

GREEN ECONOMY THROUGH DISTILLATION TECHNOLOGY TRANSFER OF CITRONELLA PLANTS ESSENTIAL OILS

Rokiy Alfanaar^{1*}, Yahya Febrianto², Shesanti Citra Riana³, Sudarman Rahman⁴,
Awalul Fatiqin⁵, Febri Nur Ngazizah⁶, Karyadi⁷, Yudhi Ekakristian Sahari⁸,
Mu'afa Purwa Arsana⁹, Thathit Suprayogi¹⁰

¹Study Program of Chemistry, Universitas Palangka Raya, Indonesia

^{2,3,4}Study Program of Pharmacy, Universitas Palangka Raya, Indonesia

^{5,6,7,8}Study Program of Biology, Universitas Palangka Raya, Indonesia

⁹Study Program of Mathematics, Universitas Palangka Raya, Indonesia

¹⁰Study Program of Physics, Universitas Palangka Raya, Indonesia

rokiy.alfanaar@mipa.upr.ac.id¹, yahyafebri15@mipa.upr.ac.id², shesanthi.citrariana@mipa.upr.ac.id³,
sudarmanrahman@mipa.upr.ac.id⁴, fatiqin@mipa.upr.ac.id⁵, febrinurngazizah@mipa.upr.ac.id⁶,
karyady.1108@gmail.com⁷, yudhiekaristiansahari@gmail.com⁸, muafa.purwa@mipa.upr.ac.id⁹,
thathit.suprayogi@mipa.upr.ac.id¹⁰

ABSTRAK

Abstrak: Green economy merupakan salah satu jenis ekonomi yang memperhatikan aspek lingkungan. Konsep *green economy* melibatkan pemanfaatan tanaman sebagai sumber daya terbarukan dalam bidang ekonomi. Sebagai kabupaten yang baru keluar dari status 3T, Seruyan memiliki potensi pengembangan ekonomi dalam bidang green economy. Pengabdian ini bertujuan mengenalkan green economy melalui transfer teknologi destilasi minyak atsiri dengan tanaman yang digunakan adalah Serai Wangi yang lazim ditemukan di Desa Bukit Buluh. Metode pelaksanaan pengabdian terdiri dari merancang alat destilasi dan pelatihan pemanfaatan alat destilasi yang dihadiri 23 peserta dari warga dan pengurus desa dengan peningkatan pemahaman dalam bidang rangkaian destilasi, pemilihan tanaman, dan optimasi ekstraksi sebanyak 95, 60, dan 85 %. Kegiatan pengabdian ini berjalan dengan baik dengan tingginya antusiasme warga dalam kegiatan pelatihan.

Kata Kunci: *Green Economy*; Minyak Atsiri; Transfer Teknologi.

Abstract: *Green economy is an economic model that prioritizes environmental considerations. The concept of the green economy revolves around utilizing plants as renewable resources within the economic sector. Seruyan, recently emerged from 3T status, holds substantial potential for economic growth within the realm of the green economy. The purpose of this initiative is to introduce the principles of a green economy by imparting knowledge about essential oil distillation technology, using Lemongrass as the primary plant source, abundantly available in Bukit Buluh Village. The method of implementing the service consisted of designing distillation equipment and training on the utilization of distillation equipment which was attended by 23 participants from residents and village administrators with an increase in understanding in the fields of distillation circuit, plant selection, and extraction optimization by 95, 60, and 85%. This service activity went well with the high enthusiasm of the residents in the training activities.*

Keywords: *Green Economy; Essential Oils; Technology Transfer.*



Article History:

Received : 30-08-2023

Revised : 15-09-2023

Accepted : 22-09-2023

Online : 01-10-2023



This is an open access article under the
CC-BY-SA license

A. INTRODUCTION

Southeast Asia's largest economy is Indonesia, which will have a 1.19 trillion USD GDP in 2021 (Napang, 2022). Over the previous ten years, the economy of the nation has grown significantly, on average by little over 5%. A solid foundation of social stability, a high level of domestic demand for goods and services, and stable prices have all coexisted with this expansion (Tampubolon & Adalakun, 2021). However, Indonesia continues to face issues like a lack of infrastructure, corruption, and a protectionist attitude (Handayani et al., 2022). Despite these difficulties, some areas have been able to go through the "3T" (*tertinggal, terisolir, dan terdepan*) classification, which refers to undeveloped, remote, and frontier territories, and grow their economies (Riau et al., 2022). To address the economic demands of their populations, these areas have used local plants and green economy ideas. These areas can sustainably grow their economies while maintaining their natural resources by adopting regional plants and green economy ideas (D'Amato & Korhonen, 2021).

Seruyan district was the only 3T district in Central Kalimantan in 2019. One of the villages in the district is Bukit Buluh, which has great potential for agriculture because its area of 60 km² has empty land that has not been fully utilized, and its main residents are farmers. One of the potential plants in Bukit Buluh is Serai Wangi. Serai Wangi or Citronella can be found easily in the gardens owned by the citizens and grows well in Bukit Buluh.

Citronella oil possesses the potential to be derived from citronella plants. Citronella oil comprises chemical components like citral, geraniol, and limonene, contributing to its unique and refreshing fragrance (Kaur et al., 2021; Solanki et al., 2019; Verma et al., 2020). Moreover, citronella oil possesses advantageous health qualities such as antibacterial and antifungal effects (Kaur et al., 2021; Yin et al., 2022). Empirical evidence suggests that citronella oil has potential as a productive component in both aesthetic and therapeutic formulations. Essential oil from Citronella can be obtained through the distillation process, an extraction method that produces essential oils by vaporizing the active compounds from the plant and then collecting the vapor through condensation (Phovisay et al., 2019; Zakri et al., 2022).

The transfer of distillation technology holds significant importance in obtaining essential oils, especially within the framework of the green economy. This method is in accordance with the concepts of sustainability and resource efficiency, as it enables the extraction of valuable aromatic compounds from plants such as Citronella in an environmentally conscientious manner. Through the adoption and integration of this technology, communities are able to not only improve their economic prospects by engaging in the production of essential oils of superior quality but also make a valuable contribution towards the development of a more environmentally friendly and sustainable local economy.

The utilization of citronella as an illustrative scenario exemplifies the multifaceted nature of this technique. Furthermore, the application of distillation processes can be expanded to include various plant species that are well-suited to the local environment (Baptista-Silva et al., 2020). Through the process of adapting technology to suit the specific characteristics of local flora, communities have the opportunity to expand the variety of products they offer and leverage the abundance of their natural resources. This method not only enhances the economic vitality of the local area but also cultivates a heightened sense of environmental responsibility as the community becomes increasingly aware of the significance of their local plant species (Kant & Kumar, 2022). The transfer of distillation technology serves as a stimulus for economic progress and ecological harmony, thereby emphasizing the interdependent nature of environmentally friendly activities and technological advancements.

B. METHOD

The community service partner in this activity is Bukit Buluh Village in Seruyan Tengah District, Seruyan Regency. This village is a village where the majority of the population has gardening jobs with a large area of family gardens. This large private garden land is widely used to grow various plants. The Community Service program encompasses three distinct phases, which include engaging in (1) dialogue with the Bukit Buluh Village Administrator; (2) developing a distillation apparatus design; and (3) providing instruction on the operation of this apparatus, as shown in Figure 1.

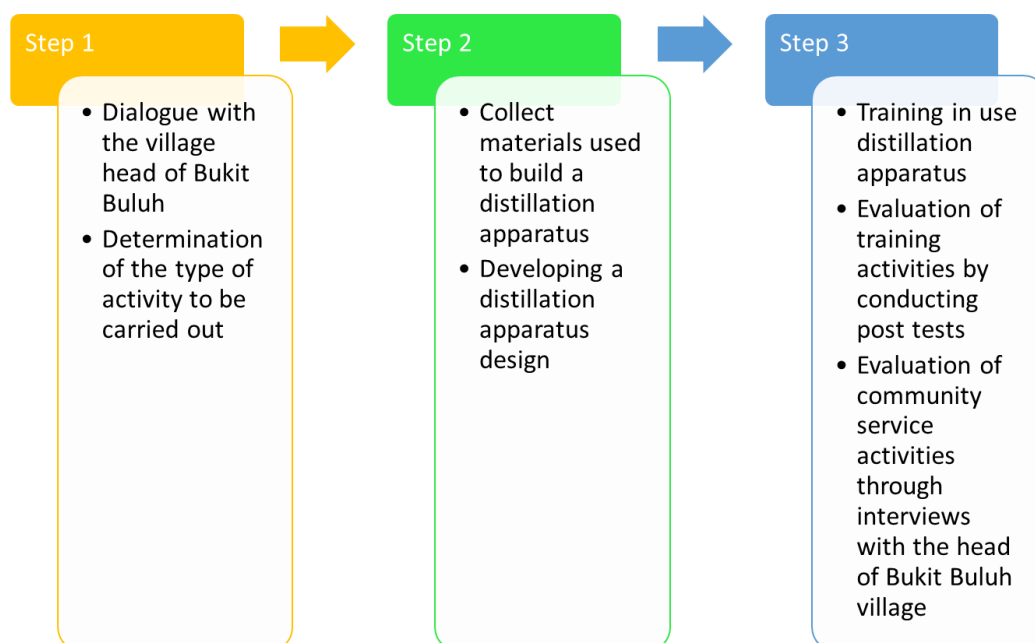


Figure 1. Design of Community Service Program

The distillation device provided to Bukit Buluh Village is constructed from stainless steel. The distillation apparatus was transferred to the administrator of Bukit Buluh Village. The provision of services was extended to include training sessions on the operation of distillation equipment, which took place at the Bukit Buluh Village Hall. The community service portion of this program employs a pedagogical approach that combines demonstration with hands-on teaching. The training was attended by 16 housewives from Bukit Buluh Village and 7 village officials. The selection of the demonstration approach is intended to generate interest within the village community regarding the technology being transferred. The demonstration was conducted by faculty members who received assistance from students affiliated with the Faculty of Mathematics and Natural Sciences at the University of Palangka Raya.

C. RESULT AND DISCUSSION

1. Dialogue with The Village Head of Bukit Buluh

The community services process commenced with an online discussion involving Mr. Hendra, the village head, in March 2023. In July, the communication progressed, delving into the specifics of the training program, including its location and schedule. Based on this communication, it was decided that a training session on the utilization of distillation equipment would take place in the third week of August 2023. The training event was held at the Community Hall of Bukit Buluh Village, Seruyan Tengah Subdistrict, as shown in Figure 2.



Figure 2. Conversation with the Village Head of Bukit Buluh

Based on the results of the dialogue with the village head, it can be inferred that the community anticipates that this participatory endeavor will catalyze the inhabitants of Bukit Buluh Village to produce commendable commodities. Implementing a village's primary product is expected to provide economic support to the community while simultaneously promoting the commercial use of local flora in the area. The village head's aspirations align

with the principles of the Green Economy idea, since they aim to establish an ecologically sustainable village (Merino-Saum et al., 2020).

2. Developing a Distillation Apparatus Design

The distillation apparatus is primarily constructed using stainless steel materials and utilizes a regular stove as the primary heat source (Nicol, 2022). The main aim of this design is to prioritize the facilitation of replication for individuals engaged in household management. The experimental setup continues to be arranged with a transparent glass container to enhance visual understanding during training sessions. Nevertheless, it is advisable to transfer to a dark receptacle featuring a slender opening to mitigate the quick volatilization of essential oils (Yingngam et al., 2019).

The selection of stainless steel as the primary material for the equipment guarantees its longevity and ability to withstand high temperatures, rendering it appropriate for multiple applications (Liu et al., 2022; Panagopoulos et al., 2020). The design is specifically adapted to accommodate domestic settings, enabling homemakers to effortlessly repeat the procedure using a conventional stove as the heat source. This approach prioritizes accessibility and affordability while also considering the capabilities and resources typically found in household situations, as shown in Figure 3.



Figure 3. (a) The Design of The Distillation Apparatus used in The Community Service Process and (b) Distillation Apparatus at Village Hall

The transparent glass container utilized in the apparatus provides a visually unobstructed observation of the distillation process during training sessions. This visual aid is of utmost importance in augmenting participants' comprehension and involvement with the technology. Nevertheless, in accordance with the suggestion, it is desirable to make a transfer to a dark

container that possesses a narrow neck. This modification serves to decrease the contact between essential oils and external factors, thereby mitigating the likelihood of premature evaporation and enhancing the efficiency of the extraction process.

The distillation apparatus is designed to integrate the practical aspects of stainless steel construction and the utilization of household stoves, resulting in a system that can be readily reproduced by those engaged in domestic activities. The use of a transparent container in the initial stages of training is beneficial; however, the optimization of the essential oil extraction process can be achieved by switching to a dark container with a narrow neck. The design of this product emphasizes simplicity, accessibility, and efficient extraction of essential oils. This aligns with the objective of enabling individuals who manage household affairs to participate in the distillation process easily.

3. Training in Use Distillation Apparatus

The community engagement initiative included a training workshop focused on utilizing distillation equipment for extracting Citronella oil. This training was conducted on August 14, 2023, at the Community Hall of Bukit Buluh Village. The event was attended by community members, primarily homemakers, and village officials. The training commenced with an introductory presentation on the concept of the green economy, delivered by representatives from University of Palangka Raya, followed by a practical demonstration of the distillation process.

The demonstration centered on the distillation of Citronella oil. As the process unfolded, the distinct aroma of Citronella oil filled the room, exemplifying one of its characteristic features (Sharma et al., 2019). The participants' enthusiasm was palpable as they engaged actively in observing the demonstration. The training was designed as a hands-on experience, involving not only community members but also the village head, who took part in learning the operational aspects of the distillation apparatus.

A notable highlight was the enthusiastic participation of the community members. They posed numerous insightful questions, underscoring their eagerness to comprehend the process and optimize the oil extraction. The engagement was not confined to theoretical knowledge; instead, it translated into practical skills as participants actively interacted with the equipment, fostering a sense of ownership and empowerment, as shown in Figure 4 and Table 1.



Figure 4. Distillation training process when (a) residents and (b) village heads pay attention to the distillation process

Table 1. Impact of knowledge change after distillation training

No	Knowledge	Before Training	After Training
1	Distillation circuit	Good	-
		Enough	10%
		Less	90%
2	Plant selection	Good	40%
		Enough	60%
		Less	-
3	Distillation optimization	Good	-
		Enough	90%
		Less	10%

The training session effectively disseminated knowledge about the principles of the green economy and facilitated a practical understanding of the distillation process for Citronella oil. Based on table 1, there is an increase in knowledge, especially in the distillation circuit section by 95%. The active involvement of both homemakers and village officials emphasized the significance of such initiatives in enhancing community engagement and capacity-building. The interactive nature of the event empowered participants not only to grasp the theoretical aspects but also to acquire practical skills that can be applied to their daily lives.

D. CONCLUSIONS AND SUGGESTIONS

The implementation of community service in Bukit Buluh Village, Seruyan Regency, has yielded beneficial outcomes through the dissemination of essential oil distillation technology. The village and its citizens have witnessed a rise in knowledge about the potential utilization of local plants within the economic domain, aligning with the ideals of a sustainable green economy. There was an increase in knowledge in the distillation circuit section by 95%, plant selection by 60%, and distillation optimization by 85%. One potential recommendation for future endeavors involves implementing knowledge transfer within essential oil formulations, to augment the economic worth of essential oil products.

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the Ministry of Education, Culture, Research and Technology for their financial support in the form of the BIMA Community Service Grant. Additionally, the authors would like to acknowledge the LPPM University of Palangka Raya for providing the necessary resources and opportunities to conduct this community service project successfully.

REFERENCE

- Baptista-Silva, S., Borges, S., Ramos, O. L., Pintado, M., & Sarmiento, B. (2020). The progress of essential oils as potential therapeutic agents: a review. *Journal of Essential Oil Research*, *32*(4), 279–295. <https://doi.org/10.1080/10412905.2020.1746698>
- D'Amato, D., & Korhonen, J. (2021). Integrating the green economy, circular economy and bioeconomy in a strategic sustainability framework. *Ecological Economics*, *188*(October 2021), 107143. <https://doi.org/10.1016/j.ecolecon.2021.107143>
- Handayani, B. D., Yanto, H., Pujiati, A., Ridzuan, A. R., Keshminder, J. S., & Shaari, M. S. (2022). The Implication of Energy Consumption, Corruption, and Foreign Investment for Sustainability of Income Distribution in Indonesia. *Sustainability (Switzerland)*, *14*(23), 1–15. <https://doi.org/10.3390/su142315915>
- Kant, R., & Kumar, A. (2022). Review on essential oil extraction from aromatic and medicinal plants: Techniques, performance and economic analysis. *Sustainable Chemistry and Pharmacy*, *30*(December 2022), 100829. <https://doi.org/10.1016/j.scp.2022.100829>
- Kaur, H., Bhardwaj, U., Kaur, R., & Kaur, H. (2021). Chemical Composition and Antifungal Potential of Citronella (*Cymbopogon nardus*) Leaves Essential Oil and its Major Compounds. *Journal of Essential Oil Bearing Plants*, *24*(3), 571–581. <https://doi.org/10.1080/0972060X.2021.1942231>
- Liu, X., Zhang, X., Wu, J., Zhu, H., & Wu, Y. (2022). Mediating phase decomposition to avoid thermal aging embrittlement in a duplex stainless steel. *Materials Characterization*, *194*(December 2022), 112411. <https://doi.org/10.1016/j.matchar.2022.112411>
- Merino-Saum, A., Clement, J., Wyss, R., & Baldi, M. G. (2020). Unpacking the Green Economy concept: A quantitative analysis of 140 definitions. *Journal of Cleaner Production*, *242*(1 January 2020), 118339. <https://doi.org/10.1016/j.jclepro.2019.118339>
- Napang, M. (2022). The Trade War Of China And The Us In 2021, And It's Impact On The Indonesian Economy. *Journal of Strategic and Global Studies*, *5*(2). <https://doi.org/10.7454/jsgs.v5i2.1102>
- Nicol, D. A. (2022). Batch distillation. In *Whisky and Other Spirits* (pp. 247–270). Elsevier. <https://doi.org/10.1016/B978-0-12-822076-4.00004-8>
- Panagopoulos, A., Loizidou, M., & Haralambous, K.-J. (2020). Stainless Steel in Thermal Desalination and Brine Treatment: Current Status and Prospects. *Metals and Materials International*, *26*(10), 1463–1482. <https://doi.org/10.1007/s12540-019-00398-w>
- Phovisay, S., Briatia, X., Chanthakoun, V., & Savathvong, S. (2019). Effect of Distillation Methods on Citronella Oil (*Cymbopogon nardus*) Content. *IOP Conference Series: Materials Science and Engineering*, *639*(1), 012053. <https://doi.org/10.1088/1757-899X/639/1/012053>
- Riauuan, M. A. I., Cahyono, N. D., & Manaf, A. M. A. (2022). Implementation of E-Planning System for Preparation of Work Plans among Local Government in

- Indonesian 3T Regions. *2022 IEEE Creative Communication and Innovative Technology (ICCIT)*, 1–9. <https://doi.org/10.1109/ICCIT55355.2022.10119038>
- Sharma, R., Rao, R., Kumar, S., Mahant, S., & Khatkar, S. (2019). Therapeutic Potential of Citronella Essential Oil: A Review. *Current Drug Discovery Technologies*, *16*(4), 330–339. <https://doi.org/10.2174/1570163815666180718095041>
- Solanki, K. P., Desai, M. A., & Parikh, J. K. (2019). Microwave intensified extraction: A holistic approach for extraction of citronella oil and phenolic compounds. *Chemical Engineering and Processing - Process Intensification*, *146*(December 2019), 107694. <https://doi.org/10.1016/j.cep.2019.107694>
- Tampubolon, J., & Adalakun, O. J. (2021). the Role of Domestic Demand in Indonesian Economic Growth. *Journal of Tianjin University Science and Technology*, *54*(10), 266–284. <https://doi.org/10.17605/OSF.IO/EY7MW>
- Verma, R. S., Verma, S. K., Tandon, S., Padalia, R. C., & Darokar, M. P. (2020). Chemical composition and antimicrobial activity of Java citronella (*Cymbopogon winterianus* Jowitt ex Bor) essential oil extracted by different methods. *Journal of Essential Oil Research*, *32*(5), 449–455. <https://doi.org/10.1080/10412905.2020.1787885>
- Yin, H., Yuanrong, Z., Li, Y., Zijing, X., Yongli, J., Yun, D., Danfeng, W., & Yu, Z. (2022). Optimization of antibacterial and physical properties of chitosan/citronella oil film by electrostatic spraying and evaluation of its preservation effectiveness on salmon fillets. *Food Packaging and Shelf Life*, *33*(September 2022), 100891. <https://doi.org/10.1016/j.fpsl.2022.100891>
- Yingngam, B., Kacha, W., Rungseevijitprapa, W., Sudta, P., Prasitpuriprecha, C., & Brantner, A. (2019). Response surface optimization of spray-dried citronella oil microcapsules with reduced volatility and irritation for cosmetic textile uses. *Powder Technology*, *355*(October 2019), 372–385. <https://doi.org/10.1016/j.powtec.2019.07.065>
- Zakri, A. A., Mulyadi, A., Syahza, A., & Aziz, Y. (2022). *The development of citronella oil distillation results into commercialized products*. *1*(1), 27–36.