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Enhancing Productivity and Family Income through the Development of Coffee Plant Breeding and Postharvest Handling Technology

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A B S T R A C T

the UUT group's family income. Agrosemesta aims to increase the productivity, capabilities, and skills of farmers' groups in the coffee business. This activity aimed to improve coffee farmers' knowledge, skills, and capabilities in breeding coffee plants, green bean storage, and marketing strategies. The method used consists of surveys, observations, mentoring, knowledge transfer, practice, documentation, and evaluation. The result showed that the UUT group. Agrosemesta has sufficient knowledge and skills to develop coffee breeding programs and has used social media to promote and increase market access. Otherwise, in terms of storage, green beans are not yet stored properly in the warehouse. The group did not use temperature and humidity control during green bean storage due to limited financial and skill resources. However, the group has a strong commitment to improving breeding techniques for coffee plants, green bean storage, and the marketing strategy to grow the coffee business in the future.

Contribution to Sustainable Development Goals (SDGs):
SDG 2 : Zero Hunger
SDG 9 : Industry, Innovation, and Infrastructure
SDG 12 : Responsible Consumption and Production

Economic development in rural areas contributes to sustainable development. Enhancing

1. INTRODUCTION

1.1. Background

Good Agricultural Practices (GAP) significantly enhance the health and productivity of coffee plants by optimizing cultivation methods like proper planting density, appropriate fertilization, effective pest and disease management, strategic pruning, and soil conservation, leading to increased yields of high-quality coffee beans while minimizing environmental impact and promoting long-term sustainability in coffee production. In addition, well-seeded coffee plants contribute to health and productivity.

There are many aspects of GAP in coffee cultivation, and their effects need to be considered, such as plant selection and spacing: choosing suitable coffee varieties adapted to the local climate and planting them at optimal densities maximises light exposure and resource utilisation, resulting in better growth and fruit set. Soil management: regular soil analysis and appropriate fertilisation practices, including organic matter application, maintain optimal nutrient levels, and improve plant vigour and bean quality. Shade management: installing shade trees or shade cloth helps regulate temperature and humidity, reducing stress on coffee plants and enhancing their resilience to environmental fluctuations. Pruning techniques: regular pruning promotes healthy growth by removing unproductive branches, encouraging

new shoots, maintaining a balanced canopy, and optimising light penetration and fruit production. 5) pest and disease control: integrated pest management (IPM) strategies like biological controls, resistant varieties, and targeted chemical applications minimize pest and disease damage, protecting plant health and yield. 6) water management: proper irrigation practices, including efficient water application methods and monitoring soil moisture levels, ensure adequate water supply during critical growth stages, preventing stress-induced yield losses.

One method to propagate coffee plants is by cuttings, which is currently growing rapidly, especially in robusta coffee. Most large state and private plantation companies have used cuttings as planting material or to rejuvenate their coffee plants. The growth of cuttings is more uniform and has the same genetic characteristics as the parent. The root system of cuttings is also quite strong, resembling that of seedlings. Propagating coffee plants by cuttings requires a suitable environment and a suitable planting medium to stimulate root development. The desired planting medium for propagating coffee plant cuttings is one with good air circulation. Addition of compost fertilizer is expected to improve soil structure therefore coffee cuttings planting medium will have good air conditioning and can also provide the nutrients needed by plants, such as organic N, P, K and C [1]. Coffee plant propagation can be done generatively (seedling), vegetative (cuttings) and a combination of generative and vegetative (grafting).

Many farmers do not know how to produce coffee plant seeds. However, some farmers breed coffee plants based on their experiences. However, breeding success is affected by farmers' knowledge and skill levels in coffee breeding technology. Otherwise, most coffee farmers lack the knowledge and skills to store their coffee beans, thereby reducing their quality and safety.

The physical quality, coffee taste, and chemical composition of coffee beans are determined by the cultivar, environmental conditions, and agricultural management [2]; [3]. According to [4] & [5], postharvest processing is a key factor contributing to the high quality of coffee. Coffee is one of the most traded commodities and popular drinks nowadays, as well as the most widely consumed and traded beverage in the world after water, due to its characteristic aroma and psychoactive effects [5]; [6]; [7]; [8]; [9]: the coffee farming group, especially UUT. AGRO SEMESTA, based on their experience of storing green beans for several months, can be stored for up to 1 year.

However, they do not know for certain the changes and quality degradation that occur during storage, nor the risk of the emergence of new compounds that could be harmful to humans. Several research results showed that storing coffee beans (green beans) in an uncontrolled room (inappropriate temperature and humidity) can cause degradation and damage to green beans. The longer the storage time, the greater the damage. On the other hand, the group still manages its business conventionally, resulting in slow business growth and weak competitiveness.

According to several research studies, the method can be used to address the challenges faced by the UUT. AGRO SEMESTA is a community service carried out by the Universitas Warmadewa team. This community service collaborates with Waseda University, Japan, and UUT. AGRO SEMESTA as local partner.

Several problems found in UUT. AGRO SEMESTA are: the breeding of coffee plants is small-scale due to limited knowledge and skills in growing coffee, lack of postharvest handling techniques, and product sales mostly use conventional marketing techniques.

1.2 Objective

The objectives of this community services namely: 1) to increasing the knowledge and skill as well as ability the group members related of breeding coffee plants techniques, 2) improving the capability and skills on storaging coffee bean techniques, and 3) to manage coffee plant seeds and coffee products based on digital marketing.

2. MATERIALS AND METHODS

2.1. Materials

Community service activities are implemented through mentoring and counselling, strengthening the UUT's human resource capacity. AGRO SEMESTA. The mentoring activities carried out include: 1) observation and interviews, 2) knowledge transfer and discussion, 3) training/practices, and 4) documentation.

2.2. Methods

The methods were used to conduct community services, including:

1. Surveys, observations and interviews
2. Identify the problem
3. Determining solutions to overcome the problems
4. Implementation of activities.
5. Providing theory, discussion and practice
6. Evaluation of activities and results.

a. Technique of breeding coffee plants

When propagating coffee plants using cuttings, superior planting material is required: from superior varieties and of a suitable age (neither old nor young). Coffee planting material is taken from orthotropic branches (primary branches) with a length of 40 cm, usually having 3 stem segments. Planting material for segment cuttings is a single segment cutting from a 5-6-month-old orthotrophic shoot and comes from the recommended superior scion clone garden (ceding). The cutting length is 6-8 cm; segments used are numbers 2-4 from the shoot, each with a pair of leaves cut, and the base is cut at an angle in one direction [10].

Based on research by Ref. [11] the highest success and growth in propagation of one-segmented cuttings for Robusta coffee is the BP 308 clone and based on research by Ref. [11], the use of Rootone-F has a good influence on the initial growth of one-segmented coffee cuttings, while the media composition of 25% sand and 75% manure provides the best root growth environment. This research aimed to determine the growth response of various numbers of coffee seedling cuttings on the media plant soil-compost.

b. Producing of organic fertilizer

Coffee skin waste is very good as an alternative to inorganic fertilizer, because of the benefits and contents of coffee skin waste. Coffee skin waste organic fertilizer is fertilizer that originates from or is made from coffee processing waste in the form of coffee skins which are processed using a wet processing system. Coffee skin waste is used as organic fertilizer by adding coconut sugar or molasses and EM4 (Effective Microorganisms), which is fermented for 2-3 weeks. The contents of coffee skin

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waste are tannins, pectin, caffeine, chlorogenic acid, cofeic acid and anthocyanins.

The process of making organic fertiliser involves decomposing organic material from coffee skin waste through aerobic fermentation with the help of microorganisms. Tools required:

(1) Scales for measuring.
(2) Spade for mixing dough
(3) Bsk/tarpaulin for processing coffee waste fertiliser.
(4) Plastic/tarpaulin for base and cover. Materials needed:
(1) 600 kg of coffee skin waste.
(2) 300 kg of manure.
(3) One kg of sugar or molasses
(4) Em4 or Tricoderma.

Procedure steps:

1) Waste coffee skins + manure are placed on the tepal.
2) Sugar or molasses and EM 4 are diluted with 100 liters of water.
3) Mixing of coffee waste and manure is piled up 20 cm thick, then sprinkled evenly with a mixture of sugar or molasses and em4. Then on top, put more coffee husk waste and cow dung, then sprinkle again with liquid sugar or molasses and EM4 until evenly mixed. And so on until the coffee husk waste runs out until it reaches a height of 75 cm.
4) The pile is incubated/aged for 2-3 weeks, covered with a tarpaulin.
5) Once a week the mixture must be stirred to regulate the temperature.
6) T he process of making organic fertilizer from coffee waste runs perfectly, with the result being that there will be no mold and a sour smell like tape.
7). Organic fertilizer from coffee waste can be applied directly to coffee plantations
8) The dosage for coffee plants is 5 - 10 kg per tree, placed in the leaf circle.

c. Improving the storage technical method of coffee beans

Most farmers/farmer groups store green beans in warehouses that do not meet SOP requirements. This condition was also found on the UUT. AGRO SEMESTA in Pajahan village Pupuan Tabanan Regency. The group does not have experience storing green beans; they were just put in the warehouse, so their quality and safety have decreased. Meanwhile, the storage stage, are not in accordance with standards. This can be seen in the condition of the storage room (warehouse), which is not equipped with appropriate temperature and humidity controls for storing green beans. Furthermore, the storage time is not known with certainty, even though storage will cause changes and a decrease in green bean quality. The business management carried out so far by the group is still mostly conventional, slowing business growth.

Based on the weaknesses mentioned above, in this PKM activity, groups will be introduced to and taught proper green bean storage techniques to maintain quality and reduce damage. The results of several studies that have been carried out show that storing green beans at room temperature 27-30^{o}C for 5 weeks still has good quality. In this condition, green beans are packaged in Al foil, which has low permeability to air and water vapour. Recommended storage room temperature is 27-30 °C. Under these storage temperature conditions, green beans still have good quality in terms of water content, caffeine, chlorogenic acid, protein and reducing sugar.

To maintain the quality of green beans and ensure their safety during storage at room temperature, the coffee-handling stages must be carried out in accordance with standard operating procedures (SOPs) that have been tested and approved. The stages of implementing postharvest coffee science and technology, especially at the storage stage, include:

Harvesting of coffee cherries

The coffee fruit used is ripe robusta coffee cherries (red skin colour), harvested from the plantation's own UUT. AGRO SEMESTA. Harvesting coffee cherries must be done properly. Improper harvesting of coffee cherries, especially regarding maturity, can affect the quality of the coffee produced.

Sortation

Sorting is the process of selecting coffee cherries to obtain good (superior) raw materials. From this sorting process, red, yellow, coffee cherries, damaged coffee cherries, dirt or other foreign materials will be obtained. Coffee cherries used is red coffee fruit and is not deformed/damaged

Washing

Washing the sorted red coffee cherries is done using clean running water. The washing process aims to remove dirt from the coffee fruit's surface and foreign materials such as small stones, soil, twigs, and leaves.

Weighing of coffee cleaned

Coffee cherries to be used are weighed at 100 kg. Weighing is carried out to determine the initial weight of whole coffee cherries (initial) before peeling process is carried out.

Pulping

Peeling outer skin of coffee cherries is done using a pulper machine. Stripping outer skin is done by inserting coffee cherries into a pulper machine which is assisted by a flow of water therefore process of peeling skin is easier and faster. The purpose of skin stripping is to improve the fermentation and drying processes of coffee beans. The outer skin of coffee cherries is then weighed again to determine weight of material to be used and to determine resulting skin waste

Fermentation

Fermentation is carried out by dried process. Coffee beans have outer skins that still contain mucilage cannot be removed by washing. The main purpose of the fermentation process is to make it easier to remove the mucilage layer from the coffee beans' surfaces. Moreover, fermentation aims to form potential flavour-forming compounds as precursors and can increase the bioactive compound content, which are beneficial for health. Fermentation is carried out by placing coffee beans in a dry container (sack) and fermenting at 30 ± 2 °C for 36-48 hours. During fermentation, the temperature must be maintained to remain stable. Fermentation is one of the most important keys in coffee processing.

Washing

After fermentation, coffee beans are washed again to remove mucilage attached to their surfaces. Washing is done with running water until the coffee beans are cleaned.

Drying

Washed coffee beans are drained and then dried in a solar dryer or under sunlight. Drying aims to reduce the water content of coffee beans to < 12.5% in accordance with SNI 01-2907-2008 standards, namely a maximum of 12.5%. The drying process takes 7-10 days, depending on the weather. After drying, coffee beans are called HS coffee beans. These coffee beans still contain hard skin. Once the HS coffee beans have a water content of

around 12.5%, the hard skin will be easily separated using a huller machine

Hulling

The HS coffee beans are then peeled using a huller machine. Separating the hard skin from coffee beans yields coffee beans without the hard skin, but still with the silver skin. These coffee beans are widely available on the market and have a long shelf life of several months when stored in a dry place.

Packaging

Coffee beans are then packaged in plastic sacks and gunny bags. The packaging size is adjusted to the weight of the coffee beans to be packaged. Each package contains 25 kg of coffee beans.

Storaging technic

Storage technology becomes essential because, during storage, damage and loss are often caused by various factors. However, some factors are beyond the storage step's control. Uncontrolled temperature and humidity during storage can affect the quality of coffee beans. [12] found that green coffee is stored for a prolonged time, its quality decreases, expressed by a typical flattening and slackening of the cup quality as well as reduction in the aroma potential in the green bean [13] : [14] reported that stored coffee beans in warehouses with a standard reference temperature of 19℃−27℃ and humidity of 60%−70%.

Moisture content is an important attribute and an indicator of quality, especially for coffee sellers and roasters. The low quality of coffee at the farm level is mainly caused by postharvest problems encountered in the field, including high water content, which can trigger mould growth, thereby affecting the final taste and lowering the selling price [15]. According to [16], a water content of 12% with a tolerance of 1% is a limit that can guarantee safety during storage. Meanwhile, coffee beans with a water content below 9% (too dry) will damage the taste and colour [14]. The water content of coffee beans after the drying process and before storage should be <14%. It is feared that storing coffee beans with a moisture content above 14% will cause the growth of ochratoxin-producing mould [15]. Based on the research by [16], it was found that storage of green beans at a temperature 27-30ºC for five weeks still has good qualities.

After packaging the green beans, continue storage in the place/room or in the warehousing at 27-30ºC. This temperature should be kept stable; therefore, a temperature controller is needed in the warehouse. Farmers from the group can check the temperature and humidity periodically to see the temperature conditions.

d. Increasing human skill in management and marketing digital strategy

Stages of implementing science and technology to increase human resource capacity in field of digital-based business management including of: introduction to business management using digital systems, providing theory and practice of creating bookkeeping and reporting administration with digital systems, providing digital marketing theory and practice, discussion or question and answer session between group administrators and resource persons, independent practice related to creating bookkeeping, reporting and marketing administration with digital systems, and evaluation of results (Questionnaire). At this step, the results of implemented activities are evaluated. If the results of observations and evaluations show that participants do not understand the knowledge and skills that have been given, they will be explained again through discussions with PKM activity participants, either offline or online.

3. RESULT AND DISCUSSION

3.1. Exiting Condition of Business Unit

UUT. Agrosemesta is a unit business was developed in 2022. This group, located in Pajahan village, Pupuan district, Tabanan regency, has 20 members. The group has many activities, including coffee plant breeding, processing robusta coffee, marketing coffee products, and developing an agrotourism plan.

In terms of breeding coffee plants, the group has produced almost 4,000 coffee plant seeds, and only 3,500 have grown. The price of coffee plant seeds is around 5,000-7,000 IDR, depending on the seed size. The selling of coffee plant seeds in the local area, Pajahan village, is increasing; however, demand is outpacing supply, so seeds are in short supply. For the certification of coffee plant seeds, the group collaborates with government agricultural officials to guarantee quality and safety.

The group's postharvest handling of robusta green beans faces several challenges, especially in storage. The storage room is used and has limited facilities, and does not meet sanitation and hygiene standards. The green beans are stored in a small room with no temperature or humidity control due to limited knowledge and financial support.

Marketing steps for coffee plant seeds and coffee products are mostly carried out in conventional and limited ways. The group learned online marketing independenly. Although some trainings has followed, it is not enough and needs to be improved consistently.

Three kinds of knowledge and skills were shared with the participants from UUT. AGRO SEMESTA in Pajahan village Tabanan Regency, Bali. The three innovation technologies include the breeding of coffee plants technique. Storage of coffee beans: techniques and management, business strategy.

Breeding coffee plants was carried out using the vegetative (cutting) method. This method can help coffee plants produce seeds that grow well and rapidly, especially for robusta coffee. Most government and private plantation companies used cuttings to breed coffee plants.

Implementing proper postharvest handling methods during storage of green beans under controlled temperature and humidity conditions. Improving the human capacity skill of UUT. AGRO SEMESTA related to marketing strategy. Storage technology becomes essential because, during storage, damage and loss are often caused by various factors. However, some factors are beyond the storage step's control. The uncontrol of temperature and humidity during storage can impacts on the quality of the coffee beans. [17] found that green coffee stored for a prolonged time has decreased quality, as evidenced by typical flattening and slackening of cup quality, as well as a reduction in aroma potential in the green bean [18]. [12] reported that stored coffee beans in warehouses with a standard reference temperature of 19℃−27℃ and humidity of 60%−70%. Moisture content is an important attribute and an indicator of quality, especially for coffee sellers and roasters. The low quality of coffee at the farm level is mainly caused by postharvest problems encountered in the field, including high water content, which can trigger mould growth, thereby affecting the final taste and lowering the selling price [13]. According to [14], a water content of 12% with a tolerance of 1% is a limit that can guarantee safety during storage. Conversely, coffee beans with a water content below 9% (too dry) will compromise taste and colour [14]. The water content of

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coffee beans after the drying process and before storage should be <14%. It is feared that storing coffee beans with a moisture content above 14% will cause the growth of ochratoxin-producing mould [15]. Research by [16] found that storage of green beans at a temperature 27-30ºC for five weeks still has good qualities. After packaging the green beans, continue storage in the place/room or in the warehousing at 27-30 ˚C. This temperature should be kept stable; therefore, a temperature controller is needed in the warehouse. The farmers from the group can check the temperature and humidity periodically to monitor both conditions.

Increase in human skills in management and marketing strategy. Stages of implementing science and technology to increase human resource capacity in the field of marketing strategy: introduction to business management using digital systems, providing theory and practice of social media and the use of four marketing strategies. Discussion or question-and-answer session between participants and speakers, and independent practice related to the use and evaluation of marketing strategy and activity results (Questionnaire).

3.2. Strengthening the capacity and ability

The community service activity was attended by thirteen (13) participants from UUT: Agrosemesta and four persons from the community service committee. The activity was conducted in UUT. Agrosemesta, Pajahan Village Pupuan, Tabanan regency on August 16, 2025. This activity consists of two steps. The first step was conducted on August 16, 2025, and the second step was conducted in September 2025 to evaluate progress.

Three topics were covered for participants during the community service activity: coffee plant breeding techniques, green bean storage technology, and marketing strategy. The three topics were presented by speakers from Universitas Warmadewa, who are experts in Agrotechnology and soil science, and from Waseda University, Japan, in Agriculture Technology, Economic Business Management, and Social Science. The speakers presented their papers directly (oral presentation) and practised after sharing the theory. Generally, most participants have good capabilities in terms of breeding coffee plants techniques, storage of green coffee beans techniques, and marketing strategies.

However, the farmers' group lacks sufficient knowledge and skills in coffee plant breeding techniques, green bean storage techniques, and marketing strategies. Based on this condition, some participants asked questions about how to grow good seed coffee plants that produce good-quality seed. How to handle green beans during storage to maintain quality and safety, and how to extend market access for coffee plant seeds and coffee products. These discussions indicated that the participants were very enthusiastic and strongly engaged in community service. This condition was also found during the transfer of knowledge and skills in marketing strategy management in another session.

Basically, the participants have understood how to sell the products, but the group lacks an effective marketing strategy, especially on social media. Meanwhile, they lack knowledge and skills in other social media such as Instagram and TikTok. Based on this problem, the speaker from economics and business management presented a theory focused on marketing strategy and how to use Instagram, TikTok, and related platforms. In the last session, there was a discussion about allowing participants to ask what they did not understand. According to the discussion showed most of them do not know how to use Instagram and TikTok applications. The speaker focused on explaining the Instagram and TikTok applications to improve human skills in management and marketing strategy. There are some steps that should be followed, namely:

- Introduction of a marketing strategy for increasing the sales of coffee plants and coffee products
- Providing 4 (four) marketing concepts: product, price, place, and promotion of coffee products to the participants.
- Discussion or question and answer session between group administrators and resource persons
- Independent practice related to carrying out social media and four marketing concepts

After completing the transfer of theory, continue practising in the warehouse where the green beans are stored. In this warehouse, the speaker explained and discussed good technical storage practices for green beans. Based on observations in the warehouse, no tools for measuring environmental temperature and humidity were found. Moreover, in the warehouse, any machine, such as a car or a motorbike, was also affect the quality and safety of green beans during storage. According to the standard, in the warehouse only green beans can be stored; meanwhile, other items can be stored in the same room because green beans can absorb environmental odours and water vapour, which can increase their moisture content.

Based on several research stated that moisture content is an important attribute and an indicator of quality, especially for coffee sellers and roasters. The low quality of coffee at the farm level is mainly caused by postharvest problems encountered in the field, including high water content, which can trigger mould growth, thereby affecting the final taste and lowering the selling price [13]. According to [14], a water content of 12% with a tolerance of 1% is a limit that can guarantee safety during storage. Meanwhile, coffee beans with a water content lower than 9% (too dry) will damage the taste and colour [14]. The water content of coffee beans after the drying process and before storage should be <14%. It is feared that storing coffee beans with a moisture content above 14% will cause the growth of ochratoxin-producing mold [16]. Based on the research by [16] found that storage of green beans at temperature 27-30ºC for five weeks still has good qualities. After packaging the green beans, continue storage in place/room or in warehousing at 27-30ºC. This temperature should be kept stable; therefore, a temperature controller is needed in the warehouse. The farmers in the group can check the temperature and humidity periodically to monitor the temperature conditions. The discussion with the management of UUT. Agrosemesta and community service activities are shown in Figures 1, 2, and 3.

Figure 1. The transfer of knowledge and skills to the participants

Figure 2. Presentation of Materials by speakers to the participants

Figure 3. Presentation of Materials by speakers to the participants

3.3 Technology Product, Innovation and Application

Based on the community service applied, participants in general have good knowledge and skills, especially in coffee plant breeding, green bean storage, and marketing strategy. To produce high-quality coffee plant seeds and coffee products, it is necessary to mentor and train farmers regularly. Transfer of knowledge and skills to the farmers' group focused on breeding coffee plants, storage techniques for coffee beans, and marketing techniques. Innovation is also introduced during community service activities, such as coffee plant breeding techniques, good storage practices for coffee beans, and marketing techniques, which help farmers produce high-quality agricultural products and increase family income and profits. In fact, not all coffee plant seeds grow well due to a lack of knowledge and skill in breeding coffee plant techniques. Based on farmers' experience, 12.5% of the coffee plant seeds did not grow; therefore, need to improve the technical skills. The green beans stored without a good standard operating procedure, and some conditions need to be controlled, such as room temperature and humidity. Otherwise, the sanitation and storage technic also not proper yet. Moreover, there was not tool for temperature and humidity control in warehouse. In the warehouse, it is not recommended to put anything or other than green beans, as this can affect coffee quality and odour, as coffee has a hygroscopic characteristic. Storage of green beans in proper conditions, such as at the correct temperature and humidity, as well as under controlled sanitation conditions, maintains their quality and improves safety. The shelf life of the green beans can be increased. The practice of breeding coffee plants technic showed in Figures 3 and 4

Figure 4. Training in coffee plant breeding techniques for UUT members. Agrosemesta

Implementing a marketing strategy through social media, such as web profiles and Instagram and Facebook, can help the farmers' group increase sales of coffee plant seeds and coffee products (Figure 3.5). However, improving the farmers' group's knowledge and skills is essential to their involvement. Educating and training participants during community service can help them better use social media to promote and sell coffee plant seeds and coffee products. Low educational level of the farmers' group and insufficient mentoring caused the transfer of social media skills to be slow; therefore, more time is needed to increase it faster.

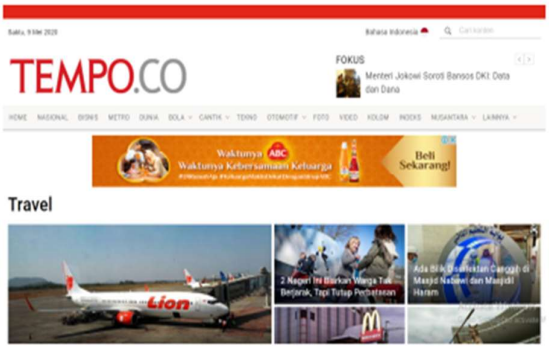

Figure 5. Marketing of coffee plant seeds and coffee products on Social media

3.4. Impact and Productivity

According to community service activities, in general, UUT. The Agrosemesta group has responded well and is very enthusiastic about conducting the community service. 13 participants out of 20 joined the activity, as some members of the group had to attend a religious ceremony. Based on the three materials that shared with participants, such as the technique of breeding coffee plants, improving the storage technique of coffee beans and the marketing business strategy in "UUT. Agrosemesta" Pajahan Village, Pupuan Tabanan. Those topics related to the existing problem found in the group.

Based on the result, the knowledge and skills of the farmer members increased from 50% to 85%. In terms of ability and skill, before the farmers joined this activity, they relied on experience; therefore, the yield was not at its maximum yet. After providing knowledge (theory), the ability and skill increased. To make it clear and increase their capacity for breeding coffee plants, the speaker also provided training to the coffee farmers, as shown in Figures 3.3 and 346.

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Participants obtained several benefits through this transfer of knowledge and training, including 1) increasing the ability and skill of the group members in terms of breeding coffee plants techniques, 2) enhancing the productivity of coffee plant seeding, and 3) increasing the farmers' income. Improving knowledge and skills can help UUT. Agrosemesta to increase coffee plant seed productivity, maintain the quality and safety of green coffee beans during storage, and increase coffee product sealing; therefore, it will increase family income and grow the village's economy. Good-quality coffee plant seeds and green beans can be sold at a good price, stored longer, and consumed safely. However. UUT. Agrosemesta group needs to keep the warehouse clean and sanitised, and avoid any bad odours in the environment. Furthermore, in the warehouse, tools such as thermometers are needed to control temperature and humidity.

According to the topic of marketing strategy and digital business management, the farmers' group was very enthusiastic about the topic. They thought that in hard competition, business management is needed, including using social media platforms like Instagram, TikTok, and Facebook. Increasing the number of social media applications will increase both promotional access and market reach. Increasing coffee plant seed productivity, improving coffee product quality, and marketing strategy became the main priorities for the farmers' group in UUT. Agrosemesta..

The sale of coffee plant seeds, green beans, and coffee products will increase when the farmers' group implements techniques for breeding coffee plants and for green bean storage. Moreover, they have to use more social media to promote and sell their products.

3.5. Output Achievement

According to the community service, some outputs were achieved, including increased UUT knowledge and skills. Agrosemesta members in terms of breeding coffee plants techniques, green bean storage techniques, and the marketing strategy used. Increasing knowledge and capabilities can reduce damage to green coffee beans during storage, thereby minimising profit loss. Storing green beans at the correct temperature and humidity will prevent increased water content, which can affect their safety and shelf life. Moreover, the group also has good knowledge and skills in using social media such as Instagram and TikTok, even though they also use Facebook. Increased use of social media will boost sales of the shell coffee product and expand its market.

Furthermore, some outputs from this community service, namely a YouTube video, online news, an article draft, and an Intellectual Property Right, will be achieved next month. The outputs, target, and achievement of community service are shown below. The end of the community service activity took a photo with all participants shown in Figure 7

Figure 6. Training of coffee plants breeding for the coffee farmers

Figure 7. Closing activity of community service with participants

4. CONCLUSION

Regarding the result of the community service conducted at UUT. Agrosemesta, in Pajahan village, Pupuan, Tabanan regency, therefore, several conclusions and recommendations were obtained, namely: in general, the level of participation of managers and group members in implementing community service activities from the preparation stage to implementation is high and enthusiastic. The farmers' group has sufficient knowledge and skills in breeding coffee plants, green bean storage, and marketing strategies. The group has used social media such as Facebook to market and promote coffee plant seeds and coffee products, but not to the maximum due to other social media not being used. UUT. Agrosemesta still needs assistance and support, especially in green bean storage techniques, using social media more effectively, expanding collaborative relationships (networking) with various parties, and carrying out promotions.

There are some recommendations to improve the coffee business in UUT. Agosemesta are: 1) to increase the productivity of coffee plant seeds the group should improve breeding technic and increase volume and quality of coffee plant seed, 2) to maintain quality and safety of green beans during storage, the group needs to complete the storage warehouse with a thermometer therefore the temperature and humidity conditions can be known and controlled. 3) In the coffee bean storage room, the group must not store other objects that can produce odors and affect the quality of the coffee beans in the room. 4). to increase market access and sales volume of coffee products, the group needs to continue to promote and collaborate with various parties, especially buyers and travel agents and 5) the group must actively collaborate with various parties, especially assistance activities

from universities, government and private sector therefore solutions can be found for the problems and coffee business can continue to develop and grow based on the goals..

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