PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol 12(1): 1-7
https://doi.org/10.14719/pst.5203

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RESEARCH ARTICLE

An analysis of the adoption level of modern tea cultivation techniques by the Small Tea Growers (STGs) of Nilgiris district

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OPEN ACCESS

ARTICLE HISTORY
Received: 22 September 2024
Accepted: 1 November 2024
Available online
Version 1.0 : 17 February 2025
Version 2.0 : 28 February 2025

Check for updates

Additional information
Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

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Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

CITE THIS ARTICLE
Bharathwaaj A, Balasubramaniam P. An analysis of the adoption level of modern tea cultivation techniques by the small tea growers (STGs) of Nilgiris district. Plant Science Today. 2025; 12(1): 1-7. https://doi.org/10.14719/pst.5203

Abstract

The Small Tea Growers (STGs) of the Nilgiris district play a significant role in Indias' tea industry, contributing notably to state and national production. Despite advancements in tea cultivation technologies, the adoption rates among these growers remain suboptimal, primarily due to limited access to modern techniques and resources. Tamil Nadu Agricultural University's Directorate of Open and Distance Learning (DODL) introduced a certificate course in Tea Cultivation Technology to address this gap. This particular study utilizes an Ex-post facto research design. The study was conducted in 2023 and 2024 in the Nilgiris and Coimbatore districts, a major tea-growing tract in Tamil Nadu, India. Using Simple random sampling method, 120 tea growers were selected as the sample size during the survey. A well-structured pre-tested interview schedule was prepared and the information was collected using personalized interview. Descriptive Statistics, Correlation and Regression analysis followed by Garrett ranking were computed to analyze the adoption level, constraints faced and the suggestions given by the Tea Growers. Based on the findings, this study revealed that most tea growers (49.17 %) had a medium level of adoption after enrolling in the certificate course. The most significant challenge was the lack of exposure visits and practical classes (14.72 %) followed by inadequate home learning environment. The most ranked suggestion is to enhance the course by increasing hands-on experience sessions and exposure visits (56.66 %). Thus, the tea growers consider distance learning as an useful educational tool for expanding their knowledge and understanding of agricultural technologies and implementing them at the field level, enabling them to enhance farm conditions and explore business venture opportunities.

Keywords

adoption level; agribusiness; agricultural technology; distance learning; tea cultivation

Introduction

Tea (*Camellia sinensis*) is a perennial evergreen shrub or small tree that belongs to the family Theaceae. It is primarily cultivated for its tender leaves and buds, which are processed to produce tea. The two main tea varieties are *Camellia sinensis* var. *sinensis* (Chinese tea) and *Camellia sinensis* var. *assamica* (Assam tea). It has long been significant in Indian culture and society, deeply embedded in religious traditions and social customs. It is one of the most consumed beverages globally (1). Tea farming is limited to specific nations across the globe because of its typical weather and soil requirements essential for optimum growth. Significant tea-producing countries are China, India and Sri Lanka (2).

India began growing tea when the British founded the countrys' first commercial plantations in Assam at the beginning of the 1800s. Since then, Indias' agricultural and economic structure has become inextricably linked to growing tea (3). By the end of the 20th century, the total area under cultivation for tea was 2563.75 × 103 hectares, growing at an annual rate of 0.42 percent. However, the area used for tea planting has continued to expand in the twenty-first century. The area used for tea cultivation increased at a rate of 3.41 percent between 2001 and 2010, from 2727.44 × 103 ha to 3691.88×103 h. This global tea production trend was similar to that of tea cultivation areas. Between 1991 and 2010, global tea production rose from 2631.05 million kg to 4162.33 million kg, with a 3.48 percent growth rate. Hence, in the last 20 years, global tea production has increased. This is because of technological advancements in tea farming and the area used for tea cultivation has been enlarged (4). Though global production and area used for tea cultivation have increased in the last 20 years, there has not been any remarkable increase in its yield. Between 1991 and 2010, global yield increased from 1026 kg/ha to 1160 kg/ha the same period (5). There are officially 400 registered small tea growers in the Nilgiris region, though the true number is estimated to be over 50000. According to the All Nilgiris Small Tea Growers' Association, these growers collectively produce more than 65 million kg of green leaf, yielding nearly 14 million kg of made tea out of a total Nilgiris production exceeding 345 million kilograms (6). These small-scale growers contribute 29 percent to the states' total tea production, accounting for 14 percent of the nations' overall production (7). To sustain the economic viability of their plantations over the long term, tea growers need to regularly update their knowledge and skills in tea cultivation (8). Offering distance education on modern tea cultivation technologies is an effective solution for improving the tea industry's efficiency, sustainability and profitability (9). Distance learning revolves around delivering education and instructional materials to learners who are not physically present in a traditional classroom setting (10). It leverages various technologies to bridge the gap between instructors and students, facilitating education across different locations and often other times (11). As a result, numerous universities have launched distance education programs that offer certificates, degrees, postgraduate degrees and postgraduate diploma courses (12). Therefore, Open and distance learning is considered a tried-and-true educational strategy for reaching the unreached. Owing to its openness, flexibility and various technological interventions, the Open and Distance Learning system is poised to emerge as a viable and affordable alternative for disseminating information to a broad audience (13). The Tamil Nadu Agricultural University established the Directorate of Open and Distance Learning in 2005 to deliver technical knowledge and concepts on agriculture-based certificate courses to prepare school dropouts, unemployed youth, self-help groups and farmers for self-employment. Since then, the DODL offers 41 certificate courses, 13 diploma courses, 6 online courses, one special certificate course and one crash course in the fields of agriculture and related fields via distance learning (14). In this regard, this study has made an effort to ascertain the adoption level of the tea growers regarding specific modern technologies on the tea cultivation, their perceived constraints and their suggestions to improve the overall course effectiveness.

Materials and Methods

Experimental design and sampling method

The research design employed in this study was Ex-post Facto. The studys' sample comprised of Small Tea Growers (STGs) who have completed the certificate course on Tea Cultivation Technology from batches 2019-2023 from the Directorate of Open and Distance Learning (DODL) of Tamil Nadu Agricultural University, Coimbatore. The Simple random sampling method was employed to select 120 growers out of 174 who studied this Tea Cultivation technology certificate course. This certificate course is offered in Tamil to those who have completed SSLC and have a minimum age limit of 18 years. The duration of the course is six months and it includes five contact classes (monthly). The Kothari Agricultural Management Centre located at Coonoor, Nilgiris is the study centre that offers Tea Cultivation Technology certificate course to the Tea Growers. Several courses are offered by the DODL, including 41 certificate course programs, 12 diploma programs, 6 online certificate programs, one special certificate course (Diploma in Agri-Inputs Programme) and one crash course in agriculture and related fields via distance learning.

Data Collection

Direct data collection from growers was carried out between 2023 to 2024, encompassing multiple regions of Nilgiris district and Coimbatore district, including Coonoor, Kothagiri, Gudalur, Ooty, Karamadai and Vaalparai. A well-structured pre-tested interview schedule was used to gather information from the selected respondents through personal and telephonic interviews. The data gathered from the respondents were coded and tabulated for statistical tests to get meaningful results. The collected data from tea growers were processed using Statistical Packages of Social Sciences (IBM SPSS Statistics 23), which included descriptive statistics, cumulative frequency, correlation, regression analysis and Garrett Ranking.

Results and Discussion

Profile of the learners

Among the tea growers, more than half (58.33 %) who had enrolled in certificate course were 35 to 45 years old. Most tea growers (86.67 %) who had enrolled in the certificate courses were only men while 13.33 % were women. Nearly half of the growers (43.33 %) had higher secondary education, followed by an undergraduate level of education (36.67 %) and 20.00 per cent had completed their postgraduate degree. More than half of the growers

(56.67 %) had farming as their primary occupation, followed by self-employment (30.00 %) and private employment (8.62 %). Only 1.67 % of them were in the category of unemployed. Most of the growers (81.67 %) had an average annual income of Rs.1,52,000-Rs.6,21,999 per year. Three-fourths of growers (75.00 %) travelled only less than 50 kilometres to the study centre. Most growers (78.33 %) came from rural backgrounds, while only 21.67 per cent came from urban areas. Nearly half of them were medium farmers (48.33 %) with medium farming experience (52.28 %). Overall analysis showed that 18.33% of tea growers had low information-seeking behaviour, followed by 65.00% of growers with medium information-seeking behaviour. The growers' levels of information-sharing behaviour (78.33 %), extension agency contact (67.50 %) and progressiveness (75.83 %) were all medium level.

Adoption Level

Adoption is the choice made by a person or farmer to fully implement an innovation as the most effective course of action. The ultimate goal of extension agencies is to see an innovation adopted (15). The degree to which Small Tea Growers adopted tea cultivation practices was analysed and interpreted. Table 1 and Fig. 1. show how learners are categorized based on their adoption of tea cultivation technology.

Based on the data presented in Table 1, it is evident that most tea growers (49.17 %) had high levels of adoption after enrolling in the ODL certificate course, followed by 37.50 % of tea growers with medium levels of adoption. Conversely, most tea growers (45.83 %) had medium levels of adoption before enrolment in the ODL certificate course, followed by 38.33 percent and 15.83 percent of growers with low and high levels of adoption, respectively. The desire of the growers to increase their farm yield and income levels may cause the adoption rate to increase. This could be because Small Tea Growers (STGs) were taught all production, protection, post-harvest technologies and skill-related aspects during the ODL course on tea cultivation technology. Because of this, the bulk of them adopted modern tea cultivation technologies at a high to medium level. These results were consistent with the findings of (16). The distribution of tea growers based on their degree of adoption of modern agricultural technologies introduced in the programs' curriculum is displayed in the following (Table 2). Before the course, only 30.83 % of growers fully adopted the recommended planting varieties, with 20.00 % partially adopting and 49.16 % not adopting. After completing the course, full adoption increased to 40.83 %, partial adoption to 23.33 % and non-adoption decreased to 36.12 %. These findings indicate the positive impact of the certificate course on growers' understanding and selection of appropriate planting materials. Following the completion of the certificate course, there was a significant increase in the adoption rates of recommended planting techniques among tea growers. The percentage of growers who fully adopted these methods rose from 21.67 % before enrolment to 45.00 % after completing the program, while non-adoption rates decreased from 40.83 % to 24.17 %. These results demonstrate the effectiveness of the certificate program in promoting appropriate planting practices. The certificate program also influenced the degree to which the growers adopted irrigation techniques. The percentage of growers who fully adopted the recommended irrigation methods increased from 22.78 % to 47.22 %. Similarly, there was a significant rise in partial adoption, as growers' percentages increased from 29.44 percent to 31.67 percent. This highlights the importance of certificate programs in advancing the knowledge of different irrigation strategies in tea cultivation technology that preserves irrigation water and increase yield.

According to the studys' findings, only 15.23 % of tea growers had fully adopted the fertigation approach before enrolling in the certificate program and only 33.33 % of growers had partially adopted. Furthermore, 50.83 % did not adopt the fertigation method. After attending the certificate course, the proportion of growers who fully and partially adopted the fertigation methods increased to (43.33 %) and (31.66 %), respectively. This indicates that the certificate course significantly impacted growers' comprehension and application of fertigation techniques. The adoption rates of nursery preparation techniques significantly improved after the ODL course, with full adoption increasing from 21.38 % to 50.83 % and non-adoption decreasing from 35.28 % to 24.44 %. This highlights the programs' effectiveness in demonstrating the importance of efficient nursery practices for optimal crop growth. Additionally, the course positively influenced growers' attitudes toward pruning techniques, with full adoption rising from 20.28 % to 43.3 % and partial adoption increasing from 33.33 % to 38.33 %. Research indicates that growers' eagerness can improve their pruning practices. The certificate course significantly improved the adoption of key agricultural practices among tea growers. The adoption of drought management practices increased from 23.33% to 47.33%, with partial

Table 1. Distribution of growers based on their adoption before and after attending the certificate course (n=120)

S.No.	Category	Before		After	
		Frequency	Percent	Frequency	Percent
1.	Low	46	38.33	16	13.33
2.	Medium	55	45.83	45	37.50
3.	High	19	15.83	59	49.17
	Total	120	100.00	120	100.00

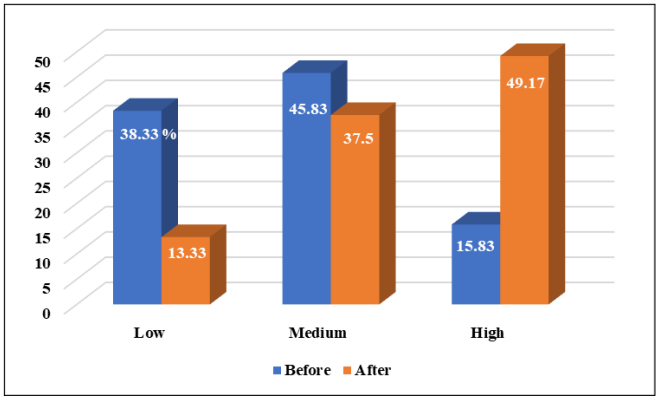

Fig. 1. Distribution of growers based on their adoption level before and after attending the certificate course (n=120).

Table 2. Distribution of tea growers according to their degree of adoption of enhanced agricultural technologies introduced (n=120)

S. No	Course Contents	Before attending course						After the course					
		Fully Adopted		Partially Adopted		Not Adopted		Fully Adopted		Partially Adopted		Not Adopted	
		F	%	F	%	F	%	F	%	F	%	F	%
	Variety	37	30.83	24	20	59	49.16	49	40.83	28	23.33	43	36.12
1.	Assam variety	38	31.67	17	14.17	65	54.16	50	41.67	18	22.50	52	43.33
	Chinese variety	17	14.17	27	22.50	76	63.33	39	32.50	27	31.67	54	45
	UPASI variety	56	46.67	29	24.17	35	29.16	58	48.33	38	23.05	24	20
	Propagation material	39	32.78	16	13.61	65	54	54	45.28	35	29.16	31	25.55
2.	From seeds	15	12.50	16	13.33	89	74.16	25	20.83	35	29.16	60	50
	Cuttings	52	43.34	12	10	56	46.67	74	61.66	32	26.67	14	11.66
	Grafting materials	51	42.5	21	17.50	48	40	64	53.33	38	31.67	18	25.55
	Nursery preparation	26	21.38	52	43.33	42	35.28	61	50.83	30	25.00	29	24.44
3.	Polythene sleeves	23	19.16	65	54.16	32	26.67	45	37.50	38	31.67	37	30.83
	Pandal system	29	24.16	52	.43.33	39	32.50	79	65.83	20	16.67	21	17.50
	Shade net	25	20.83	39	32.43	56	46.67	59	49.16	31	25.83	30	25.00
	Nature of planting	19	15.83	55	45.83	46	38.33	51	42.50	38.5	32.08	30.5	25.42
4.	New planting	20	16.67	56	46.67	44	36.67	54	45.00	38	31.67	28	23.33
	Replanting	18	15.00	54	45.00	48	40.00	48	40.00	39	32.50	33	27.50
	Planting techniques	26	21.67	45	37.5	49	40.83	54	45.00	37	30.83	29	24.17
5.	Single hedge	24	20.00	42	38.33	54	41.67	52	43.33	38	31.67	30	25,00
	Double hedge	28	23.33	48	40.00	44	36.67	56	46.67	36	30.00	28	23.33
	Irrigation	27	22.78	36	29.44	58	47.78	57	47.22	38	31.67	26	21.11
	Rainfed	48	40.00	26	21.67	46	38.33	68	56.67	32	26.67	20	16.67
6.	Drip irrigation	18	15.00	42	35.00	60	50.00	52	43.33	40	33.33	28	23.33
	Sprinkler	16	13.33	38	31.67	66	55.00	50	41.67	42	35.00	28	23.33
	Surface irrigation	32	26.67	48	40.00	40	33.33	48	40.00	42	35.00	28	23.33
7.	**Fertigation method**	19	15.83	40	33.33	61	50.83	52	43.33	38	31.66	30	25
8.	**Value addition**	14	11.66	28	23.33	78	65.00	59	49.16	36	30.00	25	20.83
	Drought management	28	23.33	33	27.22	60	49.44	58	48.33	37	30.28	26	21.39
9.	Mulching	20	16.67	44	36.67	56	46.67	54	45.00	37	30.83	29	24.17
	Cover crop (mimosa)	16	13.33	22	18.33	82	68.33	52	43.33	40	33.33	28	23.33
	Shade trees	48	40.00	32	26.67	40	33.33	68	56.67	32	26.67	20	16.67
	Pruning	25	20.28	40	33.33	55	45.83	52	43.33	46	38.33	22	18.34
10.	Rejuvenation pruning	16	13.33	32	26.67	62	60.00	62	43.33	48	40.00	20	16.67
	Light/ medium pruning	32	26.67	48	40.00	40	33.33	58	48.33	44	36.67	18	15.00
	Hard pruning	25	20.83	56	46.67	39	32.50	46	38.33	35	29.33	39	32.50
	IPM	28	23.06	31	25.56	62	51.39	70	57.78	29	23.89	22	18.33
	Cultural method	52	43.33	26	21.67	42	35.00	64	53.33	24	20.00	32	26.67
11.	Mechanical method	20	16.67	46	38.33	54	45.00	72	60.00	28	23.33	20	16.67
	Chemical method	11	9.17	20	16.67	89	74.17	72	60.00	34	28.33	14	11.67
	Biological method	55	45.83	27	22.50	38	31.67	68	56.67	24	20.00	28	23.33
	Harvesting	45	37.50	38	31.67	37	30.83	55	45.83	31	25.83	34	28.33
12.	Hand-picking	58	48.83	42	35.00	20	16.67	36	30.00	38	31.67	46	38.33
	Mechanical Harvest	32	26.67	34	28.33	54	45.0	74	61.67	24	20.00	22	18.33
	Grading	38	31.67	19	15.33	63	52.50	62	51.67	28	23.33	30	25.00
13.	Based on the Size	6	5.00	16	13.33	98	81.67	82	68.33	28	23.33	10	8.33
	Based on the Quality	70	58.33	22	18.33	28	23.33	42	35.00	28	23.33	50	41.67

adoption rising from 27.22 % to 30.28 %, highlighting the courses' effectiveness in promoting soil water conservation. Similarly, integrated pest management (IPM) practices saw a sharp rise, with full adoption increasing from 23.06 % to 57.39 %, while non-adoption dropped from 51.39 % to 18.33 %. The adoption of harvesting technologies also improved, with full adoption rising from 37.50 % to 45.83 %. After completing the certificate course, the adoption of grading practices among tea growers significantly improved, with full adoption rising from 31.67 % to 51.67 % and partial adoption from 15.33 % to 23.33 %. Before the course, 65.00 % of growers did not engage in value-addition practices, with only 11.66 % fully and 23.33 % partially adopting them. Post-course, full adoption of value addition practices increased to 49.16 % and partial adoption to 30.00 %, while non-adoption dropped to 20.83 %, highlighting the courses' positive impact on promoting value addition. These results indicate that the certificate course in tea cultivation technology has successfully inspired and encouraged Small Tea Growers (STGs) to adopt and integrate value-addition practices into their work. The course has been instrumental in enhancing their understanding of the benefits and methods of value addition in tea cultivation.

Association and contribution of independent variables with the level of adoption

The association between the independent variables and the level of adoption of learners was examined using simple correlation and multiple regression analysis (Table 3-4; Fig. 1.). Out of the 19 independent variables used in the study, Table 3 shows that the variables annual income (X_5), farm size (X_9), farming experience (X_{10}), determinant factors (X_{16}) and attitude towards entrepreneurship (X_{19}) have demonstrated positive and significant association with the knowledge level of the learners at the 1% level of significance and 5 % level of significance, the variables social participation (X_{11}), extension agency contact (X_{12}), progressiveness (X_{15}) and job aspiration (X_{17}) demonstrated a positive association with the adoption level. Higher adoption rates of innovations are often linked to higher yearly income. In this study, 48.33 % of distant learners operated medium-to-large farms and 81.67 % had medium-to-high yearly incomes, suggesting a correlation between income and adoption. A positive attitude toward entrepreneurship also contributed to higher adoption rates, as learners were motivated to succeed and embrace new technologies. Furthermore, 74.17 % of learners demonstrated medium to high levels of progressiveness, reflecting their openness to new concepts and methodologies.

Participants in the certificate program actively applied various technologies learned to enhance their farming practices, which positively impacted their adoption levels. Enrolling in the remote learning program was likely a strategic choice to improve their credentials and increase job prospects in the tea industry. The training provided practical knowledge and skills that participants could immediately apply to their roles in tea cultivation. The amount of independent variables that contributed to the dependent variable was ascertained through multiple regression analysis. With an R2 value of 0.505, it was discovered that the nineteen independent variables selected for the study explained 50.50 % of the variation in the degree of adoption of the most recent, improved technologies taught in the certificate program in tea cultivation technology. The F value was significant at the one percent probability level. The prediction equation was used to fit the adoption level of the most recent, upgraded technologies included in the tea cultivation technology certificate course curriculum because the 'F' value was significant. The results are displayed below.

Adoption level (Y) = 19.265 + 0.194 (X_1) + 0.205 (X_2) -0.069 (X_3) + 0.120 (X_4) + 0.246 (X_5)** - 0.080 (X_6) + 0.157 (X_7) + 0.042 (X_8)* + 0.174 (X_9) + 0.286 (X_{10}) + 0.134 (X_{11}) + 0.070 (X_{12}) + 0.038 (X_{13}) + 0.106 (X_{14}) + 0.130 (X_{15})* + 0.260 (X_{16})** + 0.052 (X_{17})* - 0.092 (X_18) + 0.119 (X_{19})

From the equation mentioned earlier, it can be seen that the variables such as Annual income (X_5) and Determinant factors (X_{16}) showed a positive relationship with the level of adoption at a 1% significance level. In contrast, the regression coefficient of Farm size (X_8), Progressiveness (X_{15}) and Job aspiration (X_{17}) showed a positive relationship with the level of adoption of learners at a 5% level of significance.

According to the results, there would be a 0.246, 0.174, 0.130, 0.260 and 0.052 unit increase in adoption for every unit increase in annual income, farm size, progressiveness, determinant factors and job aspiration, respectively. The contribution could be anticipated from the nature of the relationship between the variables. The Empirical model showing the relationship between the independent variables and the Adoption Level of the learners is shown in Fig. 2. Table 4 illustrates a marked difference in adoption levels before and after the training, with significant changes observed at the 0.01 and 0.05 levels. This indicates that after completing the certificate course in tea cultivation technology, there was an apparent increase in adoption levels compared to the learners' status before enrolling.

Table 4. Paired t-test–adoption level of tea growers–before and after attending the course

Pair 1	Before- After
'T' value	36.200
Degrees of freedom	119
Significance	0.000

Table 3. Correlation and multiple regression analysis between the independent variables and adoption level of growers after attending the certificate course

Variable No.	Variables	R value	Regression coefficient	Standard error	T value
X_1	Age	0.152 NS	0.194	0.685	1.843
X_2	Gender	0.023 NS	0.205	1.223	2.536
X_3	Educational status	0.150 NS	-0.069	0.587	2.690
X_4	Occupational status	0.096 NS	0.120	0.373	-0.838
X_5	Annual income	0.248**	0.246	0.970	3.165**
X_6	Geographical distance	-0.150 NS	-0.080	0.927	1.636
X_7	Rural-Urban background	0.031 NS	0.157	0.999	-1.048
X_8	Medium of instruction	0.018 NS	0.042	0.934	2.081
X_9	Farm size	0.302**	0.174	0.538	0.530*
X_{10}	Farming experience	0.395**	0.286	0.972	2.258
X_{11}	Social participation	0.212*	0.134	0.528	3.427
X_{12}	Extension agency contact	0.184*	0.070	0.153	1.765
X_{13}	Information seeking behavior	0.069	0.038	0.715	0.923
X_{14}	Information sharing behavior	0.145 NS	0.106	0.277	0.488
X_{15}	Progressiveness	0.188*	0.130	0.537	1.388*
X_{16}	Determinant factors	0.416**	0.260	0.194	3.201**
X_{17}	Job aspiration	0.250*	0.052	0.280	1.669*
X_{18}	Attitude towards ODL course	0.139	-0.092	0.059	0.669
X_{19}	Attitude towards entrepreneurship	0.273**	0.119	0.032	-1.139
		$R^2 = 0.505$	F = 5.359**		

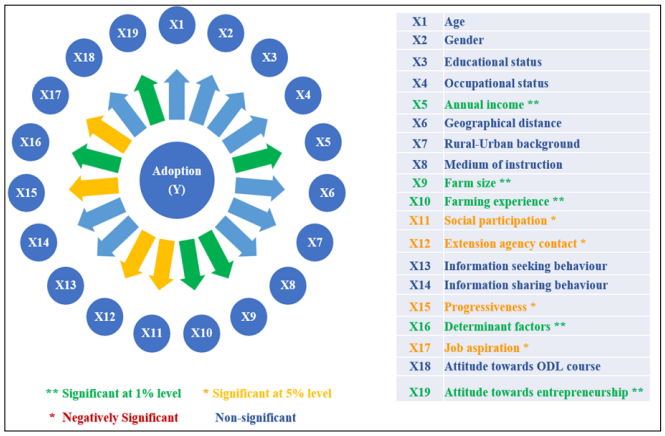

Fig. 2. The empirical model showing the relationship between the independent variables and the adoption level of the learners (n=120).

Constraints faced by the tea growers during the course

Tea growers reported several constraints, with the lack of exposure visits and practical classes ranked first (14.72 %) due to insufficient hands-on training for planting, pruning, pest control and harvesting, which are best learned through direct experience. Distractions in the home environment ranked second d (14.64 %), followed by insufficient study time (14.53 %), as many growers balance farming and family duties. Attending in-person sessions ranked fourth (13.87 %) due to distance, transportation issues and time constraints. Distance to study centres ranked fifth (11.31 %) due to travel difficulties, while financial limitations ranked sixth (11.12 %). Limited experience with instructional technologies (10.17%) and lack of support from family or employers (9.65%) were also notable challenges. Fig. 2. shows the suggestions given by the tea growers to enhance the effectiveness of the certificate course in tea cultivation technology.

Suggestions given by the growers

The key suggestions for enhancing the course are increasing the hands-on experience sessions and exposure visits (56.66 %) and the number of contact classes (49.16 %). Establishing connections with various stakeholders (43.33 %) is ranked third, as it is valuable for networking and knowledge-sharing. Improving awareness of the course ranked fourth (38.33 %), followed by updating course materials and other suggestions given in Fig. 3.

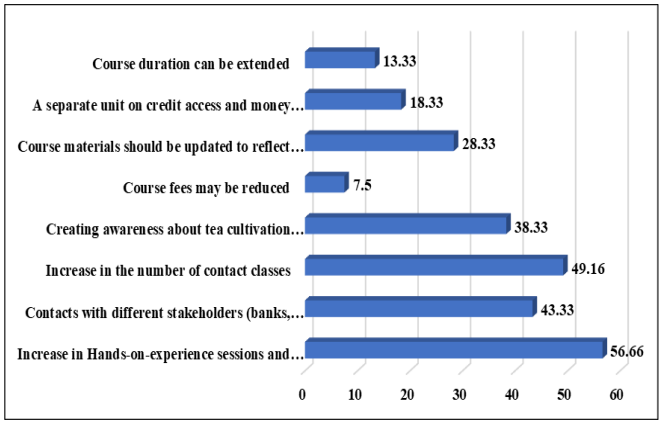

Fig. 3. Suggestions given by the growers for improving the certificate course.

Conclusion

This 2-year study found that 49.17 % of tea growers exhibited a medium degree of adoption of practices after completing the certificate course. The primary challenge was the lack of exposure visits and practical workshops (14.72 %), followed by inadequate home learning environments, limited study time and difficulties attending in-person sessions. To address these issues, 56.66 % of respondents recommended enhancing the course with more practical experience and exposure visits. Tea growers view distance learning as a valuable tool for improving their tea cultivation practices and exploring new business opportunities. The study suggests that agricultural distance education on India can benefit from better ICT integration and practical skill development, supported by researchers, government and institutions, to enhance economic efficiency and expand its reach.

Acknowledgements

We would like to sincerely thank the Directorate of Open and Distance Learning (DODL) of Tamil Nadu Agricultural University for funding this research project through the Students Think Tank Fellowship Scheme during 2023–2024. Special thanks to the Chairman Director (DODL) and the advisory committee members for their valuable feedback and constructive suggestions throughout the research.

Authors' contributions

AB conducted the experiment, took observations, analyzed the data and summarized the manuscript. PB guided the research by formulating the research concept, helped secure funds and approved the final manuscript. The authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

References

1. Langford NJ. From global to local tea markets: the changing political economy of tea production within Indias' domestic value chain. Develop Change. 2021;52(6):1445–72. https://doi.org/10.1111/dech.12652
2. Deka N, Goswami K. Economic sustainability of organic cultivation of Assam tea produced by small-scale growers. Sus Prod Consump. 2021;26:111–25. https://doi.org/10.1016/j.spc.2020.09.020
3. Baruah P, Handique G. Perception of climate change and adaptation strategies in tea plantations of Assam, India. Env Mon Ass. 2021;193(4):165. https://doi.org/10.1007/s10661-021-08937-y
4. Das AK, Ghosh A, Majumder S, Saha S, Acharyya S, Sarkar S, et al. Characterization of tea and tea infusion: a study of marketed black tea samples from some tea growing regions of India. J

Pharmacogn Phytochem.. 2020;9(5):1532–40. https://doi.org/10.22271/phyto.2020.v9.i5v.12553

5. Bag S, Mondal A, Banik A. Exploring tea (*Camellia sinensis*) microbiome: Insights into the functional characteristics and their impact on tea growth promotion. Microbio Res. 2022;254:126890. https://doi.org/10.1016/j.micres.2021.126890
6. Saha JK, Adnan KM, Sarker SA, Bunerjee S. Analysis of growth trends in area, production and yield of tea in Bangladesh. J Agric Food Res. 2021;4:100136. https://doi.org/10.1016/j.jafr.2021.100136
7. Parida BR, Mahato T, Ghosh S. Monitoring tea plantations during 1990–2022 using multi-temporal satellite data in Assam (India). Trop Ecol. 2024;65(3):387–98. https://doi.org/10.1007/s42965-023-00304-x
8. Paul T, Mondal S, Islam N, Rakshit S. The impact of blockchain technology on the tea supply chain and its sustainable performance. Technol Forecast Soc Change.2021;173:121163. https://doi.org/10.1016/j.techfore.2021.121163
9. Liu Z, Bashir RN, Iqbal S, Shahid MM, Tausif M, Umer Q. Internet of things (IoT) and machine learning model of plant disease prediction-blister blight for tea plant. IEEE Access. 2022;10:44934–44. https://doi.org/10.1109/ACCESS.2022.3169147
10. Liang S, Granato D, Zou C, Gao Y, Zhu Y, Zhang L, et al. Processing technologies for manufacturing tea beverages: From traditional to advanced hybrid processes. Trends Food Sci Technol.. 2021;118:431–46. https://doi.org/10.1016/j.tifs.2021.10.016
11. Bui HT, Nguyen HT. Factors influencing farmers decision to convert to organic tea cultivation in the mountainous areas of northern Vietnam. Organic Agric. 2021;11: 51–61. https://doi.org/10.1007/s13165-020-00322-2
12. Parasar S, Das PK, Barman I, Sultana S, Barman S, Deka SD, et al. Factors influencing the extent of technological gap in adoption of scientific practices of tea cultivation by small tea growers of Assam. Int J Curr Microbio Appl Sci. 2020;9(7):1782–89. https://doi.org/10.20546/ijcmas.2020.907.204
13. Babu MR. A study on extent of knowledge level among distant learners of Tamil Nadu Agricultural University. Asian J Agric Exten Econ Socio. 2023 Aug 25;41(10):32–36. https://doi.org/10.9734/ajaees/2023/v41i102137
14. Bharathwaaj A, Balasubramaniam P, Sriram N, Nirmala D, Gangai S. A study on motivational factors and the constraints faced by distance learners of odl certificate course tea cultivation technology. Arch Curr Res Int. 2024;24(7):30–8. https://doi.org/10.9734/acri/2024/v24i7826
15. Cole SA, Fernando AN. Mobilezing agricultural advice technology adoption diffusion and sustainability. The Econ J. 2021;131(633):192–219. https://doi.org/10.1093/ej/ueaa084
16. Akila N. Impact assessment of bachelor of farm technology (BF Tech) Degree Programme Offered Through Open and Distance Learning Mode. Unpub. MSc Agriculture [Thesis], AC and RI, Madurai, TNAU, Coimbatore; 2015.
17. Sridevi TRKK, Balasubramaniam P, Anusuya A, Vasanthapriya S. Extent of awareness of distance learners of Tamil Nadu Agricultural University. J Exten Edu. 2017;29(4):5958–65. https://doi.org/10.26725/JEE.2017.4.29.5958-5965