JURNAL PENGABDIAN MASYARAKAT BIOLOGI, EDUKASI DAN KESEHATAN

https://www.rjupublisher.com/ojs/index.php/JABK

Increasing Production of Cocoa Agroforestry Systems Based on Environmentally Friendly Technology

Imran RACHMAN[a], Sudirman Dg. MASSIRI[a], Budi SETIAWAN[a], Andi Sahri ALAM[a], RAFIUDDIN[b]

[a]*Forestry Study Program, Faculty of Forestry, Universitas Tadulako, Palu, Indonesia*
[b]*Faculty of Agriculture, Universitas Muhammadyah Palu, Palu, Indonesia*

*Corresponding author: andisahrialam77@gmail.com

Abstract

The purpose of the service is to develop an environmentally friendly intensive agricultural cultivation technology system to increase the productivity of cocoa plantations and the quality of cocoa beans. So far, farmers have been inaccurate in their cultivation, such as using cocoa seeds whose clones are not clear, applying fertilizer and conserving the fertility of cocoa land incorrectly, pruning cocoa plants which are not done by pruning rules, not even pruning at all and not carrying out shade management properly. It is hoped that this activity can overcome problems with cocoa plants in Sidondo I Village in particular and even throughout Central Sulawesi in general. To overcome the decline in productivity and the cocoa agroforestry cultivation system with an environmentally friendly intensive farming system in Sidondo I Village, this activity process is carried out in the form of training which includes: 1. Technical training: a). Application of plant rehabilitation using side grafting technology, b). Application of fertilizing and spraying activities using organic fertilizer. c). Application of correct and timely pruning techniques. d) Shade management application. e). post-harvest training (harvesting techniques, fermentation, and storage of fermented beans). 2. Non-technical training which includes: entrepreneurial management, and strengthening group institutions. The implementation method is the training and counseling method. This program also uses a learning-by-doing approach, meaning learning while working/doing business through group mentoring. Through this service activity, it is hoped that changes will occur in society through partner groups in terms of increasing income, increasing knowledge, skills, and mastery of technology.

Keywords: Cocoa agroforestry, intensive cultivation, environmentally friendly

Acknowledgments: Thanks to all parties who have supported the implementation of this research. I hope this research can be useful.

For citation:

Rachman, I., Massiri, S. D., Setiawan, B., Alam, A. S., & Rafiuddin. (2024). Increasing Production of Cocoa Agroforestry Systems Based on Environmentally Friendly Technology. *Jurnal Pengabdian Masyarakat Biologi, Edukasi dan Kesehatan, 1*(1), 40-46.

Introduction

Sidondo I Village is one of the villages in Sigi Biromaru District, Sigi Regency, Central Sulawesi Province. The location of Sidondo I Village is on the Palu - Kulawi road axis. Initially, Sidondo I Village was a forest. Sidondo comes from the name of a type of tree that grows a lot in the Wisolo Sambo area, Dolo District after an event occurred that happened to the people who inhabited the area, namely a disease caused by 9 caterpillars in the Kaili language called Tandadu. The outbreak affected all types of crops, including foodstuffs and equipment, so people moved to a new area called Sidondo village, which means cooperation, which comes from the word Nosidondo. Until now, the people of Sidondo I Village have been inhabited by tribes, namely Balinese, Javanese, Kaili, and Buginese. The leading commodities are Cocoa, Rice, Coconut, Teak Wood, Nantu, Palapi and other forest products.

The condition of the area in Sidondo I Village is around 20% residential, 40% rice fields and around 40% is cocoa plantations and agroforestry (Oktiani Perida Merang et al., 2019); (Saleh et al., 2022). With the availability of this natural resource (cocoa agroforestry), the community in Sidondo I Village generally uses the land for the development of cocoa agroforestry, but the community is not appropriate in cultivation, such as using cocoa seeds whose clones are not clear, applying fertilizer and preserving the fertility of cocoa land incorrectly pruning of cocoa plants is carried out not by pruning rules or even no pruning is carried out at all (Murniati et al., 2022). In Sidondo I Village, a farmer group has been formed, namely the Chocolate Flower Farmers Group, with 30 members. From the past until now, the people in Sidondo I Village, especially cocoa farmers, have experienced a very real decline in productivity with very low quality, especially post-earthquake and liquefaction conditions, in fact almost half of the cocoa plantation area is not producing at all.

Based on the main problems faced by farmer groups, through this service program, the community is given training and counseling so that the community in Sidondo I Village in particular, and the community in Sigi District in general can understand the cocoa agroforestry cultivation system with an environmentally friendly intensive farming system so that it can increase income. and improve welfare (Yalu & Matous, 2024). Cocoa is an important economic crop in Indonesia because it is a source of regional income and foreign exchange (Fahmid et al., 2022). Farming communities, especially in Central Sulawesi, are a source of regional income and foreign exchange (Tenriawaru et al., 2022). This commodity produces cocoa beans as raw materials for various food and beverage industries as well as the cosmetics industry. Cocoa plants are the main crop in Sidondo I Village, Sigi District. Sigi because this plant is a source of income for the community so the cocoa plant is very important for the community.

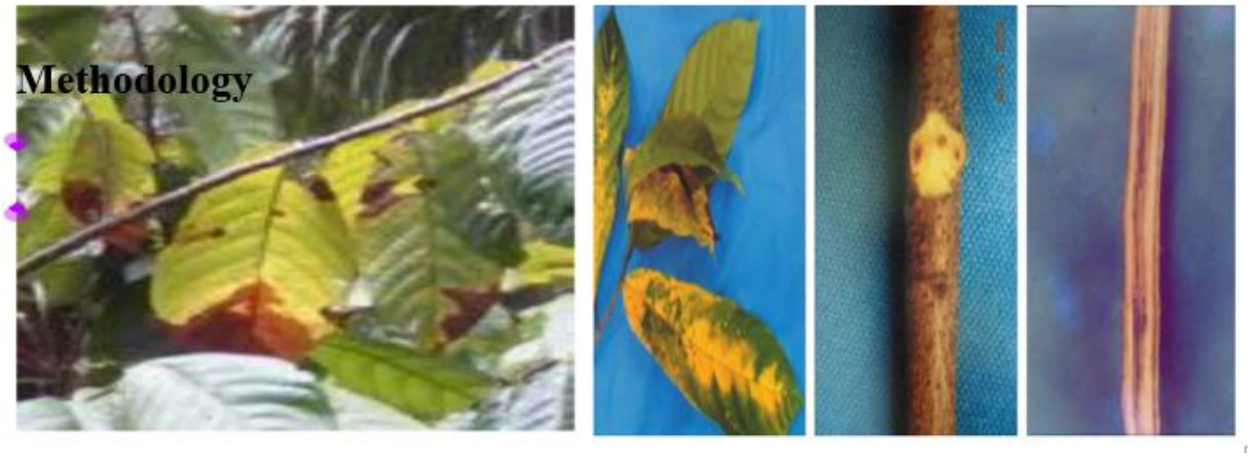

Figure 1. Cocoa Plants Attacked by Vascular Streak Dieback (VSD)

The justification of the proposer and partners in determining priority issues is as follows (Gustavsson & Lindblom, 2023): Providing knowledge, and skills and introducing technology related to the use of cocoa cultivation with an intensive system that is environmentally friendly and provides profits; Group coaching by providing organizational and administrative knowledge and entrepreneurship; Opening new business opportunities and disseminating information.

Methodology

The implementation method developed in this Community Service program activity can overcome partner problems. The method implemented is as follows: preparation phase, implementation stage, post-training, and evaluation.

Results

Under the stages designed at the initial stage of the activity, the initial activities carried out were counseling and delivering material regarding the delivery of basic theories related to making fertilizer and how to apply fertilizer to cocoa plants which was delivered by Mr. Dr. Sudirman Dg. Massiri, S.Hut.M.Sc.

Figure 2. Counseling on Institutional Strengthening

Delivery of material related to entrepreneurial and institutional management as well as preparation of tools and materials used by Mr. Dr. Hut. Budi Setiawan, S. Pd. MP. Technical

training for making Organic Solid Fertilizer and Technical training for making Organic Liquid Fertilizer. Training materials for microorganisms isolated from nature, then purified, identified, multiplied and tested for their ability to work as nutrient decomposers and produce secondary metabolic compounds that are useful for the growth of cocoa plants, were carried out by Mr. Prof. Dr Ir. H. Imran Rachman, MP.

Figure 3. Making Organic Fertilizer

The results of implementing community service activities, namely Cocoa Agroforestry Farmers for group partners which will be carried out in Sidondo I Village, are knowledge to the community related to entrepreneurial and institutional management as well as increasing knowledge about environmentally friendly intensive cocoa development. Plant rehabilitation application using side grafting technology using superior clones whose results have been recognized so far. This fertilization application uses organic fertilizer, namely organic fertilizer and biological liquid fertilizer which is applied to the soil to improve the physical, biological and chemical properties of the soil. Application of foliar fertilizer. which is sprayed on plant leaves to improve the health of cocoa plants. Application of correct and timely pruning techniques., Application of correct shade management techniques.

Cocoa is an important economic crop in Indonesia because it is a source of regional income and foreign exchange (Fahmid et al., 2018); (Tothmihaly et al., 2019). Farming communities, especially in Central Sulawesi, are a source of regional income and foreign exchange (Umar et al., 2021). This commodity produces cocoa beans as raw materials for various food and beverage industries as well as the cosmetics industry. Cocoa plants are the main crop in Sidondo I Village, Kec. Sigi District. Sigi because this plant is a source of income for the community so the cocoa plant is very important for the community. Fertilizing cocoa agroforestry management is important because fertilization is a problem in cocoa cultivation (Olwig et al., 2024), so far farmers have used chemical fertilizers where we know that chemical fertilizers can damage the chemical and physical properties of the soil thereby threatening the sustainability of agriculture, as well as unwise control of pests and diseases, namely the application used to apply excessive pesticides which damage the growth of cocoa (Bisht & Singh Chauhan, 2021).

To restore soil conditions and maintain land conditions, the thing that must be chosen is to use organic fertilizer in combination with other cocoa cultivation technologies. It is believed

that the use of organic fertilizer can restore soil fertility in a sustainable manner and improve soil fertility and crop ecology so as to suppress the development of pests and diseases. The solid fertilizer used is fertilizer that utilizes organic sources found in the environment such as animal waste, legume organic materials which are mixed in a modern way through fermentation using decomposer microorganisms (Vurukonda et al., 2024). The application of solid fertilizer is carried out together with liquid biological fertilizer with the aim of encouraging the fertilizer decomposition process further (Chew et al., 2019); (Chen et al., 2020); (Pajura, 2024). It is expected to produce secondary metabolism in the form of the hormones auxin, cytocinin and giberlie as well as biological liquid fertilizer containing microorganisms that are pathogenic to disease. One of the components in liquid fertilizer contains non-symbiotic microorganisms so it can increase soil fertility, especially soil nitrogen (Wei et al., 2024); (Fahde et al., 2023); (Bargaz et al., 2018); (Ammar et al., 2023). Liquid foliar fertilizer is applied to leaves and other upper parts of plants in the hope of speeding up the growth and production process of plants because this fertilizer contains nutrients that can be absorbed more quickly by plants when compared to being applied to the soil.

Specifically, the problems faced by this group (Chocolate Flower Farmers Group) in terms of production and management are:

1. Low productivity so that farmers' income decreases
2. Cocoa production is not yet optimal and efficient
3. Very low quality cocoa beans.
4. Cocoa pod borer pests, fruit rot disease (Phytophthora) and Vascular Streak Dieback (VSD) are difficult for farmers to overcome.
5. The cocoa beans produced are not healthy for human consumption
6. Production of cocoa that is still contaminated with chemicals
7. Limited knowledge and skills of the group regarding the importance of using natural (organic) ingredients in cocoa cultivation
8. Limited group knowledge in organizational management and entrepreneurial management.

Conclusion

This program activity for the Farmer group will produce 2 forms of output in the form of products and services, namely:

1. Output in the form of products includes:
   a. Organic liquid fertilizer products and organic fertilizers.
   b. Organic fertilizer products
2. Output in the form of services:
   a. Formation of independent farmer groups in implementing friendly intensive cultivation environment.
   b. Producing cocoa plantations that have quality and sustainable production
   c. Creating a network and disseminating information on cocoa cultivation techniques

Conflicts of Interest

The authors declare no conflict of interest.

References:

Ammar, E. E., Rady, H. A., Khattab, A. M., Amer, M. H., Mohamed, S. A., Elodamy, N. I., AL-Farga, A., & Aioub, A. A. A. (2023). A comprehensive overview of eco-friendly bio-fertilizers extracted from living organisms. *Environmental Science and Pollution Research*, *30*(53), 113119–113137. https://doi.org/10.1007/s11356-023-30260-x

Bargaz, A., Lyamlouli, K., Chtouki, M., Zeroual, Y., & Dhiba, D. (2018). Soil Microbial Resources for Improving Fertilizers Efficiency in an Integrated Plant Nutrient Management System. *Frontiers in Microbiology*, *9*, 1606. https://doi.org/10.3389/fmicb.2018.01606

Bisht, N., & Singh Chauhan, P. (2021). Excessive and Disproportionate Use of Chemicals Cause Soil Contamination and Nutritional Stress. In M. L. Larramendy & S. Soloneski (Eds.), *Soil Contamination—Threats and Sustainable Solutions*. IntechOpen. https://doi.org/10.5772/intechopen.94593

Chen, T., Zhang, S., & Yuan, Z. (2020). Adoption of solid organic waste composting products: A critical review. *Journal of Cleaner Production*, *272*, 122712. https://doi.org/10.1016/j.jclepro.2020.122712

Chew, K. W., Chia, S. R., Yen, H.-W., Nomanbhay, S., Ho, Y.-C., & Show, P. L. (2019). Transformation of Biomass Waste into Sustainable Organic Fertilizers. *Sustainability*, *11*(8), 2266. https://doi.org/10.3390/su11082266

Fahde, S., Boughribil, S., Sijilmassi, B., & Amri, A. (2023). Rhizobia: A Promising Source of Plant Growth-Promoting Molecules and Their Non-Legume Interactions: Examining Applications and Mechanisms. *Agriculture*, *13*(7), 1279. https://doi.org/10.3390/agriculture13071279

Fahmid, I. M., Harun, H., Fahmid, M. M., Saadah, & Busthanul, N. (2018). Competitiveness, production, and productivity of cocoa in Indonesia. *IOP Conference Series: Earth and Environmental Science*, *157*, 012067. https://doi.org/10.1088/1755-1315/157/1/012067

Fahmid, I. M., Wahyudi, Salman, D., Kariyasa, I. K., Fahmid, M. M., Agustian, A., Perdana, R. P., Rachman, B., Darwis, V., & Mardianto, S. (2022). "Downstreaming" Policy Supporting the Competitiveness of Indonesian Cocoa in the Global Market. *Frontiers in Sustainable Food Systems*, *6*, 821330. https://doi.org/10.3389/fsufs.2022.821330

Gustavsson, E., & Lindblom, L. (2023). Justification of principles for healthcare priority setting: The relevance and roles of empirical studies exploring public values. *Journal of Medical Ethics*, jme-2022-108702. https://doi.org/10.1136/jme-2022-108702

Murniati, M., Suharti, S., Yeny, I., & Minarningsih, M. (2022). Cacao-based Agroforestry in Conservation Forest Area: Farmer Participation, Main Commodities and Its Contribution to the Local Production and Economy. *Forest and Society*, *6*(1), 243–274. https://doi.org/10.24259/fs.v6i1.13991

Oktiani Perida Merang, Lahjie, A. M., Syahrir Yusuf, & Ruslim, Y. (2019). Productivity of three varieties of local upland rice on a swidden agriculture field in Setulang village, North Kalimantan, Indonesia. *Biodiversitas Journal of Biological Diversity*, *21*(1). https://doi.org/10.13057/biodiv/d210108

Olwig, M. F., Asare, R., Vaast, P., & Bosselmann, A. S. (2024). Can Agroforestry Provide a Future for Cocoa? Implications for Policy and Practice. In M. F. Olwig, A. Skovmand Bosselmann, & K. Owusu (Eds.), *Agroforestry as Climate Change Adaptation* (pp. 147–166). Springer International Publishing. https://doi.org/10.1007/978-3-031-45635-0_6

Pajura, R. (2024). Composting municipal solid waste and animal manure in response to the current fertilizer crisis—A recent review. *Science of The Total Environment*, *912*, 169221. https://doi.org/10.1016/j.scitotenv.2023.169221

Saleh, A. R., Gusli, S., Ala, A., Neswati, R., & Sudewi, S. (2022). Tree density impact on growth, root length density, and yield in agroforestry-based cocoa. *Biodiversitas Journal of Biological Diversity*, *23*(1). https://doi.org/10.13057/biodiv/d230153

Tenriawaru, N., Amiruddin, A., Arsyad, M., Mahyuddin, M., Kharisma, N., Nie, F., & Ridwan, M. (2022). Autoregressive Integrated Moving Average For Cocoa Production In Sulawesi Island 2021-2030. *Jurnal AGRISEP: Kajian Masalah Sosial Ekonomi Pertanian Dan Agribisnis*, 425–436. https://doi.org/10.31186/jagrisep.21.2.425-436

Tothmihaly, A., Ingram, V., & Von Cramon-Taubadel, S. (2019). How Can the Environmental Efficiency of Indonesian Cocoa Farms Be Increased? *Ecological Economics*, *158*, 134–145. https://doi.org/10.1016/j.ecolecon.2019.01.004

Umar, S., Yodo, S., Narawi, M., Pribadi, H., Samudin, S., & Prianto, W. (2021). Community readiness model for social forestry in Central Sulawesi, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *713*(1), 012010. https://doi.org/10.1088/1755-1315/713/1/012010

Vurukonda, S. S. K. P., Fotopoulos, V., & Saeid, A. (2024). Production of a Rich Fertilizer Base for Plants from Waste Organic Residues by Microbial Formulation Technology. *Microorganisms*, *12*(3), 541. https://doi.org/10.3390/microorganisms12030541

Wei, X., Xie, B., Wan, C., Song, R., Zhong, W., Xin, S., & Song, K. (2024). Enhancing Soil Health and Plant Growth through Microbial Fertilizers: Mechanisms, Benefits, and Sustainable Agricultural Practices. *Agronomy*, *14*(3), 609. https://doi.org/10.3390/agronomy14030609

Yalu, A., & Matous, P. (2024). Which community network structures can support sustainability programs? The case of the Sustainable Cocoa Production Program in Indonesia. *Ecology and Society*, *29*(2), art16. https://doi.org/10.5751/ES-15003-290216