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Environmentally Friendly Technological Innovations in The Form of Botanical Pesticides and Biological Pesticides for Cocoa Plants in Ransiki Tourism Areas

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ABSTRACT

Ransiki area is the capital of South Manokwari regency which has tourism potential with its exotic natural beauty so that it is visited by many tourists. In addition, the area has a lot of endemic plant diversity that has the potential to produce secondary metabolic compounds, one of which is black fruit trees (pohon buah hitam). The leaves of the black fruit tree contain secondary metabolic compounds of tannins (8.34-37.26%), more than flavonoids and alkaloids. For the development of environmentally friendly technological innovations, the Faculty of Agriculture UNIPA continues to develop black fruit tree leaves as liquid and powder botanical pesticides, as well as the biological pesticide from *Trichoderma* sp with inoculum sources obtained around the cocoa plantation in the Ransiki area. Cocoa plants are managed by indigenous people, immigrants and companies/cooperatives, have produced food products in the form of chocolate bars and cocoa powder, have potential for regional income and sales have reached overseas. Community service activities carried out from October to December 2021, use counseling methods, technical guidance/training, dissemination, and demonstration plot, mentoring. This activity is in line with the increasing promotion of tourist attractions in the Ransiki area, aiming to introduce and utilize regional superior agricultural products that can be applied to cocoa plants. Furthermore, it is expected to provide an increase in regional income, welfare of farmers and companies/cooperatives, and improve the quality of cocoa products from organic farming towards sustainable agricultural development. The application of botanical pesticides in cocoa plantations has proven to be able to control cocoa pod sucking ladybugs (*Helopelthis* spp), stem borers (Zeuzera coffea), and the dissemination of pesticide products are used as guidelines for preparing work plans for the Department of Agriculture, Cooperatives, Industry and Trade, South Manokwari Regency.

1. Introduction

South Manokwari Regency has an area of about 2,812.44 km^2, located in the eastern part of Indonesia, namely in West Papua. It has a topography that offers tourism potential with its exotic natural beauty. South Manokwari Regency is a division of Manokwari Regency, which was officially divided on November 17, 2012, along with the expansion of Arfak Mountains Regency. One of the interesting places to visit is the city of Ransiki, which is a sub-district as well as the capital of South Manokwari regency.

The rate of development and increase in regional income will continue to take into account the progress and development of technological innovation while still paying attention to the safety, comfort and health of products produced by plant commodities. The Ransiki area besides having exotic tourist attractions also has a lot of biological plant diversity that has the potential as a producer of secondary metabolic compounds, one of which is black fruit trees. The black fruit (*Haplolobus* spp) locally by the residents or the Wondama community is known as "Pi Airawi". Based on research conducted by Somar (2012), black fruit leaves or "Pi Airawi" have secondary metabolic content such as flavonoids, alkaloids, and tannins. The content of these compounds has been investigated to control plant pests, then by a lecturer in the Agrotechnology Study Program, Faperta, University of Papua, it was developed as a product of environmentally friendly technological innovations of botanical pesticides. Cocoa is the potential agricultural crop commodity that is considered to have the potential for regional income Ransiki as well as the welfare of farmers and the community.

Unhealthy plants affect farmers' income, one of the criteria that needs to be considered is the rate of plant damage due to pests and diseases. Management of plant pests and diseases known and carried out by farmers and the government by using chemical pesticides. The continuous use of chemical insecticides with short time intervals can have a negative impact on health and the environment (Budartini et al., 2018), so alternatives are needed in controlling pests and diseases. The use of botanical insecticides and biological pesticides is one component of integrated pest control (IPM) which is very appropriate to limit the use of chemical insecticides.

Environmentally friendly agricultural products are starting to become a trend and are much sought after by consumers. Environmentally friendly agriculture can be supported through the use of plant-based pesticides and biological pesticides to control pests and diseases in plants. The Laboratory of Plant Pests and Diseases, Faculty of Agriculture, UNIPA has made agricultural products of black fruit leaf botanical pesticides and *Trichoderma* sp biological pesticides as environmentally friendly technological innovations with the aim of developing pest and plant disease control measures sourced from the biological richness of the Ransiki area.

2. Methods

2.1 Time and study place

Community service activities in the form of counseling, technical guidance, plot demonstrations, and dissemination were carried out in the Ransiki subdistrict, South Manokwari Regency, West Papua Province, from October to December 2021. Community service activities was attended by 40 people.

2.2. Community service method

This activity uses extension methods for face-to-face lectures and dissemination; methods of technical guidance and training for demonstration plots in cocoa fields; assistance methods for the preparation of materials and tools as well as a demonstration of the application of pesticide products.

2.3. Implementation of community service activities

The implementation of the method used in Community Service activities (PKM) refers to Kartina et al., (2018) and Hasanah and Andri (2021). The extension method is given theoretically but is practical in the meeting room or hall of the Ebier Suth Cokran Cooperative and the hall of the South Manokwari Regency Agriculture Office, using audio-visual (in focus) and exhibitions of innovative products of black fruit leaf botanical pesticides and biological pesticides *Trichoderma* sp., presentations, lectures, and then a question and answer session or discussion related to the explanation of the material explained in the hope that participants understand more about the material that has been explained.

The method of technical guidance and training is in the form of plot demonstrations, namely conducting and training participants in activities by conducting and demonstrating the manufacture of black fruit leaf botanical pesticides and *Trichoderma* sp biological pesticides based on work instructions that have been prepared by facilitators or trainers.

The mentoring method was carried out during the preparation of tools and materials for the manufacture of botanical pesticides and biological pesticides as well as the application of black fruit leaf botanical pesticides on the cocoa plantation owned by the Ebier Suth cooperative. In this activity, participants went directly to prepare tools and materials for making botanical pesticides and their application in the field under the direction of the facilitator.

3. Results and dicussion

3.1 Genaral informatioan about study site

South Manokwari Regency is a division of Manokwari Regency, which was officially divided on November 17, 2012, along with the expansion of Arfak Mountains Regency. Ransiki is one of the subdistricts is located in the South Manokwari regency. The capital city of South Manokwari Regency is Ransiki City with the landmark of the South Manokwari regent's office, the area per the year 2020 is 2,812.44 km^2 has 6 Districts (subdistrict) and 13 Villages, and the population is 35,949 people (Kemendesa, 2020).

The tourism potential in South Manokwari Regency is the same as other regions in Papua, namely natural and historical tourism. Potential tourist attractions (PTA) are scattered throughout Ransiki, Momi Warren, and Neney Districts. Syari Beach is one of the beaches located in Momi Waren (Ransiki) District, South Manokwari Regency, can be reached by public transportation or private vehicles, is known as a tourist spot that offers various tourist objects to tourists, such as cultural tourism, nature tourism, and other tours. It is also famous for the hospitality of the people and their customs (Rombe et al., 2021).

The city of Ransiki, which produces delicious chocolate, was once the center of a cocoa plantation managed by the COKRAN (Coklat Ransiki) company. The company has closed but the cocoa plantation has potential for production and cultivation activities as well as the management of the plantation is still active today and is still managed by the people who used to work at the company. The local government decided to establish the Cokran Eiber Suth Farmers' Cooperative, where the cooperative buys the cocoa from the farmers and sells it for around 20 thousand rupiahs per kilogram. In addition, this cooperative also processes the cocoa into processed chocolate. The chocolate produced from this type of cocoa from West Papua is also different from cocoa grown in other areas, using cocoa with a dark chocolate content of 72% and a unique taste. The taste is not too bitter even though there is a high content of dark chocolate, which tends to be creamy, nutty, and earthy.

The life of the Papuan people is very dependent on the availability of potential natural resources where they interact and adapt intensively to the forest (Dorewa), land (Kakopa), and sea (Hatiwa) (Lekitoo et al., 2012). The potential for biodiversity found in Ransiki is the black fruit plant (*Haplolobus* spp) (Ungirwalu et al., 2016), which is used as a source of raw material for botanical

pesticides, while the biological agent *Trichoderma* sp which is used as a biological pesticide naturally comes from the cocoa garden in Ransiki.

Community service activities (PKM) with counseling methods, technical guidance and training, plot demonstration assistance and dissemination of environmentally friendly technological innovations of botanical pesticides and biological pesticides in Ransiki, South Manokwari Regency in collaboration between the Ebier Suth Cooperative, the Agriculture Service and the Manokwari Regency Cooperative and Trade Office South and Faperta UNIPA can be improved and sustainable in order to advance agriculture in this region. It is necessary to build further cooperation, especially in an effort to improve the agricultural sector in the South Manokwari Regency. It is hoped that the activities carried out are in accordance with the targets to be achieved in improving the economy and community welfare.

3.2 Implementation of Extension Activities, Technical Guidance and Training, Dissemination

According to Sumardjo (2012) in Indraningsih (2019) that the challenge of agricultural extension in the delivery of future agricultural innovation is how to always be able to develop agricultural innovations that are effective, participatory, and sustainable. This kind of challenge is increasingly difficult to answer with an extension system that is subordinated to the narrow interests of government projects that are more oriented only to budget expenditures than addressing the needs of farmers. Therefore, he explained the challenge by creating an interface between the roles of 1) extension institutions; 2) research or development institutes of science, technology, and art (science and technology); 3) educational and training institutions (Universities and Agricultural Education and Training); 4) regulatory agencies (policy makers), the business world (private); and 5) service institutions (departments and related agencies); and 6) the needs of farmers and farming businesses. Dissemination of agricultural innovations using appropriate media and communication is expected to increase innovation adoption. This is in line with Berlo (1960) that the media is one of the elements of communication used to convey messages from the source to the recipient. Dissemination of information through communication media is a reciprocal and inseparable series in the effort to spread innovation (Rahmawati et al., 2017). The presentation of material related to extension activities, technical guidance, and training as well as dissemination was delivered by 3 lecturers of Faperta UNIPA Manokwari, including:

Table 1. Title of material presented in Extension, Technical Guidance, and Training and Dissemination at Ransiki.

No	Title	Lecturer
1	Botanical Pesticide from Black Fruit Leaf	Ir. Sutiharni, MP.
2	Utilization of Antagonistic Microorganisms as Environmentally Friendly agent to Controlling Plant Pest Organisms	Dr. Ir. Eko Agus Martanto., MP
3	Research Experience Observing Plant Pest Populations at Eiber Suth Cokran Ransiki Plantation	Ir. Yacob Bodang, M.Si.

The presentation time is according to the time schedule, during the presentation activity, participants are given the opportunity to submit questions or opinions (discussion). From the results of the discussion, it can be concluded that:

1. Some farmers did not fully understand the material provided, so the questions from the participants of the farmer group in the extension, technical, and training activities were very responsive and wanted to know more about the material presented and the introduction of the black fruit leaf botanical pesticide and *Trichoderma* sp biological pesticide on display.

2. Presentations using power points and exhibitions of pesticide products from black fruit leaves and biological pesticides *Trichoderma* sp provide serious attraction and understanding for farmers and heads of offices and staff from both the Ebier Suth cooperative and the government agency.
3. The presence of the activity participants was also attended by 5th-semester students of the Agrotechnology Study Program
4. Faperta UNIPA is doing an internship at the Cokran Ebier Suth cooperative.

Several questions or statements were also raised by farmers and technical guidance participants during the presentation as notes for improving the development of environmentally friendly technological innovations for black fruit leaf botanical pesticides and *Trichoderma* sp biological pesticides in the future. Black Fruit pesticide products, both in liquid packaging (bottles) and powder packaging (tea bags and plastics) as well as the biological pesticide *Trichoderma* sp. were distributed free of charge to farmers, the manager of the Eiber cooperative, Suth Cokran, and the head of the department and staff of the South Manokwari Regency Agriculture Service. The activites of extension, technical guidance and training, dissemination can be seen in figure 1-6.

Figure 1. Black fruit leaf botanical pesticide products

Figure 2. *Trichoderma sp* . biological pesticide product

Figure 3. Material presentation

Figure 4. Community service participants

Figure 5. Botanical pesticide product exhibition, biological pesticide

Figure 6. Participants from relevant offices

3.3 Implementation of Assistance in Plot Demonstration (Demplot) of Botanical Pesticides and Biological Pesticides

Agricultural developments and research results are often unknown to farmers, transfer of knowledge and skills is hampered by ineffective communication. Extension methods such as Focus Group Discussion (FGD) and demonstration plots are some of the methods to introduce research results into actual agricultural practices at the farmer level. The extension is an effective method for communicating knowledge and skills, as well as for generating interest and stimulating farmers to start practicing something new. Focus Group Discussion (FGD) is a quick assessment method, to obtain data with a semi-structured method aimed at participants who are deliberately selected to discuss the theme determined by the facilitator (Kumar, 1987). According to Faisal (2017), extension is two-way communication between extension workers and farmers, which is a policy tool used by the government to improve national agriculture. Extension activities are closely related to mentoring activities, especially in facilitating farmers in matters related to agriculture. Therefore, a facilitator function is

needed to help a group of people understand, convey and connect information and get used to facilitating farmers, especially in group management and planning (Zulhak et al., 2020).

This demonstration plot activity aims to facilitate farmers in understanding and understanding plant pest and disease control techniques, especially on cocoa plants, plant sampling techniques, techniques, and methods of controlling powder products that have been packaged as bags on cocoa plants.

Table 2. The title of the material presented in the demonstration of assistance plots on cocoa plantation land.

No	Title	Lecturer
1	Method of determining plant samples and application of pesticides black fruit leaf powder on cocoa plants	Ir. Sutiharni., MP
2	Pesticide Application Techniques Black Fruit Leaf Powder and Observation Methods for Calculation of Damage to Cocoa Plants	Ir. Yacob Bodang., MP

The following is a Figure 7 of what was done in the demonstration plot area during the mentoring of plot demonstration activities at the cocoa farm of the Ebier Suth Ransiki cooperative:

Figure 7. Locations and activities for the demonstration plot for the application of botanical pesticides on black fruit leaves at the cocoa plantation of the Eiber Suth Ransiki Cooperative.

According to Amanah (2007), the subject of extension science is humans who are part of a social system, while the object of extension science material is the behavior resulting from the education or learning process, communication, and social processes. Extension science is able to explain that the transformation of human behavior is designed by applying an educational approach, communication, and in accordance with the social, economic, and cultural structure of the community, and its physical environment. Demonstration plots (Demplots) are one of the best methods to improve outcomes and are utilized by extension workers to obtain desired behavioral changes in rural communities. The extension approach with demonstration plots will lead to a learning situation, as well as communication and interaction between extension workers and farmers. At least through FGD and demonstration plots, there will be changes in knowledge, opinions, aspirations, and skills; namely the lowest behavior change after the intervention program according to "Bennett's Hierarchy" (Radhakrishna, 2010).

In this plot demonstration mentoring activity, the product of Pesticide botanical Leaf Leaves Black Fruit is also distributed in powder bags to farmers who grow cocoa plants on farmers' private land for application. so that what has been done through technical guidance and plot demonstrations can be better understood and continued by farmers and field officers of the cooperative Ebier Suth as well as agricultural extension workers from the Agriculture Service of South Manokwari Regency. The monitoring results submitted, carried out as research by students of the Agrotechnology Study Program interested in Pests and Plant Diseases in collaboration with cooperative managers and farmers, were carried out from December 2021 to February 2022, still in the preparation of a final project report or thesis. Interim results that have been reported that black fruit leaf powder botanical pesticides can control cocoa plant pests include controlling cocoa pod-sucking ladybugs (*Helopelthis* spp), stem borer (*Zeuzera coffea*), while the results from the dissemination of pesticide products are used as guidelines for preparing the work plan of the Dinas. Agriculture, Department of Cooperatives, Industry, and Trade, South Manokwari district.

4. Conclusions

Community service activities (PKM) with counseling methods, technical guidance and training, dissemination, mentoring, plot demonstrations, related to the botanical pesticide Black Fruit Leaf and the biological pesticide *Trichoderma* went well. Farmers, communities, cooperative managers and government staff were very enthusiastic and responsive during the activities. The government through the Department of Agriculture, and the Department of Cooperatives, Industry, and Trade will follow up on the application of environmentally friendly technological innovations for black fruit leaf botanical pesticides and *Trichoderma* sp biological pesticides in the preparation of the 2022 or 2023 budget. It is still necessary to provide assistance to cocoa farmers and carry out similar activities for other agricultural commodities, considering this area has the potential as a center for lowland agricultural commodities.

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6. Authors Note

The authors state that there is no coercion of interest regarding the publication of this article. The author confirms that this article is free from plagiarism.

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