New Countryside (2023) Volume 2 Issue 1, *16 pages*.
doi: https://doi.org/10.55121/nc.v2i1.28

Japan Bilingual Publishing Co.

Original Research Article

Lessons Learnt from Application of Farmer Field School Approach for Dissemination of Technologies to Seed Potato Farmers in Sri Lanka

M.K.S.L.D. Amarathunga [1*], U.S.G.Dilshan [1], A.M.C.Amarakoon [1], K.P.Somachandra [2]

*[*1] Department of Export Agriculture, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka. E-mail: lalith@uwu.ac.lk*

[2] Regional Agricultural Research and Development Center, Bandarawela, Sri Lanka

ABSTRACT

Farmer Field School (FFS) approach is an adult education intervention that uses intensive discovery-based learning to promote skills. The approach is based on the idea that the best learning comes from experience, particularly in the case of potato farmers, from field observations. Hence, this study aims to determine the effectiveness of the Farmer Field School Approach in disseminating technologies for improving farmers' knowledge and adoption of cultivation practices related to seed potato cultivations in Sri Lanka. The stratified purposive sampling technique was performed to select 40 seed potato farmers who participated in FFS programs (FFS group) and another 40 farmers who were not attended the same (NFFS Group) living in five Agricultural Instructor (AI) ranges in the Kandy district in Sri Lanka. A cross-sectional field survey was administrated using pretested questionnaire followed by focus group discussions to collect primary data on socio-economic status, knowledge and adoption level, yield and cost of production, etc., and also farmers' attitude towards the FFS approach on five dimensions (Effectiveness, Efficiency, Relevance, Impact, Sustainability). The qualitative parameters of the above were measured using 5 points Likert scales and developing indexes and applying descriptive analysis, hypothesis testing, and inferential analysis using the Ordered Logistic Regression model to measure variables and explain the relationship among the tested parameters using SPSS statistical package.

A significant difference was observed between FFS and NFFS seed potato growers in terms of knowledge, field practices adoption, land productivity, and production cost. The Ordered Logistic Regression model findings reveal that the model as a whole fit significantly at a 95% confidence level. Pseudo R square expresses that 26.75 % proportion of the variance in adoption level significantly improved the recommended potato cultivation practices as explained by seven independent variables (Education at 2 levels, Experience, Index of Social Participation, Group dynamics, Satisfaction, and Sustainability). Hence, this study proved that the Farmer Field School approach is effective as an agricultural innovation and dissemination platform in all dimensions for significantly improving farmers' Knowledge and adoption level of cultivation practices leading to increased productivity and profitability.

Keywords: Effective; Farmer Field School; Group Dynamics; Social Participation; Seed Potato Farming,

1. Introduction

Potato (Solanum tuberosum L.) is the staple food of almost half of the world's population and is ranked fourth among the world's food crops. The annual requirement of potatoes is 228,000 Mt in Sri Lanka; however, approximately, 35% of the annual requirement is fulfilled via local production [1, 2]. In Sri Lanka, the average national potato production is around 80,000 Mt and the extent under cultivation is approximately 5,000 ha. Sri Lanka imports 140,000 tons of potatoes for consumption purposes

every year at a cost of 70 million USD as the local potato production is not sufficient to meet the demand which leads to an increased outflow of foreign exchange. Additionally, about 15,000 – 20,000 Mt of seed potatoes is needed as a planting material to meet the target local potato cultivation requirements, annually. Approximately 1,000 – 2,000 Mt of seed potatoes is currently being produced on government farms, while another 1,000 – 1,500 Mt are being imported to the country. The rest, (i.e., 80% of the total seed potato requirement) is produced by farmers themselves as self-produced seed potatoes[3].

At present, potato is extensively cultivated in the highlands of Nuwara-Eliya district in the up-country wet zone (WU3) and also in the highlands of Badulla district in the up-country intermediate zone (IU3)[1, 2]. The absence of specific climatic conditions for tuber bulking in potatoes is a major constraint to expanding the cultivated area in Sri Lanka. Hence, productivity improvement is the only alternative to increasing local potato production. The use of quality seeds free from tuber-borne diseases and improved cultivation techniques are prerequisites to increase the productivity of potatoes. The best solution is to encourage farmers to produce the required quantity of potato seeds themselves by using the limited quantity of seeds produced by the Department of Agriculture as the primary seed. This process will save a considerable amount of money on seed imports and will enable the farmer to obtain high-quality seeds at a very low cost.

1.1.Research problem

Potato has become an increasingly popular agricultural crop, especially among farmers in the central highland lands located in Nuwara-Eliya and Badulla districts in Sri Lanka due to the conducive environment for the growth of potatoes and amplified consumer demand over the years. Although farmers in the Badulla district can gain higher income by cultivating potatoes compared to other crops, they have to face more challenges as the potato requires inputs intensively for its cultivation in comparison with other vegetable crops. Only the seed potato accounts for more than 50% of the total cultivation cost due to the scarcity of locally produced quality seed potatoes at a reasonable price[4]. Although the Extension arm of the Department of Agriculture has conducted several conventional training programs on seed potato production, farmers are reluctant to adopt recommended good agricultural practices. They have been misconducted by local agrochemical dealers to overuse agrochemicals and fertilizers. Therefore, the cost of production for the cultivation of seed potatoes was further increased unnecessarily (Fig. 1).

ARTICLE INFO
Received: July 26, 2022 | Accepted: May 7, 2023 | Available online: July 13, 2023

CITATION
M.K.S.L.D. Amarathunga, U.S.G.Dilshan, VA.M.C.Amarakoon, et al. Lessons Learnt from Application of Farmer Field School Approach for Dissemination of Technologies to Seed Potato Farmers in Sri Lanka. New Countryside 2023; 2(1): 27-42 pages.

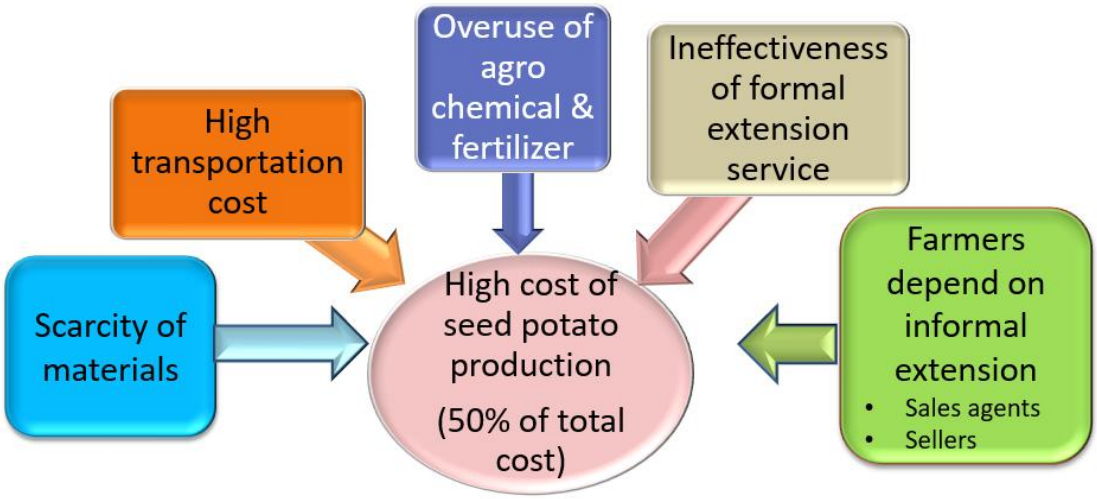

Figure 1 Outline of the Research Problem

Under these scenarios, the extension division of the Department of Agriculture has already realized that imparting knowledge through conventional farmer training programs, is not so effective in changing the attitudes of farmers on the use of production technologies. Having concerned the importance of the availability of a novel, participatory, and interactive model approach for the dissemination of technologies to seed farmers, the Department of Agriculture has decided to launch a pilot program of Farmer Field School (FFS) among the selected seed potato growers located in five Agriculture Instructors (AI) ranges of Badulla district[4].

1.2. 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 FFS, an adult education intervention that uses intensive discovery-based learning to promote skills. The FFS has grown into a novel, participatory, and interactive model approach to farmer education in Asia, several parts of Africa, Latin America, and, more recently, the Middle East, North Africa, and Eastern/Central Europe. FFS is a participatory education approach that brings together a group of small-scale food producers to solve production problems through sustainable agriculture[5]. The FFS approach offers space for hands-on group learning, enhancing skills for observation and critical analysis and improved decision making by local communities. It was found that 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[6]. In a study of the impact of FFS in the Philippines, discovered that in the FFS context, tea smallholders unravel their behavior with regard to the use of agrochemicals with the help of trained facilitators[7]. The impact of the FFS training intervention on tea smallholders' decision-making is significant. Tea smallholders were educated on how to raise a healthy crop while also maintaining a healthy environment by reducing their reliance on external chemical inputs and implementing other pest management strategies that sustain yield at a lower cash cost. By enhancing tea smallholders' knowledge (technical and socioeconomic), decision-making and problem-solving skills, and

encouraging collective action, the FFS approach empowers tea smallholders to be their own technical experts and adapt potentially suitable technology to their own particular conditions. 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[8] .These findings provide sufficient evidences that the FFS Approach could be considered 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 towards the improvement of the rural livelihoods.

1.3. A pilot program of Farmer Field School introduced among seed potato growers in Sri Lanka

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 farmers as seed potato growers in 5 Agriculture Instructors (AI) ranges of Badulla district and AIs in respective ranges were trained for FFS concept and given them the task of changing farmers attitude using FFS approach to produce good quality seeds[9]. Additionally, this program has formed virtual platforms using social media tools of WhatsApp groups among peer farmers and they have also been linked with both officials of public and private organizations attached to the supply chain of the potato farming system for effective communication and sharing information and experiences under prevailing pandemic situations. This program was conducted in the Yala session (March to August)-2020 and was continued during the Maha session (September-February) 2020/2021.

1.4. Objectives

The objectives of this study were to explore the potential of the Farmer Field School Approach as an effective agricultural innovation and dissemination platform for improving Farmers' knowledge of appropriate cultivation practices related to seed potato production and changing their attitude toward the adoption of such practices and thereby improving land productivity and profitability and living standard of self-seed potato farmers in Badulla district.

2. Methodology

2.1. Development of research methodology and action plan by application of FFS Approach

Research methodology and action plan were developed based on information gathered from a literature survey, and conducting a focus group discussion with expert team on Farm Field School curriculum development for the seed potato sector and Research officials of Regional Agricultural Research and Development Center, Department of Agriculture in Bandarawela. These Expert Teams developed the guidelines for Farmer Field School for seed potato growers based on information gathered and derived from experience during last season and planning to assess its effectiveness s in the current season.

In their study, Waddington and White[10] argue that numerous evaluations of FFS design and implementation have been conducted, yet, the findings are conflicting, which leads to remain the matter of the effectiveness of FFS is debatable. Consequently, based on the information gathered during the literature survey, the research team has developed the above conceptual framework for this study in order to assess the effectiveness of the introduced FFS approach for the seed potato farming community (Fig. 2). The conceptual framework illustrates the effects of Human capital, Social capital, Physical capital, and Financial capital on the Success factors of Farmer Fields School Approaches which in turn influences on the farmer on Knowledge, Attitude, Adoption, of GMP

for improving seed potato production, productivity and profitability and finally their livelihood, etc.

2.2. Conceptual framework for the study

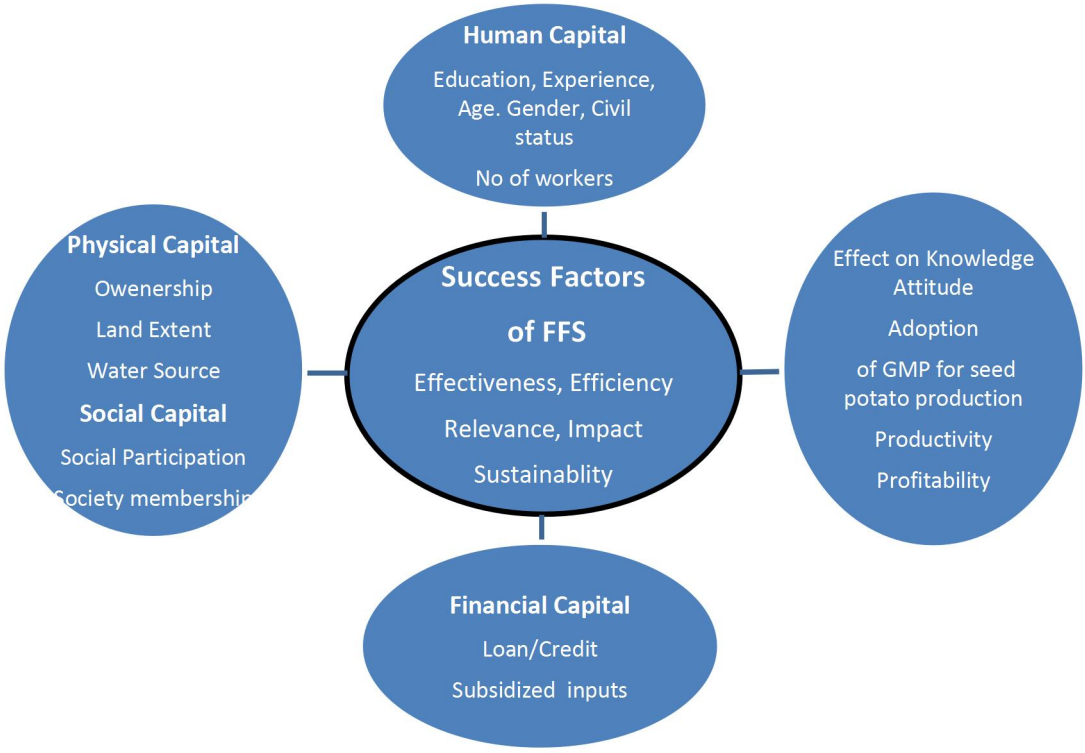

Figure 2. Conceptual Framework for Farmer Field School

2.3. Farmer Field Schools Approach

A FFS is a group-based learning process that has been used by a number of governments, NGOs, and international agencies to promote Integrated Pest Management (IPM). The first FFSs were designed and managed by the UN Food and Agriculture Organization in Indonesia in 1989 for IPM in paddy cultivation[5]. Since then, more than two million farmers across Asia have participated in this type of learning FFS is a group-based adult learning approach that teaches farmers how to experiment and solve problems independently. Sometimes called "schools without walls". Farmer field schools are normally intensive, season-long programs where farmers meet weekly to learn and experiment on a given topic. Using document analysis, key informant and group interviews, and personal observations[11]. Therefore, the FFS have been enunciated as vehicles to propagate or disseminate information on Good Agricultural Practices (GAP) to seed potato farmers.

2.4. Sampling method and location of study

A cross-sectional survey design was used for sampling of the farmers participating in FFS and farmers who are not participating in FFS (NFFS) extension training approaches, in line with recommendations of Wiersma[12], for studies involving sampling from a specific population at only one point in time. Accordingly, a stratified purposive sampling method was performed to select 40 small-scale seed potato farmers located in the Agriculture Instructor range (AI-Range) of Etampitiya, Mirahawaththa, Perahettiya, and Halpe. In addition, another 40 seed potato-producing farmers who were living in the same locations and not exposed to the above pilot project, have been selected as a control group (NFFS) of this study in order to fulfill the research objectives (Table 1).

Table 1. Locations and sample size

Location	AI Range	Sample Profile	
		FFS	Non-FFS
Perahettiya/Katugaha	Perahettiya	18	12
Kirinda	Halpe	07	10
Wepassawala	Etampitiya	08	08
Higurugamuwa	Mirahawatta	07	10

2.5. Data collection instruments and instrumentation

A cross-sectional field survey followed by focus group discussions was undertaken using a pretested structured questionnaire for the collection of primary data from both FFS and NFFS groups on socio-economic status, knowledge, adoption level, yield, and cost of production, and farmers' attitude toward the FFS approach. A scoring system and 5-point Likert scales were developed to measure the above criteria and index. Secondary data were collected from related sources of the Department of Agriculture, Census and Statistics Reports on potato cultivations, and FFS guidelines developed by an expert team. The data analysis process followed various procedures with regard to the specific objectives and nature of the information reported. Collected data were coded and constructed. Consequently, the index for Knowledge, adoption, Social Participation, FFS Group dynamic, FFS Satisfaction, and FFS Sustainability variables were developed as explained by Saravanan and Veerabhadraiah[13] and Amarathunga[14].

$$\text{Index of Knowledge} = \frac{\text{Marks achieved by farmer}}{\text{Total potential marks}} X\ 100$$

$$\text{Index of adoption} = \frac{\text{Marks achieved by farmer}}{\text{Total potential marks}} X\ 100$$

$$\text{Index (for reference variables)} = \frac{\text{Marks achieved by farmer}}{\text{Total potential marks}} X\ 100$$

2.6. Reliability of the instrument

To ensure clarity and reliability, the instrument was pre-tested by randomly selected five FFS and five NFFS seed potato farmers in Perahettiya AI range. This was one of the areas where the study was conducted. Pre-testing enabled shortening of questions judged too long and improvement on clarity for questions that were judged ambiguous. In this study, the reliability of the instrument for consistency was estimated using Cronbach's` alpha, which is appropriate for ascertaining both Knowledge and Adoption levels consistency. The calculated alpha was 0.931, which was higher than the reliability coefficient threshold set at 0.700 as recommended by Cronbach[15].

2.7. Data analysis

Descriptive analysis, reliability analysis, and regression analysis were applied to measure the degree of variation and relationship among the tested parameters using SPSS software. Descriptive analysis was used to analyze the 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 (FFS farmers and NFFS farmers) on knowledge and adoption.

2.8. The Ordered Logistic Regression Model

Ordinal data, also known as ordered categorical data, is frequently used in scientific fields where measuring instruments are people. For such data, cumulative link models are an effective model class since observations are appropriately treated as categorical, and the use of ordered nature and an adaptable regression framework permits thorough analyses. An ordinal variable is predicted using ordinal logistic regression, often known as ordinal regression. the dependent variable, given one or more independent factors. It may be thought of as either a generalization of binomial logistic regression or multiple linear regression. There are many interesting ordinal variables. That is, order the values but focus on the actual. There is no known distance between categories[16].

Having considered the relevance of analytical model since the collected data and observations are appropriately treated as categorical, and the use of ordered nature, the Ordered Logistic Regression Model was selected to explain the impact of independent variables on the dependent variable (Y-level of adoption which has meaningful order of high-2, medium-1and low-0).

3. Results and discussion

3.1. Socio-economic status of farmers

The socio-economic status of farmers revealed that almost 90% of farmers in both groups (FFS and NFFS) (Table 2) were male. It is evident that most women are reluctant to participate in farming. This result is common with previous scholarly work as well. For instance, the Ministry of Foreign Affairs of Denmark[17] has identified that women's participation in FFS is less due to traditional restrictions on mobility, combined with a generally decreasing absorption capacity for the intake of new members to particular farming groups.

However, contradictorily, Davis et al,[18] have found that FFS participation was equally available to both male and female community members, which was not significant in this study. 45% of farmers in the FFS group are over 50 years of age while the majority (35%) of NFFS farmers belong to the 37-50 years age group. Approximately, half of the farmers in both groups have GCE O/L examination qualifications however, two farmers in the NFFS group possess University Degrees.

ADL(Pred.)= βo + Eul1(X1)+Eul3(X2)+Ex(X3)+Sp.ind(X4)+Gd.ind.(X5)+ Sl.ind.(X6)+Su.ind.(X7)+ ε

ADL=Adoption Level βo =Coefficient of Constant ε -Error

Eul1=Education Level1 Eul1=Education Level1 Ex=Experience

Sp.ind=Social participation index Gd.ind=Group dynamics index

Sf.ind=Satisfaction index Su.ind=Sustainability index

Table 2. Socio-economic status of farmers

Variable	Farmer Field School (FFS) Respondents		Non-Farmer Field School (NFFS) Respondents	
	N	%	N	%
Gender				
Male	38	95	34	85
Female	02	05	06	15
Age (years)				

18-25	02	05	02	05
26-36	04	10	12	30
37-50	16	40	14	35
51- above	18	45	12	30
Education Level				
5-11 Grades	08	20	09	23
O/L Pass	19	48	21	53
A/L Pass	13	32	08	20
Diploma	00	00	01	02
Degree	00	00	01	02
Civil Status				
Single	03	07	05	13
Married	37	93	35	87
Agriculture is primary occupation				
Yes				
No	33	83	28	70
	07	17	12	30
Land ownership				
Own				
Rent	40	100	40	100
	00	00	00	00
Land preparation				
Manual				
Mechanical	01	02	00	00
	39	98	40	100
Membership of Farmers' association				
Yes				
No	36	90	35	88
	04	10	05	12
Mobile phone used for sharing farming experience				
Yes				
No	35	87	09	22
	05	13	31	78

Source: Field survey, 2021

In overall, the authors can agree with the findings of Davis et al,[18] , who have emphasized that the FFS approach is much more popular in less educated farming community. Nearly 90% of the farmers in both groups were married and agriculture is the primary occupation and income source (82.5% and 70% in FFS and NFFS respectively) for their families. All farmers in both samples cultivate their own lands using machines except one farmer in the FFS group who does field operations manually. Most farmers are active members of farmer organizations and 90% of FFS and 87.5% of NFFS farmers are involved in such activities.

All farmers in the FFS group have received seed potatoes and fertilizers as subsidies while 87.5% in the NFFS group were lucky enough to receive such subsidies. The majority (87%) of FFS farmers used mobile phones as an effective communication tool to exchange ideas among farmers and extension workers and to solve field problems by discussing with experts in public and private organizations. Therefore, they use WhatsApp social media as the mode of communication which was created by the facilitators of the FFS program at the very beginning. Use of such technologies is very low (22%) among NFFS farmers and they were reluctant to exchange field experiences themselves.

3.2. Hypothesis testing

The results of the mean comparison of predetermined knowledge and adoption indices between FFS and NFFS self-seed potato growing farmer groups are shown below.

Comparison of the index of knowledge

The average values of knowledge were 86.70 and 75.67 for the FFS group and NFFS group respectively (Table 3). Since the p-value (0.000) is less than the chosen significance level α = 0.05, the null hypothesis is rejected, and it can be concluded that the average knowledge level for recommended practices of potato farming is significantly different between the FFS group and NFFS group.

Table 3. Mean comparison of the index of knowledge

Parameter	Group	N	Mean	Std. Deviation	Std. Error Mean	Df (n-1)	p	t
Index of knowledge	FFS	40	86.7000	4.09001	.64669	79	0.000	11.64**
	NFFS	40	75.6667	4.38334	.69307			

Source: Field survey, 2021

H0 = the difference of the average knowledge is equal to zero
H1 = the difference of the average knowledge is not equal to zero

It proves that the farmers in the FFS group show significantly greater knowledge compared to the farmers in the NFFS group. The findings are similar to the idea of Waddington and White[19] who recognize that FFSs as a means of empowering farmers by improving their analytical and decision-making skills.

Comparison of the level of adoption

Table 4. Mean comparison of the index of adoption

	Group	N	Mean	Std. Deviation	Std. Error Mean	DF (n-1)	p	t
Index of Adoption	FFS	40	80.5667	5.43399	.85919	79	0.000	7.94**
	NFFS	40	72.9333	2.72082	.43020			

Source: Field survey, 2021

H0 = the difference of the average adoption is equal to zero
H2 = the difference of the average adoption is not equal to zero

The average values of adoption were 80.5667 and 72.9333 for the FFS group and non-FFS group respectively (Table 4). Since the p-value (0.000) is less than the chosen significance level α = 0.05, the null hypothesis is rejected, and it can be concluded that the average adoption level for recommended practices of potato farming is significantly different between the FFS group and NFFS group. Accordingly, it is evident that the farmers in the FFS group have a significantly higher adoption compared to the farmers in the NFFS group.

The findings suggest that the Farmer Field School approach is effective as an agricultural innovation and dissemination platform for improving farmers' knowledge of appropriate cultivation practices related to seed potato cultivation and changing their attitude toward the adoption of such practices.

Comparison of the cost of production

The averages of cost of production of seed potato are LKR 25,100.00 and LKR 27,562.50 for the FFS group and NFFS group respectively (Table 5).

Table 5. Mean comparison of the cost of production

Parameter	Group	N	Mean	Std. Deviation	Std. Error Mean	DF (n-1)	p	t
Cost of production	FFS	40	25100.00	1706.699	269.853	79	0.000	-5.729**
	NFFS	40	27562.50	2115.836	334.543			

Source: Field survey, 2021

H0 = the difference between the average costs of production is equal to zero
H3 = the difference between the average costs of production is not equal to zero

Since the p-value (0.065) is less than the chosen significance level $\alpha = 0.1$, the null hypothesis is rejected, and it can be concluded that the average cost of production of potato farming is significantly different between the FFS group and NFFS group (Table 4). Farmers attached to FFS groups follow recommended good agricultural practices (GAPs)[20] and they have been able to reduce the cost of production by curtailing the overuse of agrochemicals and fertilizers.

Comparison of seed potato yield

Table 6. Mean comparison on seed potato yield

	Group	N	Mean	Std. Deviation	Std. Error Mean	df (n-1)	p	t
Yield	FFS	40	11.05	1.694	.268	79	0.000	4.039**
	NFFS	40	9.73	1.198	.189			

Source: Field survey, 2021

H0 = the difference of the average yield is equal to zero
H4 = the difference of the average yield is not equal to zero

Average seed potato yield obtained by farmers in FFS group (11.5 mt/ha) was significantly higher than that of NFFS group farmers (9.73 mt/ha) and the p value for yield is less than the chosen level of significance ($\alpha = 0.05$) (Table 6). Therefore, the null hypothesis is rejected and it can be concluded that the average yield of seed potato of FFS farmers is significantly higher than that of NFFS farmers. It is clearly indicated that the FFS approach had a positive influence on the productivity improvement of seed potatoes by changing farmer attitudes towards the adoption of recommended good agricultural practices and modification of their cultural practices.

Level of Adoption recommended practices of FFS

The level of adoption high (above 80%) was reported as 35% of the FFS tea smallholders whilst medium (70-80%) and low level of adoption (< 70%) were reported 40% and 25% respectfully. When compared with FFS seed potato farmers, 6% of farmers reported as a high degree of adoption, while 66 of farmers was reported as a medium level of adoption and 28% of farmers was reported as a low level adoption (Table 7).

Table 7. Results of frequency and percentage of adoption level for recommended practices of FFS and NFFS seed potato farmers

Category	FFS Farmers			NFFS Farmers	
	Adoption level	**Frequency**	**(%)**	**Frequency**	**(%)**
High	< 80	14	35	3	6
Medium	70 – 80	16	40	33	66
Low	>70	10	25	14	28

Source; Field survey, 2021

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, Rola,[21] discovered that the majority of FFS tea smallholders fall into the medium and high adoption categories.

The Application of Ordered Logistic Regression Model

In this study, since the dependent variable (level of adoption to recommended practices by FFS farmers) contains several categories in order (high, moderate, and low), an Ordered Logistic Regression model was used in analyzing the impact of the selected factors on adoption to recommended practices of seed potato production by FFS farmers (Table 8).

Table 8. Results of the Ordered Logistic Regression

Adoption level	Coefficient	Standard Error	Z	P>[Z]
Education level 1	1.603598	1.007866	1.59	0.112
Education level 2	1.334921*	0.792017	1.69	0.092
Experience	-0.035981	0.032723	-1.10	0.272
Social participation index	0.023848	2.886362	0.83	0.409
Group dynamics index	0.155258**	0.071049	2.19	0.029
Satisfaction index	0.252773**	10.21619	2.47	0.013
Sustainability index	7.606636*	4.205755	1.81	0.071
/cut1	41.41556	12.41178		
/cut2	44.17165	12.71747		

* = significant at 90% significance level

** = significant at 95% significance level

According to the model summary, Prob > chi2 value is 0. 0016, 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 0.2675. Accordingly, R square expresses that 26.75% proportion of the variance in the adoption level of recommended seed potato cultivation practices is explained by seven independent variables in the model. Among seven independent variables estimated, four variables such as education at secondary level 2, group dynamic index related farmer motivation in the extension

program, satisfaction index related level of satisfaction on the extension program conducted on agricultural practices, sustainability index related land productivity are significantly and positively correlated with the level of adoption of such practices whilst balance three variables (educational level at level 1), experience related to the years of involvement on seed potato cultivation and social participation index related to the involvement farmers on FFS extension program) are also positively correlated with the degree of adoption without significantly.

The Empirical Equation of Ordered Logistic Model developed from the findings of study:

Adoption Level = -31.659+1.6036 Edul. 1 + 1.3349 Edul. 2 – 0. 03598 Ex + 0. 02384 Sp. Index.+ 0. 15525 Gru. index + 0. 25277 SF index + 7.6066 Sus. Index+ ε

Predicted Probabilities -Margins

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**
Education level1	-.242447	0.087	.0553033	0.248	0.1871435	0.801
Education level2	-.201826	0.070	.0460374	0.239	0.1557883	0.078
Experience	0.00544	0.274	-0.001241	0.239	-0.0041991	0.246
Social participation index	-0.00361	0.402	0.000824	0.462	0.0027831	0.404
Group dynamics index	-0.02347	0.014	0.005354	0.200	0.018119	0.017
Satisfaction index	-0.03822	0.006	0.0087174	0.226	0.0294991	0.002
Sustainability index	-.115004	0.041	0.2623301	0.166	0.8877116	0.066

Education- Education level of tea small holders. Tea smallholders with sound education may quickly understand innovations[22]. The results show that, a unit increases in education level the change in probability is decreased by -24.2447% at a low adoption level, 15.53033% medium adoption level and a unit increases in education level the change in probability is increased by 18.71435% at high adoption level (Educational Level 1-secondary level education). Similar relationship was observed in lower education level (Educatioal level 2 -primary education level). These findings are consistent with previous studies by Shinde, Bhople & Valeker[23], Mungai,[24], and Max[25], which that showed education level has a significant effect on the adoption of recommended practices. The

importance of education for the FFS approach has been highlighted by Waddington and White[19]. The authors state that alternatively, participants of FFS may not have sufficient education levels and resources (including time) to be able to attend the complete training and implement the practices learned. In this context, given the other variables are held constant in the model, the ordered logit model results for farmers' level of adoption in education level 1 (who are having secondary education qualifications) is 18.71435 which is greater than farmers with the primary level of education (15.57883) (reference category education level 2). However, only the impact of secondary education is significantly affecting the adoption of recommended practices of seed potato production ($P< 0.1$). This could be because when the farmers are more educated (for example having tertiary level education), they tend to do the practices with more understanding that comes from their own knowledge, rather than being instructed by a third party.

Experience - When farmers' experience is increased, there is less tendency to adapt to the FFS approach. The findings indicate that farmers with less experience are willing to adopt good cultural practices related to new technology received through the novel extension approach of FFS, compared to highly experienced farmers who had more practical experience by working in a similar profession for a longer period. The results indicate that if a unit increases in the farming experience of tea smallholders, the change in probability is increased by 0.5440% at a low adoption level, 0.1241% medium adoption level and a unit decreased in farming experience the change in probability is further decreased by 0.4199% at high adoption level. This relationship has marginally low influenced on degree of adoption and which is not significant at any level.

Social participation index- When the social participation index score is increased the adoption is expected to increase[5]. The findings reveal that the social participation of farmers in the FFS extension program make a significant influence on the adoption of cultural practices related to seed potato production. The results show that, a unit increases in social participation, the change in probability is decreased by -0.361% at a low adoption level, whilst it increased by 0.0824% medium adoption level and also increased by 0.027831% at high adoption level and these relationship has marginally low influence and which is not significant at any level.

FFS group dynamics index - When the group dynamics index score is increased adoption is increased, while the other variables in the model are held constant. The results show that, a unit increases in FFS group dynamics, the change in probability is decreased by -0.2347% at a low adoption level, whilst it marginally increased by 0.0535% medium adoption level and also increased by 0.018119% at high adoption level and these relationship has marginally low influence and which is significant at low adoption level and high adoption ($P < 0.05\%$) . The Findings indicate that the FFS approach is effective as an agricultural innovation and dissemination platform for creating group dynamic among the FFS of farmer groups as a participatory and interactive learning tool sharing inputs and information, taking collective decision making and problem-solving and doing discovery-based learning, etc.[5,6,21], and which makes a significant influence on the adoption of cultural practices related to seed potato production.

FFS satisfaction index - While the other variables in the model are held constant when the FFS farmers' satisfaction index is increased adoption is also increased. The results show that, a unit increases in social participation, the change in probability is decreased by -0. 08222347% at a low adoption level, whilst it marginally increased by 0.087174% medium adoption level and also increased by 0.294991% at high adoption level of FFS satisfaction. The findings reveal that having realized relative advantages and felt overall satisfaction with FFS

Extension activities, seed potato farmers are significantly motivated towards the adoption of cultural practices related to seed potato production ($P < 0.05\%$). These findings are consistent with previous studies by Shinde, Bhople & Valeker[23], Mugwe[24], and Max[25].

FFS sustainability index - As the FFS sustainability index score has increased the adoption is also raised, the other variables in the model are held constant. The results show that a unit increases in sustainability of engaging FFS Extension program, the change in probability is decreased by -11.5004 % at a low adoption level, whilst it significantly increased by 26.23301% medium adoption level and also increased by 88.77116 % at high adoption level ($p < 0.05\%$). The findings ensure that seed potato farmers are willing to long term engagement with FFS Extension activities towards the adoption of cultural practices related to seed potato production. These findings are consistent with previous studies by Shinde, Bhople & Valeker[23].

Findings of this study revealed that, Farmer Field School approach is very effective as technology innovation and dissemination tool in changing farmers' attitudes towards the adoption of good agricultural practices. It helps the farmers to reduce the excessive use of agrochemicals and fertilizers, use of quality seed potatoes for cultivation, and proper planning of field operations. This adoption positively affects the overall improvement of land productivity, reduces the cost of production, and higher the yield. Additionally, the FFS pilot program implemented by the Department of Agriculture with financial support from the Rehabilitation of Degraded Agricultural Land Project of FAO (RDALP-FAO) provided experimental learning opportunities for FFS farmers and empowered them with the knowledge and management skills for the adoption of good agricultural practices to produce quality seed potatoes.

4. Conclusion

On the basis of the study findings, it could be concluded that

- This study confirmed that education level has a significant positive effect on the adoption of recommended practices whilst farmers' experience has negative influence to adopt such practices learnt from the FFS educational program.
- FFS enhance the social participation, group dynamic status of seed potato farmers, facilitate experiential learning opportunities, and motivate them to improve their observational, analytical, and decision-making ability.
- FFS empower seed potato farmers with the knowledge and management skills for the adoption of Good Agricultural Practices to produce quality seed potato.
- FFS is an effective tool for improving seed potato productivity and profitability by reducing the cost of production.
- The findings of this study ensured that seed potato farmers are willing to long term engagement with FFS Extension activities towards the adoption of cultural practices related to seed potato production.
- This study proved that the Farmer Field School approach is effective as an agricultural innovation and dissemination platform in all dimensions for significantly improving farmers' Knowledge and adoption level of cultivation practices leading to increased productivity and profitability towards their livelihood development,

5. Recommendations

Findings of this study proved that the FFS approach is an effective tool in improving seed potato productivity 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 farmers, hence this approach could be effectively introduced for the improvement of productivity and profitability of other crop sectors as well.

Conflict of interest

The authors declare no conflict of interest.

6. Acknowledgment

The authors are grateful to the Uva Provincial Director of Agriculture, Additional Director and Deputy Director of Agriculture, Bandarawela and Badulla, Sri Lanka, Officer In Charge of Inservice training center, Bidunuwawa and Agricultural Instructors of respective AI -Divisions, Mr. Nimal Gunasena, Project Manager and other officers of RDAL-FAO Project who have given numerous assistance for conducting this research project successfully and also wish to express sincere thanks to Dr. R.M.S.D.Rathnayake, Senior Lecturer, Department of Export Agriculture for her guidance for data analysis.

References

1. Agricultural statistical information on Highland crops. http://www.statistics.gov.lk/Agriculture/StaticalInformation/HighlandCrops/2015
2. Department of Census and Statistics, 2017. Agricultural statistical information on Highland crops. http://www.statistics.gov.lk/Agriculture/StaticalInformation/HighlandCrops/2017
3. Babu AGC, Merz U., 2011. First Confirmed Report of Powdery Scab Caused by Spongospora subterranea f. sp. subterranea on Potato in Sri Lanka. Plant Dis. 2011 Aug;95(8):1033. DOI: 10.1094/PDIS-03-11-0162. PMID: 30732073. https://pubmed.ncbi.nlm.nih.gov/30732073/
4. Wickramasinghe, W. and Jayasooriya, C.2012., Multiple effects and impact of a small farmer (FFS-based) seed potato production in Badulla district. Colombo: HARTI.10-15.
5. Food and Agriculture, 2015. A training package: Introducing the farm business school by Kahan, D. (ed) (also available at http://www.fao.org/nr/research-extension-systems/res-home/news/detail/en/c/317325
6. Bunyatta, D. K., & Mureiti, J. G., 2010. Farmer Field School As An Effective Approach In Empowerment of Gender Participation, Decision Making And Diffusion of Soil And Crop Management Technologies Among Small Scale Tea smallholders Trans-Nzoia District, Kenya.
7. Rola, A. C., Provido, Z. S., Olanday, M. O., Paraguasi, F. P., Sirue, A. S., Espadon, M. A.,& Hupeda, S. P., 1998. Making tea smallholders better decision-makers through the farmer field school.
8. Hounkonnou, D., Offei, S. K., Röling, N. G., Tossou, R., Van Huis, A., Struik, P. C., & Wienk, J. F., 2004. Diagnostic studies: a research phase in the Convergence of Sciences programme.
9. Food and Agriculture, 2020. FAO/GEF Project on rehabilitation of degraded agricultural lands in Kandy, Badulla and Nuwara Eliya Districts in the Central Highlands GCP/SRL/063/GFF https://sricat.net/index.php/en/projects.
10. Waddington H. and White H., 2014. Farmer field schools From agricultural extension to adult education, Systematic Review Summary 1. https://onlinelibrary.wiley.com/doi/pdf/10.4073/CSR.2014.6
11. Anandajayasekeram, P., Davis K. and Sindu W., 2007 Farmer Field Schools: An Alternative to Existing Extension Systems? Experience from Eastern and Southern Africa, Journal of International Agricultural and Extension Education 14(1).
12. Wiersma, W.,1994 Research Methods in Education-An Introduction. 6th Edition. Allyn Bacon Inc ISBN 10: 0205156541ISBN 13: 9780205156542
13. Saravanan R. and Veerabhadraiah V., 2003. Clientele satisfaction and their willingness to pay for Public and Private Agricultural Extension Services', Tropical Agricultural Research, 87-97.
14. Amarathunga, M.K.S.L.D.,2019. Public Private Partnership Extension Model for Tea Smallholding sector. text book, Publisher Scholars press, International Book Marketing service Ltd 17, Meldrum, street, Beau Bassein, 71569, Mauritius, 1-263.
15. Cronbach, L.J.,1951. Coefficient alpha and the internal structure of tests, Available at Psychometrical 16 (3), 297-334 (Accessed: https://doi.org/10.1007/BF02310555).
16. Park, S.Y., 2009 An Analysis of the Technology Acceptance Model in Understanding University Students Behavioral Intention to Use E-Learning. Educational Technology and Society, 12, 150-162.
17. Ministry of Foreign Affairs of Denmark (2011). Evaluation of the Farmer Field School Approach in the Agriculture Sector Programme Support Phase II, Bangladesh. ISBN: 978-87-7087-592-9.
18. Davis, K., Nkonya, E., Ayalew, D., & Kato, E.

(2009). Assessing the Impact of a Farmer Field Schools Project in East Africa. In Proceedings of the 25th AIAEE Annual Meeting, Puerto Rico, 136, ÁVol. 147.

19. Waddington H, White H, Snilstveit B, Hombrados J, Vojtkova M, Phillips D, Davies P, 2014 Farmer Field Schools for Improving Farming Practices and Farmer Outcomes: A Systematic Review. https://doi.org/10.4073/CSR.2014.6
20. Bamunuarachchi, B.A.D.S., Hitihamu, S., Susila Lurdu M.D., 2019, Research Report No.: 227 on Good Agricultural Practices (GAP) in Sri Lanka:Status, Challenges and Policy Interventions, Colombo: HARTI.19-32.
21. Rola, A. C., Provido, Z. S., Olanday, M. O., Paraguasi, F. P., Sirue, A. S., Espadon, M. A.,& Hupeda, S. P. (1998). Making tea smallholders better decision-makers through the farmer
22. Feaster, J. G., 1968. Measurement and determinants of innovativeness among primitive agriculturists. Rural Sociology, 33(3), 339-348.
23. Shinde, P. S., Bhople, P. P., & Valekar, R. B. (2000). Factors associated with knowledge status of Rabi jowar in Maharashtra state. Maharashtra Journal of Extension Education, 19, 202-205.
24. Mungai, P.C., Mwagi, G. O., Onyango, C. K., Mureithi, J. G., 2003. Effectiveness of farmer field school approach on technology adoption and empowerment of tea smallholders: A case of farmer groups in Kisii District, Kenya. In Soil Science Society of East Africa (SSSEA), Annual Conference, 21, Nairobi (Kenya), 1-5 Dec 2003. Soil Science Society of East Africa.
25. Max, N. A. 2015. Effect of Tea smallholders Socio-economic Towards Adoption Level of Agricultural Technology in Sigi Regency Indonesia. Journal of Applied Sciences, 15: 826-830.