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Original article

The Effectiveness of Farmer Field School Extension Approach for Technology Transfer to Tea Smallholders in Sri Lanka

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Abstract

Although tea smallholders play a dominant role in the tea industry in Sri Lanka, they have faced many constraints such as poor adoption of technology, scarcity of skilled labor and inputs, low productivity, high cost of production, etc. In searching for a viable mechanism to address the technology adoption issues, this study designs to assess the effectiveness of the Farmer Field School (FFS) extension approach implemented in Kandy district in Sri Lanka to improve the adoption rate of cultural practices toward increasing productivity and profitability in tea smallholdings. The stratified purposive sampling technique was performed to select 50 tea smallholders who participated in FFS programs and another 50 tea smallholders who have not attended the same programs (NFFS Group) in eight Grama Niladhari Divisions in the Kandy district. A cross-sectional field survey using a pretested and validated survey instrument was administrated to collect primary data. Using the 5-point Likert scale, indices were developed to measure variables, and descriptive analysis and ordered logistic regression analysis were performed to analyze the data. The results show that there was a significant difference in the adoption of agricultural practices between FFS and NFFS tea smallholders ($t = 3.362$, $p < 0.001$), the productivity of land ($t = 1.991$, $p < 0.05$), and cost of production ($t = -3.976$, $p < 0.001$). The results of the ordered logistic regression model revealed that the model was fitted significantly ($p < 0.05$) and confirmed that the degree of adoption of recommended cultural practices by tea smallholders was positively and significantly correlated with their educational level ($p < 0.05$), attitude on field practices ($p < 0.1$), knowledge of tea field technologies ($p < 0.01$), experience in tea cultivation ($p < 0.1$), tea land productivity ($P < 0.05$), and group dynamic interaction in the learning process of tea farm field school-extension related learning activities ($p < 0.05$). Hence, this study proved that the FFS approach is a useful agricultural innovation and dissemination platform for improving tea smallholders' knowledge and changing their attitude toward the adoption of cultivation practices for improving tea smallholdings' land productivity and profitability in Sri Lanka.

Keywords: Adoption; Effectiveness; Farmer Field School; Tea smallholders.

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INTRODUCTION

The tea industry has been a key contributor to Sri Lanka's economy in terms of foreign exchange earnings, national output, and employment for more than a century. In the year 2021, 285,867 MTs of tea were exported, and USD 1.32 billion in export revenue was earned (Sri Lanka Export Development Board, 2021). Tea smallholders cultivate about 60% of the total tea extent and produce more than 75 % of the total annual tea production. In terms of productivity, the smallholder (1,995 kg/ha) (TSHDA, 2019), subsector performs better the corporate plantation sector (1,602 kg/ha). There are 1.5 million dependents in the smallholder sector. As a result, the tea industry's future in Sri Lanka will be largely determined by smallholders and their production practices. Although tea smallholders play a dominant role in the tea industry in Sri Lanka, they have to face more difficulties such as lack of essential inputs (fertilizer, chemicals, equipment, etc.), land degradation, low productivity of land and workforce, high cost of production, inadequate outreach extension facilities, less effective conventional extension services and less knowledge and adoption of appropriate cultural practices of tea cultivation (Perera, 2014; Amarathunga et al., 2017 and Amarathunga, 2019). Several extension approaches were used in the tea smallholding sector in the past to help smallholders improve their living standards. However, all of these approaches only partially succeeded in obtaining the required objectives due to many restrictions. Under these scenarios, a pilot program of FFS had been launched with the financial assistance of the Rehabilitation of Degraded Agricultural Land project of FAO (RDALP-FAO) by selecting tea smallholders in Grama Niladhari Divisions (GN) of Doluwa secretariat division of Kandy district in 2018. Tea Inspectors (TIs) and Agriculture Research and production Assistants (Kupanisa) in respective ranges were trained for the FFS concept and given the task of changing tea smallholders' attitudes and improving the adoption of appropriate cultural practices using the FFS approach.

Farmer Field School Approach

Since the late 1980s, support for agriculture has moved from top-down agricultural extension towards more participatory approaches that better suit smallholders. One such approach is the Farmer Field School (FFS), an adult education intervention that uses intensive discovery-based learning to promote skills. This approach is based on the idea that the best learning comes from experience, particularly in the case of tea smallholders, from field observations. Accordingly, Bunyatta et al. (2006) found that Farm Field School (FFS) graduates had significantly higher levels of knowledge of the technologies presented compared to non-FFS tea smallholders in research on the FFS effectiveness for soil and crop management technologies in Kenya. More recently, FFS has been viewed as an appropriate vehicle for the general empowerment of rural actors, in which lifelong learning processes, the strengthening of local institutions and networks, the stimulation of social processes, and collective actions may all contribute to improved rural livelihoods (Hounkonnou et al., 2004). These findings

provide evidence for improving knowledge, attitude, and adaption to sustainable agricultural practices of FFS participants compared to other tea smallholders.

Having focused on the impact of the above pilot program on the transformation process of conventional extension approaches into newly introduced farmer participatory extension approaches, this study was designed to assess the effectiveness of the FFS extension approach in improving the adoption rate of cultural practices toward increasing tea smallholdings' land productivity and profitability.

General Objective

This study aims to assess the effectiveness of the FFS extension approach in improving the adoption rate of cultural practices toward increasing tea smallholdings' land productivity and profitability.

METHODOLOGY

Conceptual Framework for the Study

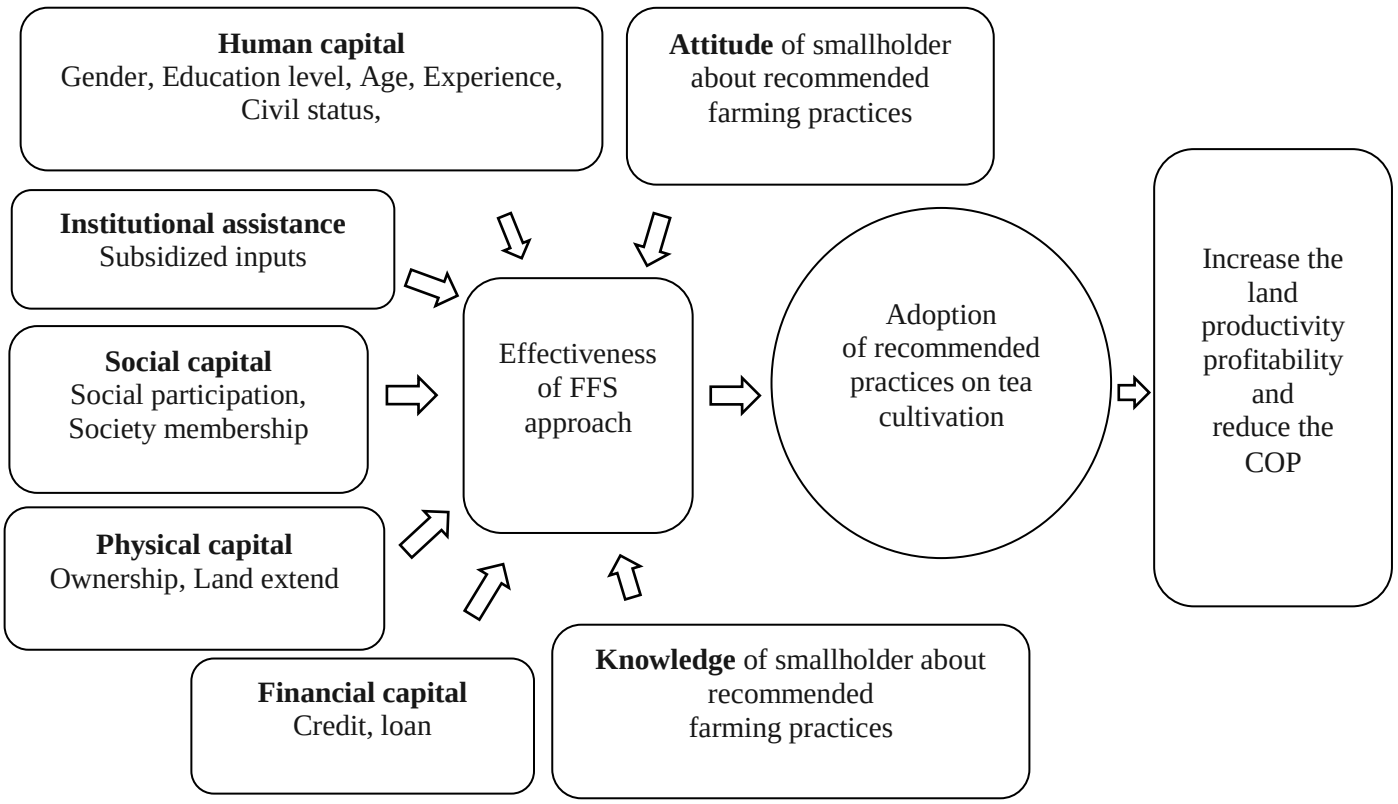

Figure 1. Conceptual framework of the study

The conceptual framework was developed for the study on the effect of independent factors such as human capital, social capital, physical capital, financial capital, institutional assistance, attitude and knowledge of tea smallholders toward the field practices on the dependent factor of the effectiveness of the Farm Field School (FFS) Approach, which could attribute to the improvement of the adoption rate of cultural practices toward increasing tea smallholdings' land productivity and profitability (Figure 1).

Sampling Method and Location of Study

In accordance with Wiersma's (1986) recommendations for research involving sampling from a specific population at only one point, tea smallholders currently participating in FFS groups and not participating in FFS groups (considered NFFS groups) were chosen using a cross-sectional survey design. Accordingly a cross-sectional survey was performed following stratified purposive sampling technique to select 50 farmers participating in FFS conducted in four Grama Niladhari Divisiosn (Lagumdeniya, Pabadeniya, Wariyagala and Panvilathanna) and another 50 farmers who were not participating in FFS (NFFS) extension training approaches as a control group, in the another Grama Niladhari Divisiosn (Nawa Gurukale, Kahawaththa, Wawathanna and Gonatuwela) of Doluwa Divisional Secretariat range in Kandy district.

Data Collection and Analysis

Pretested structured questionnaire, focus group discussions, interviews and field observations were undertaken to collect primary data on socio-economic status, awareness, knowledge, attitude, adoption level, cost of production and secondary data of annual yield, from tea smallholders of FFS participatory group and non-participatory groups. The primary data on further improvement, evaluation criteria, and pros and cons of the FFS approach were collected from only FFS participatory group. The gathered data were cleaned, edited, coded and entered into the computer software Excel and it imported by STATA statistical package. A scoring system and 5-point Likert scales were developed to measure the above criteria and index (Rathnayaka et al., 2014; Amarathunga et al., 2021).

Reliability Analysis

The tool used to measure the scale reliability was Cronbach's alpha. The calculated alpha values of the questionnaire instrument were higher than 0.700 with a significance of 5%. According to the result can conclude that the internal consistency was acceptable and the research tool was reliable and gave credible results (Table 1).

Table 1. Summary of the reliability analysis result

Variable	Number of questions	Cronbach's alpha
Adoption of tea smallholders	22	0.720
Attitude of tea smallholders	14	0.724
Group dynamic of the tea Smallholder group	6	0.712
FFS approach evaluation criteria	27	0.742

Descriptive analysis, hypothesis testing, and ordered logistic regression model were applied to measure variables and explain the relationship among the tested parameters. Consequently, an index was measured for each FFS and Non-FFS farmer separately by the Excel software. The following variables are used in the calculation of the index: adoption level, attitude, knowledge and social participation of tea smallholders; dynamics of the farmer group; and the effectiveness, relevance of the FFS extension Approach.

Descriptive analysis was used to analyze socio-economic factors of both FFS and NFFS farmers. Additionally, an independent t-test was used to test the mean difference between the two groups on adoption, land productivity, and cost of production. The ordered Logistic Regression model was used to explain the relationship of the dependent variable (Y- level of adoption which has meaningful order of high-2, medium-1and low-0) with independent variables.

Empirical Model

An empirical model was created to determine the degree of effect of the following parameters on the level of adoption of recommended practices by the tea smallholders on their tea cultivations.

$$AL = \beta_0 + \beta_1 GEN + \beta_2 EDU + \beta_3 EXP + \beta_4 REL + \beta_5 SOC + \beta_6 KNW + \beta_7 GRP + \beta_8 LAN + \beta_9 ATT + \beta_{10} SUS + \varepsilon i$$

β_0 = Coefficient of constant, β_1 to β_{10} = Coefficient of variables, εi = Error

Table 2 presents the variables and their measurements that were specified in the empirical model.

Table 2. Variable description of empirical model

Notation	Variables	Remarks
AL	Adoption level of recommended practices	Scores
GEN	Gender	If female = 1, Otherwise = 0
EDU	Education level of farmer	5-11 Grades = 0, O/L Pass = 1, A/L Pass = 2, Higher education = 3
EXP	Experience on tea cultivation	Years
KNW	Knowledge on recommended practice	Scores
LAN	Land productivity of tea land	Made tea per ha. per year
REL	Relevance of the FFS approach	5-Point Likert scale (1-5)
SOC	Social participation	5-Point Likert scale (1-5)
GRP	Group dynamic of the farmer group	5-Point Likert scale (1-5)
ATT	Attitude on recommended practices	5-Point Likert scale (1-5)
SUS	Sustainability of the FFS approach	5-Point Likert scale (1-5)

RESULTS and DISCUSSION

The Characteristics of Human Capital of Respondents

In this study, it was important to evaluate the gender, age, farming experience, knowledge and education levels of tea smallholders as these characteristics usually have an impact on adoption (Wasula, 2000).

Gender of the Smallholder

According to the sample's human capital data (FFS and NFFS), 84% of the tea smallholders were women who have participated in the FFS programs. However, a higher number of respondents (56%) in NFFS were male. These results are consistent with the study by Bunyatta and Mureiti (2010). According to those findings, the female tea smallholders' participation in the FFS programs was higher than that of male tea smallholders.

Age and Experience of the Smallholders

Tea smallholders' decision making may be influenced by their age, particularly when it comes to adopting soil and crop management technologies disseminated through the FFS approach. (Bunyatta and Mureiti., 2010). According to this study results, middle-aged tea smallholders (37 to 50 years) participate in the FFS approach at a rate of 54%, compared to 10% of young tea smallholders (aged 26 to 36) and 36% of older tea smallholders (aged 51 and above). The low participation of young tea

smallholders may be attributed to their lack of farming experience, or maybe because it is still a new endeavor for them, which suggests that they have not acquired adequate knowledge of agricultural techniques. It is reasonable to assume that tea smallholders over the age of 50 are more confident with their own techniques developed and experience gained by repeated application of the same techniques with long-term engagement in their agricultural practices and therefore, they are reluctant to accept not new technologies or methodologies. However, middle age tea growers are seeking new technologies to improve their productivity and they prefer to attend the FFS seasons more frequently. These results are consistent with the findings of Wasula, (2000). According to their findings, older tea smallholders are less likely than younger tea smallholders to participate in and eventually adopt new agricultural practices.

Education Level of the Smallholder

Tea smallholders with higher levels of education responded more positively to new technologies because considerably simpler to introduce new inventions for respondents with higher education tended to have perspectives and attitudes that were generally more open, reasonable, and capable of analyzing the advantages of the technology (Kusmiati et al., 2007; Suharyanto et al., 2005; Isgin et al., 2008). According to results 24%, 56%, and 20% of FFS tea smallholders in the sample respectively passed 5 -11 grades, O/L and A/L tests, and 30%, 32% and 38% of tea smallholders in the NFFS group respectively passed 5 -11 grades, O/L and A/L. These results are consistent with the study by Amarathunga et al,. (2021).

Civil Status of the Smallholder

In both the FFS and non-FFS groups, 85% of the tea smallholders got married.

Knowledge Level of the Smallholder

According to Hashemi et al. (2008) Knowledge is regarding as requirement for the adoption of new technologies. Tea smallholders with higher knowledge level regarding tea cultural practices focus more on new technologies. According to results 22%, 55%, and 20% of FFS tea smallholders in the sample respectively have high, medium and low level of knowledge on farming technologies, and 18%, 30% and 54% of tea smallholders in the NFFS group respectively have high, medium and low level of knowledge on farming technologies. These results are consistent with the study by Amarathunga et al. (2021).

The Institutional Assistance of Respondents

The results reveal that 80% of the respondents in FFS group have received subsidies like fertilizer, planting materials and financial capital etc. Only 28% of respondents in the non-FFS group were received such subsidies.

The Physical Capital of Respondents

Ownership

All the farmers in both groups of samples (FFS and non-FFS) cultivated their own lands.

Land extend

Most NFFS smallholders (34%) and FFS smallholders (40%) had 0.75 acres and 1 acre, respectively, of tea-growing land.

Mean Difference of Adoption Level of Recommended Practices Between FFS and NFFS groups

The study's findings reflect the mean value of adoption for recommended practices by FFS and NFFS smallholders (Table 3). Mwagi et al., (2003) found that FFS tea smallholders adopted technologies for organic and inorganic fertilizer mixtures significantly more than non-FFS tea smallholders did. Their findings were comparable to those in this study, where participants' average mean scores on the adoption level were much higher than non-participants.

Table 3. Mean comparison of the index of adoption

Parameter	**Group**	**N**	**Mean**	**Std. DE**	**Std. Error Mean**	**DF**	**t**	***P***
Index of Adoption	FFS	50	2.16	0.5841	0.0826	98	3.3620	0.0011
	NFFS	50	1.78	0.5455	0.0771			

H_0 = The difference of the average adoption is equal to zero.

H_1 = The difference of the average adoption is not equal to zero.

In contrast to NFFS smallholders, FFS smallholders had a relatively higher mean adoption value, as shown in Table 3. The results also show that there were differences between the two groups that were statistically significant at the 5% level. For the FFS group and non-FFS group, the average rates of adoption are 2.16 and 1.78, respectively. The null hypothesis is rejected since the p-value (0.0011) is less than the selected significance level $\alpha = 0.01$, thus the average adoption level for recommended tea cultivation practices differs substantially between the FFS group and NFFS group.

Frequency on Adoption Level of Recommended Practices of FFS and NFFS groups

The adoption rate was medium for 74% of the FFS tea smallholders. In comparison to the low level of adoption, which was reported by 10% of small holdings, a high level of adoption was recorded by 26% of smallholders (Table 4). 66 % of NFFS tea smallholders had a medium adoption rate. 6% of small holdings reported a high degree of adoption, while 28% of smallholders reported a low level

(Table 5). The findings show that more FFS smallholders than NFFS smallholders fall into the medium and high adoption groups.

Table 4. Results of frequency and percentage of adoption level for recommended practices of FFS respondents

Category	Adoption level	Frequency	Percentage (%)
Low	< 44	5	10
Medium	44– 52	32	64
High	>52	13	26

Table 5. Results of frequency and percentage of adoption level for recommended practices of NFFS respondents

Category	Adoption level	Frequency	Percentage (%)
Low	< 44	14	28
Medium	– 52	33	66
High	>52	3	6

These findings are consistent with a number of previous studies that have examined the extent to which FFS-recommended farming practices have been adopted. For instance, Roy et al. (2013) study in Bangladesh discovered that the majority of FFS tea smallholders fall into the medium and high adoption categories. Amarathunga et al. (2021) also found similar observations on the comparison of adoption of field practices in potato farmers in Sri Lanka

Mean Comparison of Yield Between FFS and NFFS Groups

The yields record for FFS and NFFS smallholders during the previous year (2021) shows that tea lands belong to FFS smallholders had a considerably greater tea yield (made tea/ha/year) than that of NFFS smallholders. This could be attributed to the high adoption rate indicated by FFS smallholders compared to NFFS smallholders.

Table 6. Mean comparison of annual yield

Parameter	Group	N	Mean Kg/ha	Std. DE	Std. Error Mean	DF	*T*	*p*
Yield	FFS	50	926.18	315.534	44.623	98	1.992	0.049
	NFFS	50	823.74	180.887	25.581			

H_0 = The difference of the average yield is equal to zero

H_2 = The difference of the average yield is not equal to zero

For the FFS group and NFFS group, the average yields are (926.18 MT/ha/year) and (823.74 MT/ha/year), respectively. The null hypothesis is rejected since the p-value (0.049) is below the chosen significance level of 0.05, indicating that there is a significant difference between the average yield of tea smallholders' land in the FFS group and the NFFS group. These findings are consistent with previous research showing the beneficial impact of FFS on production (Gockowski et al., 2006; Godtland et al., 2004; Ortiz et al., 2004; Yamazaki and Resosudarmo 2006; Amarathunga et al., 2021). For instance, the Peruvian study by Godtland et al., (2004) found that the adoption of FFS increased tea smallholders' knowledge of IPM (Integrated Pest Management) methods and that this was significantly connected with productivity in the tea industry.

Mean Comparison of Cost of Production Between FFS and NFFS Groups

According to Table 7, FFS smallholders experience a lower relative cost of production than non-FFS smallholders. The results further demonstrate that there were statistically significant differences between the two groups. By implementing proper field practices and adopting the new technical practices recommended by the FFS approach, FFS tea smallholders have been able to lower the cost of production. These findings are consistent with several previous studies that showed a reduction in production costs and an increase in profit when FFS recommended procedures are followed (Rola,1998; Pincus, 1999; Van den Berg and Jiggins,2007.

Table 7. Mean comparison on cost of production

Parameter	Group	N	Mean Rs	Std. DE	Std. Error Mean	DF	*t*	*P*
Cost of production	FFS	50	165648.8	89529.44	12661.37	98	-3.9769	0.0001
	NFFS	50	221357.6	42377.09	5993.03			

H_0 = The difference in the average cost of production is equal to zero.

H_3 = The difference in the average cost of production is not equal to zero.

For the FFS group and NFFS group, the average cost of production is (SLR 165648.8) and (SLR 221357.6), respectively. The null hypothesis is rejected since the p-value (0.0001) is less than the

predetermined significance level $\alpha = 0.01$, and it can thus be concluded that the average cost of producing tea is significantly different between the FFS group and the NFFS group. The results show that the FFS approach is successful in lowering the cost of production associated with growing tea for FFS groups compared to NFFS groups as an agricultural innovation and dissemination platform.

The Ordered Logistic Regression Model Analysis

An ordered logistic regression model was used in this study to analyze the influence of the chosen factors on FFS tea smallholders' adoption of recommended practices for the production of tea because the dependent variable (level of adoption of recommended practices by FFS tea smallholders) has several categories in order (high, medium, and low) (Amarathunga et al., 2021). Table 8 exhibits the results of the regression.

Model Summery;

Number of obs. = 50
LR chi 2(10) = 51. 91
Prob > chi 2 = 0.0000
Pseudo R2 = 0.5994

According to the model summary, Prob > chi2 value is 0. 0000, which is less than 0.05 significance level indicating that the regression model as a whole fit significantly at 95% confidence level. The estimated model has a pseudo R square 0.5994. Accordingly, R square expresses that 59.94 % proportion of the variance in the adoption level of recommended tea cultivation practices is explained by ten independent variables in the model.

Table 8. Results of the Ordered Logistic Regression

Factors effect on adoption for recommended practices	Coef.	Std. Error	Z	P>[Z]
Gender	0.619338	1.698114	0.36	0.715
Education level	2.240117	1.034522	2.17 **	0.030
Experience	0.237176	0.122291	1.94 *	0.052
Relevance index	0.026712	0.115045	0.23	0.817
Social participation index	0.086803	0.060367	1.44	0.151
Knowledge	0.108034	0.042209	2.56 ***	0.010
Group dynamic index	0.375102	0.165641	2.27 **	0.023
Land productivity	0.003092	0.001544	2.00 **	0.045
Attitude	0.296835	0.171272	1.74 *	0.083
Sustainability	0.405584	0.276183	1.47	0.141
/cut1	101.428	36.25091		
/cut2	110.792	38.45428		

*, **, *** significant at 10%, 5% and 1% levels respectively

Among ten independent variables estimated, six variables such as education level, experience, knowledge related to agricultural practices, group dynamic of FFS members, tea land productivity, and

attitude towards recommended good agricultural practices are significantly and positively correlated with the level of adoption of such practices whilst balance four variables (gender, relevance, social participation and sustainability of continues adaption) are also positively correlated with the degree of adoption but without significant (Table 8).

Results of the Ordered Logistic Regression model were further analyzed to explain average marginal effect of independent variables on the dependent variable at low, medium and high adoption Level (Table 9).

Predicted Probabilities of Average Marginal Effects

Average Marginal Effects of Education Level of Tea Smallholders on Adoption Level

Tea smallholders with sound education may quickly understand innovations (Feaster, 1968). The results show that, a unit increases in education level the change in probability is decreased by 5.88% at a low adoption level, 12.16% medium adoption level and a unit increases in education level the change in probability is increased by 18.04% at high adoption level (Table 9). These findings are consistent with previous studies by Shinde et al. (2000); Mugwe, (2014); Max (2015), which that showed education level has a significant effect on the adoption of recommended practices.

Average Marginal Effects of Experience of Tea Smallholders on Adoption Level

The results indicate that if a unit increases in the farming experience of tea smallholders the change in probability is decreased by 0.62% at a low adoption level, 1.28% medium adoption level and a unit increases in farming experience the change in probability is increased by 1.91% at high adoption level (Table 9). There was tendency to adopt suggested techniques when smallholders farming experience increased. It could be because smallholders have become more aware of tea farming practices over time. They made an effort to implement FFS's suggested strategies into practice. The findings of this study also showed a significant impact of work experience on level of adoption because highly experienced tea smallholders usually try to practice innovative technologies. These findings are consistent with previous studies by Morse and Buhler (1977).

Table 9. Average Marginal Effect Results for low, medium and high adoption Level

Independent Variable	Average Marginal Effect ("1" low adoption level)		Average Marginal Effect ("2" medium adoption level)		Average Marginal Effect ("3" high adoption level)	
	dy/dx	p value	dy/dx	p value	dy/dx	p value
Gender	-.0174	0.730	-.0309	0.689	.0483	0.704
Education level	-.0588**	0.041	-.1216*	0.063	.1804**	0.023
Experience	-.0062*	0.082	-.0128**	0.047	.0191**	0.025
Relevance index	-.0007	0.819	-.0014	0.813	.0021	0.815
Social participation index	-.0022	0.155	-.0047	0.192	.0069	0.149
Knowledge	-.0028**	0.039	-.0058***	0.005	.0087***	0.000
Group dynamic index	-.0098***	0.005	-.0203*	0.097	.0302**	0.029
Land productivity	-.0000*	0.071	-.0001*	0.059	.0002**	0.029
Attitude	-.0077*	0.089	-.0161	0.129	.0239*	0.081
Sustainability	-.0106	0.121	-.0220	0.186	.0326	0.133

* significant at 10%, ** significant at 5%, and *** significant at1% Source; Sample survey, 2022

Average Marginal Effects of Knowledge of Tea Smallholders on Adoption Level

For the adoption of new technologies, such as IPM, knowledge and awareness are usually regarded as prerequisites (Rogers, 1995). The marginal values for knowledge of tea small holders for low adoption, medium adoption, and high adoption levels are - 0.28%, -0.58%, and 0.87%, respectively (Table 9). When tea smallholders have a high level of knowledge regarding tea cultivation techniques, they focus more on the new technology they acquire via the innovative extension approach of FFS. These findings are consistent with previous studies by Hashemi et al., which showed knowledge has a significant effect on the adoption of new technologies like IPM.

Average Marginal Effects of FFS Group Dynamics Index on Adoption Level

The marginal values for group dynamics among the FFS of farmer for low adoption, medium adoption, and high adoption levels are - 0.98%, -2.03%, and 3.02%, respectively. The results of the study show that the FFS approach is facilitating group dynamics among the FFS of farmer groups through participatory and interactive learning, sharing of inputs and information, group decision-making, problem-solving, and discovery-based learning, among other things, and has a significant impact on the adoption of farming practices related to tea cultivation (Table 9). These findings are consistent with previous studies by Chandra et al., (2017) which described the factors affecting group dynamics.

Average Marginal Effects of Attitude of Tea Smallholders on Adoption Level

The results indicate that a unit increases the change in probability in the attitude of tea smallholders on recommended field practices is decreased by 0.77% at a low adoption level and increased by 2.39% at high adoption level. Smallholders that have a positive attitude are likely to

incorporate new technologies gained through the FFS approach into their cultural practices (Table 9). This result is consistent with earlier research. According to investigations by Erbaugh et al., (2010) and Dinpanah et al., (2010) the effect of FFS courses on tea smallholders' attitudes about the adoption of agricultural practices.

Average Marginal Effects of Productivity of Tea Land on adoption level

The marginal values for the productivity of tea land among the FFS of farmers for low adoption, medium adoption, and high adoption levels are - 0.00%, -0.01%, and 0.02%, respectively. The tea smallholders with high land productivity are open to incorporating farming techniques with new technology they have access through the FFS approach (Table 9). These findings are consistent with previous research showing the beneficial impact of FFS on production (Gockowski et al., 2006; Godtland et al., 2004; Ortiz et al., 2004; Yamazaki and Resosudarmo, 2006; Amarathunga et. al, 2021).

The Advantages and Disadvantages of the FFS Approach

As shown in Table 10, smallholders have explained their perceptions about the FFS approach in terms of the advantages and disadvantages of the approach. All the smallholders in the FFS program have agreed with the facts that there are advantages. FFS helps to gain knowledge about new technologies, improves the decision-making skills of the smallholders, involves doing experimental learning by doing activities, and constructs two-way communication passages. Most smallholders in the FFS group have agreed with the fact that, as advantages, FFS helps to reduce the cost of production (94%), better than the conventional extension approach (98%), and enhances leadership and group work interaction (96%).

Table 10. The advantages and disadvantages of the FFS approach

Statement on FFS Approach	Advantage (%)	Disadvantage (%)
FFS helps to gain knowledge about new technologies	100	
FFS improves decision making skills of the smallholders (capacity buildup)	100	
FFS involves doing experimental learning by doing activities	100	
Construct two - way communication passage	100	
FFS better than conventional extension approach like farm and field visit, telephone call, meeting etc.	98	2
Enhance leadership and group work interaction	96	4
FFS help to reduce the cost of production (reduce indiscriminate practices, fertilizer over usages and use recommended agrochemical dosage)	94	6
FFS extension approach is costly than other extension approaches (for internet connection, provide technical equipment etc.)	20	79
FFS takes more time than traditional extension approach, it is difficult for smallholders to implement	06	94

The FFS takes more time than the conventional extension approach, and the participation cost is higher than others. These are the disadvantages of the FFS approach. Accordingly, they have responded that FFS programs take more time than the traditional extension approach, and therefore, they have limited time to involve with regular FFS programs. Additionally, they implied that implementation and logistic arrangement of FFS extension approach is costly than other extension approaches (for internet connection, provide technical equipment etc.) This result is consistent with a prior study by Amarathunga et al. (2021) on the efficacy of the farmer field school approach as a dissemination tool for technologies to self-seed potato producers in the Badulla district.

Strategies for Further Improvement of FFS Approach

Some strategies have been suggested for further improvement of the FFS approach (Table 11). According to the majority of the FFS smallholders, the number of group members for an FFS program, the number of sessions, and the number of days per week are better to be increased, and the time period allocated for a single session is better to be reduced. This result is also consistent with a prior study by

Amarathunga et al. (2021) on the efficacy of the farmer field school approach as a dissemination tool for technologies to self-seed potato producers in the Badulla district.

Table 11. Results of strategies to further improvement of FFS approach

Items	Better to increase (%)	Better to reduce (%)	Do not change current situation (%)
No. of group members	60	6	34
No. of session	70	18	12
No. of days per week	72	10	18
Time period allocation for a session	36	52	12

Conclusion

Based on major findings of the study, following conclusions can be derived.

This study confirmed that tea smallholders having a sound education background are willing to get more hands on experiences by adopting good agricultural practices learnt from the FFS educational program.

Tea smallholders who have a high level of knowledge regarding tea cultivation techniques, are more focusing on adoption of new technology they acquire via the innovative extension approach of FFS.

FFS is an effective technology transferring tool for improving tea smallholders land productivity and profitability by reducing the cost of production.

This study findings also confirm that the group dynamic activities of the FFS tea smallholders in social participating the FFS extension program make a significant influence on the changing attitudes towards the adoption of cultural practices related to tea cultivation.

The study findings confirm that there are advantages and disadvantages of the FFS approach implementation process. Among the advantages, it can be concluded that FFS helps to gain knowledge about new technologies to improve the decision-making skills of the smallholders and involves experimental learning by doing activities and to construct two - way communication passage. Major disadvantages found in this study are more time and cost involvement in the technology dissemination and implementation process of FFS approach compared to the traditional extension approaches.

Based on the study's findings, it is concluded that tea smallholders in the study area are willing to engage with long-term FFS extension activities to improve their knowledge and adoption of cultural

practices related to tea cultivation aiming to enhance tea land productivity in a sustainable manner. Hence, this study proved that the FFS approach is a useful agricultural innovation and dissemination platform for improving tea smallholders' knowledge and changing their attitude toward the adoption of cultivation practices for improving tea smallholdings' land productivity and profitability in Sri Lanka

Recommendations

Fundings of this study proved that the FFS approach is an effective tool in improving the productivity of tea smallholding as a result of the acquisition and effective utilization of improved production technologies, knowledge, and related agronomic practices. The results of this study demonstrated that effective use of the FFS approach has had a positive impact to increase the knowledge and adoption of some field practices of FFS tea smallholders. Hence the policy makers should be taken in to consideration that this approach could be effectively introduced for the improvement of productivity and profitability of tea smallholders in Sri Lanka.

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