



ECO ROCKET STOVE: ECO-FRIENDLY STOVE INNOVATION AS AN EFFICIENT WASTE MANAGEMENT SOLUTION WITH MINIMAL COMMUNITY-BASED POLLUTION

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Abstract:

The problem of waste management remains a challenge in rural areas, including in Desa Bago. Limited waste management facilities cause residents to rely on open burning practices, which have the potential to create environmental pollution and health problems. This Community Service Program (KKN) aimed to provide an alternative solution through the implementation of the Eco Rocket Stove as an environmentally friendly, efficient, and low-emission stove innovation based on community participation. The method used in this activity was a participatory approach involving the community actively through the stages of observation, socialization, stove-making training, implementation, as well as mentoring and evaluation. The results showed an increase in community understanding and awareness of the importance of environmentally friendly waste management. In addition, the use of the Eco Rocket Stove was able to produce more efficient combustion with lower smoke emissions compared to open burning. This activity not only provided a technical solution for waste management but also contributed to community empowerment and encouraged behavioral changes toward sustainable environmental management in Desa Bago. Thus, this program demonstrates that the application of appropriate technology based on community participation can be an effective strategy to address rural waste problems while improving health and environmental quality sustainably. This activity is also recommended to be replicated in other villages with adjustments to local conditions and support from relevant stakeholders.

Keywords: *Eco Rocket Stove, waste management, appropriate technology, community service, Desa Bago*

INTRODUCTION

Real Work Lecture (KKN) is a form of community service carried out by students as part of the higher education curriculum. This program provides opportunities for students to be directly involved in community life, apply the knowledge that has been gained during lectures, and make a real contribution in answering social problems in the surrounding environment. Through KKN activities, students are not only required to have academic skills, but also social sensitivity, communication skills, and leadership in dealing with community dynamics.

The waste problem is still a crucial environmental issue in various rural areas, including in Bago Village. Along with the increase in household activities and the growth of the population, the volume of waste produced also continues to grow. However, the limitations of waste management facilities, such as adequate landfills and waste sorting systems, cause some people to choose a practical way of burning waste openly. This practice, although considered simple, has the potential to have negative impacts on the environment and health, such as air pollution, respiratory disorders, and increased harmful gas emissions.

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The open burning of garbage produces thick fumes and toxic residues that not only pollute the air, but also contribute to the deterioration of the quality of the environment. This condition is a challenge for the people of Bago Village, most of whom still rely on traditional methods of handling household waste. Therefore, an appropriate technological innovation is needed that is easy to apply, environmentally friendly, and can be operated independently by the village community.

One of the solutions that can be applied is *the Eco Rocket Stove*, which is a combustion furnace based on *the rocket stove* principle which is designed to produce more perfect, efficient, and minimal pollution burning. Eco Rocket Stove is able to utilize dry organic waste and biomass as alternative fuels, thus not only reducing the volume of waste, but also reducing the smoke emissions produced. Its simple design, relatively affordable manufacturing costs, and easy-to-obtain materials make this technology suitable for application in rural environments such as Bago Village.

Through the KKN program, the implementation of the Eco Rocket Stove is expected to be a strategic step in increasing public awareness of the importance of sustainable waste management. The community-based approach is carried out by actively involving residents starting from the process of socialization, manufacturing, to the use of furnaces. Thus, Eco Rocket Stove not only functions as a technical solution for waste management, but also as a means of empowering the community towards a cleaner, healthier, and more environmentally friendly lifestyle in Bago Village.

RESEARCH METHOD

The method used is a community-based participatory approach, which places villagers as the main subject in each stage of the activity. This approach was chosen to ensure that Eco Rocket Stove's innovation can be accepted, applied, and sustainable in the lives of the people of Bago Village. The implementation of the activity began with field observation and identification of problems through direct observation and interviews with village officials and local residents. This stage aims to find out the condition of household waste management, people's habits in burning waste, and the level of public understanding of the environmental impact caused. The identification results show that waste incineration is still the main solution used by the community, but it has not been supported by efficient and environmentally friendly combustion technology.

Based on these findings, the KKN team prepared a program plan by designing the application of Eco Rocket Stove as an appropriate technology for waste management. Planning includes determining the design of the furnace, selecting materials that are easy to obtain in the Bago Village environment, and preparing socialization materials that are tailored to the conditions and needs of the community. At this stage, coordination is also carried out with the village government to support the smooth implementation of the program.

The next stage is socialization and education activities to the people of Bago Village about the importance of environmentally friendly waste management. The socialization focused on the negative impact of open waste burning as well as the introduction of the concept and working principles of Eco Rocket Stove. Through this activity, the community is expected to gain an initial understanding of the benefits of the innovation in reducing the volume of waste and reducing air pollution. After the socialization, the activity continued with training on making an Eco Rocket Stove

which involved the community directly. The training process is carried out by practical methods, starting from material preparation, furnace assembly, to trial use. Community involvement in this process aims to increase the skills and independence of residents in utilizing the technology, so that it can be used sustainably after KKN activities are completed.

The Eco Rocket Stove that has been made is then implemented for the burning of dry organic waste and other biomass materials. The KKN team provides assistance in the use of the furnace to ensure that the combustion process takes place more efficiently and produces minimal smoke. This assistance also aims to ensure that the use of stoves is carried out safely and in accordance with environmentally friendly principles.

RESULTS AND DISCUSSION

The implementation of the Real Work Lecture (KKN) program with the theme Eco Rocket Stove: Environmentally Friendly Furnace Innovation as a Solution for Efficient and Minimal Community-Based Pollution Waste Management in Bago Village was carried out through several stages of activities, namely problem identification, socialization to the community, design and construction of tools, training in use, and evaluation of program impacts. Bago Village was chosen as the location of the program because there are still problems with household waste management that are not optimal, where people still often burn waste openly without environmentally friendly processing. The problem of open burning waste is a common phenomenon in rural areas due to limited waste management facilities and low public awareness of the environmental impact caused (Sari, Al-illahiyah, Kaban, Hasibuan, Nasution 2023). Open burning produces dense fumes that contain harmful particles as well as toxic gases that have the potential to harm public health and environmental quality (Sidebang, Arianty & Nasrun, 2025). Therefore, the application of appropriate technology in the form of Eco Rocket Stove is one of the alternative solutions that can be applied on the scale of rural communities.

1. Implementation of Eco Rocket Stove in Bago Village

The results of the activity show that the Eco Rocket Stove was successfully designed and built by utilizing local materials that are easy to obtain such as bricks, cement, and iron pipes. The development process involves the active participation of the local community through mutual cooperation activities so as to increase the sense of ownership of the tools made.

Rocket stove is a combustion technology designed with an optimal airflow system so that it produces more perfect combustion than conventional methods. The working principle of this tool utilizes the vertical combustion chamber and chimney to increase the combustion temperature and accelerate the fuel oxidation process. Research shows that rocket stoves are able to reach high combustion temperatures so that the waste reduction process becomes more efficient and faster.

In addition, rocket stove technology is included in the category of appropriate technology because the design is simple, relatively cheap, and easy to operate by the public without requiring special skills. The implementation of appropriate technology in community service activities has proven to be effective in increasing community independence in managing environmental problems independently. Similar programs

carried out in KKN activities in various regions also showed the same success, namely increased community participation in waste management after the introduction of community-based rocket stove technology.



Figure 1. *Eco Rocket Stove*

2. Reduction of Smoke Pollution and Environmental Impact

Reducing air pollution is one of the main benefits of using an Eco Rocket Stove. Open burning of garbage usually produces thick smoke because the burning process is not perfect. In contrast, the Eco Rocket Stove has a closed combustion system that allows secondary combustion to occur so that the gas produced by combustion can be burned again before exiting through the chimney (Rais, Hidayat, Syaira, Haryono & Khanza, 2025).



Figure 2. Conditions of burning organic waste before the construction of the *Eco Rocket Stove*

3. Increasing Public Awareness and Participation

The Eco Rocket Stove program in Bago Village shows an increase in public awareness of the importance of environmentally friendly waste management. Socialization, education, and training activities carried out during the KKN program provide understanding to the public about the negative impacts of open burning and the benefits of using environmentally friendly technology.

A participatory approach that involves the community from the planning stage to implementation has been proven to increase the success of the program because the community feels responsible for the sustainability of the use of tools. The participatory action research approach in community service programs is able to encourage changes in community behavior towards better environmental management.

In addition, rocket stoves can also be an effective environmental education medium because people can directly see the benefits of technology in their daily lives. This activity is also carried out in a cooperative manner to increase community social

solidarity and strengthen the relationship between KKN students and the local community. The KKN program based on environmental technology innovation also contributes to supporting sustainable development and achieving the Sustainable Development Goals (SDGs), especially in the aspects of environmental health, clean energy, and sustainable waste management.



Figure 3. Eco Rocket Stove Making Process

4. Program Challenges and Sustainability

Although it provides significant benefits, the implementation of the Eco Rocket Stove program in Bago Village also faces several obstacles, including: The habit of people burning waste openly that has been going on for a long time, Limited initial understanding of rocket stove technology, Limited cost of equipment development, Need for sustainable assistance, Availability of varied waste fuel. The sustainability of the Eco Rocket Stove program in Bago Village is greatly influenced by community participation and the support of the village government. This technology has the potential to be developed more widely because its design is simple, relatively inexpensive, and easy to replicate in other environments with similar conditions (Rais, Hidayat, Syaira, Haryono & Khanza, 2025).

KKN programs based on appropriate technological innovations such as Eco Rocket Stove can be a real contribution for students in helping the community overcome environmental problems independently. In addition, this program also has the potential to be developed into a sustainable village program that is integrated with a community-based waste management system.

CONCLUSION

The implementation of the Real Work Lecture (KKN) program with the theme *Eco Rocket Stove: Environmentally Friendly Furnace Innovation as a Solution for Efficient Waste Management and Minimal Community-Based Pollution in Bago Village* can be concluded to have gone well and had a positive impact on the community. The implementation of Eco Rocket Stove was successfully carried out through the stages of problem identification, socialization, tool development, user training, and program evaluation by involving the active participation of the local community. The existence of the Eco Rocket Stove has proven to be an alternative solution for household waste management that is more environmentally friendly than the open burning method. A more optimized combustion system results in reduced smoke, improves combustion efficiency, and helps reduce potential air pollution and public health impacts. In addition, the use of local materials at a relatively affordable cost shows that this

technology is an appropriate technology that is easy to apply and replicate on the scale of rural communities. This program also has a social impact in the form of increasing public awareness and participation in the importance of sustainable waste management. A participatory approach through mutual cooperation, education, and training activities is able to foster a sense of community ownership of the tools built so as to support the sustainability of the program. Although there are still several obstacles such as the community's old habits, limited technological understanding, and the need for follow-up assistance, overall the Eco Rocket Stove program has great potential to be developed more widely with the support of the village government and the community. Thus, KKN activities based on appropriate technological innovations such as Eco Rocket Stove can be a real contribution for students in helping to solve environmental problems in the community while supporting sustainable development, especially in the aspects of environmental health, waste management, and environmentally friendly energy. This program is expected to continue to be developed and become a model of sustainable community-based waste management in Bago Village and other areas.

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