

Optimization of the Cultivation of ‘Sleman’ *Longan* Cultivar and Local *Klanceng* Bees by Applying Appropriate Techniques and Technology Integrated Agricultural Systems (SIMANTRI) to Strengthen the Economic Resilience of the Hargowilis Farmers Group

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ABSTRACT

Hargowilis Village is located in Kokap Sub-district, Kulon Progo, on the westernmost side of the Special Region of Yogyakarta, where most people work as horticultural crop farmers. One of the cultivation objects developed by the community is local *longan* which is the result of downstream research products from the Laboratory of Genetics and Breeding, Faculty of Biology, UGM. The downstream program encourages people to pioneer *longan* cultivation to raise the community's economic level. However, there are obstacles, such as slow growth and flowering, so further optimization is needed. The Community Partnership Program of the Ministry of Education, Culture, Research and Technology aims to solve the problem by initiating an integrated agricultural system (SIMANTRI). The SIMANTRI concept can be a solution to optimize *longan* cultivation through efforts to increase pollination effectiveness by applying stingless bee pollinators. The implementation of the program is carried out through counseling, practical training, and periodic mentoring. Community service is carried out by delivering knowledge about; non-productive soil management, induction of flowering hormones, post-anthesis *longan* treatment technology, rest time management, pest control technology, *Klanceng* box technology, colony transfer and maintenance techniques, education system techniques for colony propagation, product harvesting and packaging techniques, feed source vegetation, and trap system. The results of the service showed an increase in the knowledge and ability of Hargowilis villagers to cultivate *longan* Sleman and *Klanceng* varieties in an integrated farming system. Through knowledge transfer, we hope the community can improve its economic quality through agricultural products and other alternative products.

Keywords: alternative product, community services, klanceng colonies, longan variety.

1 Introduction

Kulon Progo Regency is the westernmost region of the Special Region of Yogyakarta. Hargowilis Village is one of the villages in Kulon Progo Regency with an area of 1,547.84 ha. There are community forests and state forests with an area of 182 ha and 216 ha, respectively [1]. Common crops developed by Hargowilis villagers are horticultural crops such as durian, *longan*, papaya, sawo, mango, coconut, pineapple, guava, rambutan, and various other types of plants.

The superior local *longan* developed by Hargowilis villagers was previously initiated through the Village Development Grant Program (PHBD) of the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia in 2019. The implementation of the grant was coordinated by the Genetics



Research Student Forum (Formasigen) from the Genetics and Breeding Laboratory, Faculty of Biology, Universitas Gadjah Mada. The program encourages the community to initiate the cultivation of superior varieties of *longan* known as Sleman *longan*. Sleman *longan* was developed by Sawitsari Research Center and Genetics and Breeding Laboratory of the Faculty of Biology UGM in 2015 with Plant Variety Registration Number 703/PVHP/2019. The advantage of this local variety is its shorter maturity, with fruiting time in 2 years after the first planting. It is 6 months earlier than the Itoh cultivar. The characteristics of Sleman *longan* fruit are thick pulp, small seeds and no watery [2].

In 2020, through the Community Service Program based on Utilization of Research Results and Application of Appropriate Technology from UGM, *Klanceng* bee cultivation was initiated and introduced to the Hargowilis Village community as a pollinating agent for *longan* plants. *Klanceng* bees (stingless bees; members of the Melliponini Tribe) are one of the pollinating insects that are widely used to increase fruit production by farmers [3]-[6]. Some studies revealed that bee activity repetition could increase chayote pollination success by 80-85% [6]. The search for pollen and nectar by *Klanceng* bees is more intensive than bees in general. This is due to the small and agile body of this animal. It is proved by the pollen diversity from various plant species in *Klanceng* honey. Research on melissopalynological analysis in the Lombok area can provide an overview of the discovery of 61 plant families with pollen contained in *Klanceng* honey [7]. Therefore, *Klanceng* honey has diverse nutrition [8, 9]. Several researchers have confirmed that the pollen content of *Klanceng* honey is relatively different, which is related to the wide ability of *Klanceng* to obtain food sources.

The community readily accepts this program because *Klanceng* bees are relatively easy to handle and maintain, and stingless characters [3]. In addition, the price of *Klanceng* honey products is almost three times higher than other types of honey (*Apis* spp.) [10]. Therefore, further development is needed by the community to create an integrated farming system to cultivate *longan* and *Klanceng* in Hargowilis village. This program aims to optimize *longan* and *Klanceng* cultivation by producing *longan* fruit products and *Klanceng* bee derivative products that are beneficial for health and have high economic value.

2 Research Methodology

The program was implemented for four months, from June 2022 to September 2022. The *longan* varieties 'Sleman' and *Klanceng* were cultivated on the land of 'Gunung Agung' farmer group members in Hargowilis Village, Kokap, Kulon Progo, Special Region of Yogyakarta. The implementation is divided into three stages: counseling, training, and periodic assistance.

2.1 Counseling

The counseling was conducted through lectures and discussions with Gunung Agung farmer group members on the cultivation of Sleman *longan* and *Klanceng* bees. The concept of Integrated Agriculture based on Sleman *longan* horticultural crops and *Klanceng* bees was also discussed. The discussion included *longan* cultivation techniques, *Klanceng* bee cultivation techniques, and economic prospects for *Klanceng* bees and Sleman *longan*. The discussion on *longan* cultivation includes unproductive soil management, induction of *longan* flowering with chemical hormones, post-anthesis *longan* handling, plant rest time management, and pest control technology. The discussion on *Klanceng* bee cultivation techniques also includes *Klanceng* box technology, colony transfer and maintenance techniques, colony splitting and propagation by reduction system, *Klanceng* pest control techniques, honey harvesting, and packaging techniques, *Klanceng* food source vegetation, and training on trap systems to obtain *Klanceng* colonies.

2.2 Training

Training on *longan* cultivation and *Klanceng* farming was conducted to prepare Gunung Agung Farmers Group members who can initiate the integrated farming concept. The program is based on research results from the Genetics and Breeding Laboratory, Entomology Laboratory, and Sawitsari Research Center, Faculty of Biology UGM.

Sleman *longan* cultivation techniques include (1) training on non-productive soil management, including planting land preparation, fertilization, and irrigation techniques; (2) induction of *longan* flowering with chemical hormones through the application of various combinations of macro and micronutrients; (3) post anthesis *longan* handling technology which includes techniques for preventing flower and fruit loss, as well as fruit care techniques; (4) management of plant rest time to maintain *longan* plant health and improve fruit quality; (5) pest and virus control with local biopesticides. Applying the Sleman variety of *longan* cultivation techniques is expected to increase *longan* fruit productivity.

The *Klanceng* cultivation techniques include (1) *Klanceng* box technology with training on standardized *Klanceng* box-making techniques; (2) *Klanceng* cultivation with training on colony maintenance techniques, *Klanceng* colony transfer techniques, graft separation, and colony propagation techniques, pest control techniques, and harvesting techniques; (3) *Klanceng* feed support vegetation cultivation, and (4) Trap system method in preserving *Klanceng* colonies. The application of technological innovation in *Klanceng* cultivation is expected to produce the best quality honey to support the economy of the Gunung Agung Farmer Group and the Hargowilis Community.

The application of appropriate technology and techniques carried out in the form of application of cultivation techniques and technology as follows:

a. Non-productive soil

Training on non-productive soil management is carried out by applying fertilization and land processing techniques. In addition, environmental observations were also carried out, which were suitable for cultivation.

b. Induction of flowering chemical hormones

The training was conducted to stimulate flowering in *longan* plants using chemical hormone induction techniques developed by Sawitsari Research Center. Chemical hormone induction is the key to stimulating the early flowering of *longan* plants.

c. Post-anthesis *longan* treatment

Post-flowering plant care techniques are ways to increase the potential of prospective fruit by preventing miscarriages. The technique applies KNO₃ (*Potassium Nitrate*) and MKP (*Monokalium Phosphate*). KNO₃ and MKP are applied twice a month to the plant canopy in specific concentrations. KNO₃ can stimulate early flowering by breaking dormancy in generative buds, increasing the number of panicles (panicles) to increase fruit production. MKP has a role in strengthening the generative organs of plants so that fruit production can be optimized [2, 11].

d. Plant rest time management

Plant rest time management is socialized to the community by explaining the circadian rhythm of plants. This is because the metabolic rhythm of *longan* plants can influence flowering induction.

e. Longan plant pest control technology

Pest and disease control used biopesticide-based applications based on extracts of Srikaya leaves, turmeric [12], Mahogany [13], and lemongrass [14]. Biopesticides were chosen because they can prevent damage to *Klanceng* colonies so that colony damage can be avoided. Biopesticides are made from 200 grams of wet plant organs with a mixture of 10 liters of clean water and 2 cc/liter of auxiliary materials, which are then sprayed evenly on infested plants every 2-3 days.

f. Klanceng box technology

The *Klanceng* bee cultivation training is based on the research and development results of the Entomology Laboratory of the Faculty of Biology UGM. The research cultivation box is a standardization to increase honey productivity.

g. Klanceng colony transfer and maintenance techniques

Klanceng colony transfer training is carried out by moving the queen bee into a new stup (box). This procedure is done very carefully, skillfully, and meticulously because it can impact the colony's future sustainability. Standardized cultivation boxes are brought closer to the location of the previous colonies. The aim is for the entire colony to move to the new culture box. This process is done in the afternoon to speed up the transfer of colonies to the new box. Stups are cleaned of debris and protected from wild insects such as ants, spiders, and wild wasps.

h. Education system techniques for colony propagation

This technique aims to accelerate the formation of new queens and colonies for large-scale cultivation. The working principle is to attract bees from the mother colony by attaching the brood nest to a new place right at the entry-exit hole of the bees fitted with a black pipette. This method requires more time and patience than vertical and horizontal colony separation. However, this method's advantage is obtaining an entire *Klanceng* hive that can be used for repeated colony separation.

i. Klanceng bee pest control techniques

Pest and disease control in the *Klanceng* colony is done mechanically and through good sanitation. Mechanical control is carried out by mechanically treating the intruder's body. Another solution offered is through adjusting the size of the cultivation box door. The goal is for *Klanceng* specificity and to prevent invasion from nuisance animals that could potentially damage the *Klanceng* colony. Meanwhile, pest control by sanitation is done by maintaining a healthy and clean environment so as not to invite the presence of pest animals.

j. Honey product harvesting and packaging techniques

The *Klanceng* bee harvesting technique is carried out under ideal conditions when the *Klanceng* colony is healthy, the food source is abundant, and there are no disturbances; with a harvest period of every six months. Honey product packaging is based on the Indonesian National Standard (SNI) in honey harvesting so that the quality of the harvested bee cultivation is guaranteed, including water content, acidity, enzymes, glucose, and insoluble solids.

k. Klanceng feed source vegetation

Klanceng breeding and forming large colonies can occur if the living environment allows it. The availability of food-source plants that produce nectar and pollen is required to support this possibility. The abundant amount of nectar (honey) will stimulate the growth of *Klanceng* bee colonies to build new nests and produce

eggs. Meanwhile, the availability of sufficient pollen in the hive will produce a generation of quality, strong, and long-lived bees. In addition to nectar and pollen, bees can find food sources derived from plant sap which is usually used as a material for propolis and nests [10, 15, 16]. Plants that have the potential to become supporting media for *Klanceng* cultivation in Kulon Progo are bilimbi (*Averrhoa bilimbi*), tears of the bride (*Antigonon leptopus*), cherry (*Muntingia calabura*), santos lemon (*Xanthostemon chrysanthus*), and dombreya (*Dombeya cayenxii*).

1. Trap system training in obtaining *Klanceng* colonies

The Entomology Laboratory of the Faculty of Biology UGM developed the trap system method with several adjustments to natural conditions in Indonesia. The trap system uses a natural colony trap in the form of bamboo which is set at the entrance angle and placed in nature. The bamboo is placed freely on the trees in various locations of the wild *Klanceng* habitat. The success of this technique cannot be indicated during the grant implementation period-as it takes 3-4 years for the colony to occupy the trap. There is even a relatively long time for a wild colony to produce a queen that can form a new colony. However, this method must be conveyed to the public because it is an effort to preserve nature.

2.3 Periodic Assistance

Monitoring and mentoring of 'Gunung Agung' farmer group members and Hargowilis residents are carried out along with the program to encourage the application of knowledge, techniques, and technologies that have been delivered. At the end of the program, members of the 'Gunung Agung' farmer group and Hargowilis residents are expected to be more capable and independent in carrying out *longan* cultivation and *Klanceng* farming.

2.4 Achievement Indicator

The success of this service activity can be seen from the outputs and outcomes achieved. The impact of this service is the realization of the Hargowilis Village community; who are proficient in applying appropriate techniques and technology in cultivating *longan* and *Klanceng* bees. As a result, there is an increase in the quality of the community's economy in the short and long term. Outputs as an index of success in this service program include trademark design, packaging design, cultivation booklet, video documentation, mass media publications, and scientific articles. Overall, the impacts and outputs of this activity have been achieved. However, regular assistance is still needed to maximize the process of transferring knowledge to the community.

3 Results and Discussion

The program implementations are divided into three stages: counseling, training, and periodic assistance. Concerning the concept of an integrated agricultural system in agriculture and animal husbandry, the implementation of this grant program has two main agendas; namely the cultivation of 'Sleman' *longan* cultivation and bee and *Klanceng* cultivation, then integrate the program into the SIMANTRI (Integrated Farming System) concept. The programs that have been implemented in the 2022 program are as follows:

1. Training on the SIMANTRI concept
2. *Klanceng* cultivation techniques training
3. The trap method to get wild colonies of *Klanceng*-bee
4. *Longan* cultivation techniques training
5. Training in the flowering hormone induction technique

3.1 Training on the SIMANTRI concept

Socialization and training for the Gunung Agung farmer group, Hargowilis Village, Kokap District, Kulon Progo was held on July 19, 2022. The socialization and training were attended by lecturers, implementing students, farmer group members, and village officials by prioritizing health protocols. This community empowerment program carries the concept of integration between Sleman cultivar *longan* cultivation and *Klanceng* (stingless bees) as natural pollinators to implement the SIMANTRI concept. The SIMANTRI concept combines the agricultural and livestock sectors, i.e., *longan* cultivation with *Klanceng* bee pollinators. *Klanceng* bees act as pollinating insects to catalyze the flowering of *longan* plants. Meanwhile, some alternative products from *Klanceng* cultivation can produce honey and propolis which have high selling value. This activity ended with the handover of the Sleman *longan* cultivar prototype and *Klanceng* boxes from the organizers to the community farmer groups; as shown in Figure 1 below.



Figure 1: Handover of downstream products

3.2 Klanceng cultivation techniques training

Klanceng bee cultivation is a community service activity carried out by the Faculty of Biology, Gadjah Mada University research team, and the Gunung Agung Farmer Group at Hargowilis Village. This program prepared tools and materials such as natural colonies, *Klanceng* bee cultivation boxes, knives; and a sheet of mica plastic. The activity began with a practical demonstration by the UGM Community Service Team; as shown in Figure 2. The demonstration was carried out by transferring *Klanceng* colonies from natural colony sources to the culture box. The transfer of colonies was done carefully. After the *Klanceng* queen was moved, the box was closed with a sheet of mica plastic glued to the *Klanceng* nest with a sticky texture. After the demonstration, representatives of the Farmer Group then practiced hands-on cultivation. This *Klanceng* bee cultivation training was conducted to increase *longan* fruit production by utilizing *Klanceng* as a natural pollinator to realize an integrated agricultural system in the Hargowilis Village community.



Figure 2: Training on the *Klanceng* cultivation techniques and colony transfer to cultivation boxes

3.3 The trap method to get wild colonies of *Klanceng*-bee.

Laboratory of Entomology, Faculty of Biology UGM produces the latest natural preservation methods. However, the demand for *Klanceng* colonies in the community still needs to be resolved. The method developed is known as the trap method; which makes it possible to obtain wild *Klanceng* colonies without cutting down trees that can destroy nature. This trap system uses a natural *Klanceng* colony trap made of bamboo and placed in nature. The bamboo will then be placed freely on trees in various locations of the wild *Klanceng* habitat. The success of this technique cannot be indicated during the grant implementation period, as it takes 3-4 years for the colony to occupy the trap. Wild colonies even take a relatively long time to produce queens in the new colonies.

3.4 *Longan* cultivation techniques training

In the socialization and training activities for cultivating the *longan* cultivar Sleman, thirty plants of various ages were handed over to be used as lessons for the community about planting and caring for *longan* plants. This activity was held at the house of the Gunung Agung farmer group member and attended by lecturers, implementing students, farmer group members; and village officials, as shown in Figure 3. Knowledge transfer activities include non-productive soil management, planting on open land; and pre-anthesis care techniques. At this event, the community was trained to practice the techniques and knowledge taught in planting Sleman *longan* plants.



Figure 3: Training on the *longan* cultivation techniques



Figure 4: Transfer of knowledge and practice of flowering hormone induction

3.5 Training in the flowering hormones induction technique.

Flowering induction activities are also carried out on Sleman *longan* trees that are ready to be chemically induced. This procedure is carried out to inhibit the plant's vegetative growth phase so that the generative growth phase of the plant will appear more quickly by releasing flowers and fruit. This is one of the objectives of this Community Partnership Program activity by conducting flowering and management methods so that the Hargowilis Village community can increase *longan* fruit production for the welfare of

Hargowilis residents. Figure 4 shows the community is also invited to practice hormone induction independently on induction-ready plants.

3.6 Periodic Assistance

The 'Gunung Agung' farming group members and Hargowilis residents were monitored and assisted during the training program. The program's aims to the members of the 'Gunung Agung' farming group and Hargowilis residents were expected to be more capable and independent in carrying out *longan* cultivation and *Klanceng* farming.

4 Conclusions

This program is a collaboration between the Gadjah Mada University research team and the Hargowilis Village community farmer group in the community service grant program organized by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia. The general educational concept is about *longan* cultivation and *Klanceng* bees. The community partnership program facilitates the transfer of knowledge and practical knowledge to the people of Hargowilis Village regarding the integrated cultivation of superior local *longan* 'Sleman' and *Klanceng* cultivation to increase the productivity of both sides. With this program, it was hoped to encourage the realization of an efficient integrated farming system to improve the economic level of the community.

5 Declarations

5.1 Acknowledgments

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5.2 Funding Source

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5.3 Competing Interests

This research has no conflict of interest with any organization or third party.

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