Using FFS to enhance farmers' knowledge and skills in citrus production management in the process of implementing GAP in the South of Vietnam

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Summary

The detailed impact assessment of more than 50 FFS across 11 provinces which resulted in the training of over 2,000 farmers from 2005 to 2006 showed many beneficial impacts. Farmers increased their knowledge and skill in citrus growing and plant protection and increased their awareness about record keeping, post harvest and marketing resulting in considerable change of farmer practice in the year following FFS. Changed practices included reduced pesticide use, change to softer pesticides, better soil management with increased use of organic material and better canopy management. As a result of these changes a majority of farmers claimed increased net profits. Participation in FFS also resulted in reports of improved farmer health and health of the citrus agroecosystem. Social benefits of participation in FFS included increased mutual respect between FFS participants and strengthened farmer networks resulting in formation of more farmer clubs and cooperatives.

Introduction

During the 1980's, the economy of Vietnam depended on rice production with more than 80 percent of the population living in rural areas. Vegetables and fruit orchards were secondary crops. The average fruit plantation size was very small and many different varieties of fruit were grown in inter-cropped orchards.

Since 1980 the Vietnamese Government has made significant changes to agricultural policy. In the Mekong River Delta many households were given approval to change land use from rice to "miscellaneous gardening land" and as a consequence larger fruit orchards of longan, guava, durian and citrus were grown in monocultures or intercropped. The production was still not market oriented even though numerous demonstrations showed that growers could get high benefits from growing fruit. Inadequate pest and disease control resulted in low quality fruits and the lack of fertilizer resulted in low yield.

During the 1990's, fruit growers in southern Vietnam and the Mekong River Delta in particular, extended the fruit orchard area, increased the number of varieties of fruit grown and increased their income. In addition the Vietnamese Government invested strongly in the rural and agricultural sector in order to improve infrastructure. This included irrigation and transportation systems, but more importantly the extension network comprising generalised agricultural extension and specialised plant protection extension.

In citrus, similar patterns occurred with increases in the area grown, greater inputs of fertilizer, higher yield and economic benefit to farmers despite unstable prices. However, with increases in yield, there were also increases in pest and disease incidence and damage.

The main insect pests and diseases that caused yield loss were mites, Fusarium, Phytophthora, Tristeza and "Greening" (Huanglongbin). Greening disease in particular infected large areas and the disease source is still present. However, changing species from orange to pomelo and mandarin and implementing control measures for the insect vector (*Diaphorina citri)* has allowed citrus production to still remain viable.

Today, total citrus growing area is around 68.000ha in the Mekong River Delta. The citrus growers want to learn how to improve citriculture through improved canopy, soil, pest and disease management. Growers are also trying to implement sustainable production methods to minimise impacts on the environment. Several programs including "Linking Environment And Farming", "Safe fruit and vegetables" and recently "GlobalGAP" and "VietGAP" are helping farmers to achieve these objectives and increase the values of their products on the market.

Since 2001 AusAID CARD Pilot Project and projects 036/04 VIE and 037/06 VIE involving Australian and Vietnamese partners from Plant Protection Department and Can Tho University have significantly contributed to the farmers education in citriculture and IPM. The pilot project conducted from 2001-2003 developed a curriculum for training in citrus IPM following the Farmer Field School model and provide learning resources primarily for trainers in the form of books. The second AusAID CARD project ran the FFS training and published several books in Vietnamese. The current project is involved in implementation of IPM aligned to "GlobalGAP" and in selected cooperatives is implementing "GlobalGAP". In Binh Minh district of Vinh Long province (Mekong delta) we have conducted 12 FFSs since 2005 of which 9 were financed by AusAID CARD and 3 by the provincial government. As a result IPM is practised today on approximately 150 ha out of 250 ha of citrus in the district. Farmers are organised in cooperatives and My Hoa cooperative got support from Metro to improve storage and introduce very basic post-harvest treatments. Today they are selling their products to Metro and exporting them to the Netherlands, France and Russia (approximately 120 T since mid last year). Twenty-six farmers from the cooperatives who are graduates from 2007 FFS will be awarded Global GAP certificates by the end of the year. We convinced local government to financially help farmers to improve their sanitary infrastructure (toilets), which was a major obstacle to meeting GAP standards.

The impact assessment for the current project will be done in 2010 so for this paper we are presenting the results of the impact assessment from the second project.

Materials and Methods

Methodology for impact evaluation of FFS is still under development and as yet there is no agreed methodological framework (van den Berg and Jiggins 2007). It is generally agreed however, that assessment of the FFS impact is complex because of the diversity of impact parameters and the different perspective held by stakeholders on what constitutes impact (van den Berg and Jiggins 2007). Impact assessments presented in this report and the methodology used is in line with the impact assessments conducted previously by other donors, government and non-government agencies. Assessments included self-evaluation by farmers and self-evaluation by other project stakeholders in order to ensure that parameters evaluated were those that were most relevant to the primary stakeholders. This method is that impacts of FFS are sometimes confounded by temporal variations such as differences in many provinces, on different citrus species (oranges, mandarins and pomelo), in yield and market prices from year to year.

However, the baseline study was a very important awakening experience for both the Australian and key Vietnamese project personnel that allowed us to better understand needs of citrus farmers in different parts of Vietnam.

The focuses on Citrus IPM trend to "GlobalGAP" based on "VietGAP", 30 farmers who graduated "FFS" and their citrus orchards were grown nearby together have been selected to carry out "GlobalGAP" as the current project' involvement.

KAP survey and analysis

A KAP (knowledge, attitudes and practices) survey was conducted with all participants who attended FFS. The pre-survey was conducted at the commencement of FFS and the post-survey conducted at the last FFS meeting. Printed surveys were provided to the FFS participants by trainers, who then read and explained each question and allowed time for farmers to write down their individual responses. Completed surveys were collected by the trainers and returned to the Southern Regional Plant Protection Centre for analysis. All answers were coded and entered into an Excel spreadsheet and then analysed using SPSS (V11.5). Surveys were conducted with FFS participants from 8 provinces in the Mekong Delta (MD) in both 2005 and 2006 and from 4 provinces in the Central Coast (CC) in 2005 and 3 in 2006. All analyses were conducted on data aggregated by region (Mekong Delta and Central Coast).

Assessment of economic, social and environmental impacts using interviews

As citrus is a perennial tree crop with a year-long growing season it is not possible to assess impacts of FFS within the timeframe of FFS itself. Economic, social and environmental impacts were therefore assessed one year after the completion of FFS using semi-structured interviews with individual farmers. Interviews were conducted with at least 5 farmers from each province who participated in FFS one year after the completion of their training. A semi-structured approach was used to allow the farmers to identify changes in their agricultural practices, major economic impacts, changes in their environment and to describe the impact of FFS on their family life and community interactions. Notes were recorded under the major categories of: change in practice; economic impacts, social impacts and environmental impacts. In each village that was visited, groups of farmers were also surveyed to determine their attitudes towards pesticide use. The group surveys consisted of seven questions and were conducted by reading each survey question to the group of farmers and asking for a show of hands to each of the three possible responses (not true, maybe true, definitely true). Farmers were required to choose the response that best represented their attitude, and the number of farmers selecting each response was recorded for each question.

Results and discussion

KAP survey and analysis

In the Mekong Delta (MD) region FFS participants were surveyed from Tien Giang, Ben Tre, Dong Thap, Vinh Long, Tra Vinh, Can Tho, Hau Giang and Soc Trang provinces in 2005 and 2006. A total of 1061 pre and post surveys were analysed from 530 farmers in 2005 and 2181 pre and post surveys were analysed from 1059 farmers in 2006. In the Central Cost (CC) region FFS participants were surveyed from Khanh Hoa, Binh Dinh, Quang Nam and Nghe An provinces in 2005 and a total of 360 pre and post surveys were analysed from 180 farmers. In 2006 participants were surveyed in Khanh Hoa, Binh Dinh and Nghe An provinces with a total of 600 pre and post surveys being analysed from 300 farmers.

Citrus growers in MD were more experienced in growing citrus with an average of 7 years experience in comparison with 5.3 years of experience of CC farmers. A majority of farmers in both regions belonged to Farmers Associations with 58% and 63% being members in the MD and CC respectively. In MD the dominant citrus variety was pomelo (34.9%) followed by orange (32.7%), mandarin (22.5%) and lime (9.9%). The commonly used classification of citrus in the MD, which includes the citrus variety "King Orange" as an orange, was used in this survey. However, King oranges are botanically closer to mandarins. If King oranges were grouped with Tieu mandarins, then together they would be the dominant group of citrus in MD followed very closely by pomelo. In CC orange is the dominant citrus variety grown by farmers (41.0%) followed by lime (24.4%), pomelo (23.8%) and mandarins (10.8%). In the MD mandarin and oranges are planted at an average density of 1600 trees per hectare (2.5x2.5) and pomelo at density of 493 trees per hectare (4.5x4.5). In the CC mandarins are planted at an average density of 714 trees per hectare (3.5x4), oranges at 550 trees per hectare (4x4.5) and pomelo at 330 trees per hectare (5.5x5.5).

In MD most of the planting materials were produced by farmers themselves (46.1%) or sourced from neighbours (16.3%) making a total of 62.4%. Only 8.7% of respondents planted certified planting materials sourced from institutes or government run nurseries (variety centres) (5.3%) and private nurseries (3.4%). More than a quarter of respondents (28.9%) did not know the origin of their planting material. The farmers that did not know the source of the planting material probably bought it from boat traders who sail the canals selling plant material produced by farmers in other districts or provinces. In the CC much more planting material comes with certification from institutes or government run nurseries (variety centres) (20.5%) and private nurseries (16.7%) making a total of 37.2%. Farmers produced 26.5% of their planting materials by themselves and 14.9% they bought from their neighbours making a total of 41.4%. The remaining 21.4% of respondents did not know the origin of their planting material.

In both regions the use of mineral fertilisers was very high, with 95% of farmers reporting their use in the MD and 88% in the CC. Use of organic fertilizers was higher in the CC with 91% respondents reporting their use, compared to 60% in the MD. However use of foliar fertilisers was higher in the MD where 51% respondents used foliar fertiliser and only 24% of respondents used foliar fertiliser in the CC.

The average number of pesticide sprays applied per year in the MD at the commencement of FFS in 2005 was 7 and it was reduced to 6.5 after FFS was completed. In 2006 the number of sprays pre-FFS was 7.7 and after FFS the average number of sprays was reduced to 6.0. In the CC in 2005 the average number of sprays pre-FFS was 3.3 and it increased to 4 after FFS, while in 2006 CC average number of sprays was 5 before FFS and it was reduced to 4 after FFS. The number of sprays applied in Dong Thap province is much higher than elsewhere with 20 sprays per year not being unusual, but after FFS the number of sprays was reduced to 12-15 per year. The number of farmers that used mineral oil was increased from 38% pre-FFS to 52.2% post FFS in the MD and from 16.9% pre-FFS to 61.1% post-FFS in the CC. That indicates a change from more environmentally destructive pesticides towards more sustainable pesticides.

The majority of farmers believe that training, field days and seminars are the best way of communicating new knowledge to farmers with 46.1% farmers nominating these methods in the MD and 54.9 % in the CC. Only 11.2% farmers in the MD and 8.9% in the CC thought that demonstration sites are a good way to learn new technologies.

Different patterns of change of beliefs about plant nutrition and citrus growing were observed between the two regions. There was a significant increase in agreement that *planting of disease free-citrus seedlings will result in higher yield* for CC farmers but there was no change in beliefs for MD farmers after attending FFS. The level of disagreement to the statement that *higher density citrus plantings will give higher yields* was significantly higher for MD farmers but unchanged for CC farmers. There was a significant decrease in agreement to the statement *application of foliar fertilizer will increase yield* for MD farmers and a significant increase in agreement for CC farmers after attending FFS.

The change in beliefs about major pests and diseases were relatively consistent between locations. There was a significantly increased awareness of effective methods for management of citrus greening disease and that psyllids are the major vector of the disease in both regions. There was also increased agreement that leafminer damage can exacerbate canker disease, although this increase was not significant for MD farmers in 2005. In the CC region there was a significant increase in agreement that *trees infected with leafminer will give lower yield* while beliefs remained unchanged in the MD region. Although famers generally agreed with the statement that *aphids must be controlled by insecticide as soon as they are detected on the trees*, in 2006 there was a significant decrease in agreement for MD farmers and a significant increase in agreement for CC farmers. These differences reflect the effect of different situations between locations and different emphases of trainers.

Participation in FFS most strongly influenced beliefs about pest control methods with a significant change in all but one case. All farmers became more aware of the damage pesticides can cause to human health and natural enemies. All farmers also increased their level of agreement that *pesticides can cause pest resurgence* and decreased their agreement that *applications of pesticide will increase the yield* and that *advanced farmers use a lot of pesticide.* Greening disease was the major concern of farmers in the MD region and this did not change after participation in FFS, although the priority of other pests and diseases did change slightly. In 2005 farmers in the CC region were also most concerned about greening disease both before and after participation in FFS. The second highest concern was root rot and the level of concern did not change. However, in 2006 farmers in the CC region were more concerned about mites prior to participation in FFS and they became more concerned about leafminer after attending FFS.

Table 1: Beliefs of FFS participants about plant nutrition and citrus growing

Knowledge, attitude and practices (KAP) survey question	Average agreement score[1]							
	Mekong delta 2005		Central Coast 2005		Mekong delta 2006		Central Coast 2006	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Planting of diseases-free citrus seedlings will result in higher yield	4.20	4.16	4.34	4.52*	4.24	4.28	4.08	4.45**
Higher density citrus plantation will give higher yield	2.46	2.20**	2.01	2.07	2.29	2.00**	2.23	2.18
Higher rates of mineral fertiliser will result in higher yield	2.95	2.79*	3.27	3.16*	2.95	2.61**	3.17	3.34*
Application of foliar fertiliser will increase the yield.	3.64	3.50*	3.76	3.98*	3.73	3.41**	3.55	4.12*

* significance at 0.05%; ** significance at 0.01%

[1]Figures represent mean score: a score between 0 and 2.50 indicates disagreement with the statement, with a lower score indicating a higher level of disagreement; a score between 2.50 and 3.50 indicates that respondents cannot make up their mind or that about equal number of respondents agree and disagree with the statement; a score between 3.5 and 5 indicates that respondents agree with the statement, with a higher score indicating a higher level of agreement.

Table 2: Beliefs of FFS participants about major pests and diseases

Knowledge, attitude and practices (KAP) survey question	Average agreement score[1]							
	Mekong delta 2005		Central Coast 2005		Mekong delta 2006		Central Coast 2006	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Citrus greening disease can be managed using disease free material and orchard management including control of psylla	3.61	3.89**	3.65	4.21**	3.78	4.12**	3.36	4.41**
Psylla is major vector of citrus greening disease	4.23	4.45**	3.92	4.44**	4.14	4.64**	3.98	4.70**
Leafminer damage can exacerbate canker disease	3.73	3.82	3.54	4.11**	3.57	3.80**	3.45	4.02**
Trees infected with leafminer will give lower yield	4.24	4.18	3.94	4.30**	4.11	4.09	3.95	4.30**
Mite control is important only in dry season	3.39	3.40	3.37	3.17	3.53	3.62	3.41	3.35
Aphids must be controlled by insecticide as soon as they are detected on the trees	4.20	4.12	3.96	3.92	4.19	3.95**	3.72	3.96**

* significance at 0.05%; ** significance at 0.01%

[1]Figures represent mean score: a score between 0 and 2.50 indicates disagreement with the statement, with a lower score indicating a higher level of disagreement; a score between 2.50 and 3.50 indicates that respondents cannot make up their mind or that about equal number of respondents agree and disagree with the statement; a score between 3.5 and 5 indicates that respondents agree with the statement, with a higher score indicating a higher level of agreement.

Table 3: Beliefs of FFS participants about pest control methods

Knowledge, attitude and practices (KAP) survey question	Average agreement score[1]							
	Mekong delta 2005		Central Coast 2005		Mekong delta 2006		Central Coast 2006	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Application of pesticide will increase the yield	3.54	3.18**	3.77	3.32**	3.57	2.74**	3.25	3.22**
Using pesticide to protect your trees can harm your health	4.43	4.49**	4.22	4.49**	4.35	4.63**	4.33	4.67**
Use of pesticide can cause pest resurgence	3.01	3.31**	2.67	3.49**	2.79	3.48**	2.85	4.05**
Use of pesticide will decrease number of natural enemies (beneficial organism)	4.12	4.25**	3.72	4.33**	4.06	4.49**	4.06	4.65**
If trees are grown using healthy planting material and good orchard management then use of pesticide may be unnecessary	3.56	3.82**	3.42	3.78**	3.60	3.82**	3.62	4.10**
Most advanced farmers use a lot of pesticide	2.63	2.28**	2.24	1.92**	2.52	2.08**	2.19	1.77**
Pesticide are cheap and easy to apply	2.46	2.33**	2.20	1.80**	2.63	2.15**	2.27	2.37

* significance at 0.05%; ** significance at 0.01%

[1]Figures represent mean score: a score between 0 and 2.50 indicates disagreement with the statement, with a lower score indicating a higher level of disagreement; a score between 2.50 and 3.50 indicates that respondents cannot make up their mind or that about equal number of respondents agree and disagree with the statement; a score between 3.5 and 5 indicates that respondents agree with the statement, with a higher score indicating a higher level of agreement.

Table 4: Pests and diseases of major concern to farmers.

Pest or disease	Proportion of farmers concerned with a particular pest or disease							
	Mekong delta 2005		Central Coast 2005		Mekong delta 2006		Central Coast 2006	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Psylla	n/a	n/a	n/a	n/a	10.2	13.2	6.6	22.2
Scales (including mealybugs)	14.7	9.7	3.9	1.1	15.8	12.8	11.8	4.2
Leafminer	4.6	4.7	15.1	15.6	4.8	3.6	20.7	23.9
Mites	11.9	12.6	15.6	10.1	12.7	13.7	21.8	19.7
Branch borer	0	0.4	15.6	11.7	0.8	0.1	5.2	2.8
Stink bug	1.5	1.2	2.8	2.2	1.6	0.8	0	0.7
Greening disease[1]	43.9	49.4	27.4	31.8	27.0	31.9	17.0	15.5
Root rot	16.2	14.0	17.9	17.9	14.5	10.4	10.3	7.7
Scab	1.5	3.5	0	1.7	3.0	4.0	1.8	0.4
Others	5.7	4.5	1.7	7.9	9.6	9.5	4.8	2.9

[1]Figure for 2005 includes farmers who answered greening disease and psylla, figure for 2006 includes only farmers who answered greening disease

Assessment of economic, social and environmental impacts using interviews

A total of 53 farmers were interviewed individually and 132 interviewed in groups from a total of 13 locations in November 2006.

Change in agricultural practices

At least one farmer in every province mentioned a reduction in the number of sprays applied but the most commonly reported change in spraying practice was a change to different pesticide types. The most commonly adopted new pesticide was PSO with 20 reports of oil being sprayed alone, and an additional 8 reports of oil being mixed with another agrichemical. Imidacloprid was the next most commonly adopted pesticide with 16 reports of its introduction. Considerable increase in the use of PSO was a result of the strong support and involvement of PSO producer Saigon Plant Protection Company (SPC) from Ho Chi Minh City. SPC supplied products for use in FFS teaching trials but more importantly the company organised distribution of PSO to pesticide dealers in the provinces where the FFS were conducted. They coordinated their marketing effort with project activities and printed marketing materials that incorporated the IPM program developed in FFS trials. Although there were only 11 reports of increased use of fertilizer there were almost 4 times as many reports of the introduction of organic fertilizers. A range of different organic materials mixed together and sometimes with *Trichoderma* were used by farmers. Another important change in agricultural practice was the introduction of record keeping and also the ability of farmers to recognise pests and diseases and the introduction of monitoring.

Economic impacts

The dominant economic impact noted by farmers who attended FFS in 2005 was a decrease in the input costs. Over all provinces a reduction in unspecified input costs was mentioned 12 times, a reduction in pesticide costs was mentioned 8 times and a reduction in labour costs mentioned 5 times, resulting in 47% of farmers declaring a reduction in input costs. Ben Tre was the only province in which no mention was made of reduced input costs. Increased yield was also frequently noted with only Vinh Long province farmers not reporting an increase in yield. Although the farmers often perceived increased yield and fruit quality, there were fewer reports of increased sale price of fruit and profit. It is not possible

to establish what proportion of the increased yield declared is due to changed management practices and how much is due to seasonal variation. As attribution of all of these increases to the respondent's participation in FFS would be an overestimation of the benefits of FFS, it has been assumed that participation does at least partly contribute to the reported yield and income increases.

Social impacts

The major social impact mentioned by farmers was an increased sharing of knowledge and experiences between farmers who attended FFS, neighbours, farmers' club members and within families. Only farmers from Dong Thap province did not mention increased sharing of knowledge and experiences, but they were all members of citrus grower clubs and in effect they do share they knowledge and experience and make many collective decisions that result in changed management decision implemented in many citrus orchards. Sharing of knowledge often appeared to be linked with the reported increased social activities related to drinking coffee and rice wine. Attendance at FFS also appears to have played an important role in increasing grower club activities including planning for and the establishment of farmer co-operatives. Respondents also reported that attending FFS assisted in the transition of farm management from father to son, husband to wife and father to daughter.

Environmental impacts

A year after attending FFS and implementing the practices they learned, many farmers reported an increase of organisms in their orchards with at least one farmer from every province commenting on an increased number of beneficial organisms. Farmers from Ben Tre, Tien Giang, Can Tho and Soc Trang mentioned either an increased number of fish or that they were able to raise fish in the canals, where they had not been able to previously Other beneficial organisms that were quite frequently mentioned were green ants and honey bees. Six farmers noted an improvement in the health of their trees and 5 commented that their own health had been improved. However, as part of the FFS training involved identification of pests, diseases and beneficial organisms, it is possible that some of the perceived increases were a consequence of an increased ability of respondents to recognise beneficial organisms.

Comparative analysis of net profit from citrus production and the cost of FFS

Net profit of citrus production

As a part of semi-structured interviews, farmers estimated their net income. It was very difficult to verify their statements because they did not keep accurate records of inputs and outputs. However the interviewer did verify with each farmer that they talking about net income not total income. It was also verified with each group of farmers that the estimated net income represented the difference between total value of sold fruits and the costs of immediate inputs like fertilizer, pesticide, irrigation fees, cost of petrol used in production, cost of hired labour, cost of packaging and transportation to the market. In calculating net profit, farmers did not include costs of their own and their family labour inputs, depreciation of equipment and orchard or interest they paid on loans taken to support production. The estimated net profit values presented in Table 5 were recalculated from the total values provided by farmers for their own orchard, to values per hectare to allow comparison between farmers.

There is a high degree of specialisation in the varieties of citrus grown within provinces in Vietnam, with farmers in Dong Thap growing almost exclusively mandarins (Tieu) and farmers in Nhge An provinces growing almost exclusively oranges. Pomelo is grown in

majority of provinces and the area planted has increased in the last decade. During surveys it was observed that different varieties of citrus seemed to provide very different returns to farmers. In order to test the hypothesis that net profit depended on the citrus variety grown, statistical analysis was performed on net profit data from different citrus species collected from semi-structured interviews. In this analysis the variety named 'King Orange" in Vietnamese was classified as mandarin because botanically it is closer to mandarin species. There was no significant species by location interaction ($F_{3, 19}$ =1.091, p=0.356) and there were significant differences in the value of net return provided to the farmers between citrus species ($F_{2, 28}$ =5.442, p=0.010). Duncan's test shows that pomelo and mandarins provided higher net profit than oranges. There were no statistically significant differences between average property size on which the citrus species were grown ($F_{2, 28}$ =0.227, p=0.797). Mean net profit averaged over citrus species and provinces was VND 78,620,000. Farmers growing mandarins in average had net return of VND 100,000,000 followed by pomelo growers with average profit of VND 93,330,000. Farmers growing oranges had average profit of only VND 37,880,000. Not surprisingly the highest profits over 100,000,000 VND were recorded in Tien Giang and Dong Thap provinces where predominantly mandarins are grown. Lowest net profit was recorded in Ben Tre province. There is high level of agreement between the average net profit declared by farmers and estimates given by provincial sub PPD with only 2 provinces showing net profit recorded in the interview to be outside the estimates given by officials. In Ben Tre province disagreement is due to very high variation between incomes of interviewed farmers with the coefficient of variation of 108% and in Vinh Long province difference was due to the small sample size (only 2 farmers) and the net profit given by officials being based on the profit of advanced pomelo growers and not on average farmers.

Compared with the net profit from rice the net returns from citrus is 3 to 6 times higher. Data also show that returns for rice do not vary between provinces nearly as much as the return for citrus.

Relationship between the profitability of citrus production and the cost of FFS

Average profit per hectare was estimated at VND 78,620,000 per year (= A$ 6,401.19). Average size of the farm was 0.69 ha. It could be estimated that average net profit per farmer household is VND 54,247,800. Cost of FFS per participant was VND 867,361 (=A$ 70.62). It can be estimated that cost of FFS per participant represents only 1.60% of their net profit. It is fair to assume that just the saving in the cost of pesticide as a result of reduction in the number of sprays was higher than the investment made in FFS.

Note:

[1]During the duration of the project exchange rates varied from VND 11,372 for A$ 1 to VND 13,200 for A$1 with the average value of VND 12,282.09. The average exchange rate value was used for all calculations presented in this report.

[2]Start-up costs do not include costs of Australian scientists that participated in the project. This project was a research project with FFS being the object of the research so the input of Australian staff in the actual training program of TOT was minimal and did not warrant inclusion in the cost of the training.

Table 5: Average size of citrus orchard and net profit per year

Province	N	Area (ha)	Net profit declared by farmers (VND/year)	Net profit estimated by province officials (VND/year)	Net profit from rice estimated by provincial officials (VND/year)
Kanh Hoa	3	1.63[1] (0.84)[2]	38,330,000[1] (7,265,000)[2]		
Nghe An	4	0.85 (0.087)	44,000,000 (5,492,000)	30-50,000,000	10-12,000,000
Ben Tre	5	0.54 (0.137)	34,600,000 (16,798,000)	50 - 70,000,000	18,000,000
Tien Giang	6	0.73 (0.193)	134,330,000 (33,200,000)	100-150,000,000	
Dong Thap	4	0.31 (0.072)	115,000,000 (8,660,000)	100-120,000,000	
Tra Vinh	2	0.58 (0.131)	83,250,000 (6,848,000)		
Vinh Long	2	1.25 (0.250)	85,000,000 (15,000,000)	150,000,000	21,000,000
Can Tho	4	0.30 (0.041)	61,250,000 (13,288,000)	60-70,000,000	20-24,000,000
Soc Trang	2	0.43 (0.075)	97,500,000 (52,500,000)	50-200,000,000	15,000,000
Total	34	0.69 (0.100)	78,620,000 (9,167,000)	30-200,000,000	10-24,000,000[3]

[1]Value is mean calculated from net profit stated by individual farmers in the semi-structured interview.
[2]Value in parenthesis is standard error of mean
[3]Net profit for rice per harvest was stated between 5,000,000 and 8,000,000 VND. In MD farmer can have 3 harvests per year and in CC only 2 that makes significant difference in income per year for unit area.

Table 6: Summary of the statistical analysis for difference in profitability between citrus species

Citrus species	N	Area (ha)	F test[4]	Net profit declared by farmers (VND/year)	Duncan test[3]
Mandarin[1]	17	0.56[2] (0.085)[3]	a	100,000,000 (14,660,000)	**a**
Pomelo	6	0.68 (0.215)	a	93,330,000 (13,824,000)	**a**
Oranges	8	0.58 (0.114)	a	37,880,000 (6,346,000)	**b**
Total	31	0.59 (0.067)		82,680,000 (9,167,000)	

[1]Citrus variety in Vietnamese called 'King Orange' was counted as mandarin because botanically it is closer to mandarin species.

[2]Value is mean calculated from net profit stated by individual farmers in the semi-structured interview.
[3]Value in parenthesis is standard error of mean
[4]Treatments with the same letter do not differ significantly from each other (p=0.05).

Conclusions

1. Farmers increased their knowledge and skills for many components of citriculture including density of plantings, pruning, plant nutrition and integrated pest management. Farmer awareness about spray application, record keeping, post harvest and marketing was increased but competence needs to be further increased in these areas. Farmers' ability to critically evaluate the process of production and elements of the agro-ecosystem was improved as a result of FFS.
2. In the year following FFS, farmer practices changed considerably resulting in a reduction of pesticide use, change of type of pesticide used from broad spectrum pesticides with high negative environmental impacts to softer pesticides, better soil management with increased use of organic material and better canopy management.
3. A majority of farmers claimed that as a result of changed practices their net profits increased, partly as a result of reduced financial inputs and partly from increased yield and fruit quality. These benefits cannot be fully quantified because of limited records kept by the farmers and the restricted evaluation time of one year which cannot fully account for temporal variations in yield.
4. Participation in FFS increased mutual respect between FFS participants and also increased the status of the farmers within the wider farming community. Strengthened networks between farmers facilitated the formation of farmers clubs and cooperatives which include FFS participants and members of the wider farming community. Within these farmer associations, FFS participants have taken leadership roles.
5. Although the level of female participation in FFS, particularly in the south, was not high, it resulted in major impacts on the position of women in the family. Attendance at FFS facilitated the transition of farm management from men who had employment outside the farm, to their wives. As opportunities for finding employment in sectors other than agriculture increase in the future, the need for women to take a leading role in agricultural production will increase. This project has demonstrated that FFS training can effectively assist women in this process.
6. There was also a small proportion of children of farming families attending FFS and although it may seem that their attendance would offer similar opportunities for transition of farm management, as was seen with working husbands and their wives, this potential was not as effectively realised. Generational hand over of management is often the subject of contention, and it seems that FFS was best able to facilitate this when children (sons) were provided with a portion of the farm that they independently managed.
7. The number of beneficial insects observed by the farmers and the use of predatory green ants as biological control agents increased, indicating that the health of the agroecosystem was improved. Some farmers also reported that they were now able to rear fish in the canals and that their own health and health of their trees had improved. Although these improvements are difficult to quantify in monetary terms, these changes indicate a considerable improvement in the quality of farmers lives.

8. The cost of FFS per participant was estimated at A$ 70.62, which was only 1.60% of the estimated average net profit per hectare. Based on these estimates the cost of FFS would be offset in just one season due to the reduction of inputs and increased yield. The cost of FFS in citrus is similar to or only slightly higher than that reported for rice, whereas returns for citrus are 4 to 5 times higher than for rice. Given the low investment cost and excellent return on investment in FFS, the possibility that farmers contribute to the cost of FFS through a small levy or contribution should be considered in the future, especially if farmers are members of citrus clubs or cooperatives.
9. To sustain benefits realised by FFS, farming groups need financial support with credit facilities enabling them to open post-harvest operations in order to improve market access. The pesticide registration process, the suite of pesticides currently registered for use in citrus and enforcement procedures need to be completely overhauled. Without government initiatives that recommend and encourage use of new generation pesticides that cause less disruption to the environment, financial incentives to pesticide companies to register these pesticides and incentives for farmers to comply with registration, the use of old generation pesticides will continue to dominate.

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