




Effectiveness of agricultural extension's farmer field schools (FFS) in Pakistan: the case of citrus growers of Punjab province

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ABSTRACT: *Citrus is one of the major exported fruits of Pakistan. Especially Kinnow cultivar is famous across the globe because of its aroma and taste. The overall production of citrus is reported as half of the potential because of the non-adoption of research-based practices and lack of agricultural extension services and training of the citrus growers. In the last few years, the department of agricultural extension has started training programs called Farmer Field Schools (FFS) for citrus growers in the major citrus growing zone of the Punjab province, i.e., Sargodha region. This research was conducted in the Sargodha district to evaluate the knowledge and skills gained by the farmers from the FFS. The interview schedule was designed for the purpose of data collection. The data was collected from 120 farmers randomly selected from 15 FFS in the study area. All the respondents were participants of the FFS. The data was analyzed using Statistical Package for Social Sciences (SPSS). The Results of the study showed that 40% of the farmers learned about citrus varieties, one-third of respondents learned about the management of new plants/orchards, 28% of the respondents got knowledge about the cultivation of fruits, and one-fourth of respondents acquired knowledge and skills about layout and management of citrus orchards. These findings conclude that training course has a positive influence on farmers' farm management skills; hence emphasize on its persistence and further improvement by the concerned authorities.*

Key words: Fruit & vegetable, farmer field school, citrus, agricultural extension, farmers' training, Pakistan.

Eficácia das escolas de extensão agrícola de campo (FFS) no Paquistão: o caso dos produtores de frutas cítricas da província de Punjab

RESUMO: *Os citros são as principais frutas exportadas do Paquistão, especialmente, a cultivar Kinnow é famosa em todo o mundo por causa de seu aroma e sabor. A produção geral de citros é relatada como a metade do potencial devido a não adoção de práticas baseadas em pesquisas e a falta de serviços de extensão agrícola e treinamento dos citricultores. Nos últimos anos o departamento de extensão agrícola iniciou programas de treinamento chamados Farmer Field Schools (FFS) para citricultores na maior zona de cultivo de citros da província de Punjab, no distrito de Sargodha. Esta pesquisa é conduzida no distrito de Sargodha para avaliar o conhecimento e as habilidades adquiridas pelos agricultores da FFS. O cronograma de entrevistas foi elaborado para fins de coleta de dados. Os dados foram coletados de 120 agricultores aleatoriamente de 15 FFS na área de estudo. Todos os entrevistados eram participantes da FFS. Os dados foram analisados por meio do programa estatístico "Statistical Package for the Social Sciences (SPSS)". Os resultados do estudo mostraram que 40% dos agricultores aprenderam informações importantes sobre citros, um terço dos entrevistados aprenderam sobre o manejo de novas plantas / pomares, 28% dos entrevistados aprenderam sobre o cultivo de frutas e um quarto dos entrevistados adquiriu os conhecimentos e habilidades sobre layout e manejo de pomares de citros. Essas descobertas concluem que o curso de treinamento tem uma influência positiva nas habilidades de gestão das propriedades; portanto, suporta a necessidade de sua persistência e melhorias adicionais pelas autoridades para alavancar ainda a produtividade dessa atividade no futuro.*

Palavras-chave: frutas e vegetais, escola de campo para fazendeiros, citros, extensão agrícola, treinamento de agricultores, Paquistão.

INTRODUCTION

Citrus belongs to the family Rutaceae and is grown in tropical and sub-tropical regions of the world, spanning more than 140 countries (BATOOOL et al., 2007). There are 78 species of the family Rutaceae

commercially grown worldwide as an important source of foreign exchange. Citrus is widely used in fresh and processed form and is an essential source of vitamins, minerals, and carbohydrates, which play a vital role in the prevention of heart, lungs, liver, and skin diseases and provides a balanced and healthy

lifestyle (AHMED & AZMAT, 2019) Among citrus fruits, sweet orange is dominant and much more widely distributed and grown than any other citrus species. Orange (*Citrus Sinensis*) constitutes approximately 70% of the world's citrus production, followed by mandarins 19%, lemons and limes 11 %, and grapefruit 50% (SIDDIQUE & GARNEVSKA, 2018).

Citrus is a prized fruit of Pakistan and ranks first among all fruits both in area and production (IJAZ et al., 2014). The climate of Pakistan is ideally conducive to producing a variety of fruits. Citrus fruits comprise about 40% of the total fruits produced in Pakistan, where it is cultivated over an area of 199,400 hectares with an annual production of about 2.29 million tons (GOP, 2019). More than 95% of citrus is produced in Punjab province, and 70% of citrus grown in Punjab is Kinnow cultivar (NIAZ et al., 2004). However, in the rest of the world, the share of sweet orange cultivars is more than 70%, owing to its more choice of varieties ranging from early-maturing to late-maturing and a smaller number of seeds per fruit. Pakistan's average yield of citrus (11000 kg/ ha) is low as compared to the average yields of other citrus-producing countries, such as Brazil, USA, and Turkey (22000, 26000, and 27000 kgs/hectare, respectively) (NAWAZ et al., 2011). The potential yield of citrus in Pakistan is 18000-20000 kg/ ha (KAMAL et al., 2013).

Given the citrus' importance to the country's foreign exchange, it is imperative to improve its production and reach the actual potential of yield by transferring the latest technology to the farmers. Agricultural Extension Department is the only responsible institution in Pakistan for delivering research-based agricultural knowledge to the farmers (KHAN et al., 2019a). Agricultural extension workers use various extension teaching methods to disseminate agricultural knowledge to the farmers to achieve the primary task of farmers' education and technology transfer (BAJWA et al., 2010; ASHRAF et al., 2011). In different ways, agricultural extension plays a vital role in poverty reduction and ensuring food security in the country (FAROOQ et al., 2010). It helps farmers in the judicious use of natural resources for sustainable agricultural development (KHAN et al., 2020b). Like many developed and developing countries, Pakistan also has a systematic structure of extension organizations in rural areas (KHAN et al., 2020a). These entities provide free of cost assistance to the farmers regarding various crop and livestock operations, including horticultural crops. Particularly the prominent initiative of the Directorate of Agriculture Extension (DoAE), the Farmers Field School (FFS), has been playing its

distinctive role in farmers' training and capacity building (BUTT et al., 2015).

The FFS, based on a participatory approach, i.e., learning by doing, is an unusual site or school without walls where farmers and trainers gather on weekly/ fortnightly basis to exchange knowledge on recent horticultural practices and technologies and analyse the crops progress (GOP, 2020a). FFS was an initiative of the government agriculture department under the umbrella of the Fruit and Vegetable Development Project. FFS was initially launched as a pilot project in 10 districts of Punjab province from July 2005 to June 2010 and was further expanded to 20 districts (GOP, 2020b). The project's main objective was to alleviate poverty by improving farmers' net income by diversifying horticulture production towards high-value fruit and vegetable enterprises. This study took the case of FFS in the citrus farming context and explored and investigated the training and information and its effectiveness in a citrus growing district of Punjab province.

MATERIALS AND METHODS

Description of the research area

The study was conducted in the Sargodha district of Punjab province (Figure 1). Sargodha district is well known for its fertile lands and was selected through a purposive sampling technique based on the highest citrus production in the country (IQBAL et al., 2009). Other than citrus, wheat, rice, and sugarcane are the major crops of the study area. Citrus is a famous product of Sargodha, especially Kinnow cultivar. The district has an area of 5,864 km square, comprising 40% of the country's total area under citrus (mainly Kinnow), with nearly half of the total citrus production (GOP, 2019). The Sargodha district's citrus is exported to around 40 countries in the Gulf, Far-east and Central Asia, Europe, and Africa. The main countries include Afghanistan, Russia, Saudi Arabia, the United Arab Emirates, Indonesia, and the Philippines (NAWAZ et al., 2011).

In the future, the demand for citrus fruits is expected to grow substantially, both inside and outside the country, due to various factors, including population growth, consumer preferences, and the increase in per capita income. However, the area under citrus in Pakistan cannot chase the growing demand. Therefore, it is needed to increase citrus productivity by advancing research and technology. Many initiatives have recently been taken to improve the country's productivity potential; for instance, the farmers' field schools (FFS) (BUTT et al., 2015). This study focuses on these FFS to investigate its effectiveness in the Sargodha district of Punjab province.

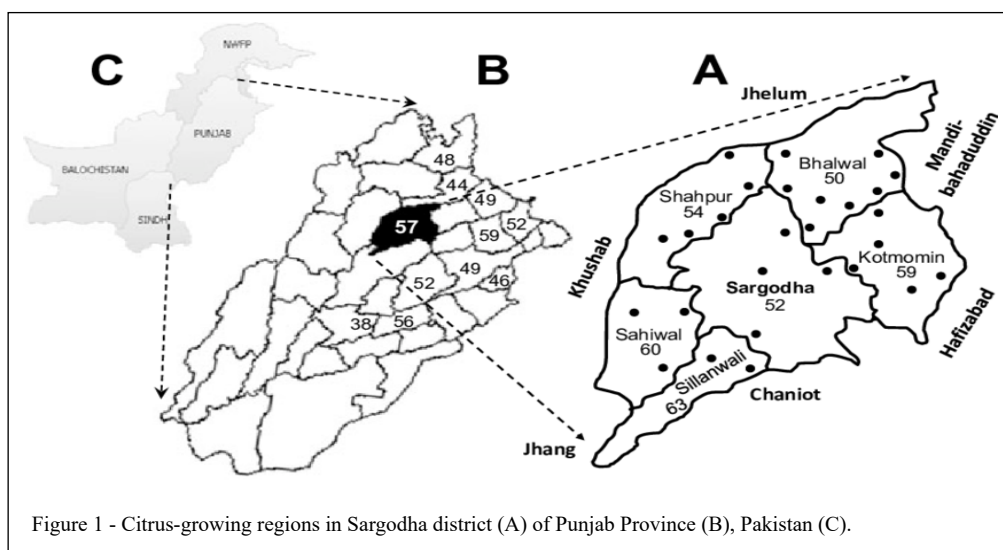


Figure 1 - Citrus-growing regions in Sargodha district (A) of Punjab Province (B), Pakistan (C).

Population and sampling

From the total population of Kinnow growers engage in training, the data was collected from 120 farmers selected from all 15 FFS in the Sargodha district through proportionate sampling technique to ensure equal representation. Eight farmers were interviewed from each of the fifteen FFS of Fruit and Vegetable Development Project in the district. The data collection was carried out in November-December 2015.

Data collection and analysis

A structured questionnaire was designed for data collection. The research instrument was discussed with the experts to ensure its validity. The reliability of the research instrument was checked through pre-testing on few respondents outside the actual sample. The questionnaire was designed in the English language, but interviews were conducted in local languages (Urdu, Punjabi), given the farmers' low literacy rate. Questions were asked directly from the respondents to ensure the collection of accurate and relevant data. The data were analyzed using the Statistical Package for Social Sciences (SPSS) software.

RESULTS AND DISCUSSIONS

Descriptive statistics of the farmers' socioeconomic attributes

The findings of the study showed (Table 1) that more than three-fourth (77.5%) of the respondents belonged to middle age (31-50 years), 11.6% were between 19-30 years old, and 10.8% belonged to

the old age group (>50 years). In line with these results, KHAN et al. (2019b) also reported that young farmers are less likely to be involved in farming in Pakistan. Further, a large majority (80%) of the respondents were married. One-fifth of the respondents attained up to the primary and secondary

Table 1 - Farmers socioeconomic attributes.

Age group	Frequency	Percentage %
Young (19-30)	14	11.66
Middle age (>30-50)	93	77.50
(>50 years)	13	10.8
Total	120	100
Marital Status		
Single	24	20.00
Married	96	80.00
Total	120	100
Education Level		
Illiterate	13	10.83
Primary	25	20.83
Middle	47	39.16
Matric	23	19.16
Intermediate	06	5.00
Graduate	06	5.00
Total	120	100
Land Holding		
Small (Up to 12.5)	113	94.16
Medium (> 12.5-25)	04	3.33
Large (> 25)	03	2.50
Total	120	100

level of education, with 10.84% of those having no formal education at all. These findings showed that most of the farmers have low literacy levels. These results are similar to previous studies conducted in Punjab, where researchers report that most farmers are illiterate (KHAN et al., 2019a; KHAN et al., 2019b). Further, an overwhelming majority (94.1%) of the respondents had small landholding (up to 12.5 acres), 3.3% had medium landholding (>12.6 to 25 acres), and 2.5% of the respondents had more than 25 acres of land. These results showed that majority of the farmers in the study area possess small pieces of land given the increased land fragmentation caused by high population growth in the country.

Farmers' attendance of training sessions and their perception of skills and knowledge acquired through FFS training

Results in figure 2 further illustrated the duration respondents had attended the FFS training regarding citrus farming. It showed that more than half (53%) of the respondents joined the training sessions between sixth to twelve months, 17.5% of the respondents joined the training for more than six months, 15% of the respondents joined the sessions for more than a year. Similarly, 7% of respondents joined for about a month, and only a small number of respondents (6%) joined for a week only. These results indicated that most of the farmers acquired the training for over half a year, which showed that they

perceived the training advantageous for their farming and hence continued them.

The respondents were further asked about the skills and knowledge they learned from FFS training. Findings (Table 2) reveal that about 40% of the farmers learned about citrus varieties, nearly one-third of respondents learned management of young plants/orchards, 28% of the respondents got knowledge about the cultivation of other fruits, and one-fourth of respondents got the knowledge and skills about layout and management of citrus orchards. Besides, about 35% of the respondents learned about the appropriate irrigation gap; 15% of the respondents learned about using the instruments like *tensiometer*, i.e., a way to check tensiometer readings in citrus orchards. One-fifth of the respondents learned about the control and management of *citrus Scylla* and *whitefly*. Similarly, 20%, 15%, and 16% of respondents learned about the control and management of *termites*, *fruit fly*, and *citrus scales*, respectively. More than half (52%) of the respondents learned about identification control and management of citrus canker, 23% about fruit drop disease and citrus scab, and 18% learned about citrus melanosis. These findings show that most farmers have been able to develop a good understanding of citrus-related diseases, which may positively influence their farm yield and hence net crop returns.

Citrus canker disease is found in citrus-growing areas of the Punjab province, affecting

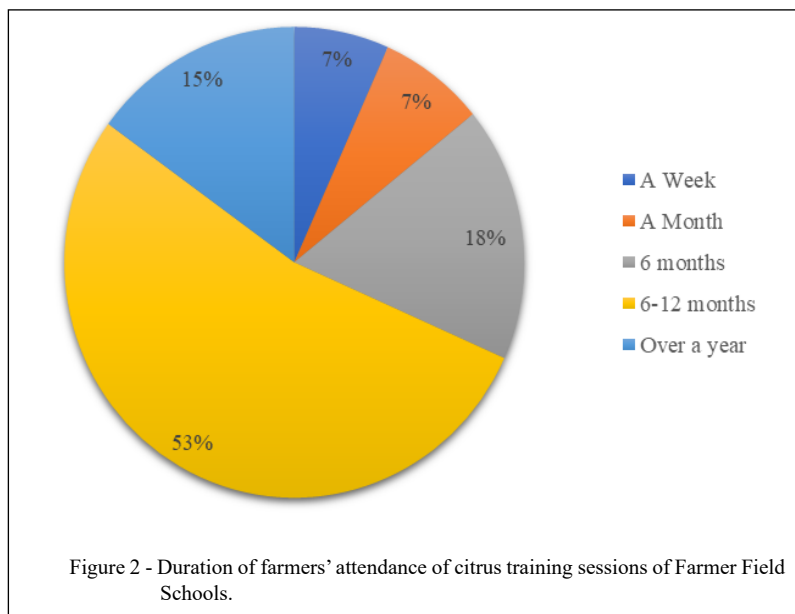


Table 2 - Distribution of respondents according to skills and knowledge acquired in the training sessions.

Skills acquired	Frequency	%
-----Basic-----		
Lay out and management of citrus orchard	20	16.67
Cultivation of fruits	28	23.33
Management of young plants/orchards	32	26.67
Citrus varieties	40	33.33
-----Irrigation-----		
Irrigation of Citrus orchard	22	18.33
Drip irrigation technique in citrus orchards	20	16.66
Tensiometer setup and reading in citrus orchards	19	15.83
Saline water treatment	24	20.00
The time duration between two irrigations	35	29.16
-----Pests, identification and control-----		
Termites	17	20.40
Fruit Fly	18	15.00
White Fly	20	16.67
Citrus psylla	23	19.16
Lemon butterfly	27	22.50
Citrus scales	15	18.00
-----Diseases, identification and control-----		
Damping-off	01	0.84
Gummosis	02	1.67
Citrus Scab	23	19.16
Wither tip	01	0.84
Fruit Drop	23	19.16
Citrus Melanose	18	15.00
Citrus Canker	52	43.33
-----Harvesting and Post Harvesting-----		
Picking	02	1.67
Grading	21	17.50
Waxing	44	36.67
Packaging	43	35.83
Marketing	10	8.33

leaves, twigs, and fruits. (GOTTWALD et al., 2002). BATOOL et al. (2007) reported that citrus diseases have emerged as a potential threat to citrus productivity globally. These diseases are graft transmissible in nature, transmitted by psyllid vectors identified as *Triozaerytrae* (Del Guercio) in Africa and *Diaphorinacitri* (Ku-wayama) in Asian countries. Similarly, the recent farm-level studies in Pakistan have also reported a significant increase in disease and insect attacks on crops (KHAN et al., 2020a; KHAN et al., 2020c). Given such a scenario, farmers' training may contribute largely to effective management and reduction of disease risks in agriculture. Parallel with our findings, VICTOR et al. (2017) stated that the FFS training program had

a positive and significant impact on the knowledge level of farmers regarding citrus production and protection practices (T-test statistics showed a highly significant ($P < 0.05$) difference in the knowledge level of FFS farmers and non-FFS farmers).

Further, nearly half of the respondents learned about waxing and packaging of the harvested fruits and one-fifths of them learned about the grading of citrus while preparing them for marketing. Notably, less than 2% learned about picking citrus fruit, which is very unfortunate as picking is among the major factors determining the citrus' shelf life. In a way that if the fruits were not picked with a recommended method, it increases post-harvest losses and quarantine standards were not approved for export.

Farmers' technology adoption and perceived effectiveness of provided training

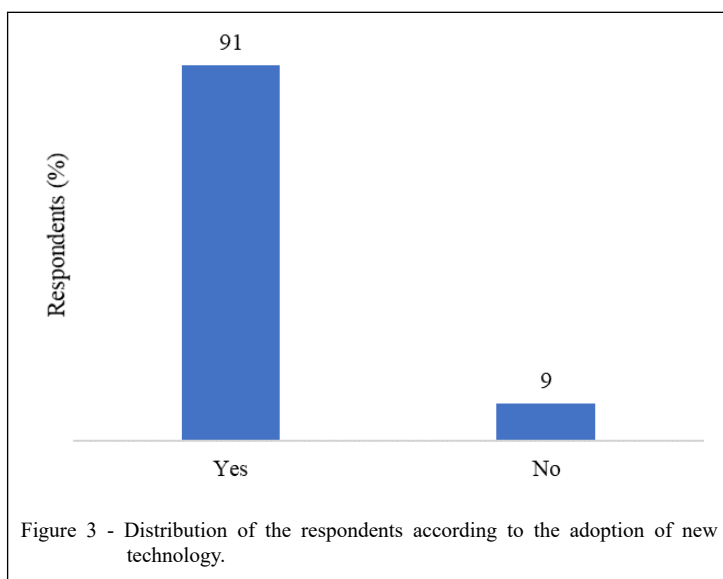
Further results showed that (Figure 3) a significant majority (91%) of the respondents adopted new technology delivered through FFS training. This means that farmers acquire better results while implementing recommended practices and inputs; hence continue to adopt farm recommendations. Findings (Figure 4) further show that FFS training has positively impacted their problem-solving ability as more than half (53%) of the respondents revealed that they have been able to identify their problems easily and 23% of respondents solved their problems quite easily. Notably, only a few (1%) farmers reported that they still faced difficulty in identifying their field problems. These findings showed that FFS training contributed to a great extent in improving farmers' skills in managing their field problems.

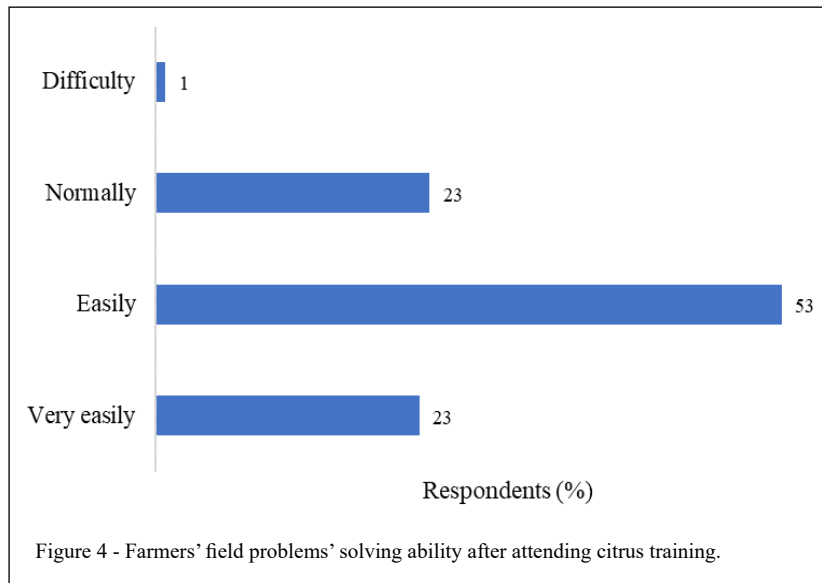
Results (Figure 5) further showed that over 37% of the farmers reported a 50% increase in citrus yield, 36% indicated a 25% yield increased, and 18% reported a 75% increase in their citrus yield after attending the FFS training. While only 8% reported, their yield increased is less than 25%. These findings indicated that most of the farmers who attended the training sessions of FFS have been able to achieve higher citrus yield. Parallel to our findings, the positive impact of FFS on farmers' yield was also reported by another study (BUTT et al., 2015).

Farmers' perception regarding FFS's provided services and training

The data in table 3 showed that 58%, 69%, and 71% of the respondent indicated a fair amount of services and training provision about pruning, budding, and integrated pest management (IPM), respectively. Farmers also reported a fair level of satisfaction regarding machinery maintenance such as tractor and till machines (81% and 63%, respectively). Furthermore, nearly half of the respondents showed a satisfactory response regarding the availability of training about agroecological system analysis (AESAs). However, a considerable (48%) proportion of the respondents were not satisfied by the extent of provided services regarding the harvesting and storage-related information. However, a decent level of response is indicated regarding information and training about tillage. A recent study also confirmed that farm advisory services mainly deal with on-farm practices, which is farmers' foremost concern (KHAN et al., 2020d).

Data in table 4 reflected that training regarding AESAs, pruning, and tillage operation ranked 1st, 2nd, 3rd, having weighted scores of 328, 304, and 297, respectively, indicating the level of satisfaction regarding provided services. Furthermore, tractor maintenance, budding and grafting, drill machine harvesting storage, and integrated pest management are in poor and fair satisfaction status categories. Except for IPM, all others inclined towards the fair category, and IPM tended towards the poor category.





Effective marketing is placed at the bottom with no weighted score. These findings indicated a lack of information and training regarding this aspect of farm practices and highlighted training and information provision regarding storage and harvesting. Notably, none of any respondents rated excellent satisfaction status regarding the extent of provided services. This showed that farmers still require more information and training regarding various aspects of citrus farming.

CONCLUSION AND IMPLICATIONS

The study analyzed the citrus farmers' perceptions about the training and knowledge provided by the agricultural extension's Farmers Field School (FFS) approach in the Sargodha district of Punjab Province, Pakistan. The study also explored farmers' socioeconomic and farm-related attributes and their extent of attendance and use of knowledge delivered by FFS.

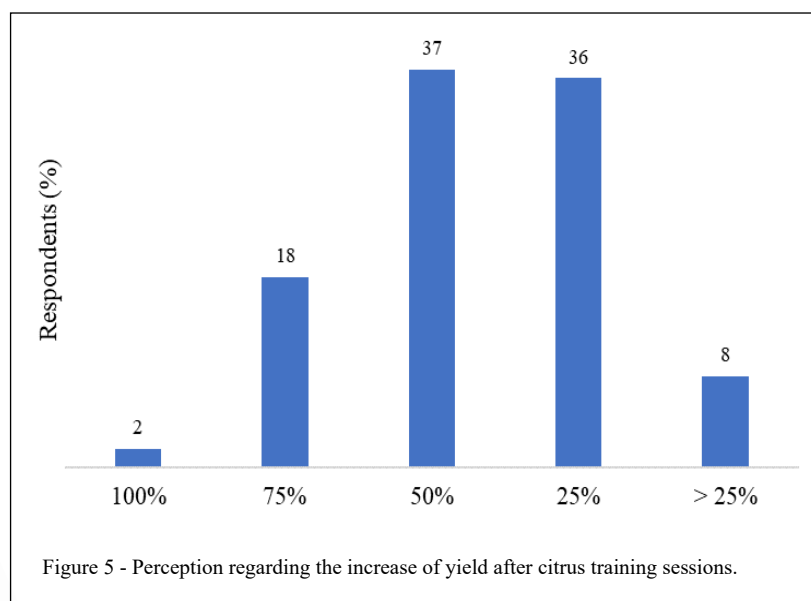


Table 3 - Response of respondents regarding services and training received.

Services	-----Poor-----		-----Fair-----		--Satisfactory--		-----Good-----		----Excellent----	
	F	%	F	%	F	%	F	%	F	%
Pruning	-	-	74	58.7	52	41.3	-	-	-	-
Budding	39	31	87	69	-	-	-	-	-	-
AESA	5	4	50	40	61	48.4	10	8	-	-
IPM	-	-	90	71	-	-	-	-	-	-
Drill machine	35	28	79	63	-	-	-	-	-	-
Tillage operation	6	4.8	69	55	51	40.5	-	-	-	-
Tractor maintenance	24	19	102	81	-	-	-	-	-	-
Harvesting storage	61	48	65	52	-	-	-	-	-	-
Effective marketing	-	-	-	-	-	-	-	-	-	-

The findings showed that majority of the farmers involved in citrus farming were old-age farmers with lacking interest from the youth. In terms of farmers' education, findings showed diverse trends as 39% of the respondents had elementary level education, and one-fifth had acquired primary level education. Alarming, a considerable proportion of the farmers did not indicate any formal education (11%). In terms of farm assets, most farmers were smallholders as a significant majority possessed less than 12.5 acres of cultivated land. Regarding farmers' attendance of FFS training, more than half of the respondents joined the training sessions for over six months, with 15% of those who attended the training for over a year. These findings showed that farmers had joined the training course for a longer duration, which has positively affected their farm management skills and knowledge.

This study concluded that FFS has been an effective approach to increasing farmers' skills and

achieving higher productivity goals. For instance, most farmers have been able to learn about citrus varieties, management of young orchards, instruments and equipment operations, disease management, and post-harvest and marketing aspects of citrus farming. Further, the FFS training also influenced the farmers' technology adoption behaviour as a significant majority (91%) of the respondents adopted the new technology imparted by FFS staff. Over half of the respondents indicated that they had easily identified their farm problems due to FFS training. However, some of FFS aspects training still have certain limitations that need to be improved. For instance, harvesting aspects such as fruits picking and storage show a lacking behaviour of the citrus growers. This means either the provided information is not contemporary or is incompatible with farmers' actual needs; hence they did not acquire such information and showed a lower level of satisfaction about it. Hence this study highlighted such gaps and seeks

Table 4 - Ranking of the response of respondents about service and training.

Services	Weighted score	Mean	SD	Ranked order
AESA	328	2.6	0.694	1 st
Pruning	304	2.41	0.494	2 nd
Tillage operation	297	2.36	0.572	3 rd
Tractor maintenance	228	1.81	0.394	4 th
Budding and grafting	213	1.69	0.464	5 th
Drill	193	1.53	0.666	6 th
Harvesting, storage	191	1.52	0.502	7 th
IPM	180	1.43	0.907	8 th
Effective marketing	0	0	0	9 th

attention from the concerned authorities to improve harvest and post-harvest aspects of FFS training.

Overall the FFS training has a positive influence on farmers' farm management skills, which may help to achieve the actual yield potential of citrus. This study endorsed the effectiveness of the agricultural extension's FFS approach and suggested that the government should continue this program considering the required improvement. The study recommends that similar programs should also be launched in other fruit and vegetable growing areas of the country to achieve higher yield targets.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

MFI, WW, and NAK contributed equally for the conception and writing of the manuscript. MHR, MAAK, and MY contributed to research methodology. All authors critically revised the manuscript and approved the final version.

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