

Development of Youth Organizations Entrepreneurship Through the Production of Organic Waste-Based Liquid Smoke

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Abstract

This community service program aims to enhance the entrepreneurial capacity, creativity, and environmental awareness through training on producing liquid smoke derived from coconut shell organic waste. The program addresses the issue of unutilized coconut shell waste, which often causes air pollution from open burning. A participatory approach was applied through four main stages: (1) socialization of the circular economy concept and environmental innovation; (2) technical training on liquid smoke production using pyrolysis and multi-stage distillation; (3) packaging, labeling, and digital marketing workshops; and (4) entrepreneurship mentoring to ensure business sustainability. The participants consisted of 20 Karang Taruna members aged 18–30 years, with balanced gender representation. Evaluation was conducted through participatory observation and interviews to measure improvements in knowledge, skills, and entrepreneurial motivation. The results, measured using a pre-test and post-test evaluation design, showed a statistically significant improvement with an average normalized gain of 85% in participants' knowledge and entrepreneurial readiness. The main outputs include three derivative products: liquid organic fertilizer, natural flavor enhancer, and herbal facial spray, which are economically valuable and environmentally friendly. The program effectively fostered youth awareness of waste-based economic potential and strengthened collaboration between universities, communities, and local government in promoting sustainable green economy initiatives.

Keywords: Liquid Smoke, Entrepreneurship, Organic Waste, Youth Organization, Creative Economy

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INTRODUCTION

The main problem faced by the people of Bulota Village, Limboto District, Gorontalo Regency is that the management of organic waste has not been optimal, especially coconut shell waste which has only been thrown away or burned openly without further utilization. This open burning practice causes air pollution, pollutes the environment, and threatens the health of the surrounding community. In fact, coconut shells are a potential raw material that has a high content of *lignocellulose*, so it is ideal to be processed into derivative products with economic value such as liquid smoke. Various studies have shown that liquid smoke contains important bioactive compounds such as acetic acid which is antibacterial, phenol which functions as a natural preservative, formic acid and propionic acid which are antifungal, and carbonyl and aldehyde compounds which act as natural antimicrobials. Research conducted by

Iacomino et al. (2024) mentioning that *wood vinegar* contains phenolic compounds, organic acids, and esters that make it effective for agricultural and biomedical applications. These findings are reinforced by Nibalvos et al. (2021) which explains that liquid smoke from coconut shells has the main chemical composition in the form of organic acids, guaiacol, and phenols that have great potential to be developed as natural preservatives and environmentally friendly pesticides. In terms of function, liquid smoke is a multifunctional product that can be used for various purposes, ranging from food preservation, plant-based pesticides, disinfectants, to cosmetic basic ingredients. According to Anggrayni et al. (2025) In his research that *wood vinegar* produced from coconut shells is effective in inhibiting the growth of plant pathogenic fungi with a certain concentration, while having non-toxic properties to plants at the right dose.

This condition shows that the community does not understand simple but high value-added organic waste treatment technology, and has not developed an entrepreneurial spirit based on local potential and environmental innovation. In this regard, as a form of solution, this service activity develops innovations in processing organic waste into liquid smoke based on the concept of circular *economy*, which is an economic system that focuses on the repeated and sustainable use of resources to reduce waste, emissions, and energy leakage (Geissdoerfer et al., 2017). This model emphasizes that waste is not the end of the production cycle, but can be processed into new resources that have high economic value. This concept is very relevant to the condition of the community in Bulota Village, Limboto District, Gorontalo Regency. Liquid smoke or *pyroligneous acid*, is the result of condensation from the pyrolysis process of organic matter such as coconut shells produced through incomplete combustion and steam condensation from wood/biomass fractions (Izza et al., 2022). This product has many practical benefits, including as a natural food preservative, plant-based pesticide, organic liquid fertilizer, disinfectant, as well as basic ingredients for cosmetics and health products. Through the application of this appropriate technology, service activities are expected to provide environmentally friendly innovation alternatives as well as new entrepreneurial opportunities for young people in the village.

This service program was initiated by a team of lecturers and students of Gorontalo State University (UNG) by involving Karang Taruna as the main partner. This partnership model is designed in a participatory manner (*community-based development*) as stated Chambers (2010) that community empowerment must place local residents as the main subjects who play a role in designing, implementing, and maintaining the results of socio-economic development activities. This is in line with what was stated by Moloi & Dlomo (2024); Abdillah et al. (2022); Sulaiman et al. (2024) that the development of social capital is also emphasized in the proposed framework as a vital element to build resilience and improve the quality of life in rural areas. Through networks and partnerships that leverage local and external resources, communities can create a fertile environment for innovation, which significantly increases the effectiveness of sustainability initiatives. In this context, the Bulota Village Thematic KKN activity is not just about moving technology from the campus to the community, but rather a collaborative process based on *learning by doing*, where participants learn through direct practice of making liquid smoke, packaging products, and managing the results into an independent business.

From the perspective of social innovation theory, this activity shows how solutions to environmental problems can create new social values. Social innovation according to Mulgan (2012) is a form of social change that arises from cooperation between community actors to meet unmet needs through traditional market mechanisms. In this case, the processing of coconut shell waste into liquid smoke not only provides economic benefits for Karang Taruna, but also produces social impacts in the form of increased ecological awareness and the emergence of community solidarity on sustainability issues. If viewed more broadly, this activity can strengthen collaboration between universities, the community, and local governments in the spirit of the *triple helix* model proposed by Etzkowitz & Leydesdorff (2000) that universities play a role as a source of innovation, the community as an implementer, and the government as a policy facilitator. This synergy is an important foundation in encouraging a sustainable village creative economy based on local resources. This service program was even identified as a prototype of a community-based circular economy development model that can be replicated in other regions in Gorontalo Province, supporting the 8th, 12th, and 13th Sustainable Development Goals (SDGs), namely decent work and economic growth, responsible consumption and production, and climate change management.

Observing the description of problems and concepts as well as relevant research of service is present to overcome and find solutions. This service is based on the results of research conducted by Isa et al. (2019); Pikoli et al. (2019); Kakilo et al. (2023). The study shows that the application of coconut shell-based liquid smoke technology is proven to produce organic pesticide products and natural preservatives that are safe for the environment and provide added economic value in rural areas. This result is in line with the vision of *green entrepreneurship*, which is *entrepreneurship* oriented towards social and environmental sustainability. By integrating the results of the research into community service activities, the KKN team succeeded in expanding its benefits through training in making liquid smoke derivative products such as liquid organic fertilizers, natural flavorings, and herbal facial sprays.

Conceptually and empirically, this service activity can contribute to strengthening *green entrepreneurship literacy* among village youth. This training program in service is not only aimed at and focuses on the transfer of technical skills but also forms a creative, innovative, and resilient mindset in the face of modern economic challenges. Thus, this service activity has three main objectives: (1) increasing the entrepreneurial capacity of Karang Taruna through the application of appropriate technology, (2) reducing the volume of organic waste in the village environment, and (3) producing innovative products that are sustainable. Each item was measured using a 5-point Likert scale (1 = very low to 5 = very high), with a maximum total score of 100development in Gorontalo Regency.

METHOD

1. Partner Profile

The partner in this activity is the Youth Organization of Bulota Village , Limboto District, Gorontalo Regency. The partners consist of 20 active members with an age range of 18–30 years, consisting of 11 males and 9 females. Most of the members do not have experience in organic waste treatment or independent entrepreneurship, but have high enthusiasm and social involvement in the community. The service activity was carried out for 45 days (Early August-End of September 2025) with the support of the village government,

LPPM Gorontalo State University, and Thematic KKN students as implementers of field activities.

2. Instrument and Data Analysis

Data were collected using a structured questionnaire consisting of 20 items divided into three dimensions which is Circular economy literacy (7 items), Technical competence in liquid smoke production (7 items), and Entrepreneurial motivation and business readiness (6 items). Each item was measured using a 5-point Likert scale (1 = very low to 5 = very high), with a maximum total score of 100.

Descriptive statistics were used to calculate mean scores and percentage improvements. To test the statistical significance pre-test conducted at a significance level of $\alpha = 0.05$. In addition, qualitative data from participatory observation and semi-structured interviews were analyzed using thematic analysis to support quantitative findings and provide deeper insights into behavioral and social changes among participants.

3. Stages of Implementation

The method of implementing activities is designed in four main stages that are mutually sustainable, namely:

1. Preparation and Socialization Stage

This stage began with a coordination meeting between the service team, the village government, and the Youth Organization to prepare an activity plan and determine the location of the training. Socialization was carried out to the community and youth about the potential of coconut shell waste and the concept of *circular economy*. This activity aims to build awareness about the economic value of waste and introduce liquid smoke production technology as an environmentally friendly innovation.

2. Technical Training Stage of Liquid Smoke Production

The training is carried out through a *learning by doing* approach. Participants were trained to process coconut shell waste through a *pyrolysis* process (imperfect combustion) to produce raw liquid smoke (*grade 1*), which was then purified through *multi-stage* distillation and filtration into ready-to-use products (*grade 2* and *grade 3*). Each training session is accompanied by expert lecturers from the field of environmental chemistry and accompanying students. From this stage, three derivative products are produced, namely liquid organic fertilizers, natural flavorings, and herbal facial sprays.

3. Entrepreneurship and Product Branding Training Stage

After the technical stage, the activity continued with entrepreneurship training including packaging, label design, digital promotional content creation, and the preparation of social media-based marketing strategies. Participants are trained to utilize platforms such as Instagram, TikTok, and YouTube to introduce liquid smoke products. This assistance aims to foster the spirit of green *entrepreneurship* in Karang Taruna members to be able to develop sustainable businesses.

RESULTS AND DISCUSSION

1. Increasing Knowledge about Waste Management and the Circular Economy

The initial stage of the activity showed that most of the members of Karang Taruna did not understand the concept of the circular economy and the potential of processing organic waste into products with economic value. Through socialization sessions and interactive

discussions, participants gained a basic understanding of the principles of *reduce, reuse, recycle* (Gonibala et al., 2024), and the importance of coconut shell waste management as a raw material for liquid smoke production.

The results of the pre-post test showed an increase in participants' knowledge from 55% to 88% after the training. Furthermore, the paired sample t-test revealed that the difference was statistically significant ($t = 14.82$, $p < 0.001$). This finding demonstrates that the integration of technical training and entrepreneurship education within a participatory framework effectively enhances both cognitive and practical competencies. The results support experiential learning theory, where knowledge acquisition is strengthened through direct practice (*learning by doing*) for youth in Bulota Village, Limboto District, Gorontalo Regency.

2. Results of Technical Training for Liquid Smoke Production

At the technical training stage, participants are directly involved in the *process of pyrolysis* of coconut shells at a temperature of $\pm 400^{\circ}\text{C}$ to produce raw liquid smoke (*grade 1*). This liquid smoke is then filtered and distilled to obtain a pure (*grade 2*) and (*grade 3*) product with a clearer color and distinctive aroma. From this process, three derivative products are produced:

- a. **Liquid organic fertilizers** containing phenolic compounds and organic acids function as a stimulant for plant growth. Liquid Organic Fertilizer from liquid smoke waste produced in the initial stage of processing (Smoke condensation) is raw material (*grade 1*) facing the smoke waste that comes out of the chimney from the combustion of the shell. The liquid from the smoke condensation can be useful to be used as fertilizer to fertilize agricultural products in the form of rice, chili, tomatoes, corn and other agricultural products, ornamental plants in this case pet flowers that beautify the yard of the house and other plants that need fertilizer so that they can grow luxuriously. The liquid fertilizer products produced are then packaged as shown in Figure 1 below:



Figure 1. Organic Fertilizer Liquid Fume Waste (*Grade 1*)

- b. **A natural flavoring** with volatile compounds such as *guaiacol* and *syringol* that function as natural *flavor enhancers*. The process of flavoring products is produced by distilling and filtering raw materials (*grade 1*) resulting from the initial stage. From the first distillation and filtration process, a product (*grade 2*) is produced that can be used as an aroma and flavor enhancer in side dishes, especially meat, fish, eggs, tofu and tempeh as a companion to the main dish such as rice. Besides being an aroma and flavor enhancer, this product can

also function and be used to preserve meat and fish as an effort to reduce the use of other chemicals such as formalin. The next stage is to do packaging and labeling on the packaging as shown in figure 2 below:



Figure 2. Flavoring from Liquid Smoke Waste (Grade 2)

- c. **Facial Spray** which functions as an antiseptic and skin lightener is the third product produced from the 2025 Thematic KKN activity in Bulota Village, Limboto District. This product is produced by *distilling* and *filtering* the resulting material (*grade 2*) resulting from the second stage. From the second distillation and filtration process, a product (*grade 3*) is produced that functions as an ingredient in the health field that can be used for skin and facial lightening. Besides that, this product can also function and be used to help the healing process of wounds or canker sores. The next stage is to do packaging and labeling on the packaging as shown in figure 3 below:



Figure 3. Facial Spray From Liquid Smoke Waste (Grade 3)

3. Monitoring and Evaluation

The evaluation was carried out using participatory observation, pre-post test questionnaires, and in-depth interviews. Success indicators include increased knowledge, technical skills, and entrepreneurial motivation. The results of the evaluation showed an increase in participants' understanding of waste treatment technology and business opportunities reached 85%, which was measured from the comparison of the results of the

initial and final tests and the participants' feedback on the activities. In addition, documentation of activities is disseminated through online media and news publications on *DailyPost.id* and YouTube channels of the KKN team.

4. Obstacles and Obstacles to Program Implementation

The main obstacles and obstacles in the implementation of the program are the limitations of production equipment (pyrolysis drums and distillation equipment) and the availability of seasonal raw materials. The solution taken is to collaborate with the village government for the procurement of permanent equipment and explore synergies with the Agriculture Office and the Gorontalo Regency Cooperatives and MSMEs Office to expand post-program business assistance.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Community service activities carried out in Bulota Village, Limboto District, Gorontalo Regency have succeeded in having a real impact on increasing the entrepreneurial capacity of Karang Taruna members in utilizing organic waste into products of economic value. Through the training on making liquid smoke from coconut shell waste, the participants were able to understand the concept of *circular economy* and apply simple pyrolysis technology that is environmentally friendly. The results of the activity showed an increase in technical ability and entrepreneurial skills by $\pm 80\%$ compared to before the training. The products produced, such as pure liquid smoke, organic liquid fertilizers, natural flavorings, and *herbal facial sprays*, are proof that waste-based innovations can be developed into creative commodities that have selling value while supporting the reduction of environmental pollution.

In addition to producing innovative products, this activity also strengthens the collaboration network between universities, communities, and local governments in the spirit of *the triple helix*. The participatory approach (*community-based development*) applied has fostered a sense of community ownership of the results of activities and increased ecological awareness and green economy at the local level. Conceptually, this activity supports the Sustainable Development Goals (SDGs) agenda, especially in the aspects of decent work, responsible consumption and production, and handling climate change.

Suggestion

As a follow-up, it is recommended that the village government and related agencies provide support in the form of providing permanent production equipment and advanced training on packaging, *branding*, and product licensing to encourage business sustainability. Strengthening cooperation with the agriculture office and MSMEs is also needed so that liquid smoke products and their derivatives can be commercialized more widely through an integrated marketing system based on the regional creative economy. In addition, similar activities can be replicated in other areas in Gorontalo Province by adjusting the potential of local resources, so that organic waste management innovations can be part of an inclusive and sustainable green economy development strategy.

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