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RESEARCH PAPER

Farmer field school: Non-formal education to enhance livelihoods of Indonesian farmer communities

Joko Mariyono[a,b], Jaka Waskito[c], Suwandi[a], Tabrani[a], Apri Kuntariningsih[d], Evy Latifah[e], and Enny Suswati[f]

[a]Program Studi Magister Manajemen, Program Pascasarjana, Universitas Pancasakti Tegal, Tegal, Indonesia; [b]Program Studi Agribisnis, Departemen Pertanian, Fakultas Peternakan dan Pertanian, Universitas Diponegoro, Semarang, Indonesia; [c]Program Studi Manajemen, Fakultas Ekonomi dan Bisnis, Universitas Pancasakti Tegal, Tegal, Indonesia; [d]Program Studi Ilmu Pemerintahan, Fakultas Ilmu Sosial dan Politik, Universitas Pancasakti Tegal, Tegal, Indonesia; [e]Assessment Institute for Agricultural Technology – East Java, Indonesian Agency for Agricultural Research and Development, Malang, Indonesia; [f]Fakultas Kedokteran, Universitas Jember, Jember, Indonesia

ABSTRACT

The Indonesian agricultural sector provides a high proportion of employment for the rural community. However, the farmers' livelihood is relatively low. Sending the farmers to non-formal education will enhance the livelihood of the community. In this study, we analyze the impact of farmer field school on Indonesia's rural community livelihoods. Data were collected using a participatory approach from 270 farmer groups that completed farmer field school in Sumatra, Java, and Bali. The results show that the farmer field school generated positive impacts on five capitals. Farmers realized the benefits of participating in the field school. They could increase farming efficiency by applying technology innovations, knowledge, and skills obtained from the field school. Farmer livelihoods in the community have been substantially enhanced.

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Empowerment of human resources; livelihood capitals; rural community; sustainable livelihood framework; vegetable farming

Introduction

Indonesian agricultural sector is a resilient economy of the country. The agricultural sector's contribution share to national income progressively declines from around 16% in 2000 to 12% in 2014. In magnitude, the amount of national income from the sector rises substantially from IDR 220 T to IDR 350 T during the same time. McCulloch (2008) reports that 75% of the poor in rural areas work in the agricultural sector, and non-poor dominates 58%. The contribution of agricultural sectors in Indonesian employment declined from nearly 44% in 2004 to approximately 30% in 2014. The number of workforces absorbed by the sector is still significant, despite a slight decrease during the same periods.

Vegetables are high-value crops or cash crops and have the potential of higher income diversification for rural communities. These include shallot, chili, eggplant, cabbage, potato, tomato, and other leafy vegetables; and are vital parts of daily foods and livelihoods and contribute essential function in the country's agricultural economy. During

CONTACT Joko Mariyono jokomariyono@upstegal.ac.id Program Studi Magister Manajemen, Program Pascasarjana, Universitas Pancasakti Tegal, Tegal, Indonesia

periods of 2000–2019, the top five vegetables: shallot, chili, cabbage, tomato, and potato productions increased progressively. Production of other vegetables: eggplant, cucumber, yard-long bean, and string bean was stagnant (Indonesian Statistical Agency, 2019). Despite increases in primary vegetable production, Indonesian productivity is still far below the potential. Compare to that of China, Indonesian vegetable productivity is just one-fifth (Vanitha, Chaurasia, Singh, & Naik, 2013). Various factors affect the low productivity.

Despite the government efforts to improve agronomic technology, vegetable productivity is still low. Inadequate human resources, the farmers, might be one of the causes. Human resources are crucial because it determines the success of technology adoption (Xayavong, Kingwell, & Islam, 2016). In Indonesia, human resource in agricultural sectors is weak. Farmers' education level is low, and farmers lack access to education in rural areas (Mangowal, 2013; Titimiranti, Sasongko, & Widiyani, 2016). Farmer empowerment using innovative technology and skills managerial in farm management can improve their livelihoods. Another alternative to empower farmers is to send them to a formal school, but it might be ineffective and too late. One of the suitable options is to engage them in the non-formal education model through adult education and training programs to contribute to community development (Mayombe, 2018). The government of Indonesia and non-governmental organizations provided farmers with non-formal education to increase their capacity.

Farmer field school (FFS) is one of the terms of non-formal education. For rice farming, FFS started equipping farmers with a new concept of crop protection strategy through integrated pest management (IPM) program executed by the central government in 1990 (Röling & Van de Fliert, 1994). The program terminated in 1999 because of political and economic reasons (Resosudarmo, 2014; Resosudarmo & Yamazaki, 2010). The FFS on rice farmers has been fruitful in improving rice productivity and reducing pesticide use (Agro-Chemical Report, 2002; Bond, 1996; Yamazaki & Resosudarmo, 2008). Globally, Waddington et al. (2014) have documented and systematically reviewed FFS's impacts on the use of pesticides and the production of rice and other food crops

Along with government programs, collaborative projects have conducted training for vegetable farmers using FFS. More than 350 units of FFS on vegetables (e.g., chili, tomato, and cucumber) spread in Northern Sumatra, Central, and East Java, and Bali. A unit of FFS trained about 30 farmers, and thus about 10,000 farmers cultivating vegetables have completed the training through FFSs. This study raises research questions as follows: (1) to what extent does the FFS provide impacts on the livelihood of farmers, (2) in what aspects farmers perceive the expected impacts. In this study, we evaluate FFS's developmental impacts on farmer livelihoods and categorize the improved aspects of livelihoods due to participation in FFSs.

Literature review

Since FFS's success in introducing IPM technology in Indonesia, there have been various impact studies on technology dissemination implemented in Indonesia through the FFS approach. There are two primary measures of the impacts of FFS, i.e., immediate impacts and developmental impacts. The immediate impacts are decreases in pesticide use and related costs, and increases in crop production, farm efficiency, and profitability. The developmental

impacts relate to human resource development (Van den Berg & Jiggins, 2007). Larsen and Lilleør (2014) show that FFS positively affects food security, resulting from labor resource reallocation to smoothing of their improved production and agricultural production. Mancini and Jiggins (2008) find that FFS group farmer members were significantly prosperous than their counterparts, and the FFS-trained farmers were also better pesticide applications.

Norvell and Hammig (1999) find that farming became more sustainable after IPM training through FFS in the vegetable sector. Sustainability relates to the reduction in the use of agrochemicals. Based on individual crop, FFS leads to a fall in the number of pesticides applied in onion farming (Yorobe, Rejesus, & Hammig, 2011), increases in potato productivity in Peruvian Andes (Godtland, Sadoulet, De Janvry, Murgai, & Ortiz, 2004), and tomato production in China (Cai, Shi, & Hu, 2016), escalation in African farmers' income by about 60% (Davis et al., 2012). A recent study shows that Indonesian farmers in Bali and East Java could increase chili and tomato productivity after completing FFS participation on chili and tomato (Luther, Mariyono, Purnagunawan, Satriatna, & Siyaranamual, 2018). FFS introduced farmers with improved agronomic technologies and crop protection strategy along with knowledge and skills. The farmers' knowledge improves after participation in FFS (Yang et al., 2008).

The developmental impacts of FFS are possible when farmers adequately gain knowledge. Such short-term impacts continue to generate other longer-term effects on the farmer participants' well-being and farmers' livelihoods. FFS is a kind of empowerment approach and adult education, frequently applied in many extension programs. Farmers in a group learn mutually. They analyze the environment and constraints and identify and develop solutions for the problems in their lands. This method highlights problem-solving, learning, and joint problem analysis. Farmers perform these activities in the fields directly. FFS is considered very useful in equipping farmers and building transparent management. It is a participatory initiative where farmers arrange collectively to understand more about the agricultural system at any selected location of their preferences (Anandajayasekeram, Davis, & Workneh, 2007).

Activities in FFS are intended to discovery-based understanding methods to enhance farmers' knowledge of agriculture and the capacity to generate both on-farm and off-farm. FFS improved knowledge of pest management and agroecosystem effectively (Guo, Jia, Huang, Kumar, & Burger, 2015). FFS has empowered farmers in terms of improved capability (Duveskog, Friis-Hansen, & Taylor, 2011). Briefly speaking, FFS can empower farmers via regular meetings in the field as demonstration sites to encourage agricultural production due to discovery learning (Mfitumukiza et al., 2017). Despite production or food security objectives, project intervention using FFS also has empowerment purposes (Waddington & White, 2014). FFS aims to train farmers on acceptable agricultural practices and develop farm management skills. FFS's objectives are to move farmer communities to accomplish a collaborative and communal analysis to initiate actions in addressing their problems (Mweri, Mombasa, & Godrick, 2001). The particular goals can be detailed into five means as follows. First, to endow farmer communities with skills and knowledge. Second, to enable them as agricultural experts in their fields and to polish farmers' capability. Third, to create informed and analytical decisions rendering the profitable farming in sustainable manners. Fourth, to increase farmers' sensitivity in problem-solving and new ways of thinking. Last, to assist farmer communities in learning the ways to organize themselves in the communities.

A manual designed by the UN-FAO describes FFS as "a school without walls" where farmer communities learn together by preparing new ideas in their fields. The process directly equips farmers to advance their answers to their existing problems. FFS has a robust didactic process constructed in both individuals and communities to revive the process of life-long education to improve community livelihoods. FFS is a part of the comprehensive sustainable development processes. It is substantiated in the education and empowerment of farmer communities, enlightening people's capabilities to find suitable methods for working in groups, and as individuals to realize their self-defined goals (Machacha, 2008). A study shows that many women participate in FFS and their expected outcomes related to food security at the household level (Westendorp & Visser, 2015). It reviews the gradual process of acceptance associated with gender issues in training. The farmer empowerment process is viewed as development progress rather than an outcome for someone or a group.

The most substantial impact of FFS is capacity building of the local community, such that they can make proper decisions leading to better access to market facilities and other services and agricultural innovation uptake (Friis-Hansen & Duveskog, 2012). Such a condition implies that FFS has benefited farmers through developmental impacts (Van den Berg & Jiggins, 2007). A broader analysis shows the impacts of FFS on livelihoods and suggests that farmers' well-being has improved in many countries due to an amalgamation of knowledge, innovation, and farmer empowerment through a practical learning experience in FFS groups (Lilja & Dixon, 2008). Deviations in the chance composition also facilitated the empowerment by reforming government staff at the local level, developing non-government service providers, and forming farmer-driven local institutions. Information on FFS's broader impacts on livelihood would be of more interest to development planners and rural development sector decision-makers. The impact has been factual to increase farmers' capacity (Van den Berg, 2004).

In Indonesia, FFS's impacts were seen as immediate outcomes, which only included a decline in pesticide use, keeping the yield unchanged or slightly increase. FFS is targeted not merely to crop protection but also to help farmers organize themselves, become experts and competent trainers of other farmers, and capable of field research (Bartlett, 2004). Questions framed along these lines would then be able to judge if farmers have benefited from an IPM program where they desire to improve themselves through increased income, have self-confidence, and become useful citizens, contributing to the community's well-being in the country (Ooi, 1998). For the most part, Van den Berg and Jiggins (2007) discuss some literature and conclude that the developmental impacts of FFSs are still inconsistent and unclear. Many empirical works on such impacts in articles published in reputable journals still provide contradictory conclusions on effectiveness (Waddington et al., 2014). As FFS implementation expands, growing concerns and interests emerge among interested parties about the impact of FFS. In Indonesia, facts that systematically document a broad impact of FFSs on the farmers' livelihood are relatively limited. This current study partly fills the gap.

Methodology

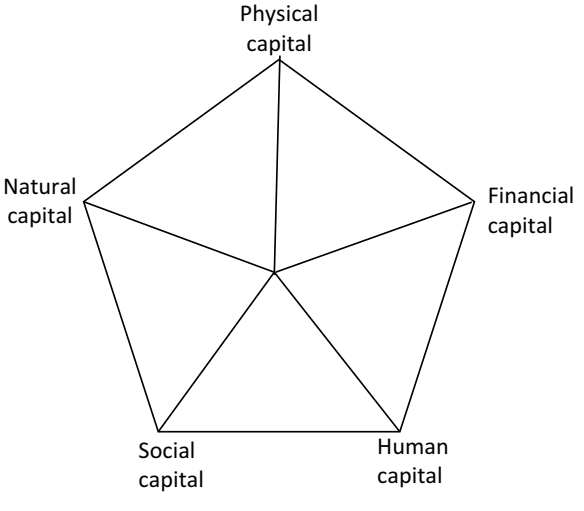
Theoretical framework

This study adopted a framework of the sustainable livelihoods approach (SLA) suggested by Serrat (2017) to evaluate FFS's long-term impact on farmer communities' empowerment.

Empowerment can be represented by improved five livelihoods capitals, which consist of human capital, financial capital, social capital, natural capital, and physical capital. This approach has been employed to assess the impacts of FFS on the livelihoods of farmer communities in India (Mancini, Van Bruggen, & Jiggins, 2007), Pakistan (Butt, Gao, & Hussan, 2015), and Indonesia (Mancini & Jiggins, 2008; Mariyono, 2018). In the Pacific Islands, the SLA method can be combined with agroecology as guidance to analyze projects related to development processes (Addinsall, Glencross, Scherrer, Weiler, & Nichols, 2015).

SLA is "an analytical structure to facilitate a broad and systematic understanding of the various factors that constrain or enhance livelihood opportunities and to show how they relate to each other" (Krantz, 2001, p. 19). The SLA approach provides a worthwhile theoretical foundation because it allows for multilevel, actor-centered, and holistic identification of dynamic behaviors in which farmers can familiarize strategies of livelihood to address transformations related to modern life (Scoones, 1998). While covering a wide range of factors will be problematic to achieve in one study (Adato & Meinzen-Dick, 2002), implementing a comprehensive framework allows scholars to identify subjects applicable to community members (Krantz, 2001). Specifically, SLA enables community members to improve their livelihoods by developing existing activities, assets, and capabilities while also guaranteeing resources for the current generation (Krantz, 2001). The SLA can make specific aspects influencing sustainable livelihood products. Hence, FFS evaluation can adopt SLA as a tool. In this context, this study adapted the SLA framework and FFS impact assessment methods to document perceptions of changes in farmers' communities' livelihoods.

Based on the components of livelihood capitals, the SLA shows that FFS impacts the continuum terms starting from short- to long-term impacts. A pentagonal diagram in Figure 1 presents five livelihoods capital assets. In general, the SLA assumes that the more and more potent sustainable capital assets, the more empowering outcomes. The SLA is suitable for analyzing community development due to an intervention program (Ansell, Hajdu, Van Blerk, & Robson, 2016).



Source: Serrat (2008)

Figure 1. Pentagonal diagram for sustainable rural livelihoods.

Research method

This study took regions Eastern Java, Northern Sumatra, and Bali, the center of vegetable production areas. Surveys were carried out immediately after the completion of FFS. In Sumatra (North Sumatra and Aceh Special Region provinces) FFS was in 2009; in Java (Central and East Java provinces), FFS was in 2010 and 2014; and in Bali, FFS was in 2014. The survey's total sample was 270 farmer groups, which consisted of 120 groups in Java, 90 groups in Sumatra, and 60 groups in Bali. Every group of FFS was represented by around ten farmers, which included 3–4 women.

Data were gathered using focus group discussions (FGDs), acceptable to agricultural extension, and agricultural economics to collect information about the farming system (Mancini & Jiggins, 2008). FGDs were employed to acquire points of view and ideas of the targeted communities on the enumerated research issues, evaluate, analyze, prioritize targets' requirements, formulate appropriate interventions, and examine the respondents' level of acceptance/rejection of new technologies, knowledge, or ideas. This study selected FGDs to discover the opinions, experiences, views, and perceptions of new technological packages for vegetable farming practices. The justification for utilizing FGDs was that the population members were relatively homogenous regarding age, social class, cultural character, and knowledge level. It also creates an atmosphere where participants feel relaxed with others and feel free to express their ideas. FGDs were conducted after the last cropping season ended.

Data collected using FGDs portray actual communities as invited participants to provide information about standard farming practices. When a participant provides erroneous information, others will counter with correct facts. When there is a disagreement, the average is approved. The use of participatory approaches can discover FFS's social and institutional and qualitative impacts (Mancini & Jiggins, 2008). Many patterns can be analyzed using this method (Purushotham & Paani, 2016). The content of the FGDs was inspected and interpreted (Janis, 2009). Krippendorff (2004) endorses this approach for its simplicity.

During FGDs, the five components of livelihood assets were indexed to quantify the impact of FFS. The index of sustainable livelihoods has been adopted in research (Kamaruddin & Samsudin, 2014; Liu, Huang, Wang, Luan, & Ding, 2018). The facilitator asked farmers in a group to answer YES or NO to questions related to the improvement of livelihood capitals after participating in FFS. The improvements were indexed in percentage changes using a formula: $I = \frac{n}{N} \otimes 100\%$, where I is the improvement index, n is the number of farmer groups providing YES, N is the total number of farmer groups in the survey.

Results and discussion

FFS is likely to favorably impact the farmer community's livelihoods detected in the changes in five livelihood assets comprising natural capital, financial capital, physical capital, human capital, and social capital. Overall, the livelihood capitals increased by approximately 40% after the participation of FFS (Figure 2).

The impacts of FFS on individual components of livelihood capitals were positive. This means that farmers gained the benefits of FFS. This finding corresponds to the fact that beneficial impacts, i.e., farm family training, lead to a better condition in terms of the households' human capital and key cropping technology and innovations. The farmers' synchronized skills, the farm's unique environmental features, the farmers' involvement in

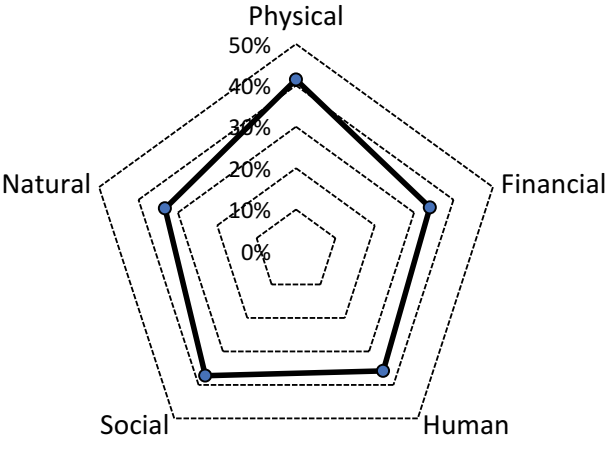


Figure 2. Percentage changes in livelihood capitals resulted from FFS.

business planning, and organizational management also play a role in inducing the farm performance (Xayavong et al., 2016). The highest increase was physical capital, which accounted for about 40%, and the lowest increase was natural capital, which accounted for 30%. Farmers recognized that improvements in physical and financial capitals were direct and immediate benefits resulting from farming activities after FFS's participation. At the same time, other capitals were identified as indirect and gradual benefits. The scale and level of perceived benefits vary across FFS sites. Several internal factors, as well as external ones in the communities, might affect the variation. Tables 1–5 present the specific increases in the elements of each livelihood capital.

Table 1 summarizes the significant impacts of FFS on the physical capitals of participants. Over two-thirds of the surveyed farmers perceived that they reduced agrochemicals in their

Table 1. Physical capital changes resulted from FFS.

	Java (N = 120)		Sumatra (N = 90)		Bali (N = 60)		Total (N = 270)	
Physical capital components	n	%	n	%	n	%	n	%
Increase in use of bio-pesticides	15	13	20	22	10	17	45	17
Decrease in use of inorganic fertilizers	80	67	55	61	25	42	160	59
Decrease in use of synthetic pesticides	85	71	72	80	15	25	172	64
Increase in vegetable production	35	29	55	61	25	42	115	43
Increase in use of organic fertilizers	25	21	15	17	25	42	65	24

n is the number of groups responding to the respective variables/physical capitals.

Table 2. Financial capital changes resulted from FFS.

	Java (N = 120)		Sumatra (N = 90)		Bali (N = 60)		Total (N = 270)	
Financial capital components	n	%	n	%	n	%	n	%
Reduction in fertilizer cost	45	38	18	20	27	45	90	33
Reduction in pesticide cost	52	43	19	21	9	15	80	30
Reduction in production cost	75	63	35	39	0	0	110	41
Increase in gross revenue	25	21	33	37	12	20	60	22
Increase in profit/income	50	42	60	67	10	17	120	44

n is number of groups responding to the respective issue

Table 3. Human capital changes resulted from FFS.

	Java (N = 120)		Sumatra (N = 90)		Bali (N = 60)		Total (N = 270)	
Human capital components	n	%	n	%	n	%	n	%
Seed technology	20	17	30	33	10	17	60	22
Pests and diseases	70	58	90	100	40	67	200	74
Soil fertility and fertilizers	40	33	20	22	30	50	90	33
Natural fertilizers and pesticides	60	50	20	22	0	0	80	30
Value chain and marketing	20	17	20	22	0	0	40	15
General farming on vegetables	70	58	20	22	20	33	110	41

n is number of groups responding to the respective issue

Table 4. Social capital changes resulted from FFS.

	Java (N = 120)		Sumatra (N = 90)		Bali (N = 60)		Total (N = 270)	
Social capital components	n	%	n	%	n	%	n	%
Communication	12	8	39	44	19	33	70	26
Sharing information	11	8	29	33	10	17	50	19
Social cohesion	108	92	32	33	60	100	200	74
Contact with extension officials	40	33	20	22	20	33	80	30

n is number of groups responding to the respective issue

Table 5. Natural capital changes resulted from FFS.

	Java (N = 120)		Sumatra (N = 90)		Bali (N = 60)		Total (N = 270)	
Natural capital components	n	%	n	%	n	%	n	%
Agroecosystem	62	50	38	44	0	0	100	37
Soil fertility	52	42	69	78	49	83	170	63
Beneficial insects	20	17	0	0	0	0	20	7
Human health	28	25	21	22	21	33	70	26

n is number of groups responding to the respective issue

vegetable farming. These components of physical are the immediate outcomes of FFS (Van den Berg, 2004). Many studies have shown that FFS improves farm productivity and increases input use (Kuntariningsih & Mariyono, 2013; Luther et al., 2018; Pananurak, 2010; Yamazaki & Resosudarmo, 2008). FFS has contributed to lowering insecticide use (Tripp, Wijeratne, & Piyadasa, 2005). Botanical pesticides partly substituted the synthetic ones. Organic materials for composts and green manure replaced inorganic fertilizers. About 60% of farmers showed increased production levels. These positive changes in physical capital were considered positive impacts of FFS. The percentage of farmers in Java and Sumatra who could reduce agrochemicals were higher than those in Bali. Different farming intensity could be the factor affecting the gap (Luther et al., 2018).

After graduating from FFS, the need for more labor input requires a higher number of paid laborers to apply organic material preparation and increase the number of periodic monitoring and field observation of diseases and pests. This condition confirms Larsen and Lilleør (2014) finding that farmers reallocate labor resources to improve agricultural production leading to increased food security. When the labor force in rural areas is uncontrolled, creating new jobs is a good outcome for social purposes related to development. Since the high level of job in neighboring urban areas is uncertain, it is unlikely

for these farmers to migrate to urban areas immediately. Overall, many farmers in the community felt that FFS's benefits were more favorable than the detrimental effects. The increasing number of workers employed in agriculture because of new technology adoption can be perceived as positive outcomes for some households because of the additional income from extra work.

The FFS improved physical capital because it closely connects to financial capital resulting from the monetary value of the physical capital valued at the prevailing price and wage rates. Table 2 indicates encouraging influences of FFS about reduced costs allocated for materials use. In particular, agrochemicals of which the farmers could not locally produce and buy from the local markets. Its replacement with organic material perhaps conserves capital scarcely used for farming practices in the communities. A financial capital improvement is advantageous to the communities as the capital provides multiplier effects that increase other forms of capital (Meikle, Green-Pimentel, & Liew, 2018). Malual and Mazur (2017) show a positive association of financial capital with social capital in a community. Eventually, social capital increases lead to happy community members (Rukumnuaykit & Pholphirul, 2016).

In general, farmers noticed an augmentation in the production value after the FFS. Farmers enjoyed extra earning resulting from a decrease in external costs and improvement in crops' productivity simultaneously. The total costs of fertilizers and pesticides decreased by about 15% to 25%, respectively. At the same time, however, the production value (or gross return) increased by about 25%. Ultimately, the efficient use of agrochemicals consisting of fertilizers and pesticides and improved productivity increased the level of profit. The average increase in the value of production was approximately 20%. The reduced total cultivation costs allow farmers to repay debt and physical assets. The participants perceived that the production system has been more economically resilient than counterparts when they faced adverse environments (Mancini et al., 2007). The FFS familiarized new techniques and improved technologies to farmer participants. The technologies have increased farmers' incomes (Mariyono, 2019a, 2019b).

The opportunity costs associated with increases in labor and wage structures improved as FFS's adverse effects related to financial capital. The wage rate increased due to increased time and labor allocated to prepare botanical pesticides and increase organic compost materials. Overall, farmers after FFS earned 45% higher than before. Labor costs associated with collecting organic environments were offset by cash resulting from the reduced use of external materials.

Table 3 shows that FFS positively impacted human capital. The rise in human capital is intensely associated with the enhanced knowledge of vegetable production. Considerable accomplishment in human capital is due mainly to the improvement of crop management and plant protection knowledge. The improvements in human capital are intangible, such that it is difficult for farmers to provide precise values of change for components of human capital. These components represent the desirable impact on the increase in the skill and farming know-how of vegetable cultivation (Guo et al., 2015; Luther et al., 2018; Ortiz, Garrett, Health, Orrego, & Nelson, 2004; Quizon, Feder, & Murgai, 2001; Thiele, Nelson, Ortiz, & Sherwood, 2001). David and Asamoah (2011) suggest improving FFS and paying full attention to how to enhance human capital in the communities for broader activities. Farmers' expectations of the advantageous impacts of FFS on human capital almost similar across the study sites. Improved knowledge of pest and

disease management and soil ferritization were the most substantial impacts. Similarly, identifying insect pests and disease types and beneficial organisms were other advantageous resultants of FFS participation. Sumatran farmers felt the best in pest and disease management.

There were no adverse impacts of FFS perceived by farmers regarding the elements of human capital. A few farmers noticed the undesirable impacts on human capital in terms of jealousy among farmers in the community who have not joined the FFS training.

The impact of FFS on social capital is presented in Table 4. The cohesiveness of farmers in the group and between groups, representing social relationships, became strong and coherent after completing FFS. Many activities in FFS have made social relations among farmers cohesive and enhanced the skills of the community. The farmers generated social networking to exchange knowledge and information. FFS also encouraged the formation of farmers' groups and improved farmers' confidence to operate farm more efficiently and effectively in the community (David & Asamoah, 2011). The improvement of human and social capital has represented farmers' empowerment (Müller, Guenat, & Fromm, 2010). The indicators are the most visible impact on the social relationship, as the neighborhood social cohesion tended to sustain community development (Cheung & Leung, 2011) and potentially build community together (Olberding & Miller, 2018).

Table 5 provides information on how FFS positively impacts natural capital. Constructive impacts on this capital were represented by improvements in soil fertility, biodiversity, environmental quality, and human health. The improvement in natural capital is substantial because "the concept of natural capital has been increasingly promoted within environmental governance as part of an expanding coalition of the world's most influential environmental organizations and corporations" (Fletcher, Dressler, Anderson, & Büscher, 2019, p. 1072). Pretty and Bharucha (2014) highlight the improvement of the sustainability of farming. FFS has played an essential role in delivering IPM (Pretty, Toulmin, & Williams, 2011; Van den Berg & Jiggins, 2007).

Overall, the agroecosystem's expected impacts were due primarily to a balanced population of pests and diseases, and beneficial organisms. FFS also led to soil fertility conservation in terms of balanced soil structures resulting from increased organic materials' content. Farmers have learned many techniques to reduce the use of agrochemicals (synthetic pesticides and inorganic fertilizers) and avoid possible poisonous contamination to the agroecosystem and pesticides' health risk. Javanese and Balinese farmers perceived deeper impressions of FFS than those of Sumatran. Engagement in FFS provided useful contributions to human health. Nevertheless, FFS's few adverse impacts might arise due to farmers' belief that pests and diseases' incidences tend to increase if farmers neglect to monitor the field regularly and do not implement suitable control strategies.

Based on the development of the livelihood capitals, this study verifies hypotheses claiming that farmers' participation in group-based FFS can empower farmer communities and increase welfare. The linkage between FFS participation and empowerment in daily livelihood was an association between FFS membership and uptake of technology and innovation, resulting in increased access to extension service providers. FFS provided a favorable impact on decision-making and critical thinking at a household level (Duveskog et al., 2011). This study also confirmed that high training quality in practices promotes a vital process of empowerment. The literature recognizes well the reduced

quality training during scaling up empowerment (Cooke & Kothari, 2001; Parkinson, 2009). Rural and agricultural development programs need to concentrate more on farmers' empowerment processes than technical aspects of agriculture that pronounce intervention programs to generate a balanced mixture of social and technological progression to achieve sustainable development (Friis-Hansen & Duveskog, 2012). A successful farming system enables farmers to realize economic independence and improved livelihoods, leading to empowerment (Khanum & Al-Mahadi, 2015). Mula and Sarker (2013) show that sustainable livelihood empowerment resulted from improved agronomic promotes or technology. Overall, FFS is promising in promoting empowerment at the personal and structural levels (Dzecoa, Amilaia, & Cristóvão, 2010; Molesworth et al., 2017). The training through FFS equips farmers with skills, knowledge, and innovations to improve their crop husbandry, productivity, and empowerment level. It is recommended that to train farmers in FFSs is affordable, effective, and sustainable in transforming farmers' behavior. Interested parties are recommended to increase financial support and adopt FFS to educate farmers (Maina, Gowland-Mwangi, & Boselie, 2012). Scoones (2009) points out that livelihood perspectives describe an imperative lens for investigating rural development multifaceted inquiries. Livelihood perspectives must deal with more curiously and concretely inquiries across the four themes of dynamics knowledge, politics, and scale. Kay (2009) suggests that a strategy that generates and augments a synergy between agriculture and other sectors goes beyond the rural-urban continuum that provides the most significant projections for creating rural development progression.

Conclusions and implication

Production of high-value vegetables in Indonesia is the challenge coming from the low level of farmers' education, which leads to the low capacity of farmers in operating farming in rural areas. Various development projects launched training programs for vegetable farming and disseminated the technology to farmers through FFS. Based on a sustainable livelihood framework theory, the FFS is expected to empower farmers by improving farmer livelihoods.

Using a sustainable livelihood framework offers evidence that FFS improved farming capacity in terms of livelihood capitals. At the community level, FFS provided positive impacts on all five livelihood capitals. After participating in the FFS, farmers efficiently used agricultural inputs, without significant losses. They could reduce environmentally detrimental agrochemical inputs and replaced them with environmentally friendly inputs. The farmer participants also reduced the cost of vegetable production by about one third. The total costs decreased due merely to adopting some IPM techniques guaranteeing high productivity and turnover from vegetable farming.

Similarly, FFS gives positive social implications in terms of good interaction among farmers, high solidarity in a group, and close communication with agricultural extension officials. The sharing of information became intense, particularly on crop production. Progress of extension became effective due to a substantial increase in the frequency of farmers' group meeting. These impacts were also due to enhancement in the human capital in terms of enhanced knowledge and innovations.

To sum up, FFS successfully empowered farmer communities. Farmers conveyed their interest to keep asking for FFS as training media in the future. Farmers have realized the

value and benefits of such FFS for augmenting livelihoods, as reflected by their willingness to provide its implementation cost partially. Farmers and gave feedback suggestions on the improvement of the FFS process. Farmers revealed that topics and materials of the school required adjustments to local needs and issues. This impact evaluation will be useful for the next implementation of FFS programs of agricultural production in the study sites and other parts of Indonesia. Since agricultural research institutions proactively improve technology, policymakers can introduce and spread technology through FFS. FFS is still one of the best approaches to empowering farmers and disseminating agricultural knowledge and innovations simultaneously.

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No potential conflict of interest was reported by the authors.

ORCID

Joko Mariyono http://orcid.org/0000-0002-0909-6665
Apri Kuntariningsih http://orcid.org/0000-0002-3201-4867

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