

Community Empowerment through Sustainable Utilisation of Mangrove Forests for the Production of Natural Dyes with an Environmentally Friendly System (Phase I: Increasing Awareness and Knowledge Enhancement)

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Abstract

Community participation in mangrove forest ecosystem conservation is an effort to overcome and avoid mangrove ecosystem deterioration. The findings show that mangrove forests in Kampung Laut's coastal region, particularly in the village of Ujung Alang, are still well preserved due to diverse mangrove planting efforts. Currently, the community uses mangrove plants by converting some plant sections into food and using the plant's stems as building materials. Efforts have been made to preserve mangrove forest ecosystems through the Sustainable Utilisation of Mangrove Forests for the Production of Natural Dyes with a Zero Waste System. The following are the activities: 1) Dissemination of the concept to raise public awareness of the potential of mangrove plants as a source of raw materials for natural dyes to increase community income and sustainably manage mangrove forests, 2) Raising the awareness of the younger generation to improve the local economy through the development of micro-scale SMEs in the field of mangrove-based natural dyes, and 3) Technical training on thinning/logging and sustainable mangrove planting to acquaint participants with the concepts of thinning/logging and sustainable man Establish the program's purpose, which should be divided into six activities. Many farmer groups anticipate that this community service under the auspices of Krida Wana Lestari will assist them in improving their existing products and estimating the potential process of their natural mangroves. This program raises public awareness of the mangrove plant's potential as a source of raw materials for natural colours. In addition, this activity enables the community to do technical logging and sustainable mangrove planting to support the availability of raw materials for natural dyes. Consequently, the creation and development of a local economic business unit with a green entrepreneurship incubator model based on mangrove conservation and zero waste from natural dye SMEs have begun.

1. INTRODUCTION

In several regions of Indonesia, the degree of community welfare is still generally low. This statement is motivated by the large number of village potentials that have not been optimally utilised, the poor quality of human resources in

rural areas, and the limited access rural communities have to essential services for developing economic enterprises, such as sources of financing, information, and technology. In addition, the infrastructure supporting the development

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of the village is limited, and the performance of community institutions in the village is not yet optimal. Efforts must be made to accelerate the development of village potential if they are to serve as the primary agents of development. Various university groups, including UGM, have published journals concerning community service with the concept of zero waste and an environmentally responsible system (Atmoko et al., 2019; Fitriyanto et al., 2015; Irawati et al., 2020; Permanasari et al., 2018; Sulistiyanani et al., 2016).

Although natural dyes are generally used in the food sector, it turns out that natural dyes can also be used as fabric dyes (Nurdin et al., 2009; Pumilia et al., 2014; Rachmawati, 2020; Lusiana et al., 2021; Junaidi & Syahrizal, 2020). One element that contributes to the attractiveness of textiles is colour. Colouring techniques that are not monotonous on fabrics can make textile craft items more engaging and varied. Textiles can be coloured using either natural or synthetic dyes. Each of these dyes has unique qualities and varieties. There are two kinds of textile dyes: natural and synthetic (artificial) dyes. Natural textile dyes come from roots, leaves, fruit, bark, and wood extracts, while artificial dyes are made from chemicals (Pujilestari, 2016; Eskak & Salma, 2020). Because natural dyes have great economic potential, several studies on natural fabric dyes have been developed (Supriyantini et al., 2017; Ruslan & Wiraningtyas, 2018; Ledoh et al., 2021).

Ujung Alang Village, Kampung Laut Regency, is one of the villages and sub-districts in the Cilacap Regency area. This sub-district is quite remote because it is far from the centre of Cilacap City and far from the main highway. The village of Kampung Laut is situated at the edge of the Segara Anakan lagoon. Due to the proximity of the water, the place is relatively secluded. Its location on the edge of the Segara Anakan lagoon allows it access to natural resources such as beaches, mangrove forests, fish cuisine, tourism, etc. The Segara Anakan Lagoon has been shown to play a crucial role in the productivity of Java Island's southern coastal waters. This lagoon has given more than 62 billion rupiahs to coastal fisheries production in a single year, and its contribution will continue to grow as the Segara Anakan ecosystem develops. Biological Resources in the lagoon can support the life of the local community in the form of salty fishery products. In addition, the mangrove forest has provided habitat and perching and laying places for some birds that move. The value of the mangrove forest reaches around 1,400 US dollars per hectare, meaning that the wider the mangrove area, the higher the value (Badan Pengelola Kawasan Segara Anakan, 2005).

The ecological awareness of the Kampung Laut community needs to be increased, especially in terms of cooperation in community development through various programs that involve all parties concerned with efforts to minimise the impact of the narrowing and silting of Segara Anakan. Based on a study that Sulastri et al. (2019) has done, Hariyadi (2018) concluded that, in general, the people of Kampung Laut have an excellent awareness of caring for and preserving the environment. This fact shows that developing people's economic thinking based on

green entrepreneurship, inclusive and targeting the younger generation, can be applied in this region. In addition, the results of a study by Triyanti et al. (2017) show that the economic use of mangroves is still minimal. The results showed that the direct benefit value of Segara Anakan water resources used for fisheries, agriculture, and mangrove wood utilisation was IDR 891,526,405,816 per year (98.9%), agriculture IDR 6,280,864,030 per year (0.7%), and the use of mangroves as fuel is IDR 3,239,599,500 per year (0.4%). The everyday use of mangroves as an economic source for the Kampung Laut community was also confirmed by Mr. Wahyono during his visit on March 3, 2021. It was even explained that the theft of mangrove wood was still happening. Therefore, it is necessary to consider how this mangrove forest can be managed sustainably, but the community can harvest it to increase the economic benefits.

Hariyadi (2018) stated that another fact shows that awareness of the importance of mangrove ecosystems is still minimal. Like the older generation, most of the schoolchildren at the junior and senior high school levels still view the mangrove ecosystem as nothing more than a habitat passed down from generation to generation as physical fulfilment, namely firewood and building materials for houses. As a result, encroachment and conversion of mangrove functions continue. On the other hand, the unemployment rate in Cilacap Regency, in general, is still high: 7.31 per cent, or 61,491 people in 2019 (Badan Pusat Statistik, 2020). Consequently, economic problems due to unemployment and the level of understanding of the younger generation need to be a concern for managing the mangrove area in Kampung Laut.

The community's awareness and knowledge of this mangrove's potential have not yet reached a high level. Therefore, the commercial scale of its goods may still be minimal. Despite the fact that the commercial scale for natural mangrove dyes is not yet perfect, this possibility has substantial economic potential. In addition, as the demand for work possibilities rises, the mangrove natural dye industry's potential becomes a highly attractive possibility to create more jobs. Due to these factors, the researchers are particularly interested in this dye and intend to develop it on a wider scale. In addition, with proper knowledge regarding the maintenance of mangrove forests, sustainable sources of mangroves as natural dyes will continue to exist and will have a positive effect on the environment, as mangrove forests may absorb toxic metals and improve water quality.

The community service program related to community empowerment through sustainable utilisation of mangrove forest for the production of natural dyes with an environmentally friendly system based on the Assisted Village and is intended to improve the welfare of the Kampung Laut community through the empowerment of its mangrove forest as a source of raw materials for natural dyes and a zero-waste system. Various small and medium-sized enterprises (SMEs) development programs have been implemented to increase people's income by manufacturing mangrove fruit-based snacks. In addition, there have been

efforts to process mangrove bark into natural dyes used to dye local people's batik. However, the business scale of this natural dye product is still minimal (Melati, 2017). It is due to the minimum understanding of the optimum extraction process, less skill in the colouring process using natural dye, and the low awareness of residents about the dangers of synthetic dyes to the environment. Aside from the above facts about the minimal usage of natural dye from mangroves, the economic potential is enormous (Amri et al., 2020; Safe'i et al., 2022). Fabrics with natural dyes have a high selling value in several developed countries, such as countries in Europe and America. If this potential continues to be developed, it can become a profitable economic sector.

In general, this activity aims to increase public awareness of the potential of mangrove plants as a source of raw materials for natural dyes to increase community income and maintain sustainable mangrove forests. In addition, we are increasing awareness of the younger generation for developing micro-scale SMEs in mangrove-based natural dyes. This activity also hopes to provide the community with the ability to carry out thinning/logging techniques and sustainable mangrove planting to support the availability of natural dye raw materials.

Through this program, it is hoped that the community can be empowered to develop a mangrove-based natural dye production unit on a larger scale by involving the younger generation as the backbone and utilising mangrove wood waste to be processed into charcoal briquettes as well as the liquid smoke took, so that it can be used for preserving marine products. Based on the results of interviews during the visit, the population of the younger generation in Kampung Laut is still relatively large, unlike most other villages in Indonesia, where many of the younger generations have migrated. The younger generation of Kampung Laut can act as agents of change in this empowerment activity. They can use online media to carry out production, marketing, and promotion activities outside the region. The younger generation generally has high ideals, has a strong physique, and is not technologically

stuttering. The management of mangroves in Kampung Laut is currently carried out by the Patra Krida Wana Lestari (PKWL) community group.

The Kampung Laut area has been a community assisted by Pertamina RU IV Cilacap and is under coordination with Bappeda and the Cilacap Regency Environmental Service. For this reason, in this community empowerment activity, the INDI UGM team, with the support of the UGM DPKM, has held initial discussions with these various parties. For this reason, this community empowerment activity will collaborate with the Patra Krida Wana Lestari Group.

2. METHOD

In the first year of this program (2021), the majority of activities were devoted to establishing an understanding and consensus of the program's broad goals. In addition, harvesting and manufacturing units for natural colouring and charcoal briquette production undergo technical preparations. In the first year, thus, lectures, FGDs, training, and mentorship were utilised as strategies. In the second year, the construction of production units and local product consumption commenced. In 2023, the production facility reached full capacity and expanded its marketing efforts. The empowerment activities in the first year are presented in Table 1.

The parameters used as a determinant of the success of this activity are the product and industrial development of natural dyes from mangroves. Several activities are carried out to achieve a good target, among others. The first is organising a hearing – disseminating the concept to build public awareness of the potential of mangrove plants as a source of raw materials for natural dyes to increase community income and maintain sustainable mangrove forests. The role of the young generation is significant, so the next activity is the Joint Dialogue-Building awareness of the younger generation to improve the local economy through micro-scale MSME development in the mangrove-based natural dyes. Technical knowledge is no less

Table 1 . Activities and implementation methods in the first year (2021)

No	Activities	Method
1	The dissemination of the concept to develop public awareness of the potential of mangrove plants as a source of natural dye raw materials to increase community income and mangrove forests to remain sustainable	FGD Sample target: Micro, Small and Medium Enterprises in Kampung Laut Objective: Obtaining information on productivity issues that are still experiencing problems in its dissemination
2	Building awareness of the younger generation to improve the local economy through the development of micro-scale MSMEs in the field of mangrove-based natural dyes	FGD Sample Target: Youth population Objective: -Increase awareness of the younger generation in improving economic conditions in Kampung Laut - Mapping various problems and potential in efforts to develop local economies based on online marketing

Continuation of Table 1

3	Technical training in looting/logging and mangrove planting sustainably to support the availability of natural dye raw materials	Direct mentoring Target: All Micro, Small and Medium Enterprises and youth organisations (Karang Taruna) Objective: Mapping potential mangroves that can be harvested for more profitable production activities
4	Training in the development of local economic growth with a green entrepreneurship incubator model based on mangrove conservation and zero waste from natural dye MSMEs	Direct mentoring Target: All Micro, Small and Medium Enterprises and youth organisations (Karang Taruna) Objective: Increasing productivity based on zero waste and awareness of mangrove forest conservation
5	Preparation for the construction of a natural dye production unit based on appropriate technology, which is suitable for kampung Laut village	Coordination meetings with various relevant parties Activity: - Equipment basic design: chemical engineering lecturer team - Outreach to users: All residents of Kampung Laut
6	Preparations for constructing a production unit to manufacture briquette charcoal and liquid smoke from mangrove waste as a new and renewable energy source based on appropriate technology suitable for Kampung Laut village	Coordination meetings with various relevant parties Activity: - Equipment basic design: chemical engineering lecturer team - Outreach to users: All residents of Kampung Laut

important, so technical training is held for sustainably thinning/logging and planting mangroves to support the availability of natural dye raw materials. With adequate technical awareness and knowledge, the preparation for constructing a natural dye, charcoal briquette, and liquid smoke production unit based on appropriate technology suitable for Kampung Laut village can go well.

The development program for the assisted villages is structured for three years, hoping that the community will be able to identify the potential of the mangrove forest as a source of natural dyes. The community service roadmap is presented in Table 2, and the detailed objectives are presented in Figure 1.

Table 2 . Roadmap of community service based on fostered villages in Kampung Laut

No	Year	Purpose
1	2021	Building understanding and agreement on the program's grand plan with various relevant parties. Identify the potential of mangrove forests as a source of natural dyes. Increase the capacity of the younger generation. Technical preparation in harvesting. Technical preparation of manufacture of natural dye production units. Technical preparation of the manufacture of briquette charcoal production units and liquid smoke.
2	2022	Construction of natural dye production units and small-capacity production trials
3	2023	Construction of briquette charcoal production units and liquid fumes trials small capacity production

3. RESULT AND DISCUSSION

This chapter contains information about the activities of our community services and the results achieved until this report is submitted. This research began to be prepared intensely in mid-April 2021. The entire research team carries out various activities, including coordination meetings, preparation of field activities, implementation of activities in Ujung Alang Village in the first year, preparation of reports, and publication of activities. Here are the field activities carried out in June and October

2021. All activities carried out are based on several journals related to community service, such as FGDs (Biasini et al., 2022), community training (Kurnianta et al., 2022), expanding marketing networks (Vertigo et al., 2022), and training various communities in destination villages (Safe'i et al., 2022; Kurnianta et al., 2022), and are proven to have positive and beneficial results in improving economic conditions in destination villages. The field activities carried out in June and October 2021 are presented in Table 3.

Table 3 . Implementation of village program activities built year 1 (2021)

No	Activities that have been done	Note
1	Dialogue - Socialisation of concepts to build public awareness of the potential of mangrove to increase public income and ensure mangrove forests remain sustainable plants as a source of natural dye raw materials	<ul style="list-style-type: none"> - Implementation with lectures and short FGD - There is already awareness about the potential of mangrove plants as a source of natural dyes. - There is already the use of mangrove skin extract as a natural dye by batik artisans.
2	Dialogue - Building awareness of the younger generation to improve the local economy through micro-scale MSMEs in mangrove-based natural dyes	<ul style="list-style-type: none"> - Implementation with lectures and FGD - A batik business group (Mekar Canting) is already in Ujung Alang Village, Kampung Laut. Mekar Canting group has 20 members. - There is already a group of small food businesses/mangrove-based snacks (e.g., jeruju leaf chips, mangrove leaf dumplings, stick putut/tancang fruit), namely Patra Bina Mandiri Group - Awareness of the importance of marketing already exists - Awareness about maintaining product quality and continuity of production also exists - There is also a Nipah-based product, i.e., hand sanitiser - There is the production of lidi nipah, an alternative to people's livelihoods in Kampung Laut, by the Rejeki Blessing Group - There is an indication of the business of making hand sanitiser from nipah raw by the Blessing Rejeki Group.
3	Technical training in looting/logging and mangrove planting sustainably to support the availability of natural dye raw materials	<ul style="list-style-type: none"> - Implementation with lectures and FGD - In general, the youth group in Krida Wana Lestari quite understand the characteristics of mangroves in the region - Several mangrove measurement techniques are already recognised.
4	Training in the development of local economic growth with a green entrepreneurship incubator model based on mangrove conservation and zero waste from natural dye MSMEs	<ul style="list-style-type: none"> - Implementation with a lecture - Krida Wana Lestari group often gets orders of mangrove seedlings from other regions (Indramayu, Cirebon, Surabaya, etc.). This fact can be a promising economic opportunity.
5	Development unit for the preparation of natural dye production based on appropriate technology, which is suitable for Kampung Laut village	<ul style="list-style-type: none"> - Implementation with a lecture - An explanation of how to extract an excellent natural dye is well conveyed - Explanation of the importance of dyeing techniques on dyeing well conveyed - An explanation of the importance of having a batik motif typical of kampung laut with distinctive colouring is well conveyed
6	Preparations for constructing a production unit to manufacture briquette charcoal and liquid smoke from mangrove waste as a new and renewable energy source based on appropriate technology suitable for kampung Laut village	<ul style="list-style-type: none"> - Implementation with a lecture - An explanation of the potential of mangrove wood waste for briquette charcoal is well conveyed

In phase I of Kampung Laut's community service programme, awakening awareness and enhancing the community's knowledge of technology to utilise mangrove forests sustainably were presented in all conducted activities. Through all the conducted activities, some improvements have been observed, such as increasing recovery in any products that have been developed, like the putut stick product shown in [Figure 1](#). In addition, guidance regarding the potential of mangrove forests and the vital role of all business entities, especially the younger generation, must be continuously carried out, as shown in

[Figure 2](#) and [Figure 3](#).

Based on this first phase, the activity needs to be continued. Although the people of Kampung Laut have shown that they can start, many aspects still need to be improved, especially from the empowerment of the younger generation and its relationship with the potential of natural resources in the Kampung Laut mangrove area. For the sustainability of this farmer group assistance, financial support is needed so that this program helps the community. The final objective of this programme will be sustainable productivity through mangrove conservation, emphasising

the zero waste system approach, as shown in Figure 4.

Based on the product and the improved public awareness and understanding regarding the use of mangroves as natural dyes, it can be claimed that this action has achieved its objective. This is demonstrated by the products created (batik and food products) and the growing public awareness and education. Through this activity, the public is made aware of the potential of mangrove plants as a supply of raw materials for natural dyes to boost people's income, so ensuring the sustainability of mangrove forests.



Figure 1 . Stick Putut is one of the packaged food products of the Patra Bina Mandiri Group



Figure 2 . Joint discussion on improving the quality and variety of naturally dyed batik patterns from mangrove wood



Figure 3 . Explanation of problems related to efforts to increase community income from representatives of the younger generation of Kampung Laut continued with question and answer session conducted by Karang Taruna members

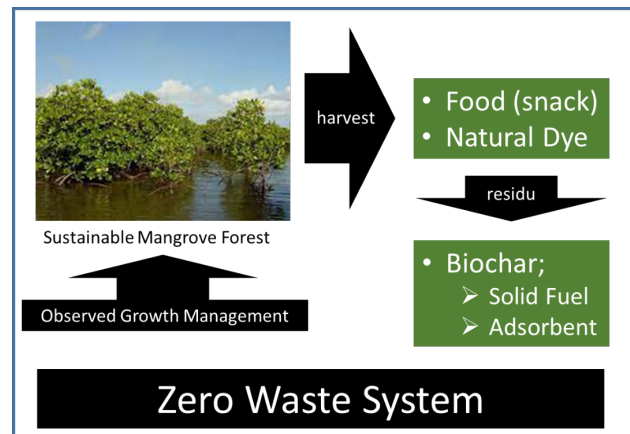


Figure 4 . Environmentally friendly system approach on sustainable utilisation of mangrove forest for natural dye

In addition, awareness among the younger generation is beginning to grow regarding the development of micro-scale SMBs in mangrove-based natural dyes. This is evidenced by the increasing number of young people participating in the activity's training and numerous events. This activity enables the community to do technical thinning/logging and sustainable mangrove planting to ensure the availability of raw materials for natural dyes. The local economic business unit with a green entrepreneurship incubator model based on mangrove conservation and zero waste from natural dye SMEs (small and medium-sized companies) has begun to be built and developed following the completion of the activity. The outcome is the formulation of a follow-up plan for the construction of a natural dye production unit, as well as a plan for the construction of a production unit for making charcoal briquettes and liquid smoke from mangrove waste as a new and renewable energy source suitable for the village of Kampung Laut based on appropriate technology. To maintain and develop the program on a larger scale in Kampung Laut, the additional assistantship will be conducted sustainably. In addition, it is believed that this sustainable mangrove exploitation best practices might be implemented elsewhere in Indonesia.

4. CONCLUSION

This endeavour has raised public awareness of the mangrove plant's potential as a natural dye raw material source. In addition, this activity offers communities the chance to engage in artificial thinning/clearing and sustainable mangrove planting to increase the availability of natural dye raw materials. Consequently, the creation and development of local enterprises commenced with an incubator model of eco-friendly entrepreneurship based on mangrove protection and zero waste from SMEs with natural dyes. Based on the findings of the completed field activities, the activities in phase I provide a provisional conclusion that the people and communities of Kampung Laut are highly enthusiastic about the activities to boost the empowerment of mangrove plant use. Efforts have been made to increase awareness and comprehension of

operating conditions associated with the extraction process. In addition, the continuation of this community service program should be encouraged to fulfill the ultimate goal of establishing a community-based, sustainable small industry. Under the auspices of Krida Wana Lestari, various farmer groups hope that this activity in the form of assisted villages will help them improve their existing products, realise the products they want to add, plan marketing to a broader audience, and calculate the potential natural mangrove they possess.

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CONFLICT OF INTERESTS

We declare that there is no conflict of interest with regard to this manuscript.

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