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DEVELOPMENT OF A LOW-COST ROCKET STOVE TO IMPROVE COMBUSTION EFFICIENCY AND REDUCE SMOKE

Suflani[1*], Bagas Abdurrohman[2], Alif Dava Mahesa[3], Maghfira Adjanni Ghifara Majammi[4], Tia Agustin[5], Aulia Fitriani[6], Ahmad Hilmy Fawwazni[7], Khoirun Nisa Fadhila[8], Dichy Wahyudi[9], Wahyu Rizki[10]
[1,2,3,4,5,6,7,8,9,10]Universitas Bina Bangsa
Corresponden E-mail: *Suflani0780@gmail.com*[1]

Abstract
His community service program aims to introduce and implement low-cost rocket stove technology in Cisaat Village, Tegal Village, as a solution to increase combustion efficiency and reduce the smoke problem often caused by burning waste in yards. This activity involved training in rocket stove construction, demonstrations of use, and mentoring the community in utilizing rocket stoves for their daily needs. The results of this activity indicate increased public awareness of the importance of using cleaner and more efficient technology. Furthermore, the use of rocket stoves has helped reduce smoke pollution levels in the surrounding environment and conserve fuel. This program is expected to have a sustainable positive impact on the health and well-being of the people of Cisaat Village, Tegal Village.
Keywords: rocket stove, community service, combustion efficiency, smoke reduction, Cisaat Village, Tegal Village.

INTRODUCTION

Kampung Cisaat, Desa Tegal, is an area that still faces challenges related to efficient energy use and the impact of smoke pollution from burning in home yards. The majority of the community still burns waste in their yards, which produces excessive smoke and contributes to health problems and environmental damage. This situation necessitates innovative and sustainable solutions to improve the community's quality of life. A community service program focused on the development and implementation of low-cost rocket stoves is highly relevant. Rocket stoves offer a more efficient alternative to combustion, reducing smoke emissions and saving fuel. These advantages align with efforts to improve public health and environmental preservation.

Collaboration with the youth of Kampung Cisaat is a key element in the success of this program. The youth and students of KKM 28, UNIBA (Community Service Program), have a strategic role as agents of change who can mobilize the community, provide education, and ensure the sustainability of the program. Active involvement of youth in every stage, from planning, stove making, training, to mentoring, will increase the sense of ownership and responsibility for the solutions implemented. Through this program, it is hoped that the community of Kampung Cisaat can experience the real benefits of rocket stove technology, such as a cleaner environment, better health, and fuel cost savings. In addition, this program also aims to empower youth as drivers of positive change in their community.

LITERATURE REVIEW

Combustion Efficiency in Rocket Stoves

Combustion efficiency is a critical factor in the development of rocket stoves, affecting both fuel consumption and smoke emissions. Rocket stoves are designed to optimize airflow and combustion temperature, enabling more complete and efficient burning of biomass fuels. Gandigude and Nagarhalli (2018) emphasize that the geometric design of rocket cookstoves is essential for improving performance by enhancing air circulation and fuel utilization, thereby maximizing thermal efficiency. Furthermore, Ayalew (2022) found that improved biomass cookstoves significantly reduce emissions while increasing energy efficiency, especially in rural cooking applications. In addition, Barbour et al. (2021) developed a wood-burning rocket stove with forced air injection, which effectively improves combustion efficiency and lowers smoke emissions.

Emission Reduction and Environmental Impact of Rocket Stoves

Besides improving combustion efficiency, reducing smoke and greenhouse gas emissions is a main goal in developing environmentally friendly rocket stoves. Proper design and efficient fuel use help minimize pollutants generated during combustion. According to Sopa Cansee et al. (2025), the configuration of air holes and the characteristics of biomass fuel strongly affect combustion efficiency and emissions, where optimized design can significantly reduce smoke output. Elias and Dino (2024) experimentally evaluated a low-cost thermoelectric integrated rocket stove, demonstrating that technological innovations can reduce pollution while also providing additional energy benefits. Bekti Yulianti et al. (2025) also highlight that rocket stoves serve not only as cooking devices but can also be used for burning and drying organic waste, contributing to sustainable waste management.

IMPLEMENTATION METHODS

This community service program is implemented through several stages involving active collaboration between the youth of Kampung Cisaat, and the local community.

Figure 1. Collaboration with youth in making rocket stoves

1. Preparation Phase
    a. Survey and Problem Identification

KKM 28 UNIBA students conduct an in-depth survey to identify the main problems related to burning waste in home yards and the impact of smoke pollution in Kampung Cisaat. Data is collected through interviews, observations, and focused group discussions (FGD) with the community.

b. Collaboration Team Formation

KKM 28 UNIBA students forms a collaboration team consisting of the youth of Kampung Cisaat and KKM (Community Service Program) students. This team is responsible for planning, implementing, and evaluating all program activities.

c. Initial Training for Youth:

KKM 28 UNIBA students provide initial training to the youth on the concept of rocket stoves, their benefits, and simple manufacturing techniques. This training aims to equip the youth with the necessary basic knowledge and skills.

d. Permitting and Socialization:

The team obtains permits from the village authorities and socializes the program's objectives, benefits, and implementation stages to the community. Socialization is carried out through community meetings and dissemination of information through community gatherings.

2. Implementation Phase

a. Rocket Stove Design and Manufacturing

The collaboration team designs a rocket stove that suits local needs and conditions. Rocket stove manufacturing is carried out collaboratively by youth and the community, with guidance from students. Efforts are made to use materials from local resources that are easily available and affordable.

b. Rocket Stove Manufacturing Training

The community service team organizes rocket stove manufacturing training for the community. This training includes demonstrations of manufacturing steps, hands-on practice, and explanations about stove maintenance and repair.

c. Testing and Evaluation

After the rocket stove is completed, testing is carried out to measure combustion efficiency, smoke emission levels, and ease of use. The test results are evaluated to make improvements and refinements to the stove design.

d. Rocket Stove Distribution and Installation

The rocket stoves that have been tested and refined are distributed to the community in Kampung Cisaat. Students assist the community in using the rocket stove correctly.

e. Assistance and Monitoring

Students provide intensive assistance to the community in using the rocket stove. Monitoring is carried out periodically to ensure that the rocket stove functions properly and provides the expected benefits.

3. Evaluation and Dissemination Phase

Program Evaluation

KKM 28 UNIBA students conducts a comprehensive evaluation of the program implementation. The evaluation includes aspects of effectiveness, efficiency, relevance, and the impact of combustion through the rocket stove.

The youth of Kampung Cisaat have a central role in every stage of program implementation. They are actively involved in: Survey and problem identification, Collaboration team formation, Initial training on rocket stoves, Rocket stove design and manufacturing, Rocket stove manufacturing training for the community, Rocket stove testing and evaluation, Rocket stove distribution and installation, Assistance and monitoring of rocket stove use, Program evaluation and report writing.

RESULTS AND DISCUSSION

The community service program focused on the development of low-cost rocket stoves in Kampung Cisaat, Desa Tegal, has yielded a series of significant positive results. The active collaboration between the community service team, the youth of Kampung Cisaat, and the local community has been key to the success of this program.

Initial surveys showed that the community's awareness of the negative impacts of burning waste in their home yards was low. The socialization efforts, carried out with the active support of the youth of Kampung Cisaat, successfully increased the community's knowledge about rocket stoves, their benefits, and the techniques for making and using them. The involvement of youth as agents of change proved effective in conveying information and motivating the community to adopt new technology, and many community members expressed a desire to build their own rocket stoves. The training, designed to be practical and interactive, with demonstrations of the manufacturing steps and hands-on practice, allowed participants to develop the necessary skills. The involvement of youth as assistant instructors also added value because they were able to provide explanations that were easy to understand and relevant. Rocket stove testing showed an increase in the efficiency of waste combustion and a minimal amount of smoke compared to direct burning in the home yards. The innovative rocket stove design, with a more efficient combustion system, was able to maximize fuel use and reduce smoke formation. More efficient fuel use also had an impact on cost savings for the community. The reduction in smoke contributed to improved air quality and public health. The use of rocket stoves has helped reduce the problem of smoke pollution in the surrounding environment.

Figure 2. Socialization of how to use a rocket stove

The positive impact of rocket stove use on the community's health and comfort is significant. Reducing smoke pollution around homes reduces the risk of respiratory diseases, especially in children and housewives. In addition, rocket stoves are also easier to use and maintain. The active involvement of youth in this program has increased their self-confidence, leadership skills, and organizational skills. They have become more active in social and development activities in their village.

This program provides an opportunity for youth to develop their potential and make a positive contribution to the community. Involvement in the planning, implementation, and evaluation of the program provides valuable experience in solving problems, making decisions, and working together in a team. The community of Kampung Cisaat has a strong commitment to continue the use and development of rocket stoves. They have formed a self-help group responsible for producing, distributing, and maintaining rocket stoves. Program sustainability is a top priority in this community service program. The active involvement of the community in every stage of the program, as well as the formation of self-help groups, ensures that the program can continue to run even after the community service team has completed its tasks. The community service program focused on the development of low-cost rocket stoves in Kampung Cisaat, Desa Tegal, has successfully achieved its intended goals. Active collaboration between the community service team, the youth of Kampung Cisaat, and the local community has been a key factor in the success of this program. This program not only provides economic and environmental benefits but also empowers youth and improves the overall quality of life for the community.

CONCLUSIONS

The community service program focused on the development of low-cost rocket stoves in Kampung Cisaat, Desa Tegal, has successfully achieved its intended goals. Through active collaboration between the community service team, the youth of Kampung Cisaat, and the local community, this program has had a significant positive impact on increasing combustion efficiency, reducing smoke emissions, raising community awareness, and empowering youth as agents of change.

The involvement of youth in every stage of the program, from planning, manufacturing, training, to mentoring, has increased their sense of ownership and responsibility for the solutions implemented. This program not only provides economic and environmental benefits but also makes a positive contribution to improving the overall quality of life for the community. The development of a sustainable business model can help the community produce and market rocket stoves independently. This can increase community income and ensure the sustainability of the program. More intensive and sustainable training needs to be provided to the community, especially in terms of rocket stove maintenance and repair. This can ensure that the rocket stoves function properly for a longer period of time. Involving more youth in similar programs in the future can increase the positive impact of the program and empower more youth as agents of change.

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