Effect of PSTU Innovation Dissemination Center′s Training on Farmers' Technological Knowledge, Pesticide Awareness, and Farm Production

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(Received Date: 13th December 2025, Accepted Date:24th February 2026)

Abstract: This study assessed the impact of training offered by the PSTU Innovation Dissemination Center (PIDC) on farmers' technological knowledge, pesticide awareness, and vegetable production in the south-central coastal region of Bangladesh. The research involved a comparative analysis of 27 farmers who participated in the training versus 28 who did not during the winter (Rabbi) season, and 29 trained farmers versus 27 non-participants during the summer (kharif-1) season, all based on a structured interview schedule conducted in March 2025 and July 2025. Findings from Chi-square and Mann-Whitney U tests indicated that participating farmers demonstrated significantly greater technological knowledge in vegetable production and heightened awareness of pesticide usage compared to their non-participating counterparts. The training participants exhibited substantial gains in their ability to identify pests and diseases, as well as an increased awareness of water pollution resulting from pesticide use, the importance of applying appropriate dosages of pesticide, and the risks associated with using multiple pesticides simultaneously. This research advocates for the regular organization of such training sessions with sufficient duration, the use of modern teaching methods, and the provision of the necessary inputs and credit support to participating farmers.

Keywords: Agricultural training; technology adoption; vegetable production; farmer knowledge; sustainability.

Introduction

Agriculture is a significant contributor to the country's GDP and is vital to the livelihoods and employment of its people (Seraj, 2022). According to BBS's provisional calculation, the sector contributed about 11.50 percent to the GDP in FY 2021-22 (Bangladesh Economic Review, 2022). The sector is also the country's chief employment sector, accounting for 43.33% of total employment (Labor Force Survey, 2022). Therefore, the country's overall economic growth depends heavily on the development of its agricultural sector. However, the progress of the country's agricultural sector depends overwhelmingly on farmers' knowledge, skills, and attitudes. Considering this, Patuakhali Science and Technology University (PSTU), a public university in Bangladesh's south-central coastal region, has established an Innovation Diffusion Center, known as Patuakhali Science and Technology University Innovation and Dissemination Center (PIDC), to provide farmers with knowledge, information, and Technological skills. Training is the acquisition of knowledge, skills, and competencies through the teaching of vocational or practical skills and this knowledge relates to specific functional competencies (O'Connell & Wong, 2014). Knowledge and capacity development of farmers has been scaled up through the farmer training programs on modern crop production technology. To raise awareness among farmers about agricultural innovations, training on technology adoption has been recognized as an effective approach (Asayehegn et al., 2012; Challa and Tilahun, 2014; Kinyangi, 2014). Training encompasses the adoption of both formal and informal approaches to impart knowledge to individuals (Drummond, 2000). A study in Sri Lanka found that training can impact farmers' technological knowledge. Not only can knowledge, but training also provides farmers with several other benefits, such as (i) an increase in work quality, (ii) an increase in farm products, (iii) cost savings, (iv) time savings, (v) an increase in income, and finally (vi) an increase in networking (Tambi, 2019).

In evaluating the effect of training at the farmer training centers on productivity and household income in Ethiopia, it was confirmed that farmer training can positively affect the productivity and income of the farmers (Ayanwale et al., 2024; Hossain et al., 2021; Wonde, 2022). In the same country, another study demonstrated that training can significantly enhance farmers' knowledge, attitudes, and practices (Tesfaye et al., 2010). A study evaluating the role of training in transferring rice production technologies to the farm level found that, overall, positive changes occurred in farmers' skills in all production techniques after training (Vanetha, 2021). Farmers possess a deeper understanding of key factors that contribute to yield, including variety selection, seedling age, transplanting timing, spacing, pest management, fertilizer application, as well as harvest and post-harvest practices, irrigation, and water management (Hossain et al., 2021). In a study in the Philippines, Palada et al. (2020) suggest that farmers' training can impact the knowledge level of farmers in commercial poultry and table egg production. A study in Allahabad, India, found that training positively affects wheat growers' knowledge and adoption of technologies (Dubey & Srivastava, 2007).

University entrepreneurship training can positively influence farmers' entrepreneurial and organizational competencies (Opolot et al., 2018). However, the effect of PIDC training is still unclear due to a lack of empirical evidence. Therefore, to collect empirical evidence and further improve training effectiveness, this study aims to evaluate the effect of PIDC training on farmers' technological knowledge, pesticide awareness, and farm production. With these research findings, PIDC will be able to deliver practical training to change farmers' knowledge, attitudes, and practices toward modern and safe agricultural farming.

Methodology

Study location and design

This study was conducted in the catchment area of the PSTU Innovation Dissemination Center (PIDC), with participants selected from the university's surrounding communities. The researchers designed a quantitative approach to assess the training effect. To evaluate the training effect, this research arranged two day-long training sessions before the Rabi and kharif-1 seasons. At the end of each season, a questionnaire was administered to both training participants and non-participating farmers to compare their technological knowledge, pesticide awareness, and vegetable production.

The training sessions were structured and delivered in two phases to address the distinct requirements of different growing seasons. One batch of farmers received training focused on winter vegetable cultivation, while the second received training focused on summer (kharif-1 and kharif-2) vegetable production. The curriculum combined theoretical instruction with practical demonstrations, covering topics such as seedbed preparation; seedling development; homestead vegetable cultivation using different homestead models; pest and disease management using chemicals, biopesticides, botanicals, bio-stimulants; fertilizer application, especially organic waste, kitchen waste, irrigation scheduling, proper harvesting practices, and post-harvest handling. This seasonal and crop-specific approach ensured that farmers were well-equipped to apply modern agricultural practices year-round, thereby improving productivity and resilience. At the end of the training programs, each participating farmer received essential agricultural inputs to support the practical application of the knowledge gained. Specifically, every trainee received two kilograms of organic fertilizer, which may promote environmentally sustainable soil enrichment practices. In addition, they were supplied with high-yielding planting materials from three distinct vegetable varieties, carefully selected to align with the crops' seasonal and regional suitability.

Population and sampling

All the vegetable farmers residing in the vicinity of PSTU composed the population of this study. However, other than considering the whole population, this study adopted a population frame to decide upon the sample. This study provides training to selected farmers from a list (sampling frame) provided by the Upazila Agriculture Office, Dumki. The enlisted farmers reside in the surrounding areas of PSTU and are involved in vegetable production. This study conducted two training programs, one in Robi season (at the end of November 2024) and the other in Kharip-1 season (at the end of March 2025). A detail of the sampling frame of the study is presented in Table 1.

Table 1. Sampling frame of the study

Season	Total listed farmers	Participants	Non-Participants
Robi (Winter)	74	27	28
Kharif-1 (Summer)	77	29	27

Data collection instrument

This study used a structured interview schedule to evaluate the effect of PIDC training. The structured interview schedule was composed of two sections. The first section contained socio-demographic variables such as age, sex, marital status, education, farm size, annual income, and other training participation. These variables were measured using standard scales, which are displayed in Table 3. The second section of the interview schedule consisted of questions related to technological knowledge of vegetable production, awareness of the harmful effects of pesticides, and the production of vegetables. However, the definitions of each variable of the second section, measurement procedures, and references are presented in Table 2.

Table 2. Definition and measurement of major variables of the study.

Variable	Definition	Measurement	References
Technological knowledge	Understanding of the application of techniques for improving the growth and production of vegetables	Using 28 multiple-choice, fill-in-the-blank, true/false questions related to various stages of vegetable production.	Hemathilake & Gunathilake (2022); Rahman et al. (2020)
Pesticide awareness	State of consciousness regarding the harmful effects of pesticides	Pesticide awareness was measured using a five-point Likert scale (SA (5) …….SD (1)) based on 11 statements	Portela Dos Santos et al. (2023)
Vegetable production	Total amount of different vegetables produced per decimal of land	In kilogram	Das (2018)

The validity of the data collection instrument was ensured by selecting study variables and relevant questions based on the existing literature (Table 2). To ensure reliability, this research conducted a pre-test of the data collection instrument on 15 similar farmers to execute necessary corrections and adjustments. An inter-rater reliability test method was deployed, and a strong correlation was found between the two groups based on technological knowledge and pesticide awareness. Inter-rater reliability measures the consistency with which different observers or raters assess the same phenomenon (Bonnet, 2023).

Data analysis

The data analysis process employed both descriptive and inferential statistics**.** Descriptive statistics, including frequency counts, means, and standard deviations, were used to summarize the socio-economic characteristics of the respondents. To assess differences in overall technological knowledge, pesticide awareness, and vegetable production, the t-test was used. For specific aspects of technological knowledge, the Chi-square test was used, and for specific aspects of pesticide awareness, the Mann-Whitney U test was used. The t-test is a parametric test preferred for comparing two groups when the data are at the ratio or interval level (Kim & Park, 2019). The chi-square test is a non-parametric test used when both variables are categorical, all observations are independent, and the expected cell counts are five or greater in at least 80% of the cells (Bobbitt, 2021). The Mann-Whitney U test is a powerful non-parametric test that allows valid comparisons between two groups when the variable is measured on an ordinal scale (e.g., Likert scales, ranking) (Food Safety Institute, 2024). IBM SPSS (version 23) was used to analyze the statistical data.

Results and Discussion

Demographic characteristics of the respondents

The demographic profile of the one hundred and eleven respondents is summarized in Table 3. The results show that the respondents are almost equally distributed across the age categories, such as young, middle-aged, and old. The results also indicate that most respondents were female, married, and had an education level up to secondary. The chi-square values in the last column of Table 3 indicate that training participant farmers differ significantly from non-participant farmers in terms of sex and educational attainment. However, the details of the other variables of the study are displayed in Table 3.

Table 3. Demographic characteristics of respondents (n=111)

Variable	Scale	Categories	Number of farmers (%)			Chi-sq
			PIDCT(Yes)	PIDCT(No)	Total	
Age	Year	Young (<35)	27(24.3)	11(9.9)	38	14.65***
		Middle-aged (35-50)	19(17.9)	17(15.3)	36	
		Old (>50)	10(9.0)	27(24.3)	37	
Sex	Male/Female	Male	25(22.5)	11(9.9)	36	7.68***
		Female	31(27.9)	44(39.6)	75	
Marital status	Married/	Unmarried	13(11.7)	5(4.5)	18	5.82
	Unmarried/	Married	43(38.73)	48(43.24)	91	
	Other	Others	0	2(1.8)	2	
Education	Categories	No formal education	0	2(1.8)	2	21.45***
		Primary	6(5.40)	24(21.62)	30	
		Secondary	24(21.62)	19(17.11)	43	
		Higher secondary	7(6.30)	3(2.70)	10	
		Graduate and above	10(9.00)	2(1.8)	12	

		Missing	9(8.10)	5(4.5)	14	
Vegetable Farm size	Decimal	Small farm (<10)	25(22.52)	20(18.1)	45	1.213
		Medium (10.01-30)	10(9.00)	14(12.61)	24	
		Large (>30)	21(18.91)	21(18.91)	43	
Annual income ('000' Taka)	'000' Tk	Low	24(21.62)	22(19.81)	46	0.131
		Medium	23(20.72)	23(20.72)	46	
		High	9(8.10)	10(9.00)	19	
Received other training	Yes/No	No	37(33.33)	33(29.72)	70	0.439
		Yes	19(17.11)	22(19.81)	41	
Growing season		Summer	29(26.12)	27(24.32)	56	0.081
		Winter	27(24.32)	28(25.22)	55	

Note: PIDCT= PSTU Innovation Dissemination Center training

Comparison of training recipients and non-recipients based on knowledge, awareness and production

The information in Figure 1 compares training recipient and non-recipient groups in terms of technological knowledge, pesticide awareness, and vegetable production per acre of land. The Figure further reveals that, based on t-test scores, training recipients show a significant increase in knowledge and pesticide awareness. No significant change was recorded in the production of vegetable crops. Specifically, in the awareness category, the trained group scored 40.64, which is significantly higher than the non-trained group's score of 37.83. This pattern is even more pronounced in the knowledge category, where the trained group achieved a score of 14.78 compared to just 9.72 for the non-trained group. Finally, in terms of production per decimal of land, the trained group scored 42.89, while the non-trained group scored 44.92 (Figure 1). Supporting our findings, a study in Bangladesh examining the effect of youth development training also found that training can significantly change trainees' knowledge (Rahman et al., 2020). Similarly, a study in Sri Lanka found that training can have a positive impact on farmers' technological knowledge (Rasanjali et al., 2021). However, in contrast to our findings, a study in Malawi found that training can significantly increase potato yields on smallholder farms (Kangogo et al., 2024).

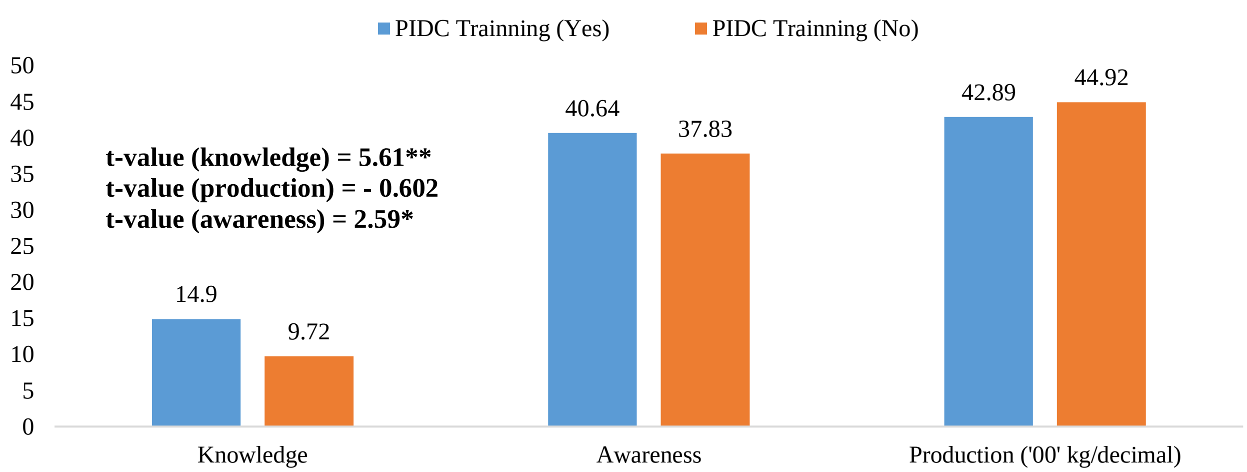

Figure 1. Comparison of technologicl knowledge, awareness and vegetable producation between two groups

Comparison of technological knowledge between training recipients and non-recipients

Data in Table 4 showed that among 28 aspects of technological knowledge in vegetable cultivation, the chi-square analysis revealed statistically significant differences across fourteen key aspects between training recipients and non-recipient farmers. In terms of nutritional awareness, a significantly higher percentage of trained farmers correctly identified the recommended daily vegetable intake (44.6% vs. 12.7%; $\chi^2 = 13.78$, $p < 0.001$). Regarding modern cultivation procedures, trained farmers demonstrated superior knowledge of soil suitability for vegetable cultivation, with 76.8% answering correctly compared to 43.6% of non-trained farmers ($\chi^2 = 12.74$, $p < 0.001$), and of compost as an organic fertilizer, with 91.1% vs. 70.9% answering correctly ($\chi^2 = 7.35$, $p < 0.01$). In pest management, training significantly upgraded the identification of major pests: 53.6% of trained farmers correctly identified the most damaging insect for eggplant, compared to 27.3% of non-trained farmers ($\chi^2 = 7.96$, $p < 0.01$); similarly, 57.1% of trained farmers correctly identified harmful insects for sweet gourd and leafy vegetables, versus 32.7% of non-trained farmers ($\chi^2 = 6.68$, $p < 0.05$). Knowledge of sustainable pest control methods also showed marked improvement: trained farmers were more acquainted with commonly used botanicals (28.6% vs. 3.6%; $\chi^2 = 12.70$, $p < 0.001$), plants used for producing biopesticides (58.9% vs. 25.5%; $\chi^2 = 12.74$, $p < 0.001$), and environmentally friendly pest control technologies (64.3% vs. 36.4%; $\chi^2 = 8.65$, $p < 0.01$). Training also uplifted the understanding of the relationship between seed quality and pest reduction, with 91.1% of trained farmers acknowledging this benefit compared to 72.7% of non-trained farmers ($\chi^2 = 6.32$, $p < 0.05$). In terms of pesticide awareness, trained farmers demonstrated a better understanding of environmental impacts, correctly identifying which environmental damage does not occur from pesticide use in 71.4% of cases, compared to 47.3% of non-trained farmers ($\chi^2 = 6.72$, $p < 0.05$). Disease identification knowledge presented consistent improvement among trained farmers: 50.0% correctly identified the fungus causing leaf spots in pumpkin, compared to 23.6% of non-trained farmers ($\chi^2 = 8.28$, $p < 0.01$); 42.9% correctly identified the disease causing powdery mildew, compared to 20.0% ($\chi^2 = 6.72$, $p < 0.05$); 48.2% recognized the spreading nature of spots on cabbage leaves, compared to 21.8% ($\chi^2 = 8.48$, $p < 0.01$); and 42.9% correctly identified the infection causing small red spots on pumpkin leaves, compared to 16.4% ($\chi^2 = 9.32$, $p < 0.01$). These comprehensive results revealed the substantial impact of the PIDC training program in enhancing farmers' Technological knowledge across multiple domains of vegetable production. A study in Bangladesh, focusing on the role of training in transferring rice production technologies, found that after undertaking training, farmers exhibited a significant increase in their knowledge of rice production (Hossain et al., 2021). In assessing the outcome of training on farmers' knowledge of table egg production and commercial poultry farming, a study in the Philippines found a significant difference in the farmers' knowledge levels before and after the training (Palada et al., 2020).

Table 4. Chi-square results showing comparison of training recipients and non-recipients regarding technological knowledge (n=111)

Aspect		**Training**		**Chi-sq (p)**
		No f (%)	**Yes f (%)**	
How many grams of vegetables should a full-grown adult eat daily?	Incorrect	48 (87.3)	31 (55.4)	13.775***
	Correct	7 (12.7)	25 (44.6)	
Which type of soil is most suitable for vegetable cultivation	Incorrect	31 (56.4)	13 (23.2)	12.744***
	Correct	24 (43.6)	43 (76.8)	
What type of fertilizer is compost?	Incorrect	16 (29.1)	5 (8.9)	7.353**
	Correct	39 (70.9)	51 (91.1)	
What is the most damaging insect for eggplant (brinjal)?	Incorrect	40 (72.7)	26 (46.4)	7.961**
	Correct	15 (27.3)	30 (53.6)	

What are the harmful insects for sweet gourd and leafy vegetables?	Incorrect	37 (67.3)	24 (42.9)	6.682*
	Correct	18 (32.7)	32 (57.1)	
What organic pesticides are commonly used for pest control?	Incorrect	53 (96.4)	40 (71.4)	12.698***
	Correct	2 (3.6)	16 (28.6)	
Mention plants used for producing biopesticides?	Incorrect	41 (74.5)	23 (41.1)	12.735***
	Correct	14 (25.5)	33 (58.9)	
Mention an environmentally friendly pest control technology for vegetable farming	Incorrect	35 (63.6)	20 (35.7)	8.654**
	Correct	20 (36.4)	36 (64.3)	
If good quality seeds are used in vegetable cultivation, disease and pest attacks will decrease	Incorrect	15 (27.3)	5 (8.9)	6.321*
	Correct	40 (72.7)	51 (91.1)	
Which environmental damage does not occur from using pesticides?	Incorrect	29 (52.7)	16 (28.6)	6.717*
	Correct	26 (47.3)	40 (71.4)	
What microorganism causes leaf spots of pumpkin?	Incorrect	42 (76.4)	28 (50.0)	8.279**
	Correct	13 (23.6)	28 (50.0)	
Which disease causes white powdery spots on pumpkin, cucumber, or vegetable leaves?	Incorrect	44 (80.0)	32 (57.1)	6.715*
	Correct	11 (20.0)	24 (42.9)	
Are the spots on cabbage leaves contagious?	Incorrect	43 (78.2)	29 (51.8)	8.483**
	Correct	12 (21.8)	27 (48.2)	
Which infection causes small red spots (disease) on pumpkin leaves?	Incorrect	46 (83.6)	32 (57.1)	9.323**
	Correct	9 (16.4)	24 (42.9)	

Note: Only aspects with significant differences are reported

Comparison of pesticide awareness between training recipients and non-recipients

The results of the Mann-Whitney U test comparing pesticide awareness between training recipients and non-recipients (Table 5) revealed statistically significant differences in three specific aspects of pesticide safety and management. Trained farmers demonstrated significantly greater awareness that washing pesticide sprayers in water bodies constitutes a source of pollution ($Z = -2.608$, $p = 0.009$). They also showed stronger awareness that pesticide dosage should not be arbitrarily altered from the recommended amount ($Z = -3.121$, $p = 0.002$). Furthermore, trained farmers were more aware that applying several pesticides simultaneously is not advisable ($Z = -2.163$, $p = 0.031$). However, no significant variations were found between the two groups regarding other aspects of pesticide awareness, including understanding of optimum dosage ($Z = -0.301$, $p = 0.763$), recognition of pesticide overuse difficulty ($Z = -0.835$, $p = 0.403$), necessity of personal protective equipment ($Z = -0.179$, $p = 0.858$), consideration of wind direction ($Z = -0.873$, $p = 0.383$), hand washing after application ($Z = -0.796$, $p = 0.426$), avoidance of eating/smoking during application ($Z = -0.018$, $p = 0.986$; $Z = -0.619$, $p = 0.536$), and proper pesticide handling ($Z = -1.434$, $p = 0.152$). These findings indicate that while the training effectively improved awareness of certain critical pesticide safety practices, other aspects of pesticide awareness remained unchanged between trained and untrained farmers. Supporting our findings, a study in France found that pesticide training can significantly affect cereal farmers' perceptions of safety climate (Grimbuhler et al., 2024). Another study in Fogera district wetland areas, south Gondar zone, Northwest Ethiopia, found that training can significantly influence the good safety practices in case of pesticide spray (Alebachew et al., 2023).

Table 5. Mann-Whitney U test results showing comparison of pesticide awareness between training recipients and non-recipients (n=111)

SL.	Aspects	Recipient		Non-recipient		Z	p
		$\bar{x}$	s	$\bar{x}$	s		
1	Using pesticides at the correct dosage helps maintain soil quality.	3.85	0.615	3.78	0.901	-0.301	0.763
2	Excessive use of pesticides can damage vegetable crops.	3.73	0.981	3.91	0.543	-0.835	0.403
3	There is no need for personal protective equipment when applying pesticides.	3.62	1.036	3.49	1.324	-0.179	0.858
4	It is essential to consider the wind direction when applying pesticides.	3.91	0.548	3.77	0.906	-0.873	0.383
5	It is not necessary to wash your hands with soap after applying pesticides.	3.85	0.672	3.70	1.034	-0.796	0.426
6	Eating and smoking can be done while applying pesticides.	3.73	0.943	3.75	0.911	-0.018	0.986
7	Eating and smoking can be done while applying pesticides.	3.98	0.133	3.85	0.742	-0.619	0.536
8	Pesticide bottles/packets can be stored with food items.	4.00	0.000	3.85	0.742	-1.434	0.152
9	Washing a pesticide sprayer in a river, pond, or canal is not a source of pollution.	3.16	1.411	2.38	1.698	-2.608	0.009
10	The pesticide dosage can be increased or decreased from the proper amount.	3.69	0.932	2.92	1.533	-3.121	0.002
11	Two or more pesticides can be applied at the same time on a vegetable farm.	3.12	1.402	2.43	1.711	-2.163	0.031

Discussion

This research was intended to evaluate the effect of PIDC training on participants. To achieve the research objectives, this study compared two groups of trained farmers with two groups of non-participating farmers based on technological knowledge, pesticide awareness, and the amount of vegetable production per decimal. The results of this study confirmed a substantial difference in technological knowledge and pesticide awareness, where participating farmers showed significant improvements. However, no significant improvement occurred in the vegetable yield of both participant and non-participant farmers.

This research found a significant change in the trainees' technological knowledge and pesticide awareness. However, this improvement was not uniform across all aspects of technological knowledge. The PIDC training participants demonstrated a low level of knowledge in vegetable production models and bed preparation, as well as eco-friendly methods for controlling pests and diseases in vegetables, including chili, okra, pumpkin, and brinjal, and the environmental impacts of pesticides. The PIDC training provided to participants was concise, allowing them sufficient time to grasp the key concepts. Moreover, the aforementioned subject matters are complex and require more time for participants to grasp. Methods of training, level of competency, and lack of learning culture may be responsible for post-training knowledge retention. Similar to technological knowledge, PIDC training participants demonstrated low awareness of safety when using pesticide equipment and when reading pesticide bottle or packet labels for precautionary instructions. Pesticide awareness building is a complex activity that requires concerted effort from various perspectives. Aslam et al. (2025) suggested integrating social diffusion strategies and education policy-driven interventions. Therefore, changes in other aspects of pesticide awareness necessitate the integration of other educational activities, policy reform, and regulatory measures.

Various socio-economic, environmental, input, technology, and market-related factors can influence farmers' vegetable production (Ahmed et al., 2022; Kamruzzaman & Takeya, 2008). Therefore, giving only training may not be sufficient to bring significant change in vegetable production. Time length is another factor that can affect the use of knowledge management practices (Boyes, 2016). As trainees did not receive sufficient time to apply the learnt technological knowledge in practice, this might explain why participant and non-participant farmers did not show a significant difference in production.

This research makes significant contributions to the literature in several ways. This research confirmed that the university can arrange training for the development of the farmers residing in the vicinity. Training can significantly influence knowledge development and awareness building among the trainees. However, this effect is not uniform regarding all aspects of the training subject matter. Along with its contributions, this study is not without limitations. The training effect can vary depending on the subject matter, trainer, trainees' competencies, duration, and season of crop production. This research considered only two sessions to evaluate the effect of training on trainees. Therefore, generalization of results needs caution. The effect of training is multidimensional and not limited to the aspects considered in this research. Therefore, this research suggests that further empirical investigation is needed to consider more dimensions of the training effect across different subject matters of training and crop production seasons.

Policy implications from this research suggest that training can have a significant impact on the knowledge and awareness of participants. However, its effect on enhancing production requires further investigation, considering other factors. Interested institutions can utilize the university's training center to advance the knowledge and awareness of farmers in surrounding areas, which may further contribute to improved production and the restoration of ecosystems in the university's vicinity.

Conclusion

The results suggested that the training was highly effective in uplifting participants' knowledge across multiple domains, including soil suitability, pest identification, use of biopesticides, and disease management. Significant progresses were also observed in specific aspects of pesticide safety awareness, such as proper dose selection of pesticides and pollution prevention. However, no significant short-term increase in vegetable yield was recorded among trained farmers compared to the non-trained vegetable growers. This indicates that while the training successfully enhanced cognitive and awareness outcomes, translating knowledge into immediate production gains may require complementary support. The program's reach was notably stronger among younger, male, and more educated farmers, indicating a need for more inclusive extension strategies. Overall, the PIDC model demonstrates potentials of university training in culminating knowledge in vegetable production and awareness development. To intensify its practical impact, future iterations should integrate training with access to inputs, credit, and continuous guidance about modern crop cultivation strategies. Such an integrated approach could better bridge the gap between knowledge acquisition and its effective application on farmers' fields, ultimately supporting sustainable agricultural development in coastal regions.

Conflict of interest

The authors declare no competing interests.

Funding Statement

The authors are cordially grateful to the Research and Training Center (RTC) of Patuakhali Science and Technology University (Grant Sl. No. PSTU/RTC-B/01/15/24/35(145), Date: 14/11/2024) for providing a research grant.

Author contributions

Md. Nizam Uddin Sabbir, Md. Nazmul Hasan Mehedi, Md. Mamun ur Rashid conceptualized and designed this training program and research work. Md. Nizam Uddin Sabbir collected the data from the respondents. Md. Mamun ur Rashid supervised the overall training program, data curation and analysis. Md. Nizam Uddin Sabbir, Md. Mamun ur Rashid and Md. Nazmul Hasan Mehedi drafted the manuscript. All authors have reviewed and approved the final version of the manuscript.

Acknowledgements:

Our heartfelt thanks go to the PIDC director, resource persons of the training program, trainee farmers group and non-trainee farmers respondents for their dedicated efforts, time and insights that made this work possible.

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