RESEARCH ARTICLE

Effectiveness of farmer field school programme of minor irrigation systems in Hambantota district

M. Wijamunige[a] and K.K.I.U. Arunakumara[a]*

[a]*Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka*

Submitted: June 12, 2020; Revised: August 28, 2020; Accepted: September 2, 2020
*Correspondence: kkiuaruna@crop.ruh.ac.lk

ABSTRACT

Farmer Field School (FFS) is used for the diagnosis of pest and diseases and make recommendations accordingly with the participation of paddy farmers. In Sri Lanka, FFS has been commenced in the Hambantota district as a pilot project. However, it has now become an institutionalized extension program in all the Agriculture Instructor ranges of the country. The present study was based on the views of 374 FFS participants chosen from Tangalle, Beliatta and, Hambantota divisional secretariats of the Hambantota district and carried out to evaluate the effectiveness of FFS as an extension approach for the management of pests and diseases in paddy cultivation. From the farmers' point of view, the importance of FFS is twofold: its role as an extension tool and its contribution to promote sustainable agriculture. The majority of the farmers (90%) expressed their satisfaction with the knowledge given by FFS and 95% of farmers have trusted the solutions provided in FFS. According to 90% of farmers, the prescriptions are relevant and appropriate. It was found that FFS has educated farmers on the use of non-chemical pest control methods. FFS has contributed to lessening crop damages, thereby an increase in income from farming. The majority of farmers (92%) showed their satisfaction with the overall activities of FFS, while 6% of farmers were not satisfied. In order to minimize the existing weaknesses and to improve the effectiveness of the present programme, the study proposes: (a) The frequency of conducting FFS should take into account the adult education principle where repeated education is a must; (b) Timing of FFS is important and the critical phases of paddy growth and maturity stage of paddy are when FFS should be held; (c) Content of FFS should be fitted to suit the target group i.e. thorough exposure of major paddy growers through demonstrations on prevention, identification and, control of pests and diseases; (d) Use of advanced teaching aids such as multimedia, lenses, leaflets and, screening of videos and demonstrations; (e) Frequent and thorough training of extension personnel with all the new knowledge on pest and diseases; (f) Ensure the ability to identify pest and disease incidence before it develops into an epidemic by expediting the mapping exercise by the Department of Agriculture.

Keywords: *Farmer field school, paddy, integrated pest management, extension approach, Hambantota*

INTRODUCTION

It is apparent that the world food production is needed to increase as the population is increasing continuously (Krishna Bahadur, 2018). However, the production of more food without damage to the environment is a challenge faced globally (Nicholls *et al.*, 2020; Pretty *et al.*, 2018; Rockström *et al.*, 2017). In light of the need for the sector to contribute directly towards the global social-

ecological challenges, several approaches such as nutrition-sensitive (FAO, 2017; Thompson and Amoroso, 2011), climate-smart (FAO, 2013) and low-carbon (João Carlos de Moraes Sá, 2017; Norse, 2012) agriculture, etc. are discussed and implemented with different degrees of success. In the Sri Lankan context, as reported by Athukorala *et al*. (2010), around 4 –7% of agricultural force suffers ill-health from pesticides each year. Therefore, attention has been paid on sustainable intensification (Redyy *et al*., 2020; Tilman *et al*., 2011).

Agricultural policies of most countries have focused on promoting Integrated Pest Management (IPM) as an alternative pest control strategy (Mohammad *et al*., 2016). It has proven to be successful as it has contributed to lessening the reliance of farmers on the use of chemicals for the control of pests and diseases (Kabir and Rainis, 2015; Ajay and Okarfor, 2006). IPM has been used as the key strategy for pest and disease control in the Farm Field School (FFS) (Braun *et al*., 2006) which is implemented at field level through Farmer Field School Committees (FFSCs) organized for Agricultural Instructor (AI) ranges. The service rendered through these FFSCs included the diagnosis of pests and diseases of paddy and make recommendations accordingly (Muhammad-Abdulla *et al*., 2014). At FFS, a thorough examination and analysis of sample plant materials for fungal, bacterial, viral, nematode, or any other pathogens are done and appropriate recommendations are made. It focuses on controlling pests and diseases while maintaining the soil health and encouraging healthy agricultural practices to improve the growth of the plant and thereby the yield (Singh *et al*., 2014; Roy *et al*., 2013).

The FFS commenced in Sri Lanka as a pilot project in the Hambantota district of Southern Province and gradually expanded to eleven districts in the Central, Eastern and Northern provinces of the country. FFS is staffed generally with four members/officials who are termed as Paddy Teachers as farmers resembling the model of Human Health School. There is an Officer-in-Charge of Agricultural Instructors (OICAI) in the area, who is designated as the Team Leader along with another two Agricultural Instructors (AI). All members undergo training with regard to the concepts and practical aspects of FFS. There are 54 Paddy Teachers, working in the present 21 FFSCs in the Hambantota district. In 2011, the programme was extended to Matale, Matara, Nuwara Eliya, Trincomalee, Batticaloa and Vavuniya districts and there were 44 FFSCs and 174 Paddy Teachers. It was expected to complete the first phase of this programme, which is the implementation of the FFS in each district, within a three-year period from 2016 to 2018. It was originally planned to have 16 FFSs be conducted by each Farmer Field School committee per annum. The target per FFS was 30 farmers; through which each FFS would reach 480 farmers per divisional secretariat per year. Generally, the FFS operates at the Agrarian Service Centre (ASC) or at any convenient place (close by Yaya) in the village.

Initially, the programme was coordinated by the Provincial Director of Agriculture (PDOA) and the general set up was for a district. The system of

operation was replaced in 2012. Since then the FFS is called the Paddy Farmer Field School (PFFS) which has an operational set up in each AI range. The PFFS is now conducted by the AI who is termed as the 'Healthy Paddy Teacher'. Disease affected samples brought to the FFS by farmers are identified, recorded and the prescription slips with recommended treatment are then given to the farmers. Unlike in the previous system, it is solely AI who conducts an FFS for the farmers.

The present system is in place only in a few districts to date (December 2019) with the other districts intending to switch to the new system in the near future. The present FFS is managed under the support of the Plant Protection Services. In setting up of the schools what is expected is that providing recommendations for the control of pests and diseases immediately based on correct diagnosis at the FFS thereby decrease the cost of production, prevention of farmers' dependence on agrochemical traders for advice on pesticide use, help farmers to reduce crop damages thereby increase farmer income, ensure farmers' ability to have an increased understanding on the pest and disease problems in the area, enhance farmers' knowledge to identify pest and disease such occurrences before they develop into an epidemic and minimize damages to the environment through minimizing excessive use of pesticides unnecessarily (FAO, 2006). The main objective of this study was to evaluate whether FFS is an effective extension approach for pest and disease control in paddy production. More specifically, to evaluate the activities of FFS, to assess the extent to which the FFS has accomplished the initially outlined objectives, to identify problems and constraints associated with FFS programme and draw lessons from the FFS and make recommendations on its continuity and/or for further improvement of this approach as an effective extension tool in promoting sustainable paddy farming in the country.

METHODOLOGY

Study area and sample selection

Hambantota district, located in Southern Sri Lanka was selected for the study. According to the agro-ecological classification (Panabokke, 1980), the region of investigation comes under the low country dry zone. The soil of the area belongs to Reddish Brown Earth and Low Humic Gley (Mapa *et al*., 1999). The climate of the area is tropical monsoonal (Panabokke, 1980), with an average annual temperature of 27.1 °C and average annual precipitation of about 1063 mm. The total population of the area is about 600,000 and 65% of them are engaged in agriculture. Most of them are paddy farmers (Census and Statistic, 2018). Paddy production of the district is $2.4*10^6$ MT per annum which in fact is the third highest paddy production in Sri Lanka (Census and Statistic, 2018). Areas with Minor Irrigation Systems (MIS) were the main focused paddy fields for the study. Generally, an MIS is having an extent lower than 200 ac. The FFS has been implemented in the entire MISs around 12 divisional secretariat areas in the Hambantota district in 2010 (Figure 1).

For the purpose of this study, three divisional secretariat areas namely; Tangalle, Beliatta and Hambantota were randomly selected. Six FFSs representing each divisional secretariat were selected randomly for the questionnaire survey. The FFSs selected from Hambantota were Kokara yaya (120 ac, 60 farmers), Udamalala Yaya (80 ac, 40 farmers), Kaligama Yaya (60 ac, 30 farmers), Thelulla Yaya (110 ac, 40 farmers), Julgamuwa Yaya (90 ac, 45 farmers) and Kapuwatta Yaya (70 ac, 30 farmers). The selected FFSs from Beliatta were Angulmaduwa Yaya (140 ac, 50 farmers), Kahawatta Yaya (140 ac, 55 farmers), Arangala Yaya (14 ac, 45 farmers), Ovilana Yaya (46 ac, 35 farmers), Pahalagoda Yaya (65 ac, 43 farmers), IllukmullaYaya (65 ac, 30 farmers), Anukkan Yaya (48 ac, 25 farmers), Talapotha Yaya (80 ac, 60 farmers), Beligalla Yaya (180 ac, 90 farmers) and Dammulla Yaya (155 ac, 60 farmers). The selected FFSs from Tangalle were TalunnaYaya (170 ac, 130 farmers), Galewela Yaya (64 ac, 40 farmers), Andaragoda Yaya (37 ac, 18 farmers), Julmulla Yaya (55 ac, 40 farmers), Vigamuwa Yaya (180 ac, 110 farmers), Andupalana Yaya (195 ac, 200 farmers), Dikkubura Yaya (130 ac, 65 farmers), Ranna Yaya (170 ac, 100 farmers) and Kahadawa Yaya (140 ac, 70 farmers). The sample consisted of a total of 374 farmers (124 farmers from Hambantota and Beliatta and 126 from the Tangalle divisional secretariat area). From the lists of participants provided by the AIs, the random sampling technique was used to select the required sample.

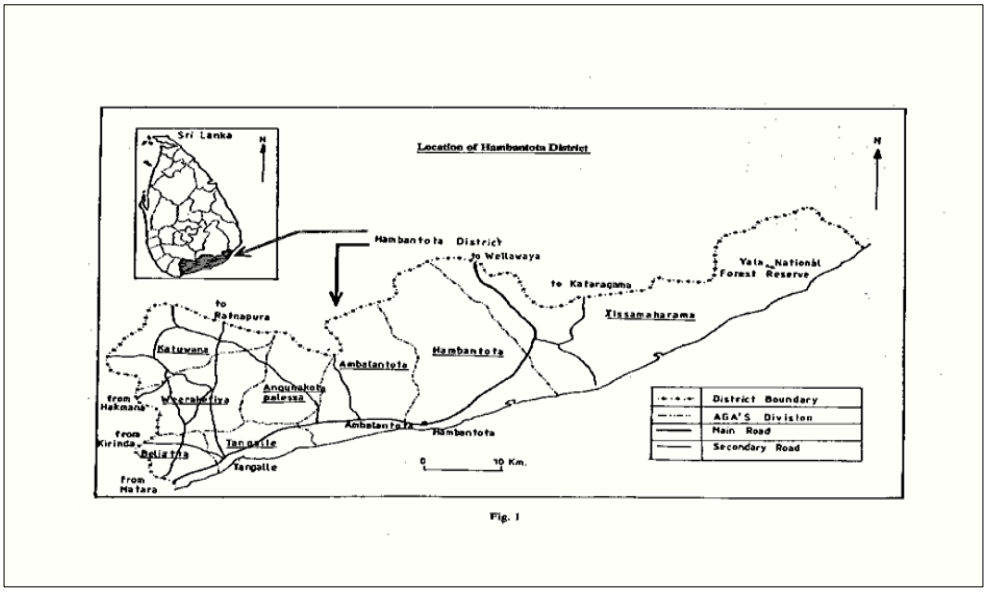

Figure 1: Divisional secretariat areas in Hambantota.

Similarly, a total of 177 farmers from the study area who had not participated in the FFSs were also randomly selected and interviewed. In addition, secondary data were collected from 23 AIs from 30 AI divisions in divisional secretariat areas and the Deputy Director office in the Hambantota district.

Data collection

The data collection procedure comprised three major elements: (1) Focused questions (2) Events observation (3) Questionnaire survey. The questionnaires were filled by farmers who participated in FFSs from 2016 to 2018. Questionnaires were prepared for the farmers and officials with the basic information about the responder and details about his/her, family, source of information, the validity of FFS, remedies for pests and diseases, Agriculture Instructors, farmer participation and agronomic practices in paddy cultivation, etc. In addition, the officers were requested to provide with job description also. Events observations were done at the FFSs in 2018/2019. Observations were made on the process of FFS, farmer participation, the involvement of officials, resource use and farmer responses while they are engaged in learning activities. Personal interactions, non-verbal indicators of interest or paying/attention, leadership roles, performance levels, and conflict indicators were also noted.

Interviews with key informants and farmer representatives helped an in-depth exploration of the issues. Officials such as the AIs, Subject Matter Officers (SMOs), Assistant Directors and Deputy Directors of the PDOA who performed as FFS coordinators and Provincial Agricultural Directors were interviewed as key informants. Questions were open-ended to ensure in-depth unique responses are generated, which in turn provided information regarding reasons why the activities are viewed differently by different key informants. Individual oral histories with district leaders, inventors of FFS and officials from the plant protection Centre of the DOA revealed patterns of practice and the use of resources for this extension activity. A questionnaire survey was carried out to collect data using a structured questionnaire which was considered to be the key source of collecting primary data. The findings of the interviews and event observations were used in deciding the wording, relevancy and the type of the questions, order of questions and the length of the questionnaire. This helped evaluate the extent of practice, preferences for appropriate technology and expectations regarding the future shape of FFS.

Data analysis

Data analysis was done based on the type of data using Excel, SPSS 20.0, and Office Word as appropriate. Chi- square test was used in estimating the variance. Before analysis, data coding was done after identifying, classifying and assigning a numeric number for quantitative data. Exploration of data was made with descriptive statistics.

RESULTS AND DISCUSSION

Farmer participation

The total number of farmers attended to FFS from Hambantota, Beliatta and Tangalle divisional secretariats are reported to be 216, 248 and 298, respectively, during the year 2019. The most number of farmers (40%) are reported to attend in

just one FFS while 33% attended in two FFSs. There are few farmers (3%) who have participated in more than four schools (Figure 2).

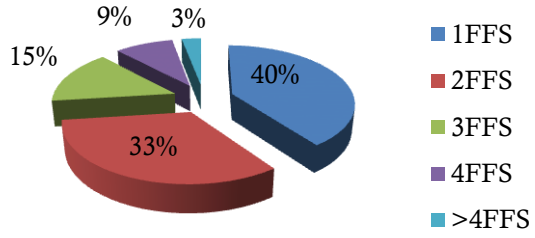

Figure 2: Number of farmer field schools participated by respondents.

The FFS programme has been more active in the Tangalle division which was revealed through the key informant discussions too. The farmers from Tangalle were more enthusiastic and there were 68% farmers who had participated in more than two FFSs. The reason lies in the fact that AIs in several AI ranges get together and conduct FFS in a Grama Niladari Division (GND) to which farmers from surrounding GNDs could participate if they have a problem that needs to be addressed. Having more chances to participate in FFSs is beneficial for some farmers, however. In general, the majority of farmers (40%) in the study locations had participated in one FFS with the rest having exposed to more than one (Table 1). The percentages of farmers who had participated in more than one farmer field school are 45% in Hambantota, 62% in Beliatta and 68% in Tangalle. Farmers have sometimes failed to recognize the FFS as a special programme designed for plant protection as the initial communication of the very concept has not reached the farmers.

Table 1: Farmer participation in farmer field schools in different divisional secretariats.

No of farmer field schools attended by farmers	Beliatta		Hambantota		Tangalle	
	No	%	No	%	No	%
1	48	38	69	55	39	32
2	45	37	40	33	36	28
3	20	16	10	8	24	19
4	8	7	1	1	23	18
>4	3	2	4	3	4	3
Total	124	100	124	100	126	100

Most of the non-participants of FFSs (60% of the sample) were aware of and had heard about FFS. The relevant information about the programme had been received from neighboring farmers who had participated in FFSs and from the AI

in the area. Dissemination of information regarding FFSs from farmer organization leaders and the ARPAs who are the other two main characters in an FFS is poor as only a very few farmers have gained knowledge about the FFS from them. Three main reasons for not attending FFSs by non-participants are:

(a) Farmers were not aware of the objective of the programme and how they could derive benefits by participating in the FFS.

(b) Farmers were not interested in the programme as they are satisfied with how they presently solve problems of paddy cultivation.

(c) Some had a problem of time allocation as they were part time farmers who also sought advice from friends and neighboring farmers who participated in FFSs.

Farmer field school procedure

Venue, date and time

Figure 3 shows the level of satisfaction of farmers on date and time of farmer field schools.

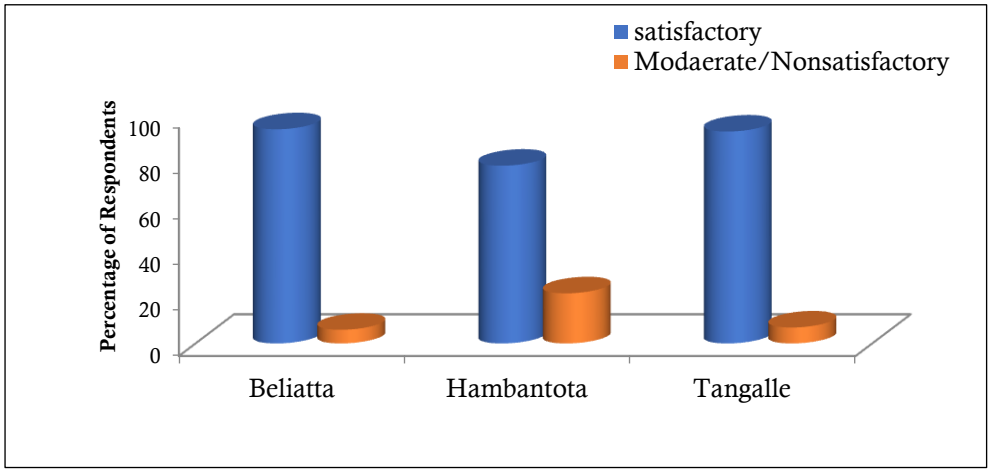

Figure 3: The level of satisfaction of farmers on date and time of farmer field schools.

The vast majority of farmers from all the study areas were satisfied with the venue of FFS organized except for six percent of farmers from the Hambantota division. A small sense of dissatisfaction about the location of the meeting was observed and suggestions were made that meetings need to be held GND level, village level or in the paddy field. The time allocation for an FFS varies, but in general, a meeting lasts for 2-3 h depending on the number of farmers participating and the live samples brought in by the farmers. Most of the farmers (97%) were satisfied with how they were made aware of the FFS. However, a certain degree of dissatisfaction was observed with regard to the date and time of FFS with a significant variation across the divisions (X^2=18.901; P = 0.000). A considerable

number of farmers (35%) are dissatisfied over the date and time of FFS (Figure 3) comparatively with a high proportion of farmers from the Hambantota division (22%). Among these farmers, 71% are full time farmers and 86% belongs to middle or high income farmer categories. Therefore, it is apparent from the results that proper planning of FFS is essential to ensure increased participation by commercial farmers.

Frequency of farmer field schools

Among the divisions, a majority of farmers (66%) from Hambantota have voiced that the need for more FFS (Figure 4) as most of them (55%) have participated in one FFS. The number of FFSs held has proved to be inadequate for 51% of the sample farmers with a significant variation across the divisions (X^2=21.528; P=0.000) as shown in the Figure 5.

They sought more FFS as they required more knowledge on pest and disease control in paddy cultivation because those occurred time to time and the incidences are high during rainy seasons but no programs are available during cultivating season. They sought more adaptive research programme to be carried out at farmer level which in fact is in agreement with Muhammad *et al.* (2014) who conducted a similar study in Pakistan. The statistical evidence too establishes that the higher the income from agriculture the greater the necessity of FFS (x^2= 9.631; P =0.008).

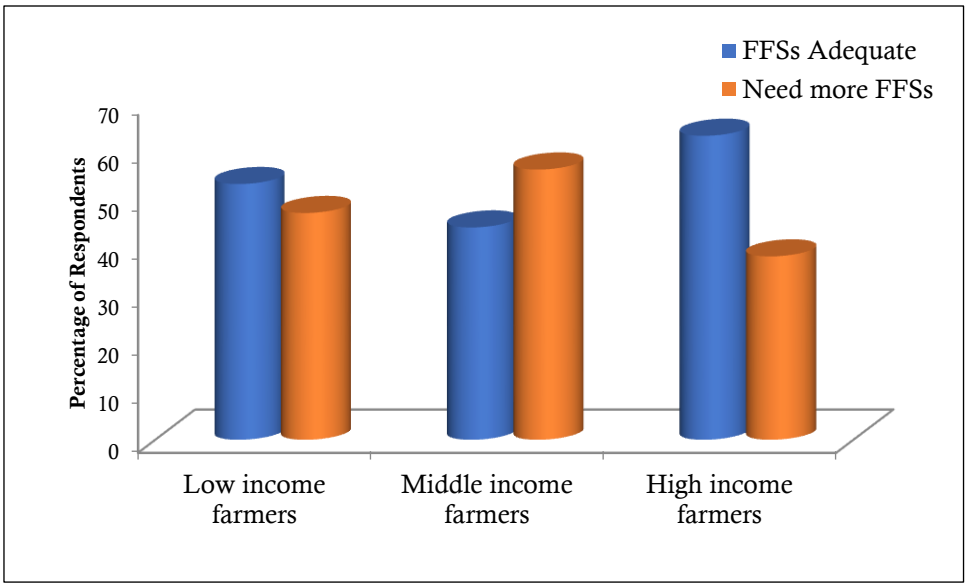

Figure 4: Adequacy of conducting farmer field schools by divisional secretariat areas.

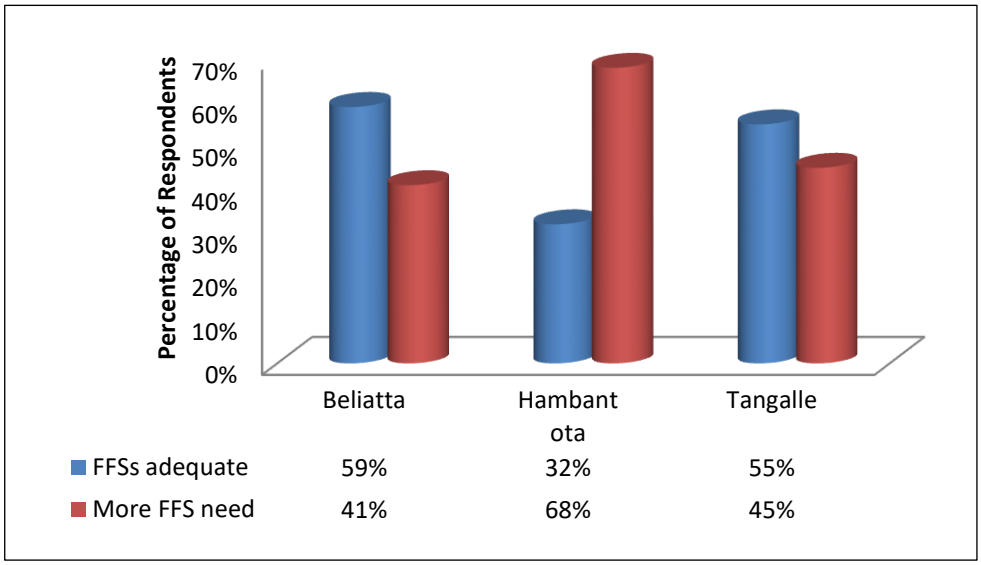

Figure 5: Adequacy of conducting farmer field school by farmer income category.

Farmers had different opinions with regard to frequency of conducting FFSs; however, the general consensus was to have schools at the onset and at the end of both *Yala* and *Maha* seasons with a total of four FFSs per year. The justification was that the pest and disease attacks are more prevalent at the initial growing stage of the paddy and then most critical at the maturity of the paddy. There should be FFS before harvesting to prevent any damage to the harvest. Therefore, the farmers needed to conduct FFSs after the establishment of paddy in the field during the growing stage and at the stage of maturity in order to get the crops protected from any possible damages of pests and diseases.

In contrast, the rest of the farmers (49%) were of the view that the number of FFSs held in their areas was sufficient due to three reasons: (a) Many low and middle income farmers sought advice on an individual basis from the AI and private sector agrochemical dealers. (b) Receive information at the 'Kanna' meeting and (c) Thought more meetings would be an added burden to them.

Use of teaching aids

The aids available to the paddy teachers to be used at schools are mostly printed materials that are circulated among the participants. On the availability of resources, each farmer is provided a copy of the printed leaflet. Recommended aids to support schools are Compact Discs (CDs) of material pertaining to paddy health and disease control. However, the number of laptops available to the AIs is limited and therefore the CDs cannot be used as often as needed at the field level.

Facilities for information technology such as the internet and laptops are available at district centers and but not at the field level which thus restricts visual presentations of required knowledge which could be imparted to the participants. Each committee also has a microscope, a tool through which pests and diseases could be identified by the paddy teachers and farmers.

Key focus

Whilst 89% of farmers who participated in FFSs had sought advice entirely for pest and disease control, the rest had participated in improving their knowledge. Table 2 presents the prominent pest and disease problems to which farmers sought advice through FFSs in Beliatta, Hambantota and Tangalle divisions, respectively. Names given in parenthesis are local terms used by the farmers for different pests and diseases.

Table 2: Prominent pests and diseases in Beliatta, Hambantota and Tangalle.

Division	Pest/disease
Beliatta	Leaf caterpillars (*Kola kodaweema*, *Kola hakulana dalambuwa*), Plant hoppers (*Keedawa*), Thrips (*Pela mekka*, *Lati*), Paddy bug (*Goyam massa*), Mites (*Maita*), Aphids (*Kuudiththa*), Yellow stem borer (*Puruk panuwa*), Damping off (*Diyamalankama*), and other fungal diseases (*Hitumareema*, *Mul Kunuweema*).
Hambantota	Paddy bugs (*Goyam messa*), Caterpillars (*Kola kodaweema*, *Kola hakulana dalambuwa*, *Kola pokutuweema*, *Karal vidina panuwa*), White fly (*Sudu massa*), Plant hoppers (*Keedawa*), Thrips (*Pela meakka*, *Lati*), Mites (*Maita*), Aphids (*Kuudiththa*), Yellow stem borer (*Puruk panuwa*), Rats, Damping off (*Diyamalankama*), other fungal diseases (*Sudu pulli*, *Angamaraya*, *Hitumareema*, *Mul kunuweema*).
Tangalle	Paddy bug (*Goyam messa*), Caterpillars (*Kola hakulana dalambuwa*, *Karal vidina panuwa*, *Kola kodaweema*), Yellow stem borer (*Puruk panuwa*), White fly (*Sudu messa*), Plant hoppers (*Keedawa*), Thrips (*Pela meakka*, *Lati*), Mites (*Maita*), Aphids (*Kuudiththa*), Rats, Damping off (*Diyamalankama*), Other fungal diseases (*Hitumareema*, *Mul kunuweeme*, *Angamaraya*, *Sudu pulli*).

Importance and contribution of farmer field school activity towards sustainable paddy cultivation

The importance of FFS is viewed by the farmers as an educational experience and its contribution to promote sustainable agriculture which has been adopted also in Indonesia to avoid excess use of chemicals to reduce pest and disease incidents (Ajayi and Okafor, 2006). FFS as a farmer education programme, the farmers accept the FFS as a valued extension effort due to four major reasons as per their first preference (Figure 6).

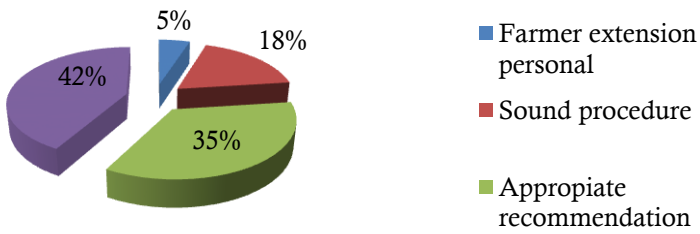

Figure 6: Reasons for farmer satisfaction on farmer field school programme.

Variations were reported in the above ratings across the divisions (Table 3). FFSs are more important for the farmers of Beliatta and Hambantota divisions as a learning experience than for any other reason. Tangalle farmers value FFSs for appropriate recommendations that led to better results. Even though FFSs are important as a learning experience and as a forum where farmers can receive advice, most farmers are not satisfied with the FFS procedure and the extent of interaction between farmers and extension personnel.

Table 3: Reasons for farmer satisfaction on farmer field school programme by divisions.

Reasons for Satisfaction	Beliatta		Hambantota		Tangalle	
	No	%	No	%	No	%
As an Effective Educational Experience	47	39	59	50	45	38
Recommendations are appropriate can derive better result	40	33	40	33	47	39
Sound Procedure Adopted	27	33	11	9	25	21
Interaction between extension personnel	6	5	9	8	2	2
Total	120	100	119	100	119	100

Farmer field school as an effective educational experience

The key reason for the satisfaction of the majority of the farmers from all study locations is how FFS became important for them as an educational experience which is in agreement with Moumeni-Helali and Ahmadpour (2013) who did a case study in Iran. Most of them (90%) value the role of FFSs in improving their knowledge on the perennial problems of pests and diseases, a variety of pest and disease control methods and new information on various cultural practices and for making them aware of traditional knowledge.

FFSs are also valued as a forum wherein they meet a group of farmers with diverse experience, who grow paddy. It was also seen as a good learning experience for the youth. Farmers (95%) show interest to participate in FFSs as they can get the answers immediately. Farmers had trust and confidence in the solutions provided at the schools due to certain factors such as solutions that were recommended after the examination of samples and in certain instances after supervision of the relevant field. New knowledge gained at FFS is mainly shared with neighboring farmers and friends, thus there is a diffusion effect which takes place to a certain extent. Present results are in agreement with Ajay and Okarfor (2006) who reported that the FFS is a better extension approach in terms of knowledge dissemination.

This study aimed at evaluating the activities of FFSs and thereby to assess the extent which the permanent FFS programme has accomplished the objectives for which it was originally established. Such objectives at the farm level are to decrease the cost of production by reducing the application of pesticides unnecessarily and to reduce crop damages due to pests and diseases and thereby increase farmer income. Due to a lack of reliable data on the use of various pest control measures in terms of the cost and their outcomes with regard to changes in yield and thereby the income, the study was unable to estimate the above impacts and to make comparisons between FFS participants and non-participants.

The only possible impact measurement was in terms of the perceptions of the farmers, thus the data was gathered on four aspects relating to effects and/or impacts of FFSs namely; the success of the paddy cultivated due to prevention and control of pests and diseases with the knowledge gained through participating in farmer field schools, reduction in cost due to prevention and control of diseases and non-use of agro-chemicals, increase in the yield due to above, resulting an increase in the income. The data (Figure 7) shows that farmers have benefited from FFSs in all the aspects mentioned above.

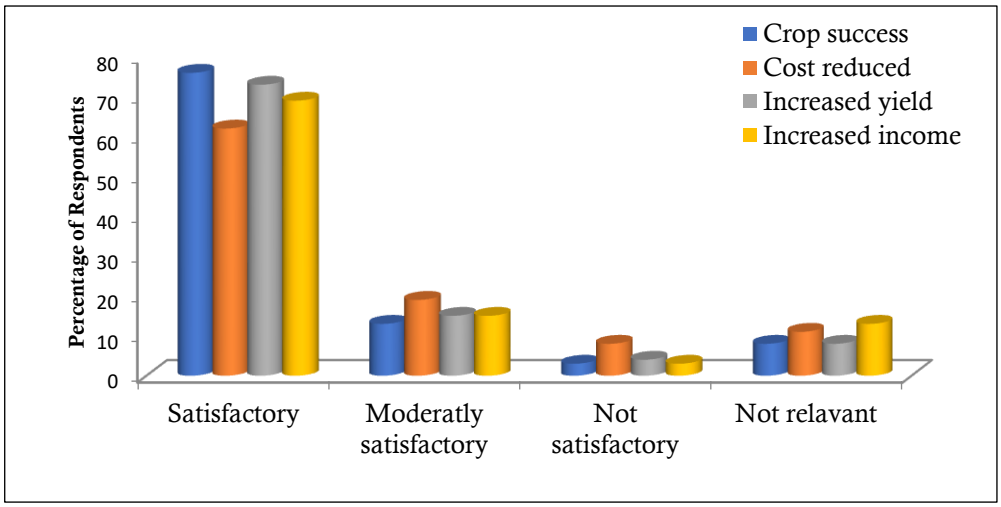

Figure 7: Impact of farmer field schools on the cost of production and yield.

Farmers value FFS as an effective educational experience that directed them to practice eco-friendly means of farming as stated by Simpson and Owens (2002). Even though the programme encountered several challenges in the way it is presently carried out, it demonstrated a revolutionary capacity to build a sustainable and pest free paddy sector if implemented more systematically. The changes required to improve the existing programme as an effective source of information on pests and diseases control are proposed as;

a) The frequency of FFS should be organized and conducted considering the adult education principles which are in agreement with Feder *et al* (2002). From the farmers' perspective, they should be ready to participate in FFS as the way they participate in *kanna* meetings.

b) The timing of FFS is a very important aspect as farmers need advice when they come across pests and diseases in paddy. Paddy crop growth and maturity stages are the critical times where live samples can be taken for diagnosis to address persistent pest attacks. If FFS is to be an effective extension tool, it should be an essential part of the cropping management system. To accomplish these requirements; i. Extension personnel requires time allocation in the annual plans for farmer FFS on a seasonal basis, ii. The support from the ARPAs should be obtained for organizing FFS, and iii. FFS should follow the target group approach.

c) The content of FFS should comply with the needs of the above target groups. It will promote farmer participation and retain the attractiveness of FFS. In order to meet the above requirements, the following recommendations are proposed.

RECOMMENDATIONS AND CONCLUSIONS

Despite the limited financial allocations for the FFS programme which was reported as a key limitation, the gradual growth of the FFS programme over time and space demonstrates the vital role played by FFS as an innovative extension tool in promoting IPM to control pest and diseases in paddy cultivation. With the reported success, the FFS programme has today become an institutionalized extension programme in provincial extension areas of the country. The FFS programme has also succeeded in terms of achieving some of the objectives for which it was originally established as highlighted below.

As anticipated FFS provides recommendations immediately based on correct diagnosis and assist farmers to prevent and control pest damages in an integrated manner. Therefore, it was possible to control pests and diseases with a single or few applications of pesticides making pest control both easy and cheaper. This in fact has prevented farmers from applying pesticides unnecessarily with an ultimate reduction in the cost of production.

The FFS procedure which encouraged practical learning and two-way communication between farmers and extension staff has improved farmers' understanding of the pest and disease problems in the area.

ACKNOWLEDGEMENTS

Authors wish to thank all farmers and Agricultural officials of the three divisional secretariats of Tangalle, Beliatta and Hambantota for taking time from their busy work schedules to help this study.

REFERENCES

Ajayi, M.T. and Okafor, C. (2006). Extension Agents' perception of participatory Agricultural Extension Approaches adopted by Agricultural Development Program (ADP) in Ondo state, Nigeria. Int. J. Agric. Biol. Sci. 4 (1), 20-25.

Athukorala, W., Wilson C. and Robinson, T. (2010). Determinants of health costs due to farmers' exposure to pesticides: An empirical analysis; Proceedings of the 85th Annual Conference of Western Economic Association, Hilton Portland and Executive Tower; Portland, OR, USA. 29th June – 3rd July 2010.

Braun, A., Jiggins, J., Rolling, N., Van den Berg, H. and Snijders, P. (2006). A global survey and review of farmer field school experiences pp 91. Report prepared for the International Livestock Research Institute (ILRI) Endelea Rietveldlaan 3, 6708 SN Wageningen, The Netherlands. Census and Statistical Department, (2018). Annual report of the department of Census and Statistics, Sri Lanka, 2018.

FAO (2006). Strengthening implementation capacity for Integrated Production and Pest Management (IPPM) training based on the Farmer Field School approach in Kyrgyzstan pp. 18. Pro forma project agreement for 2006 and 2007, FAO, Rome.

FAO (2013). Climate-Smart Agriculture Sourcebook. FAO, Rome, Italy: 2013.

FAO, (2017). Nutrition-sensitive agriculture and food systems in practice: Options for intervention. FAO, Rome, Italy: 2017.

Feder, G., Murugai, R. and Quizon, J.B. (2002). Sending farmers back to school: The impact of farmer field schools in Indonesia. Rev. Agric. Econ. 26(1), 1-18.

João Carlos de Moraes Sá, R. L. (2017). Low-carbon agriculture in South America to mitigate global climate change and advance food security. Environ. Int. 98, 102-112.

Kabir, M.H. and Rainis, R. (2015). Do farmers not widely adopt environmentally friendly technologies? Lesson from Integrated Pest Management (IPM). Modern Appl. Sci. 9, 208–215. doi: 10.5539/mas.v9n3p208.

Krishna Bahadur, K.C., Dias, G.M., Veeramani, A., Swanton, C.J., Fraser, D., Steinke, D., Lee, E., Wittman, H., Farber, J.M., Dunfield, K., McCann, K., Anand, M., Campbell, M., Rooney, N., Raine, N.E., Van Acker, R., Hanner, R., Pascoal, S., Sharif, S., Benton, T.G. and Fraser, E.D.G. (2018). When too much isn't enough: does current food production meet global nutritional needs? PLoS One doi: 10.1371/journal.pone.0205683.

Mapa, R.B., Somasiri, S. and Nagarajah, S. (1999). Soils of Sri Lanka. Soil Sci. Soc. SL pp 2392.

Muhammad Abdulla, Li Cui Xia, Jia li, Sidra Ghazanfar, Yasir Mehmood, Mazhar Nadee Ishaq and Shah Saud (2014). Effectiveness comparison between the farmers field school and the training visit approaches of agricultural extension in two districts of Pakistan. American – Eurasian J. Agric. Environ. Sci. 14(1), 33-39.

Mohammad, Z.A., Md. Manjurul Haque, Md. Sirajul Islam, Emran Hossain, Sabiha Binta Hasan, Shahela Binte Hasan, and Md. Sakhawat Hossain (2016). Comparative study of integrated pest management and farmers practices on sustainable environment in the rice ecosystem. Int. J. Zool. https://doi.org/10.1155/2016/7286040.

Moumeni-Helali, H. and Ahmadpour, A. (2013). Impact of farmer field school approach on knowledge, attitude and adopotion of rice producers toward biological control: the case of Babol Township, Iran. World Appl Sci. J. 21(6), 862 – 868.

Nicholls, E., Ely, A. and Birkin, L. (2020). The contribution of small-scale food production in urban areas to the sustainable development goals: a review and case study. Sustain. Sci. https://doi.org/10.1007/s11625-020-00792-.

Norse, D. (2012). Low carbon agriculture: Objectives and policy pathways. Environ. Dev. 1,25–39. doi: 10.1016/j.envdev.2011.12.004.

Panabokke, C.R. (1980). Handbook of the soils of Sri Lanka. J. Soil Sci. Soc. 2, 83-85.

Pretty, J., Benton, T.G., Bharucha, Z.P., Dicks, L., Flora, C.B., Godfray, H.C.J., Goulson, D., Hartley, S., Lampkin, N., Morris, C., Pierzynski, G., Prasad, P.V.V., Reganold, J., Rockström, J., Smith, P., Thorne, P. and Wratten, S. (2018). Global assessment of agricultural system redesign for sustainable intensification. Nat. Sustain 1, 441–446.

Redyy, V.R., Chiranjeevi, T. and Geoff Syme (2020). Inclusive sustainable intensification of agriculture in West Bengal, India: policy and institutional approaches. Int. J. Agric. Sustain. 18(1). https://doi.org/10.1080/14735903.2019.1698489.

Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., Wetterstrand, H., DeClerck, F., Shah, M., Steduto, P., de Fraiture, C., Hatibu, N., Unver, O., Bird, J., Sibanda, L. and Smith, J. (2017). Sustainable intensification of agriculture for human prosperity and global sustainability. Ambio. 46, 4–17.

Roy, D., Farougue, M.G. and Rahaman, M.Z. (2013). Effectiveness of farmer field school for soil and crop management. Bangladesh Int. J. Sci. 13(2), 24-29.

Simpson, B.M. and Owens, M. (2002). Farmer field schools and future of Agricultural extension in Africa. J Int. Agric. Ext. Educ. 9(2), 29-36.

Singh, D., Singh, A.K. and Kumar, A. (2014). On-farm evaluation of integrated management of Rice Yellow Stem Borer (*Scirpophaga incertulas* Walk.) in Rice-Wheat cropping System under low land condition. J. Agri. Search 1, 40–44. http://www.academia.edu/7038623/.

Tilman, D., Balzer, C., Hill, J. and Befort, B.L. (2011). Global food demand and the sustainable intensification of agriculture. Proc. Natl. Acad. Sci. USA. 108, 20260–20264.

Thompson, B. and Amoroso, L. (2011). FAO's Approach to Nutrition-Sensitive Agricultural Development. FAO; Rome, Italy: 2011.