or higher education reported the most significant gains.

Table 3 Association between Tenancy Status and Visits of Extension Field Staff

Tenancy Status	**Visits of Extension Field Staff**		**Total**
	Yes	**No**	
Owner	50(49.0)	8(7.8)	58(56.9)
Owner Cum Tenant	18(7.8)	8(7.8)	26(25.5)
Tenant	6(5.9)	12(11.8)	18(17.6)
Total	74(72.5)	18(17.6)	102
Chi x^2= 18.42 **P-Value**=0.000			

Source: Data Survey 2025

Land tenancy status and access to extension services are significantly associated (Chi x^2= 18.42, $p < 0.001$), according to the Chi-square test in table 3. According to the findings, there is a "service gap," with landowners having much greater access to advisory visits (49%) than tenants, who reported the lowest level of participation (5.6%). This shows that extension outreach is now skewed toward permanent landholders, stressing a need for more inclusive policies that target landless or tenant farmers.

Table 4 Spearman's Rho Correlation Matrix among Key Variables

Variables	**Education**	**Tenancy**	**Access**	**Yield Improvement.**
Education	1	0.214*	0.312**	0.405**
Tenancy Status		1	0.418**	0.295**
Access (Visits)			1	0.684**
Yield Improvement				1
**. Correlation is significant at the 0.01 level (2-tailed).				
*. Correlation is significant at the 0.05 level (2-tailed).				
Weak Correlation: Light Colour			**Strong Correlation:** Dark Colour	

Sources: Data Survey 2025

The Spearman's correlation matrix in table 4 demonstrates that all analyzed variables are positively and strongly connected. Visit frequency and yield improvement had the greatest association (r_s=.684, $p < 0.01$), offering empirical proof that the extension service is accomplishing its main objective of raising production. Additionally, the socioeconomic bias in service delivery is quantified by the substantial correlation between tenancy status and access (r_s=.418), indicating that landowners are given preference over tenants. Most importantly, the positive correlation between education and yield (r_s=.405) suggests that although extension works, its effects are enhanced when the recipient has a greater level of formal education.

Conclusions

This study concludes that agricultural extension services are a powerful, yet inequitably distributed, tool for enhancing melon productivity. The empirical evidence confirms a strong positive correlation between the frequency of extension visits and yield improvement, proving that consistent technical advisory is the most significant driver of farmer success. However, a critical "Service Gap" exists; land tenancy status and formal education levels act as significant barriers to access. Landowners are nearly three times more likely to receive extension support than tenant farmers, who remain marginalized despite their high involvement in the labor-intensive stages of melon cultivation. While the extension system has successfully transferred knowledge regarding pest management, it has largely failed to address modern irrigation and sowing needs. Ultimately, the effectiveness of the extension service is currently limited by its reach, not its quality.

Recommendations

1. The "farmer registration" procedures used by extension offices should to be changed to require tenant farmers to be identified. In order to guarantee that advising services reach the actual growers, databases based on land ownership must be replaced.
2. Instead of using text-heavy brochures, extension agents should use Farmer Field Schools (FFS) and visual guides to address the literacy barrier found in this study. This will enable farmers with non-formal education to use sophisticated melon-growing methods.
3. A monthly required visitation schedule should be put in place because "Off & On" visits produce the worst effects. The most straightforward strategy to increase the uptake of the latest agricultural technologies is to increase the frequency of contact.
4. Training in fertigation and drip irrigation must be given top priority in future extension initiatives. The support levels were lowest in these places.
5. All farmer categories should be able to get real-time weather and pest-control information through SMS alerts and mobile-based advisory apps, which help to fill the gap between in personal visits.

Literature Cited

Adamczewska-Sowińska. K. (2024). The Use of Soil Surface Mulching on Melon (Cucumis melo L.) Production under Temperate Climate Conditions. Agriculture, 14(8), 1398.

Adıgüzel. P., Nyirahabimana. F., Shimira. F., Solmaz. İ., & Taşkın. H. (2022). Applied Biotechnological Approaches for Reducing Yield Gap in Melon Grown Under Saline and Drought Stresses: an Overview. Journal of Soil Science and Plant Nutrition, 23, 139-151.

Akrami. M., & Arzani. A. (2019). Inheritance of fruit yield and quality in melon (Cucumis melo L.) grown under field salinity stress. Scientific Reports, 9(1), 7249.

Alzahrani. K., Ali. M., Azeem. M. I., & Alotaibi. B. A. (2023). Efficacy of public extension and advisory services for sustainable rice production. Agriculture, 13(5), 1062.

Antwi-Agyei. P., & Stringer. L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. Climate Risk Management, 32, 100304.

Argaw. B., Yehuala. K., & Aschalew. A. (2023). Review on the role of agricultural extension Service on increasing farm productivity in Ethiopia. International Journal of Finance Research, 4(2), 77-89.

Aroyehun. A. R., Ugwuja. V. C., & Onoja. A. O. (2024). Determinants of melon farmers' adaptation strategies to climate change hazards in south–south Nigeria. Scientific Reports, 14(1), 17395.

CRS KP. (2024). Crop Statistics of Khyber Pakhtunkhwa 2023-24. Directorate of Crop Reporting Service (CRS), Agriculture Department, Government of Khyber Pakhtunkhwa, Peshawar.

Cuartero. J., Pascual. J. A., Vivo. J. M., Özbolat. O., Sánchez-Navarro. V., Egea-Cortines. M., ... & Ros. M. (2022). A first-year melon/cowpea intercropping system improves soil nutrients and changes the soil microbial community. Agriculture, Ecosystems & Environment, 328, 107856.

Eze. E. U., Enyia. C. O., Nwogu. C. V., Ugochukwu. G. C., & Nwaizuzu-Daniel. J. C. (2023). The role of extension agents in ensuring increased productivity for food security in Ohaji Egbema, Imo State. 176-181.

Flores-León. A., García-Martínez. S., González. V., Garcés-Claver. A., Martí. R., Julián. C., ... & Picó. B. (2021). Grafting snake melon [Cucumis melo L. subsp. melo Var. flexuosus (L.) Naudin] in organic farming: Effects on agronomic performance; resistance to pathogens; sugar, acid, and VOC profiles; and consumer acceptance. Frontiers in Plant Science, 12, 613845.

GoP. (2024). Government of Pakistan. Pakistan Economic Survey 2023-24. Finance Division, Economic Adviser's Wing, Islamabad. [Available at: https://www.finance.gov.pk]

Ibironke. S., & Oyeleke. O. (2014). Contributions of Melon Production to Livelihood Sustainability of Rural Farming Households in Oyo State, Nigeria.. Journal of Biology, Agriculture and Healthcare, 4, 8-18.

Kamal. A. B., Sheikh. M. K., Azhar. B., Munir. M., Baig. M. B., & Reed. M. R. (2022). Role of agriculture extension in ensuring food security in the context of climate change: State of the art and prospects for reforms in Pakistan. Food security and climate-smart food systems: Building resilience for the Global South, 189-218.

Khan. N. A., Shah. A. A., Tariq. M. A. U. R., Chowdhury. A., & Khanal. U. (2022). Impact of farmers' climate risk perception and socio-economic attributes on their choice of ICT-based agricultural information services: empirical evidence from Pakistan. Sustainability, 14(16), 10196.

Melo. A. S. D., Dias. V. G., Dutra. W. F., Dutra. A. F., Sá. F. V. D. S., Brito. M. E. B., & Viégas. P. R. A. (2020). Physiology and yield of piel de sapo melon (Cucumis melo L.) under water deficit in semi-arid region, Brazil. Biosci. j.(Online), 1251-1260.

MNFSR. (2024). Fruit, Vegetables and Condiments Statistics of Pakistan 2023-24. Ministry of National Food Security and Research, Economic Wing, Government of Pakistan, Islamabad.

Nor. Z. M., Abdullah. I. N. M., Rabaâ. S., Khandaker. M. M., & Yusof. N. A. M. (2022). Needs for Terengganu sweet melon growers for quality production using fertigation system. Journal Of Agro biotechnology, 13(1S), 49-63.

Onyemekonwu. R. C., Belonwu. E. N., & Ehiwario. F. A. (2019). Analysis of small-scale farmer's income in melon production in delta state, Nigeria. Journal of Agripreneurship and Sustainable Development, 2(2), 147-155.

Paltasingh. K. R., & Goyari. P. (2018). Impact of farmer education on farm productivity under varying technologies: case of paddy growers in India. Agricultural and Food Economics, 6(1), 1-19.

Prasetyo. R. A., Rustinsyah. R., & Adib. M. (2022). Determining sustainability in contract farming: An evidence of melon farmers from Klotok Village, Plumpang District, Tuban Regency, Indonesia. Masyarakat, Kebudayaan & Politik, 35(1).

Raj. V. (2024). Effectiveness of Agricultural Extension Programs on Crop Productivity in India. International Journal of Agriculture. https://doi.org/10.47604/ija.2535.

Raji. E., Ijomah. T. I., & Eyieyien. O. G. (2024). Improving agricultural practices and productivity through extension services and innovative training programs. International Journal of Applied Research in Social Sciences, 6(7), 1297-1309.

Saediman. H., Alwi. L. O., Rianse. I. S., Taridala. S. A. A., Salahuddin. S. A. L. A. H. U. D. D. I. N., Indarsyih. Y. U. S. N. A., & Astuti. R. W. (2020). Comparative profitability of melon and watermelon production in South Konawe District of Southeast Sulawesi. WSEAS Trans. Bus. Econ, 17, 933-939.

Sawe. T., Eldegard. K., Totland. O., Macrice. S., & Nielsen. A. (2020). Enhancing pollination is more effective than increased conventional agriculture inputs for improving watermelon yields. Ecology and Evolution, 10, 5343 - 5353.

Ullah. K., & Haq. I. (2025). Strengthening livelihood development of small scale wheat farmers: Comparative effectiveness of public and private extension in supporting crop adaptation strategies. Social Science Review Archives, 3(1). https://policyjournalofms.com

Ullah. K., Haq. I., & Iqbal. M. (2025). Linking human capital to higher income: A comparative evaluation of public and private agricultural extension for small-scale maize farmers' livelihoods. Journal of Physical Education, Health and Social Sciences, 3(4). https://doi.org/10.63163/jpehss.v3i4.1038

Wen. M., Yang. S., Huo. L., He. P., Xu, X., Wang. C., ... & Zhou, W. (2022). Estimating nutrient uptake requirements for melon based on the QUEFTS model. Agronomy, 12(1): 207.

Yavuz. D., Seymen. M., Yavuz. N., Çoklar. H., & Ercan. M. (2021). Effects of water stress applied at various phenological stages on yield, quality, and water use efficiency of melon. Agricultural Water Management, 246, 106673.

Yekti. A., Darwanto. D. H., Jamhari. J., & Hartono. S. (2017). Technical efficiency of wet season melon farming. Jejak: Jurnal Ekonomi Dan Kebijakan, 10(1), 12-29.

Yitayew. A., Abdulai. A., Yigezu. Y. A., Deneke. T. T., & Kassie. G. T. (2021). Impact of agricultural extension services on the adoption of improved wheat variety in Ethiopia: A cluster randomized controlled trial. World Development, 146, 105605.

Yue. W., Chen. S., Gao. L., Li, N., & Liu. L. (2023). Effects of water and nitrogen coupling on yield, quality, water and nitrogen use efficiencies of greenhouse muskmelon. Water, 15(14), 2603.