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Application of appropriate technology for banana cultivation in Sentang Village, Serdang Bedagai Regency

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ABSTRACT

Sentang Village has a tropical climate with low rainfall, and its geographical location is directly adjacent to the sea, so it is prone to salinity and drought stress. The Bina Mangrove Forest farmer group is cultivating yellow kepok bananas intensively on 15 ha of forest land in Sentang village. This farmer group has problems in the production and management aspects of their banana cultivation, namely low crop yields and soil organic matter, prone proneness to salinity and drought stress, high attacks by plant pests and no source of quality seeds. Based on the above problems, the Kosabangsa UNIVA-UMA 2024 team provided a solution, namely the implementation of the Appropriate Technology Package for Banana Cultivation in Sentang Village, consisting of Appropriate Technology Package 1. Kosabangsa Compost Formulation, 2. Banana Plant Care, 3. Improving the Quality of Banana Seeds. The implementation of package 1 were making local microorganisms from banana tubers and stems and compost from banana stems and brassica waste, for package 2 were pumping technology for water supply and ecological engineering with refugia, for package 3 were planting tissue culture banana seeds with a double row planting system for mulyo and barangan varieties. The evaluation test showed that farmers' knowledge increased by 75.5% from the pre-test results and the quality of knowledge and human resource skills was 100% achieved. The kosabangsa products namely "MOL BONGGOL PISANG, MOL GEDHEBOG PISANG, KOMPOS KOSABANGSA", and a demonstration plot for planting 1,500 bananas from tissue culture of the Mulyo and Barangan varieties.
Keyword: Appropriate technology, Banana Cultivation, Sentang Village, compost, Tissue culture seeds

ABSTRAK

Desa Sentang beriklim tropis dengan curah hujan rendah, dan letak geografisnya berbatasan langsung dengan laut sehingga rawan cekaman salinitas dan kekeringan. Kelompok tani hutan Bina Mangrove membudidaya pisang kepok kuning secara intensif pada lahan seluas 15 ha dilahan desa Sentang. Mitra ini memiliki permasalahan dalam aspek produksi dan manajemen budidaya pisangnya yaitu hasil panen dan bahan organik rendah, rawan cekaman salinitas dan kekeringan, tingginya serangan organisme pengganggu tanaman serta belum adanya sumber bibit yang berkualitas. Berdasarkan permasalahan tersebut diatas, tim kosabangsa 2024 UNIVA-UMA, memberikan solusi yaitu Implementasi Paket Teknologi Tepat Guna Budidaya Pisang Desa Sentang yang terdiri penerapan teknologi tepat guna 1. Formulasi Kompos Kosabangsa, 2. Perawatan Tanaman Pisang, 3. Peningkatan Kualitas Bibit Pisang. Pelaksanaan paket 1 yaitu pembuatan mol dari bonggol pisang dan batang pisang, pembuatan kompos kosa bangsa dari limbah batang pisang dan brasicca, paket 2 yaitu teknologi

pemompaan untuk penyediaan air rekayasa ekologi dengan refugia, paket 3 yaitu penanaman bibit pisang kultur jaringan dengan sistem tanam double row untuk varietas mulyo dan barangan. Uji evaluasi menunjukkan pengetahuan petani meningkat sebesar 75,5% dari hasil uji pendahuluan dan kualitas pengetahuan dan keterampilan sumber daya manusia tercapai 100%. Produk kosabangsa yaitu "MOL BONGGOL PISANG, MOL GEDHEBOG PISANG, KOMPOS KOSABANGSA", dan demplot penanaman pisang kultur jaringan varietas Mulyo dan Barangan sebanyak 1.500 buah.
Keyword: Bibit Kultur Jaringan, Budidaya Pisang, Desa Sentang, Kompos, Teknologi Tepat Guna

1. Introduction

Bananas are an economic and important crop in North Sumatra. BPS [1] noted that North Sumatra's banana production for the last three years, namely 2021-2023, was recorded at 121,364 tons, 164,533 tons, and 130,725 tons, respectively. Serdang Bedagai (Sergai) banana production in 2020-2021 was recorded at 5,357 kw and 20,303 kw, respectively [2] . The low banana production is generally caused by less than optimal cultivation methods, low awareness, knowledge, and capital factors of farmers, and agro-ecosystem conditions that are less suitable for banana cultivation. Hindersah and Suminar [3] grouped the constraints on banana cultivation into five categories, namely 1. natural resources and water; 2. cultivation methods; 3. nutrition management; 4. marketing; and 5. farmer behavior.

The Bina Mangrove Forest farmer group is located on the coast of Sentang Village, Serdang Bedagai Regency, and has several activities, one of which is cultivating yellow Kepok bananas. The agro-ecosystem characteristics of the social collaboration location including the Regency (Sergai) are located at coordinates 3°01'25" N - 3°46'33" N and 98°44'22" E - 99°19'01" E [4]. Sentang Village is located 0-9 meters above sea level on a land area of 8.8 Km2 [5]. Sentang Village has a tropical climate, a daily temperature of 30°C, rainfall of 491 mm, and 6 months of rain, air humidity of 75% [6]. The geographical location directly adjacent to the sea and low rainfall mean that agricultural land has the potential to experience salinity and drought stress. The problem of soil affected by soil salinity and drought stress has devastating effects on banana growth, yield, and production. Regions with little rainfall and a high evaporation rate experience an even greater negative impact from salinity stress on agriculture [7]. Coastal soil has poor fertility because it has a sandy texture and high water permeability. The chemical properties of coastal sandy soil are also less favorable for plant growth, with low CEC value and low nutrient and organic matter content [8].

The Bina Mangrove Forest farmer group was formed based on the Decree of the Minister of Environment and Forestry of the Republic of Indonesia Number SK.9187/MENLHK-PSKL/PKPS/PSL.0/12/2018 on December 31, 2018, consisting of 30 members and given management rights to utilize 48 ha of land for 35 years. The intensively managed land for planting yellow kepok bananas covers an area of 15 ha, with 33 ha remaining. The limited knowledge of farmers in banana cultivation methods and nutrition management causes low banana production. In addition, due to farmers' lack of knowledge about the value of preserving plants and the garden environment, diseases in farmer's garden in the work area have grown to be quite large [3]. Minimal maintenance triggers intensification of banana plant diseases such as Panama disease/fusarium wilt [9], blood disease/bacterial wilt [10]. The problems of banana production from the marketing aspect include the lack of market guarantees and sufficient prices; banana agribusiness is not well organized. While from the aspect of farmer behavior, banana cultivation is still considered less important as a source of income, it is still planted on limited land, and banana cultivation is still based on hereditary experience [3].

Based on site surveys and interviews with partners, namely KTH Bina Mangrove, it was agreed that the problems faced in the production and management aspects were low harvest yields, lack of knowledge about good practice of banana cultivation, low levels of soil organic matter, cultivation locations susceptible to salinity and drought stress, high incidence of plant diseases such as Fusarium wilt, blood disease, and not using quality seed sources. Based on these problems, the Kosabangsa 2024 UNIVA-UMA team provides appropriate technology solutions to overcome the problems faced by the Bina Mangrove farmer group in banana cultivation entitled "Implementation of an appropriate technology package for banana cultivation in the coastal village of Sentang, Sergai Bedagai Regency". There were three packages of appropriate technology in banana cultivation, namely the first package is kosabangsa compost formulation, the second package is banana plant care, and the third package is improving the quality of banana seeds. The objectives of this kosabangsa program are to enchance the independence, economy, and welfare of the Sentang village community; to support the

government in community empowerment programs; to strengthen UNIVA's collaboration with the Sentang village government regarding the implementation of appropriate technology for banana cultivation.

2. Methods

This kosabangsa community service program was implemented in Sentang Village, Serdang Bedagai Regency from September to December 2024. The participants in the activity were members of the KTH Bina Mangrove, Sentang village officials, students and UNIVA-UMA Kosabangsa 2024 lecturer team.

The methods chosen in implementing this program include: a) observation method by collecting initial data for mapping in program classification; b) lecture method, by providing information and knowledge to partners or participants about program implementation through socialization; c) training method, by providing opportunities for direct practice in using technology tools and innovations provided, one of which is the practice of making local microorganisms and compost, planting tissue culture seeds and d) mentoring method, by accompanying partners in implementing the program to partners/participants.

This kosabangsa community service program was divided into three stages, namely pre-activity, implementation of the activity, and evaluation which is adjusted to the needs of implementing this activity.

2.1. Pre-activity

The initial stage of the implementation of this pre-activity is to build communication and cooperation with the partner KTH Bina Mangrove.The next stage is to conduct initial observations and interviews to obtain data that meets and supports the implementation of this kosabangsa program. The final stage in this pre-activity is to formulate, plan and determine the implementation of kosabangsa community service activities in a structured manner according to mutual agreement. The right technological solutions are summarized in the activity plan program entitled Implementation of an appropriate technology package for banana cultivation in the coastal village of Sentang, Sergai Bedagai Regency.

2.2. Implementation of the activities

In the implementation of this activity, the stages of activities have been determined, which include socialization, training, and mentoring. First, the activity begins with the implementation of this activity by carrying out socialization activities with all partners related to the manufacture of local microorganisms and compost from banana waste, good cultivation and care of banana plants, tissue culture seedlings, and refugia. Second, at this stage, all partners are given information and direct practice related to training needs for each partner, which includes training in making local microorganism and compost, banana plant care, planting tissue culture banana seedlings and refugia, and training in the use of technological tools and innovations for making compost. Finally, for the mentoring itself, the entire team implementing this community service also provides comprehensive and actual mentoring to meet the needs of partners in implementing this activity.

2.3. Evaluation

The activity evaluation is carried out as an effort by the implementing team Kosabangsa to assess the achievement of this implementation as feedback. The activity evaluation system used is the participation evaluation system. The main focus of the participation evaluation includes the implementation process, methods, and strategies used. This can be demonstrated by conducting pre-tests and post-tests, FGDs after the program, and participatory interviews through video testimonials before and after the program. The evaluation results will be summarized and analyzed in a table of partner empowerment levels as a way of measuring the success of the program.

3. Results and Discussion

3.1. Pre-activity

Based on this observation, priority problems of target partners were found, and the most appropriate community service method approach to use was identified. From this observation, the top issues for targeted partners were identified. And the best way to perform community service. The main issues of KTH Bina Mangrove are as follows: (i) the large amount of banana waste that has not been used and may serve as a

breeding ground for disease, necessitating the use of technology to turn banana waste into molasses and compost; and (ii) the lack of banana plant maintenance, resulting in a dense garden, numerous disease outbreaks, and low output, necessitating training in proper banana plant cultivation and care. And (iii) the plant seeds used are still in the form of banana shoots in the field, so that banana production is low and still conventional, so that technological innovation is needed by using tissue culture seeds for new varieties, namely Mulyo and Barangan. The implementation method of the activity consists of observing partner needs, program socialization, training, monitoring, and mentoring. In addition to conducting field observations of target partners, the implementation team also always coordinates with the local government to jointly oversee this community service.

Taib [11] reported that every ton of bananas picked, around four tons of waste is produced consisting of 100 kg of discarded fruit, 160 kg of stems, 480 kg of leaves, 440 kg of peel, 3 tons of pseudo stems. Banana stem waste can be utilized into various more useful products such as a source of local microorganisms [12] and compost [13]. Unprocessed banana stem waste can cause piles that smell bad and can be a host for several types of diseases, especially those caused by bacteria and fungi. Such as Pseudomonas solanacearum pv. Celebensis for blood disease/bacterial wilt and Fusarium oxysporum f.sp. cubense for Panama disease/fusarium wilt [14].

3.2. Implementation of the activities

In implementing this activity, the stages of the activity have been determined which include pre-test, socialization, training, and mentoring. At the first step of implementing the programs on September 14, 2024 were pretest, socialization of good banana care, socialization of tissue culture banana seeds, socialization of ecological engineering with refugia plants, socialization of making compost, and local microorganisms.

After the socialization activities, the activities continued with direct practice of banana plant care, like cleaning equipment to prevent disease transmission, reducing the number of tillers and killing growing points. The participants were very enthusiastic about this community service activity, and there were 30 training participants attended the socialization and training activities.

(a) (b)

Figure 1. (a) Socialization activities; (b) Pretest.

(a) (b)

Figure 2. (a) Training of banana plant care; (b) Participants enthusiastically participated in the training.

The next step was training and application of technology were carried out on October 9, 2024. The activities implementing technology such as demonstration how reducing the number of tillers and killing growing points,

application technology for ecological engineering by planting refugia like Tagetes erecta, Zinnia sp, Lantana camara, Basil sp, demonstration plot by planting tissue culture banana seeds of Mulyo and Barangan varieties with double row planting system, demontration and application technology by making compost from banana stems and brasicca waste with bioactivator from local microorganisms from banana tubers and stems, adding compost and inorganic fertilizer with the 60 % doses.

Minimal banana care triggers an increase in banana plant diseases. Banana disease control is recommended to be more curative through sanitation. Sanitation should be carried out every 45 days including cleaning dry leaves, reducing the number of tillers and disposing of crop residues after harvest [15].

Agricultural ecosystem engineering uses colorful flower plants planted around agricultural lands such as kenikir flowers, dewandaru flowers, sunflowers, paper flowers/Zinnia, Marigold flowers or Chicken dung, cockscomb flowers, and tapak dara flowers. These flowers will function as homes for natural enemies, both predators and parasitoids of plant pest organisms from cultivated plants [16].

Banana tissue culture is one of the efforts to increase banana seedlings in a relatively short time and in large quantities. In addition, tissue culture is able to produce seedlings that are free from pests and plant diseases [17].

The practice of making local microorganisms from banana tubers and banana stems:

a. Making local microorganisms from banana tubers or banana stems is done by preparing 5 kg of banana tubers or banana stems, then chopping them into small pieces with chopping machine. The multi-purpose chopping machine is one of the tools provided by the Kosabangsa team for KTH Bina Mangrove with specifications of 145 x 85 x 110 cm, 1 ton/hour cohe capacity, 8 PK diesel
b. 200 g of molasses or brown sugar is dissolved in 2 L of rice washing water and 2 L of coconut water
c. All ingredients are put into a jerry can, closed tightly and provided with air holes, insert a hose connected to a bottle filled with water, the end of the plastic hose must be submerged in water.
d. Then leave it for 2 weeks anaerobically
e. The solution is then filtered and placed in a storage container (jerry can)
f. Local microorganisms are ready to be used/applied to the field to make organic fertilizer

The practice of making compost from banana stems and brassica waste:

a. Making compost from banana stems and brasicca waste is done by preparing 1 kg of banana tubers or banana stems, 375 g of brasicca waste, then chopping them into small pieces.
b. 200 g of molasses or brown sugar is dissolved in 1 L of healthy banana stem water, the ingredients are mixed, and placed in a closed container. Then left for 4 weeks anaerobically.
c. In the 4th week, the compost is mature, you can check it by squeezing the compost material and smelling it; it smells like soil. Compost can be used for plants.

The practice of planting tissue culture banana seeds of Mulyo and Barangan varieties with double row planting system:

a. Minimum soil cultivation, in the form of cleaning weeds around the planting hole location,
b. Making a planting hole measuring 40 cm x 40 cm x 40 cm,
c. Source of seeds from tissue culture seeds of Mulyo and Barangan varieties,
d. Planting uses a double row system where the distance between two rows is 0.9-1.2 m and the distance between plants is 1.2 m to 2 m so that there are 2.300 banana plants per ha,
e. Providing nutrients in the form of manure or compost of around 4 kg per planting hole.

The mentoring stage carried out in the Kosabangsa programs included assistance related to all stages of demonstration activities. The results of kosabangsa community service program were the product of local microorganisms from banana tubers namely “MOL BONGGOL PISANG”, local microorganisms from banana tubers namely “MOL GEDHEBOG PISANG” and compost namely “KOMPOS KOSABANGSA”, and a demonstration plot for planting 1.500 bananas from tissue culture of the Mulyo and Barangan varieties.

(a)  (b) 

Figure 3. (a) Making compost from banana and brassica waste; (b) Making local microorganism.

(a)  (b) 

Figure 4. (a) Land cleaning; (b) Refugia plant.

(a)  (b) 

Figure 5. (a) Measuring planting distance; (b) Planting tissue culture banana seeds.

(a)  (b) 

Figure 6. (a) Product “MOL BONGGOL PISANG”; (b) Product “MOL GEDHEBOG PISANG”.

(a) (b)

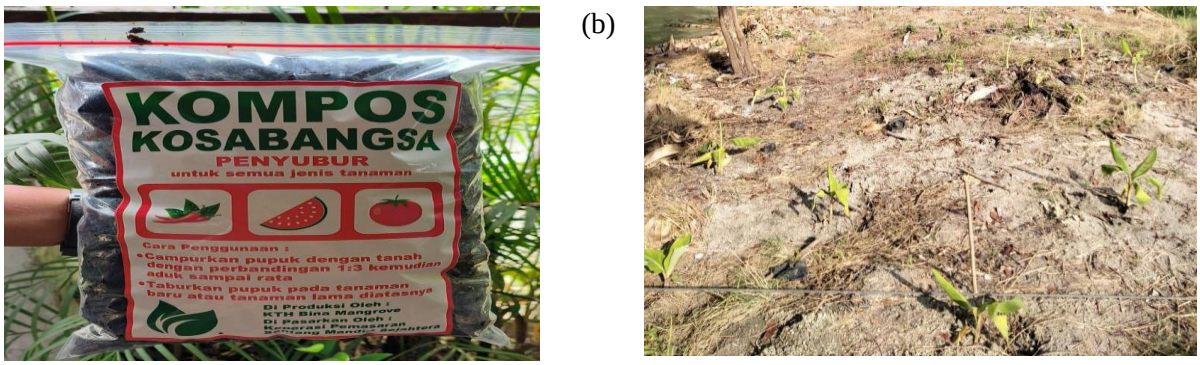

Figure 7. (a) Product “KOMPOS KOSABANGSA”; (b) Demonstration plot.

3.3. Evaluation

Based on the results of the pre-test and post-test conducted by the UNIVA-UMA kosabangsa implementation team, the results/values of the pre-test and post-test from 25 members of the Bina Mangrove KTH were obtained, namely: Average pre-test score = 45, Average post-test score = 79

Based on the results mentioned above, it can be seen that there was an increase in knowledge from the target partners, namely the Bina Mangrove forest farmer group, by 75.5% where before the kosabangsa activity the initial test score was 45, while after the kosabangsa activity another test was conducted to measure the knowledge of the partners after being given various socializations, counseling, mentoring and application of technology, the test score increased to 79.

The success of this kosabangsa community service program can be seen from the table of partner empowerment levels before and after the following service, as seen in Table 1.

No	Before	After	Achievement
1	Don't know how to make compost from banana and Brassica waste	Know how to make compost from banana and Brassica waste	achieved
2	Don't know how to make local microorganisms from banana stems and tubers	Know how to make local microorganisms from banana stems and tubers	achieved
3	Don’t know how to use technological tools to make compost, namely chopping machines, sieving machines and granule machines	Know how to use technological tools to make compost, namely chopping machines, sieving machines and granule machines	achieved
4	Don’t know how to apply the double row method for planting tissue culture banana seedlings	Know how to apply the double row method for planting tissue culture banana seedlings	achieved
5	Don’t know how to use refugia in banana cultivation to overcome plant pests	Know how to use refugia in banana cultivation to overcome plant pests	achieved
	Conclusion		**100 % achieved**

Table 1 shows data that there is an increase in knowledge and skills of HR in target partners. The increase can be measured from 5 indicators in the table of increasing partner empowerment before and after service. All indicators have a 100% achievement, this is because all members of the target partners receive intensive training and assistance related to making compost from banana stems and brasicca waste, making local microorganisms from banana tubers and stems, using technological tools to make compost, double row planting system for planting tissue culture banana seedlings and using refugia in banana cultivation.

4. Conclusions

Community service activities in Sentang Village, carried out in collaboration with the Sentang Village government and the Bina Mangrove Forest farmer group, aim to address the challenges faced by local partners. The implementation of these activities at Bina Mangrove includes the delivery of educational materials and

awareness sessions, group discussions, hands-on practical training in the production of local microorganisms and compost, banana plant care, as well as mentoring, monitoring, and the distribution of appropriate technological tools. Evaluation results showed a significant improvement in farmers' knowledge, with post-test scores increasing by 75.5% compared to the pre-test. Additionally, there was a 100% achievement in improving the quality of knowledge and human resource skills. The outcomes of the program include the production of local microorganisms derived from banana tubers—MOL Bonggol Pisang and MOL Gedebog Pisang—as well as compost branded Kompos Kosabangsa, and the establishment of a demonstration plot for cultivating 1,500 banana plants from tissue culture, featuring the Mulyo and Barangan varieties.

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