

Development of Small-Scale Charcoal Briquettes and Natural Dyes Production Units to Implement Zero-Waste System through Utilizing Mangrove Forests

Dwi Tyaningsih Adriyanti^{1*}, Aswati Mindaryani², Agus Prasetya², Himawan Tri Bayu Murti Petrus², Vincent Sutresno Hadi Sujoto², Mukmin Sapto Pamungkas², Tri Winarni S Putri³

¹Department of Silviculture, Faculty of Forestry, Universitas Gadjah Mada, Indonesia

²Department of Chemical Engineering, Faculty of Engineering, Universitas Gadjah Mada, Indonesia

³Department of Social Development and Welfare, Faculty of Social and Political Sciences, Universitas Gadjah Mada, Indonesia

*Corresponding author's email: dtadrianti@ugm.ac.id

doi: <https://doi.org/10.21467/proceedings.151.18>

ABSTRACT

Through the participation of local communities in the preservation of mangrove forest ecosystems, an attempt is being made to prevent further damage to the mangrove environment and recover from any damage already caused. The mangrove forests along the shore of Kampung Laut, most notably those located in the Ujung Alang Village, are kept in pristine form because of the numerous and varied types of mangrove plantation activities that are carried out there. The local people are currently utilizing mangrove plants as a source of food (certain parts of the plant) and building materials (the stems). On the other hand, its use as a natural dye source is not yet common enough to be considered a significant industry. So, the mangrove forest ecosystem can be protected through the Sustainable Utilization of Mangrove Forests for the Production of Natural Dyes with a Zero Waste System, which includes: (1) the preparation and completion of a natural dye production unit based on the right technology for Kampung Laut village; (2) the preparation and completion of the production unit to produce charcoal briquettes and liquid smoke from mangrove waste as a new and innovative use for mangrove waste; and (3) the preparation and completion of the production unit to produce naturally.

Keywords: Community Empowerment, Implementation of a Zero Waste System, Protection of the Mangrove Forest.

1 Introduction

One of the villages and sub-districts comprising the Cilacap Regency is Ujung Alang Village, located in the Kampung Laut District. The Cilacap city center and main highway are significantly far from this sub-district. The village of Kampung Laut Cilacap can be found on the outskirts of the Segara Anakan lagoon. This location is extremely remote compared to other communities because it is between two coastal regions. This village benefits from abundant economic possibilities thanks to its location and conditions, which allow it to capitalize on natural resources, beaches, mangrove forests, fish, culinary arts, tourism, and other industries. It has been demonstrated that the Segara Anakan Lagoon plays an important part in the productivity of the southern coastal waters of Java Island. This is evidenced by the fact that the lagoon has contributed more than 62 billion rupiahs in a single year, and this number is expected to continue growing for as long as the Segara Anakan ecosystem continues to function. Products derived from salt fishing are one way the lagoon's natural resources contribute to the neighborhood's well-being. Additionally, the mangrove forest has served as a home to many birds, and its value is estimated to be around 1,400 USD per hectare. This indicates that the greater the extent of the mangrove, the greater its value. [1].

In general, the population of Kampung Laut is aware of the importance of preserving the environment [2]. The ecological knowledge of the Kampung Laut community needs to be raised, particularly about working together on community development through various initiatives involving all parties concerned to lessen



© 2023 Copyright held by the author(s). Published by AIJR Publisher in "Proceedings of the 3rd International Conference on Community Engagement and Education for Sustainable Development" (ICCEESD 2022). Organized by the Universitas Gadjah Mada, Indonesia on December 7-8, 2022.

Proceedings DOI: [10.21467/proceedings.151](https://doi.org/10.21467/proceedings.151); Series: AIJR Proceedings; ISSN: 2582-3922; ISBN: 978-81-961472-6-6

the effects of Segara Anakan's narrowing and sedimentation. It demonstrates that the expansion of the populist economic paradigm might be used in this region based on environmentally conscious business, an inclusive realm, and the recruitment of young people. In addition, the mangrove's contribution to the economy is still just negligible [3]. The direct benefit values of using the aquatic resources of Segara Anakan were IDR 911,046,869,346 annually, with the utilization value of (1) fishing activities being IDR 891,526,405,816 annually, which is equivalent to 98.9%; (2) agriculture being IDR 6,280,864,030 annually, which is equivalent to 0.7%; and (3) mangrove as fuel being IDR 3,239,599,500 annually, which is equivalent to 0.4%. Wahyono, during a visit in March 2021, confirmed that mangroves are not being utilized to their full potential as economic resources by the local population in Kampung Laut. This is due to the fact that mangrove wood theft is still a widespread problem [4]. Because of this, it is vital to explore how this mangrove forest could be managed sustainably in addition to the community's rights to harvest them to achieve more significant economic benefits. Several institutions within the academic world, most notably UGM, have been researching community service topics in conjunction with the idea of zero waste [5]-[9]. Additional evidence supports the conclusion that people have a minimal understanding of the significance of mangrove ecosystems [10]. As the older generation also perceived, the younger generation (middle school to senior high school), in general, sees the mangrove ecosystem as nothing more than a habitat inheritable for physical needs, such as firewood and house-building materials; as a result, attempts on mangroves' encroachment and conversion continue to take place. On the other hand, as of the year 2019, the rate of unemployment in the Cilacap area is generally still high and stands at 7.31 percent, equivalent to 61,491 persons [11]. Therefore, to effectively manage the mangrove regions of Kampung Laut, it is necessary to address the economic issues caused by the high rates of youth unemployment and low levels of comprehension.

This foster village-based community service initiative aims to promote the welfare of the Kampung Laut local community by leveraging its mangrove forests as a source of raw materials for natural colors and a zero-waste system. The Community Development Foundation of Kampung Laut is running the program. Several different MSME development projects have been implemented to raise people's incomes by producing snacks made from mangrove fruits and processing mangrove skins into natural colors for use in local batik. However, the business scale for this natural dye product is very small, and it has little value from an economic standpoint [12, 13]. It is intended that the community would be equipped with the skills necessary to construct mangrove-based natural dye production units on a broader scale as a result of this program. Additionally, the youths employ the leftover mangrove wood to turn it into charcoal briquettes and then extract the liquid smoke to preserve various marine products. According to the findings of the interviews conducted during the trip, the youth population in Kampung Laut is still quite substantial. This contrasts with most villages in Indonesia, where many young people have moved away. It is intended that the youth of Kampung Laut would be able to carry out production, marketing, and promotion activities beyond the region via online platforms, which will allow them to act as agents of change within this empowerment project [14]-[16]—because most members of the younger generation have admirable goals, are physically capable, and are well-versed in modern technologies.

Since the Patra Krida Wana Lestari (PKWL) community group is currently responsible for managing the mangroves in Kampung Laut, this community services initiative will collaborate with them to provide community support. The local community of Kampung Laut in Cilacap has benefited from the assistance provided by the Pertamina RU IV Cilacap in coordinating with Bappeda and the Cilacap Regency Environmental Service. In addition, the UGM INDI Team and the Directorate of Community Services at Universitas Gadjah Mada were among the parties who participated in the early conversations in connection with this community empowerment initiative.

Due to the results of the field activities, the first stage provided provisional findings regarding the level of interest shown by the local community in Kampung Laut in initiatives designed to promote mangrove use empowerment. The numerous farmer cooperatives that fall under the aegis of Krida Wana Lestari harbor the sincere wish that the aided villages would be able to continue operating in an environmentally and socially responsible manner. In addition, several different efforts are made to materialize additional products, improve existing ones, assist in planning product marketing for a wider audience, and assist in calculating the potential of the natural mangrove.

2 Research Methodology

The majority of the first-year activities were prioritized to build comprehension and agreement on this program's primary schemes. The production units' technical preparation of natural dye harvesting and charcoal briquette manufacturing are also conducted. The method used were lectures, Forum Group Discussions (FGDs), training, and mentoring. The production units and utilization construction on a local scale are designed to begin in the second year. The third year is focused on the high-capacity operation of production units and broader marketing. The first year's detailed empowerment activities are presented in Table 1 as follows.

Table 1. *Methods of implementation and activities that have been planned for the following year*

No.	Activity	Method
1.	The development and construction of the natural dye production unit based on Kampung Laut's appropriate technology acceptability	Direct coordination and mentoring with various related parties
2	The preparation of the production unit for construction and its eventual implementation to produce mangrove waste charcoal briquettes and liquid smoke as a new and renewable energy source using the relevant technology developed by Kampung Laut.	Direct coordination and assistance with various related parties
3	The actualization of the mangrove potential calculation and the development of a blocking design to govern sustainable harvesting practices are needed.	Direct mentoring
4	Piloting sustainable methods for thinning and logging mangroves, as well as planting new trees, to support the supply of natural color raw materials	Direct mentoring
5	A formulation for the third year of follow-up	Coordination meetings with various relevant parties

The facilitated village development program will last for three years, and its primary objective is to assist the local community in recognizing the potential of its mangrove forests to provide a source of natural dyes. Table 2 presents the community service road map, timeline, meanwhile Figure 1 contains an illustration of the specific goals, from the road map.

Table 2. Roadmap of Community Service Based on Fostered Villages in the Village of the Sea

No.	Year	Purpose
1	2021	<ul style="list-style-type: none"> • Come to an understanding and reach a consensus among the numerous key parties over the program's overarching plan. • Determine how much mangrove ecosystems could serve as a source of natural dyes. • Boost the capabilities and capacities of the young people. • Performing the necessary technical preparations before harvesting. • Preparation of the manufacturing process for the natural dye production unit technically. • Preparing the technical aspects of the charcoal briquette production units and the fabrication of liquid smoke.
2	2022	<ul style="list-style-type: none"> • The building of natural dye production equipment and the conducting of production tests on a smaller scale • Constructing a machine for the production of charcoal briquettes and conducting preliminary experiments in the creation of liquid smoke on a smaller scale
3	2023	<ul style="list-style-type: none"> • Assistance in the beginning stages of harvesting mangrove raw materials responsibly and making natural dyes. • Charcoal briquettes and liquid smoke are required to create a waste-free system.

**Figure 7.** Details of the Kampung Laut's Village-Based Community Service Roadmap.

3 Results and Discussion

This chapter provides information regarding the activities that were carried out and the results that were attained up until the time that this report was filed. In the middle of April 2021, extensive preparation work was initiated for this investigation. The entirety of the research team participated in a variety of activities, such as coordination meetings, the creation of essential equipment for extraction, the production of liquid smoke fiber briquette charcoal, the preparation for activities to be carried out in the field, and the execution of activities in the Ujung Alang Village. The following Table 3 provides an overview of the actions in the community at the beginning of August 2022.

Table 3. *Second Year Assisted Village Program Activities*

Timing of implementation	26-28 June 2022
Executive	<ul style="list-style-type: none"> • The Fostered-Village UGM-INDI Team • Dr Dwi T Adriyanti, • Dr Aswati Mindaryani • Dr Tri Winarni • Dr. Agus Prasetya, • Dr Himawan Bayu • Mukmin Sapto P., M.Eng.
Activities	<ul style="list-style-type: none"> • Collecting and analyzing information regarding the potential of mangrove plants • This project aims to compile a database regarding the potential use of mangrove plants as a source of raw materials for natural dyes. • Training on using instruments for extracting natural dyes from mangrove bark materials is intended to improve the capabilities of the local populace and the quality of mangrove-dyed batik products. • Training on using briquette charcoal-making equipment from waste extracted from mangrove-based natural dyes is intended to enhance the community's skills in waste processing.

Training activities on using natural dye extraction tools from mangrove bark were carried out on August 8th, 2022, attended by farmer groups Krida Wana Lestari, Patra Bina Mandiri, PokDarWis youth, and Batik Mekar Canting that can be seen in Figure 2 below. The appropriate technology includes extraction pans, filters, and portable biomass or gas stoves. The design of the furnace or stove is flexible and can be used for biomass or gas fuel.



Figure 2: *Training Process for the Use of Natural Dyes Extraction*

This extraction tool's capacity is 40 L with a suggested temperature of 70-80 degrees Celsius. This step is intended to maintain the natural coloring compound content. If the extraction temperature is too high, the tannin content in the resulting extract will be small or degraded. The extraction tool has a filter that can hold solids, so it would not be included in the extracts. The extraction process can be done by lifting the filter to induce turbulence. The filter in the extraction tank facilitates the separation process. The recommended extraction process is carried out for two hours with a ratio of solid and solution of 1:10. The extracted bark is considered old (five years or older) due to the higher tannin content.

Meanwhile, based on the previous year's mapping research results, the highest tannin content was found in the *Ceriops tagal* mangrove's bark. Apart from demonstrating the extraction machine, enthusiasm can be seen from the Mekar Canting Batik Team, who actively consulted regarding the quality of natural dyes produced independently and the quality of batik cloth, which could not be standardized. The Cilacap Foster Village Team responded to this by assisting in maintaining the quality of natural dye extracts by using similar bark of the same age and processing at temperatures below the boiling point for around two hours. The extraction process is as much as possible using bark cut into pieces.

As a result of the fact that detergent is still used in the pre-mordanting process, the quality of the batik has not yet been standardized, and alum soda ash must be used in its place. This is one factor contributing to the low rate of batik production. The quality of the dye extract varies (an independent standard note needs to be created), and the quality of the locking solution varies as well (fixation solution made with a ratio of 40 grams in 1 liter of hot water, left overnight, and filtered). Both of these factors contribute to the inconsistency in product quality. Both of these issues need to be addressed. The potential of the Batik Mekar Canting team's enthusiasm needs to be considered for the activities of the third year, which will be centered on the standardized outputs of mangrove-based products. The equipment for the extraction machine was handed over to the staff at Batik Mekar Canting for them to manage it and conduct routine tests on it. Overall, the two activities have successfully met the work indicators of the fostered-village activities, including constructing a natural dye manufacturing unit based on acceptable technology and suitable for the village of Kampung Laut.



Figure 8. *Training Process for the Use of Natural Dyes Extraction*

The Charcoal Briquette Making Tool from Leftover Extraction of Mangrove-Based Natural Dyes usage training was carried out by directly demonstrating the charcoal briquette making to the Krida Wana Lestari Team, youth Pokdarwis (*Kelompok Sadar Wisata*, Tourism Awareness Group), and the Patra Bina Mandiri Team. The technology for manufacturing charcoal and liquid smoke briquettes was provided to the team representatives. The charcoal-making process was not demonstrated due to time constraints, as the Cilacap Design Team has carried out the machine usage tutorial. The Patra Bina Mandiri team also has experience in the distillation process, which is almost similar to the liquid smoke-making process. Liquid smoke is

obtained from gas condensation due to fumigation. The pipe is portable and needs to be immersed in water to produce liquid smoke. The UGM 2022 KKN-PPM Team assisted in the briquettes-making process demonstration as it aligned with the KKN Team's objectives. The community directly tried on briquette dough-making and forming in tubes with simple tools as shown in Figure 3. Suppose the charcoal briquette-making process from the natural dyes extraction can be carried out, it is expected that the energy source for the extraction process can come from biomass briquettes as implementing a zero-waste system.



Figure 9. Training Process for the Use of Charcoal Briquette

4 Conclusions

The conducted field activities show that the second year's activity results conclude that the Kampung Laut local community is very enthusiastic regarding the activities involving mini plant extract construction from mangrove wood waste and making charcoal briquettes and liquid smoke. The community hopes this fostered-village activity can occur sustainably and help improve their economic value. For instance, improving the existing products, realizing the additional products, assisting with the marketing plan, and directly helping them to calculate the existing natural mangroves' potential.

5 Declarations

5.1 Acknowledgments

We would like to extend our deepest gratitude to Universitas Gadjah Mada for awarding us the grant that will allow us to carry out this initiative at Desa Binaan (Fostered-Village) between 2021 and 2023. This research, on the other hand, did not secure specific grants from any funding agencies in the public sector, the commercial sector, or the non-profit sector.

5.2 Publisher's Note

AIJR remains neutral with regard to jurisdictional claims in published map and institutional affiliations.

How to Cite

Adriyanti *et al.* (2023). Development of Small-Scale Charcoal Briquettes and Natural Dyes Production Units to Implement Zero-Waste System through Utilizing Mangrove Forests. *AIJR Proceedings*, 120-127. <https://doi.org/10.21467/proceedings.151.18>

References

- [1] Badan Pengelola Kawasan Segara Anakan (BPKSA). 2005.
- [2] E. Sulastri, T. Haryadi, and E. Inayah, "Tingkat Kesadaran Ekologis Masyarakat Kampung Laut, Kabupaten Cilacap, Jawa Tengah," *Jurnal Kawistara*, vol. 9, no. 1, pp. 78. 2019. <https://doi.org/10.22146/kawistara.31484>
- [3] R. Triyanti, R. A. Wijaya, S. Koeshendrajana, and F. N. Priyatna, "KARAKTERISTIK DAN NILAI MANFAAT LANGSUNG SUMBER DAYA PESISIR (Studi Kasus di Perairan Segara Anakan, Kabupaten Cilacap)," *Jurnal Sosial Ekonomi Kelautan Dan Perikanan*, vol. 5, no. 1, pp. 31. 2017. <https://doi.org/10.15578/jsekp.v5i1.5790>

-
- [4] INDI LPPT, KEMBANGKAN PERTUMBUHAN EKONOMI LOKAL KAMPUNG LAUT CILACAP: Tim Desa Binaan INDI UGM 2021 Lanjutkan Kegiatan Peningkatan Pemberdayaan Masyarakat Melalui Pemanfaatan Hutan Mangrove Secara Lestari Untuk Produksi Pewarna Alami Dengan Zero Waste System. 2021. <https://indi.lppt.ugm.ac.id/2021/10/19/kembangkan-pertumbuhan-ekonomi-lokal-kampung-laut-cilacap-tim-desa-binaan-indi-ugm-2021-lanjutkan-kegiatan-peningkatan-pemberdayaan-masyarakat-melalui-pemanfaatan-hutan-mangrove-secara-lestari-untuk/>
- [5] B. A. Atmoko, E. Baliarti, and N. A. Fitriyanto, "IPTEK Bagi Masyarakat (IbM) Melalui Peningkatan Panen Pedet dan Produksi Kompos Berkualitas Pada Kelompok Ternak Sapi Potong," *Jurnal Pengabdian Kepada Masyarakat (Indonesian Journal of Community Engagement)*, vol. 5 no. 1, pp. 72. 2019. <https://doi.org/10.22146/jpkm.33874>
- [6] N. A. Fitriyanto, S. Triatmojo, A. Pertiwiningrum, Y. Erwanto, M. Z. Abidin, E. Baliarti, and Y. Y. Suranindyah, "Penyuluhan dan Pendampingan Pengolahan Limbah Peternakan Sapi Potong di Kelompok Tani Ternak Sido Mulyo Dusun Pulosari, Desa Jumoyo, Kecamatan Salam, Kabupaten Magelang," *Jurnal Pengabdian Kepada Masyarakat (Indonesian Journal of Community Engagement)*, vol. 1, no. 1, pp. 79. 2015. <https://doi.org/10.22146/jpkm.16955>
- [7] D. Irawati, G. Lukmandaru, J. Sulistyono, S. Sunarta, T. Listyanto, J. Widada, and Y. Rizal, "Penanganan dan Pemanfaatan Limbah Biomassa Sawit Ramah Lingkungan di PT Semen Baturaja," *Jurnal Pengabdian Kepada Masyarakat (Indonesian Journal of Community Engagement)*, vol. 6, no. 4. 2020. <https://doi.org/10.22146/jpkm.44874>
- [8] E. Permanasari, F. Hendola, R. Purisari, and R. Safitri, "Penyelamatan Air Tanah dan Penanggulangan Sampah Melalui Program Biopori Dan Komposter Di Pemukiman Kecil di Kelurahan Ciputat dan Ciputat Timur," *Jurnal Pengabdian Kepada Masyarakat*, vol. 4, no. 1, pp. 51. 2018. <https://doi.org/10.22146/jpkm.33412>
- [9] A. T. Sulistiyani, D. Aisyah, I. Mamat, and M. Sontang, "Pemberdayaan Masyarakat Pemanfaatan Limbah Tulang Ikan untuk Produk Hidroksiapatit (Hydroxyapatite/HA) Kajian di Pabrik Pengolahan Kerupuk Lekor Kuala Terengganu-Malaysia," *Jurnal Pengabdian Kepada Masyarakat (Indonesian Journal of Community Engagement)*, vol. 2, no. 1, pp. 14. 2016. <https://doi.org/10.22146/jpkm.22086>
- [10] H. Hariyadi, Peran Masyarakat dalam Pengelolaan Ekosistem Mangrove untuk Mitigasi Bencana: Studi di Segara Anakan, Kab. Cilacap. 2018. <https://doi.org/10.22212/kajian.v23i1.1873>
- [11] Badan Pusat Statistik, Kabupaten Cilacap dalam Angka. 2020.
- [12] T. Bechtold, A. Turcanu, E. Ganglberger, and S. Geissler, "Natural dyes in modern textile dyehouses – how to combine experiences of two centuries to meet the demands of the future?" *Journal of Cleaner Production*, vol. 11, no. 5, pp. 499-509. 2003. [https://doi.org/10.1016/S0959-6526\(02\)00077-X](https://doi.org/10.1016/S0959-6526(02)00077-X)
- [13] J. Choi, and S. Kim, "Purchase intention on naturally dyed clothing depending on fabric benefit sought and attitudes - A cross-cultural study between Korea and the United States," *The Research Journal of the Costume Culture*, vol. 22, no. 2, pp. 183–197. 2014. <https://doi.org/10.7741/rjcc.2014.22.2.183>
- [14] W. Handayani, S. Muljaningsih, and H. Ardyanfitri, "Online Marketing Supports Promotion And Advertising Sales In Communities Dolly Localization," *THE SPIRIT OF SOCIETY JOURNAL*, vol. 2, no. 1, pp. 75–87. 2018. <https://doi.org/10.29138/scj.v2i1.728>
- [15] M. G. Haque, "The Effect of Digital Marketing and Media Promotion Utilization to a Bakpia Patok Yogyakarta SMES' Sales Performance," *Jurnal Ilmiah Ilmu Administrasi Publik*, vol. 10, no. 1, pp. 233. 2020. <https://doi.org/10.26858/jiap.v10i1.14336>
- [16] B. Rawat, P. A. Sunarya, and V. T. Devana, "Digital Marketing as a Strategy to Improve Higher Education Promotion During the COVID-19 Pandemic," *Startupreneur Business Digital (SABDA Journal)*, vol. 1, no. 2, pp. 114–119. 2022. <https://doi.org/10.34306/sabda.v1i2.105>