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Development of sustainable agriculture innovation in farmer women group

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Abstract
Women are mostly involved in agricultural activities in their daily life. The Farmer Women Group (FWG) was formed so that women are directly involved in efforts to increase agricultural output and as a motor for sustainable agricultural innovation. This can be done if supported by well-educated FWG, regular arrival of agricultural extension agents, facilitator guidance, ease of technological innovation that being developed, and infrastructure for the technology implementation. The research aims to review and describe the sustainable agricultural innovations which developed and implemented by Farmer Women Grup (FWG) of Wonoasri in Tulungrejo village, Batu City, East Java. Data collection using questionnaires and interviews. Since 2016, farmer women of Wono Asri has been trying to implement an organic farming system. Some of the agricultural innovations applied are the use of organic fertilizers, use of vegetable pesticides, sales and processing of agricultural products. Farmer women choose to combine the use of organic and chemical fertilizers with the reason that organic fertilizers alone are slow to grow and weigh less. Chemical pesticides are still used in combination with vegetable pesticides with the reason that they have longer killing power and are still rarely on the market. The marketing of the crop yields of the Wono Asri farmer women is taken directly by middlemen (wholesalers) who already have organic certificates. Processing of agricultural products is also carried out and marketed online through the social media of Village Business.

Keyword: sustainable development, agriculture, innovation, farmer women group, qualitative

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INTRODUCTION

The agricultural sector plays an important role because it contributes to people's lives and the sustainability of a nation's food (Muller et al., 2017; Garcia-Llorente et al., 2018). The agricultural sector creates high employment opportunities in the absorption of the workforce, provides food diversity so that the agricultural sector affects people's consumption and nutrition (Zurek et al., 2018; Faridi and Sulphey, 2019; Borsellino et al., 2020). In the Batu area, East Java, women play an important role in the agricultural sector. They are involved and carry out daily agricultural activities such as sowing seeds, moving and planting seeds from the nursery to the land, weed weeding, and harvesting.

Because women play an important role in agricultural activities (Allen et al., 2018; Dias et al., 2019; Osabuohien et al., 2019), then one of the Batu city government programs to optimize the potential of women in the agricultural sector is to form the Farmer Women Group(FWG). Farmer Women Group(FWG) was formed as an effort to directly involve women in efforts to increase agricultural products, such as being part of a motivator in the adoption and introduction of agricultural technology. Farmer Women Group (FWG) is a self-help group that grows from, by, and for the community, where government agencies, especially the Regency/City Agriculture Office, only function as motivators, facilitators, and stabilizers for this movement. The role of farmer women is very strategic in increasing the productivity of farming and has the potential to increase income and food security (Kerr et al., 2019; Fonjong and Gyapong, 2021).

One aspect that emphasized on the FWG is the importance of sustainable agriculture. The development of agricultural innovation is very urgent considering that land degradation is getting worse,

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the ecological balance is disturbed so that it affects agricultural productivity. Sustainable agriculture is not only defined as the problem of ecological damage and farming, but also post-harvest aspects, especially at the level of the trade system so that the added value of agricultural commodities can increase incentives for farmers(Eaton et al., 2008). In other words, sustainable agricultural innovation is a program that includes on-farm and off-farm development efforts, namely includes farming and market accessibility. (Hossain et al., 2017; Hermans et al., 2019; Zwane, 2020). The awareness of the importance of an environmentally friendly agricultural system has made the government continue to direct farmers to switch to organic farming systems. The area of organic farming in Indonesia since 2007-2018 has continued to increase. At the start of the Go Organic movement, in 2007 the total area of organic land in Indonesia was 69.605,9 hectares. In 2018 the organic land reached 251.630, 98 Ha.

Several research results prove that the institutional practices of farmer women are able to implement sustainable agricultural activities compared to conventional farmer institutions (Gramm et al., 2020). Empowering women through the forum for farmer women groups has a probability of success in implementing sustainable agricultural practices than conventional farmer groups. Farmer women institutions more emphasize on the efforts to increase the role of female farmers in meeting the primary needs of the family. The group of farmer women, on average, has a variety of activities that are dominant, such as home gardens cultivation which have been neglected (Manoppo et al., 2018). Sustainable agricultural innovation can be implemented properly if it is supported by well-educated farmer women groups, the presence of agricultural extension agent who comes regularly, the guidance of facilitators, the ease of technological innovation being developed, and the support of technology application infrastructure.

In Batu city, East Java, as one of the Agropolitan cities, women play an important role in the agricultural sector. From BPS data from the 2018 workforce census, the number of workers in Batu city is 108 990. There are 27.361 workers in the agricultural, fishery and forestry sectors, where as many as 8.397 are women. (https://batukota.bps.go.id/statictable/2019/10/09/469).

Batu City as an agropolitan tourism destination, through the Office of Agriculture, continues to encourage and facilitate farmers to implement organic agriculture. Since the Batu Go Organic program was launched, the area of organic land in Batu city has increased every year. In 2017, the area of development of the organic area was 134,335 Ha with an area of 18,4252 Ha that passed the certification. In 2018 the area for the organic area development reached 140 Ha, with an area of land that passed the organic certification of 25,0624 Ha (Laporan Akuntabilitas Kinerja, 2018). Organic farming land that continues to grow along with the increasing number of farmer groups, especially the Farmer Women Group, which one of them is FWG Wono Asri. Farmer Women Group (FWG) which based in the agropolitan area of Batu City, with the average commodity of organic vegetables. According to Riyani (2017)as an organic farming area for tourism purposes, in Batu city, there are 19 Farmer Women Groups (FWG) that continue to convert agricultural land to organic. Based on this, this study aims to review and describe sustainable agricultural innovations developed and implemented by Wonoasri Farmer Women Group in Tulungrejo village, Batu City, East Java.

METHOD

This research is a qualitative research, namely research used to examine the conditions of natural objects, where the researcher is the key instrument (Sugiyono, 2005).The research was conducted in Tulungrejo Village, Bumiaji Subdistrict, Batu City. The research subjects were members of the Wono Asri Farmer Women Group. Data collection methods are through observation, questionnaires and direct interviews with respondents. The qualitative data is reduced, then presented in the form of a matrix and verified. This research was conducted through action research that raised KWT empowerment through deepening and field exploration. Some of the ways (activities) carried out to operationalize the action research approach in this study have the following stages (Cooper and Schindlers, 2014):

1. Learning scenarios
   At this stage, the researcher identifies, determines, and compiles a framework of activities and models used in action research related to KWT participation in sustainable agricultural innovation and its effect on household welfare.
2. Corrective action
   In this stage, the researcher assesses the activities and participation of KWT in the research location to see whether the implementation of these activities is running smoothly, has obstacles, and so on. Then the researcher

compiles and formulates corrective action from the assessment.

3. Planning and implementation
   After evaluating stage 2, the researcher then makes a plan for improvements to the problems faced by KWT and then implements it.
4. Observation and recording of observations
   The implementation results are then observed and recorded, regarding whether it is running smoothly, the obstacles that are still being faced, and the level of success of these activities.
5. Assessment.
   At this stage, the researcher conducted an assessment from the results of stage 1 to stage 4.

RESULT AND DISCUSSION

RESULT

From the results of interviews with the Farmer Women Group (FWG) regarding the profile of FWG activities in the development of sustainable agricultural innovations, it can be seen that they already know about organic farming. Agricultural extension workers have often provided assistance and training with FWG in Tulungrejo. Based on the interview with the head of the WKT, it was revealed that:

"*For cultivation of the land I used to hire people to hoe, sir. For the area of my land, it takes three people to work it, usually before planting. For the selection of seeds, I buy seeds from the farm shop. Choose the one with good results, the F2 fertilizer is one of the most important things to increase agricultural yields. In order the soil is not too damaged, I use manure.In this village there is a lot of cow dung, which belongs to the farmer groups themselves. So manure is always available. How many times it depends on the plant, Sir. As soon as the growth slows down, I add manure. Each plant also has different needs. Carrots the more often, the more intensely they are fertilized. Cabbage is a bit rare. For the mustard greens, the fertilizer is enough just once during planting until harvest.It is the most difficult to control pests and diseases, because my land is open land. There are pests that attack, especially Chinese cabbage and carrots. So pesticides are very important to me. For pesticides I use chemical and vegetable pesticides. So combined, sir. For post-harvest activities, thank God there are no problems. The types of vegetables I grow are the types of vegetables that are selling well in the market. It was really difficult at first, sir. This is semi organic. The price is a bit expensive. But in the end there was an organic vegetable seller who put it on the market. I transported the crops myself. Incidentally there is a vehicle itself, to make transportation easier. Delivered to organic vegetable traders, usually from the land directly taken to traders so that they can be directly packed*"

For the total application of sustainable agricultural innovations, farmers are still in difficulties. Some agricultural innovation activities that can be applied are the use of organic fertilizers and the use of vegetable pesticides to control pests and plant diseases.The results of the interviews from 7 (seven) informants, for land management, the FWG member is still with the traditional way, namely hoeing. There are no FWG members who have tractors. Some of them hire people to cultivate the land because the land is large enough or their husbands have their own work. For those who hire people to hoe the land, there is an extra expense to pay. Some of the land is cultivated by their husbands themselves, because the land is not too large. Even though they have been given training on how to select good seeds/plant seeds, but from the results of the interviews show that FWG farmers prefer factory-produced seeds. Their reasons are more practical, easy and also affordable.

The members of Wono Asri Farmer Women Group mostly use manure in the form of cow dung as the main fertilizer. This is based on interviews with WKT representatives:

"For fertilizer problems, I use manure and chemical fertilizers as well. Yes, it is mixed like that. Incidentally, the Farmer Women Group here has a cattle farm. Yes, this cow dung is used as manure. But wow, if this pest problem is the heaviest one. Actually, I don't want to use chemical pesticides. But I still have a hard time. So complicated hehe. So, part of it was forced to use vegetable pesticides, and some for pests and diseases mostly using chemical pesticides"

The reason is the abundant availability of cow dung in the village of Tulungrejo. They perform fermentation themselves before the manure is applied to the land. Almost all farmers who are members of Wono Lestari Farmer Women Group are aware of the impact of applying chemical fertilizers to the land. So far they have received extensions from officers or agricultural assistants. The longer the soil fertility will continue to decline so that the fertilizer that must be given continues to increase. This will cause a continued rise in operating costs for the purchase of chemical fertilizers.

There is one of the FWG members who has left chemical fertilizers and totally uses organic fertilizers in the form of cow dung and organic liquid fertilizers which are sold in the market. According to her, plant growth is slower and the yield is smaller. It takes more effort and accuracy to apply organic fertilizers, because there are no definite rules for the intensity of

fertilizer application for each plant. If the plant's growth seems to be slowing down, that means it's time for the plant to be fertilized. According to her, there is a fairly large fee for buying organic liquid fertilizer. But she tried to be discipline applying to maintain land fertility.

Some members of Wono Asri Farmer Women Group use chemical fertilizers as well as organic fertilizers, depending on the type of plant. For cauliflower, carrots and broccoli plants given chemical fertilizers. Meanwhile, pakcoy, spinach and chicory were given organic fertilizer. According to them, the growth of cauliflower, carrots, broccoli and cabbage will be very slow and the yields cannot be large when given organic fertilizers alone. So it needs to be given chemical fertilizers. Meanwhile, pakcoy and chicory, the results are quite good even if only given organic fertilizer. They usually obtain chemical and organic fertilizers by buying at the farm shop. The price is quite expensive and the intensity of frequent fertilizer application causes the operational costs for fertilization to be quite large. However, some of them persist in fertilizing with chemical fertilizers because the results are quickly visible. So that most of the FWG farmers just want to see the results immediately, ignoring the environmental consequences and increasing operating costs.

After being given extension and training in making organic fertilizers with the addition of microbes, several FWG members began to provide additional organic fertilizers to meet nutrient needs. Chemical fertilizers are still used for certain plants, while other plants are replaced by organic fertilizers. Interview Result:

> *"In terms of fertilization, just taught how to make organic fertilizer, but the effect is faster on plant growth. So, what was given yesterday sir? Yes, given microbes. So that the growth is faster. So now I try to apply it, sir. In terms of costs that is definitely cheaper, sir. Homemade fertilizer, it is cheaper. So that reduce costs, sir hehehe"*

According to them, with this way, the operational costs of fertilizers are reduced considerably, so that they can be saved. However, there are also many FWG members who continue to only use chemical fertilizers. They do not consider the ever-increasing costs and the consequent land damage. For FWG members who have used organic fertilizers from the start, the existence of training to make organic fertilizers with the addition of microbes can certainly reduce the cost of buying fertilizers. With the addition of microbes, it can accelerate the process of plant growth, so that plants are more fertile and hopefully a faster harvest period.

From the results of the interviews, it can be seen that pest and disease control is the main problem for FWG farmers in Tulungrejo. From the total 29 members, only 14 use vegetable pesticides to control pests. Even then, they only apply it to several types of vegetable plants. While most of the other plants they still apply chemical pesticides to control pests. According to them, the operational costs to buy pesticides are quite large because of the high price. Moreover, before harvest they will be more intense spraying the plants with pesticides for fear of crop failure. There are also farmers who use vegetable pesticides, because the killing power of pests is not too high, becomes the main reason for other farmers to keep using chemical pesticides as the main pest control.

With training on making vegetable pesticides from neem leaves, some FWG members switched from buying vegetable pesticides to making their own. Materials that are widely available in the environment and relatively easy way of making make them interested. According to them, the cost of purchasing vegetable pesticides can reduce the cost of purchasing pesticides which are quite expensive. However, some FWG members still chose chemical pesticides with the reason that they had a faster killing power and less intensity of spraying. So that it can save time and effort. They do not take into account the high cost of purchasing the chemical fertilizers

The activities carried out by FWG farmers during post-harvest are marketing the crop yields. There are several FWG members who have their own vehicles so that from their land they can directly transport their crops to the vegetable market. There are also vegetable traders who directly visit them from the land and buy them at a relatively cheap price. Especially during the big harvest, if lots of similar vegetables are harvested at the same time, the price will drop sharply. Even just for a return on investment is difficult.For farmers who have organic vegetable crops, their crops will be taken by organic vegetable traders. Their crops are used to supply demand for organic vegetables in hotels, restaurants and cosmetic companies. Even though there are organic vegetable traders who take the harvest, they sometimes reject their vegetables because sometimes the size of their organic vegetables does not meet the standard. This rejected organic vegetable that is difficult to market, because most residents in the village of Tulungrejo and surrounding areas do not yet have an awareness of the importance of consuming organic vegetables. Moreover, the price is quite expensive.

In addition to marketing fresh ingredients, the farmer women of Wono Asri, also conducted the processes of agricultural products. Some of the products produced are organic banana chips, mushroom sticks, organic strawberry jam, coffee powder and ginger powder. By conducting the

processing of agricultural products, it can increase the selling value. Products are sold online through social media accounts managed by PKK Usaha Desa.

According to community leaders and village heads, the government continues to encourage the application of the system of organic farming in the Tulungrejo village. The government deployed a team of agricultural extension workers and assistants to provide the extension about the environmental damage caused by conventional farming systems. The high operational costs for fertilizers which will continue to increase are also explained. Even the government provides financial assistance every month for farmers who are willing to switch to an organic farming system, because one of the reasons farmers are reluctant to switch to an organic farming system is because of the length of time to harvest. However, it turns out that even with the special funds for organic farmers, not many farmers in Tulungrejo are willing to switch to the organic farming system. There were also residents who initially agreed, but after the first harvest they returned to the conventional farming system.

DISCUSSION

The sustainable agricultural system is a new phenomenon that has started to develop since the 1990s (Harwood, 1990; Reganold et al., 1990). This agricultural system emerged as an answer to various problems resulting from the application of conventional agricultural systems that use a lot of chemical substances such as chemical fertilizers and pesticides(Offenberg, 2015; Gupta et al., 2017; De Oliveira et al., 2018; Zulfiqar et al., 2019; Singh et al., 2020). This agricultural system became widely known among farmers around the 1970s and had a positive impact on a significant increase in agricultural production. However, on the other hand, this agricultural system also has negative impacts, such as environmental damage and health problems due to the use of fertilizers and chemical drugs which continue to increase(Dewi et al., 2019).

Go Organic farming program! By the city of Batu with an agropolitan area, one of which is the Bumiaji sub-district, many Farmer Women Groups (FWG) were formed. One of them is Farmer Women Grup (FWG) of Wono Asri, in Tulungrejo village, Bumiaji sub-district. Agricultural extension workers from the Office of Agriculture and educational institutions often provide assistance and training with FWG in Tulungrejo, so that farmers in Bumiaji know a lot about organic farming. Farmers' knowledge about the impact of using chemical fertilizers on soil conditions, the impact of chemical fungicides and pesticides on the environment and health is also quite good.

The formation of the Wono Asri Farmer Women Group (FWG), as a forum for increasing knowledge in the agricultural sector for women, so that farmer women can get access to resources (land, fertilizers, pesticides, labor and capital in the form of funds), training (making organic fertilizers, vegetable pesticides, processing products), as well as information on organic markets, especially in Malang. The FWG organization plays a very important role in the implementation of sustainable agricultural innovation, because through a forum for institutions/organizations it can facilitate education to the public about the dangers of conventional agriculture and the importance of returning to organic farming.

Farming behavior includes knowledge, attitudes and skills (Öztaş et al., 2018; Truman and Elliott, 2019; Yanti et al., 2020). These three aspects play an important role in the implementation of a sustainable agricultural system. The higher the level of farmer knowledge, then the more positive the response of the farmer's attitude (Zamasiya et al., 2017; Jiang et al., 2018). This knowledge and attitude will then encourage the high skills of farmers in relation to the success of the benefits that can be obtained from the application of a sustainable agricultural system (Dewi et al., 2019).

The farmer women who are members of the Wono Asri farmer women group (FWG) have identified themselves as farmers, as in the results of interviews when asked what their occupation was, 98% answered that their work was farmers.As farmers, they have access to agricultural land, can get labor for large areas of land, and access capital from farmer cooperatives or through the arisan system in FWG.The sustainable agricultural innovation of the farmers of Wono Asri Farmer Women group (FWG) is emphasized on a smaller agricultural scale, planting types of crops that are in high demand in the market so that they have the potential to increase their income.

The results of interviews with the member of Wono Asri Farmer Women group (FWG), they have tried to implement sustainable agricultural innovation (organic farming), although not completely. Among the efforts made by members of Wono Asri Farmer Women Group (FWG) is to use organic fertilizers as the main fertilizer.The organic fertilizer used is manure from cow dung which is abundant in the village of Tulungrejo. They ferment themselves before the manure is applied to the land.

Fertilizer is one of the things that farmers really need to add nutrients to plants (Siregar, 2018; Gajah, 2020).The use of chemical fertilizers for decades in Indonesia has been proven to damage the soil and the environment(Guangming et al., 2017; Li et al., 2017; Lu et al., 2019). So that in recent years, farmers in

Indonesia have started to be encouraged to use organic fertilizers to reduce soil and environmental damage. Organic fertilizers applied to agricultural land will improve soil quality while providing nutrients for plants, so that the plants will experience good growth which in turn will increase agricultural production.

It is hoped that a sustainable agricultural system can minimize the negative impact of a chemical-based agricultural system, so that the balance of the ecosystem is maintained. Sustainable agricultural systems are often referred to as a concept of thinking about the future, because they not only provide benefits to mankind at present, but also in the future(Edwards, 2020; Stearns, 2020; Darnhofer, 2021).

Some of the farmers who are members of Wono Asri Farmer Women Group (FWG) admit that they have difficulty using 100% organic fertilizer on their land, due to low yields, slower plant growth and difficulty in obtaining organic fertilizers on the market. Researchers provide training in making organic fertilizers with materials that are widely available in Tulungrejo village, namely manure, liquid fertilizer and compost. To get organic fertilizers that can be absorbed more quickly by plants (thereby increasing the growth rate), microbes are added to the making of fertilizer.

A sustainable agricultural system is needed to change the mindset of farmers, which initially was only oriented towards economic development to then involve social and ecological development. Sustainable agriculture is not only oriented to produce products continuously but also to preserve existing resources and maintain soil fertility for the long term and maintain social stability(Boutasknit et al., 2020; Shrestha et al., 2020).

With the existence of the training in making organic fertilizers with the addition of microbes, some members of the Farmer Women Group (FWG) of Wono Asri were able to reduce their dependence on chemical fertilizers. For FWG members who are accustomed to using organic fertilizers, making their own fertilizers can reduce the cost of buying fertilizers. Some FWG members chose to keep using chemical fertilizers for certain plants, while other plants were replaced by organic fertilizers. And some FWG members have persisted in using chemical fertilizers, by wanting to harvest quickly and get immediate results.

The principle of maintaining soil fertility without adding chemical fertilizers is to maintain the nitrogen cycle and carbon cycle in the soil. The presence of nitrogen in the soil is very important because plants need nitrogen for growth (Mahmud et al., 2020; Munasinghe-Arachchige and Nirmalakhandan, 2020; Plett et al., 2020). Meanwhile, carbon is an important element whose cycle occurs through the exchanges between the soil and the atmosphere through the process of photosynthesis and decomposition (Hisatomi and Domen, 2017; Gong and Zhao, 2018; Bercel and Kranz, 2019).

Conventional agricultural activities that have been running in Indonesia so far have changed the condition of the soil becomes damage due to the use of agrochemicals. Diversification of soil biota continues to decline, both earthworms and microorganisms. Microorganisms that are in the soil will soften the organic waste which will then be broken down by earthworms. Earthworm activity can maintain the availability of N, P, K in the soil so that it is good for plant growth and agricultural activities(Teodoro et al., 2015; Dulaurent et al., 2020; Pramanik et al., 2020).

Quality soil can be maintained by preventing various things that can cause soil erosion (Gianinetto et al., 2020; Mohammed et al., 2020; Yu et al., 2021). This can be done by enriching soil fertilizing organisms, planting part of the land with strong rooted plants, making terraces on sloping land, applying countur farming (a planting system based on soil contour lines) so that plant roots can be solid and able to withstand erosion, and optimize waterways. To maintain soil fertility, composting and using mulch can also be done (Abd El-Mageed et al., 2018; Jabran, 2019).

Most of the FWG members use chemical fertilizers as well as organic fertilizers, depending on the type of plant. For cauliflower, carrots and broccoli plants given chemical fertilizers. Meanwhile, pakcoy, spinach and chicory were given organic fertilizer. According to them, the growth of cauliflower, carrots, broccoli and cabbage will be very slow and the yields cannot be large when given organic fertilizers alone. So it needs to be given chemical fertilizers. Meanwhile, pakcoy and chicory, the results are quite good even if only given organic fertilizer.

The knowledge of the farmers of Wono Asri Farmer Women Group (FWG) member about the dangers of chemical fertilizers is quite good. They can explain that the use of chemical fertilizers for a long time will damage the soil, so that the production costs to buy fertilizer will continue to increase. The FWG farmers also have a good understanding of the benefits of organic fertilizers. All members can explain well the importance of organic fertilizers in maintaining soil quality. However, it turns out that not all members of Wono Asri Farmer Women Group (FWG) are 100% willing to apply organic fertilizers to agricultural land. There are those who choose to combine organic and chemical fertilizers, and a small proportion (2 people) choose to stick with chemical fertilizers. For KTW members who do not apply the advice of extension workers and researchers to use organic fertilizers on their agricultural land is because they are still in doubt about the results obtained if they switch to organic fertilizers. Lower yields with longer growth lead them to prefer chemical fertilizers.

Pest and disease control is a major problem for farmers of Wono Asri Farmer Women Group (FWG)

in Tulungrejo. At the beginning of the study, from 19 members, only 3 used vegetable pesticides to control pests, and they were limited to a few types of vegetable crops. While most of the other plants they still apply chemical pesticides to control pests. The use of these chemical pesticides will increase during the rainy season and before the harvest to avoid crop failure. There are some members who use vegetable pesticides, but due to the low availability in the market, they choose to combine with chemical pesticides.

The presence of training to make vegetable pesticides from Neem leaves, garlic, galangal and lemongrass made some FWG members switch from buying vegetable pesticides to making their own. Materials that are widely available in the environment and relatively easy way of manufacture make them interested. According to them, the cost of purchasing vegetable pesticides can reduce the cost of purchasing pesticides which are quite expensive. However, some FWG members still chose chemical pesticides with the reason that they had a faster killing power and less intensity of spraying. So that it can save time and effort. They do not take into account the high cost of purchasing chemical fertilizers.

The availability of vegetable pesticides that are not yet widely available on the market, there are still few types of plant pests and diseases that can be controlled, the slower killing power of pests and their distribution to the community/organic farmers is still small, affecting the interest of the farmers of Wono Asri Farmer Women Group (FWG) to switch to vegetable pesticides. Agricultural extension workers have provided education about planting with a rotating system, planting various types of plants in one land and providing a special place for habitats for natural enemies of plant pests but FWG members still experience difficulties in practice in the field. In one land mostly only 2 or 3 types of plants are planted. Most of their reasons are the relatively narrow land area, if planted with various kinds of vegetables, the harvest time is not the same, it will only produce a small amount of yield per harvest. This made it difficult for them in marketing, because traders would not want to go to the land to take a small amount of harvest.

The agricultural intensification program for decades in Indonesia has made farmers dependent on chemical pesticides to control pests. The stigma that exists in conventional farmers is that chemical pesticides are effective and kill pests quickly, are quite low cost, and are easy to use (Munggarani et al., 2018). Even though the use of chemical pesticides has a negative impact that can damage the ecosystem (Srivastav, 2020). The thing that not many farmers (in fact most people) know about is the effects of acute toxicity on the food chain. All members of Wono Asri Farmer Female Group (FWG) have good knowledge about the negative impact of chemical pesticides on the ecosystem. They can explain that chemical pesticides can kill non-target organisms, and even pollute and destroy air, soil and water. Chemical pesticides also kill non-pest organisms, thereby reducing the diversity of living things in the long term. The use of pesticides for a long time will increase pest resistance. As a result, the need for farmers for chemical pesticides will continue to increase, so that the cost of dealing with pests will increase, the higher the dosage will endanger the ecosystem and human health(Rani et al., 2020; Terziev and Petkova-Georgieva, 2020; Warra and Prasad, 2020).

Pest control technology (OPT) in sustainable agricultural innovation applied by the farmers of Wono Asri Farmer Women Group (FWG) is by using vegetable pesticides. In fact, there are innovations in managing pests without damaging the environment, and can even maintain environmental sustainability and balance, namely through biological control. Biological control is carried out using natural enemies of pests(Iturralde-García et al., 2020; Le Gal et al., 2020). Natural enemies are organisms capable of killing or weakening other organisms, consisting of (1) predatory insects and mites; (2) parasitoid, namely insects that live freely in the adult stage, while in the larval stage are parasitoids in other insects; and (3) parasites, pathogenic microbes and antagonists, such as nematodes, fungi, bacteria, viruses and protozoa (Bailey *et al*., 2010). To carry out this biological control, it is necessary to know what types of plant-disturbing organisms and their natural enemies, what plants are preferred as habitat for natural enemies so that farmers can provide their habitat. So controlling pests with sustainable agricultural innovation can be done by providing habitat for natural enemies, making physical barriers (can use greenhouses and trenches), and regulating planting times. Crop rotation is an important factor in sustainable agricultural innovation activities. Crop rotation is also a way to control pests. Crop rotation will destroy the life cycle of pests, so that pests cannot damage crops at a detrimental level economically(Mpumi et al., 2020).

Harvest and post-harvest activities are activities that are linked in sustainable agricultural innovation. From the research, it is known that since 2016 the members of Wono Asri Farmer Women Group (FWG) have implemented sustainable agricultural innovations by using organic fertilizers and reducing the use of chemical pesticides. Support from the Office of Agriculture by providing companion extension agent keeps them motivated. However, at harvest time, according to the vegetable collectors, the vegetable quality from the members of Wonosari Farmer Women Group (FWG) did not meet the standard. Organic vegetable collectors carry out sorting, to separate the crop yields from a physical point of view and whether the vegetables are attractive or not. Then they classified the vegetables by weight. It turned out that only a few of the crop yields from the members of FWG met the standards

set by the collectors, so many were rejected. From this incident, many members of FWG decided to return to conventional farming using chemical fertilizers and pesticides.

Consumers of organic vegetables in Indonesia are still limited, most of whom are middle and upper class. The low level of education of the members of Wono Asri Farmer Women Group (FWG) makes it difficult for them to penetrate the technical and marketing channels which controlled by other organic entrepreneurs. In Malang Raya area, the place for organic product marketing is still concentrated in certain areas. The members of Wono Asri Farmer Women Group (FWG), who has been implementing organic farming, have marketed their crops to the large organic vegetable traders. Of course they buy at a lower price. These traders market their crops to supermarkets and meet hotel demands.

Many supermarket chains are currently accepting organic vegetables. However, the members of the farmer women group (FWG) of Wono Asri, is a community that is not very strong financially. Marketing by entering supermarket chains can increase the number of sales and bigger profits, but they are constrained by the high cost of listing fees and the payment system in the behind for quite a long time. The minimum number of certain vegetables that must be sent is difficult for FWG farmers to fulfill because the size of the land is not too large.

Most of the members of Wono Asri Farmer Women Group (FWG) have secondary education (Junior High school and Senior High school). While the others graduated from elementary school. The low level of education of the members of the Wonosari Farmer Women Group (FWG) greatly has an influence on the running of sustainable agricultural innovation.At first, farmers of FWG members on average still low on the long-term negative impact of using chemical fertilizers and chemical pesticides on the soil and environment. Low education also resulted in the farmers of Wonosari Farmer Women Group (FWG) becomes unwise in using chemical pesticides.The presence of agricultural extension agents and assistants makes the farmers of Wono Asri Farmer Women Group (FWG) understand the impact of chemical fertilizers and pesticides on the environment. But it turns out that just knowing the impact of chemical fertilizers and pesticides does not make the farmers of Wono Asri Farmer Women Group (FWG) want to convert from conventional farming to organic farming. There are many factors that influence whether the farmers of Wono Asri Farmer Women Group (FWG) want to convert from conventional farming to organic farming or not. The educational factor plays an important role in this(Abdullah and Samah, 2013; Saqib et al., 2018; Mexmonov, 2020). Farmers who have higher education, will have more knowledge including the impact of the use of chemical fertilizers and chemical pesticides on the environment and human health, have clear objectives on sustainable agriculture, and have a good view on the quality of organic farming(Öztaş et al., 2018; Truman and Elliott, 2019; Yanti et al., 2020). Farmers with good education have a critical attitude about the negative impact of pesticides on food quality (Bondori et al., 2018; Bagheri et al., 2021).

Farmers of the Wono Asri Farmer Women Group (FWG) member is known to use vegetable/fruit seeds from factory production. So all are conventional seeds. Conventional seeds produced by factories are generally conditioned to be cultivated so that they are adaptive to the use of chemical fertilizers and chemical pesticides. As a result, seeds will have difficulty developing optimally if cultivated with an organic system that is in line with sustainable agriculture.To implement sustainable agricultural innovation, Farmer Women Group (FWG) of Wono Asri requires organic vegetable plant seeds that can be adaptive to the Batu city environment. Batu's local fruit and vegetable seeds are reliable seeds for organic farming. However, obtaining superior organic seeds in Batu is still difficult. Organic seeds must come from organic plants that are processed without the use of chemicals at all, so they have a great risk of contamination. The FWG farmers find it difficult to prepare their own seeds from their crops. Without the use of chemicals, the seeds they prepare are damaged, do not grow, or not optimally grow because they have been attacked by disease from the start

In the end, the high and low levels of education and knowledge will affect various other things in the implementation of sustainable agricultural innovation (Pivoto et al., 2018; Zwane, 2020). Their perspective on the use of chemical fertilizers and pesticides and their impact, selection of seeds, marketing methods, and various aspects related to sustainable agricultural innovation. This problem of perception is very important for the conversion of conventional agriculture to organic farming. A farmer is more likely to become an organic farmer if he/she has a positive perception about the sustainability of organic farming and the harmful effects of pesticides on food quality. Farmers of Wono Asri Farmer Women Group (FWG) who have the goal of maximizing profits and indeed want to continue to be farmers will be more likely to switch to an organic farming system. So that a fundamental change in attitudes and perceptions is needed to convert (switch) from conventional agricultural systems to sustainable agricultural systems or organic farming.

CONCLUSION

Since 2016, Wono Asri farmer women have tried to implement a sustainable agricultural system using organic fertilizers and vegetable pesticides on part of their agricultural land, marketing of their crops is carried out through certified organic vegetable

traders with prices relatively the same as the price of non-organic vegetables so that it less motivates farmer women in trying to organic farming.

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