

Resilient School of Food and Agriculture: Development of School and Canteen Waste Management Systems

Rici Tri Harpin Pranata¹, Tri Budiarto², Firman Muhammad Basar³, Fahmi Fuad Cholagi⁴, Willy Bachtiar⁵, Vivien Febri Astuti⁶, Ika Sartika⁷

^{1,2,3,4,5,6,7}Digital Communication and Media Study Program, Vocational School, IPB University, Indonesia

ABSTRACT: The *Resilient School of Food and Agriculture* program is a strategic initiative aimed at strengthening food security and environmental awareness through an educational approach at the school level. Schools serve as social agents with a unique position in shaping consumption behavior, health awareness, and sustainability values from an early age. This study was conducted at Semai School, Jepara Regency, Central Java, focusing on developing a sustainable waste management system and a healthy school canteen. The Participatory Action Research (PAR) approach was applied to actively engage students, teachers, and school administrators in the learning and implementation process. The program consisted of three main components: nutrition education through the *Isi Piringku* (My Plate) guideline, organic waste management using Local Microorganisms (MOL), and eco-friendly canteen management training. Evaluation results showed an increase in students' knowledge scores from 2415 (pre-test) to 2540 (post-test). Although the knowledge improvement was significant, weaknesses remained in understanding the basic principles of organic waste management, school green policy, and the history of national nutrition guidelines. This study demonstrates that participatory education based on real-life practice can enhance nutrition literacy, ecological awareness, and the formation of sustainable behavior within the school environment.

KEYWORDS: balanced nutrition, environmental education, healthy canteen, MOL, resilient school of food, waste management

I. INTRODUCTION

Food security and environmental sustainability have become global priorities that require synergy between the education, agriculture, and health sectors. Schools, as formal educational institutions, play a major role in shaping young generations' behavior toward food consumption and environmental management (Morris et al., 2020). Through education, students can learn to connect food consumption with personal health and the preservation of natural resources. Indonesia, as an agrarian country, faces serious challenges in agricultural regeneration and food resilience. According to the Central Bureau of Statistics (2021), the number of young farmers continues to decline, while urbanization causes a growing disconnect between youth and traditional agricultural practices. Instilling agricultural values early in schools is therefore a strategic step to strengthen national food awareness (Supriyadi, 2020).

In addition to food security challenges, schools also face issues related to waste and unsustainable consumption patterns. Food leftovers from canteens and single-use plastics are common problems found in many schools (Putra et al., 2021). Therefore, the *Resilient School of Food and Agriculture* program was developed to integrate values of nutrition, health, and sustainability through waste management and the development of healthy, practice-based canteens.

Schools are the foundation for building food and nutrition awareness among young people. According to FAO (2021), school-based food education not only increases nutrition knowledge but also cultivates agricultural skills and local consumption awareness. Schools with integrated agricultural programs can strengthen students' food literacy and food sovereignty (Arifin et al., 2022). Practice-based food education is also linked to social and cultural aspects. Schools can serve as spaces for introducing local wisdom in food consumption, such as the use of regional food ingredients that are healthy and environmentally friendly (Hidayat & Lestari, 2022). Furthermore, food self-reliant school programs contribute to strengthening the local economy by utilizing school garden produce. Hence, the concept of a resilient school of food is not only about providing nutritious meals but also about reinforcing the educational, environmental, and social ecosystem that supports food sustainability.

Resilient School of Food and Agriculture: Development of School and Canteen Waste Management Systems

Environmental education plays an important role in shaping sustainable behavior. UNESCO (2020) emphasizes the importance of Education for Sustainable Development (ESD) to build ecological awareness through direct action. In the school context, waste management and hygiene practices are key components that can develop students' ecological behavior. Research by Nugroho and Prasetyo (2020) shows that project-based environmental learning increases students' sense of responsibility for cleanliness and waste management. Environmental education connected with hands-on activities such as composting or waste sorting also encourages internalization of sustainability values. Proper waste management habits have been shown to enhance discipline, cooperation, and students' social concern for their school community (Sulaiman, 2020).

The Ministry of Health of the Republic of Indonesia (2018), through the "Isi Piringku" (*My Plate*) program, highlights the importance of balanced nutrition composition. This guideline provides a foundation for schools to offer nutritious meals and cultivate healthy eating habits among students. Research by Rahmawati and Suryanto (2019) found that students exposed to a healthy canteen environment demonstrated higher learning concentration. FAO (2021) also states that eating habits in schools significantly affect children's nutritional status and academic performance. The implementation of "Isi Piringku" in schools thus goes beyond serving healthy meals, it also serves as part of an integrated nutrition education curriculum.

Local Microorganism (MOL) technology is a simple yet effective innovation for converting organic waste into natural fertilizer. MOL acts as a biological activator that accelerates the fermentation process. According to Sulaiman (2020), MOL use can reduce household organic waste volume by up to 40%. In the school context, MOL provides hands-on experience for students in understanding natural recycling and life cycles. The resulting organic fertilizer can be utilized in school gardens, which then supply ingredients for the school canteen. Beyond ecological benefits, MOL practices also enhance science literacy and appropriate technology innovation among students.

II. RESEARCH METHODOLOGY

This research adopted the Participatory Action Research (PAR) approach, chosen for its ability to foster active collaboration between researchers, teachers, students, and school administrators. The study site was Semai School in Jepara Regency, Central Java, an institution recognized for its environmental and agricultural-based education. The research stages included: (1) participatory planning through focus group discussions (FGDs) with school stakeholders; (2) training on MOL production and "Isi Piringku" socialization; and (3) evaluation of knowledge and behavioral changes through pre- and post-tests. Participants included 60 students and 8 teachers. Data were collected through observation, interviews, and questionnaires. Quantitative data were analyzed using descriptive statistics, while qualitative data were analyzed thematically (Miles et al., 2014).

III. RESULTS AND DISCUSSION

A. Introduction and Implementation of "Isi Piringku"

The "Isi Piringku" education activities at Semai School successfully improved students' knowledge and healthy consumption practices. Before the program, most students lacked understanding of balanced nutrition composition. After the educational sessions and menu creation practice, 72% of students were able to explain the proportional composition of carbohydrates, proteins, vegetables, and fruits.

Beyond knowledge improvement, this activity also changed students' canteen consumption behavior. Observations revealed that students began choosing nutritious meals such as rice with tempeh and vegetables instead of fast food. Teachers reported a 25% decrease in the purchase of packaged foods.

From an educational perspective, this demonstrates the effectiveness of participatory methods in internalizing nutritional values. In line with Hidayat and Lestari (2022), practice-based nutrition learning enhances students' understanding and emotional engagement toward healthy eating habits.

B. Waste Management Using MOL

The application of MOL for organic waste management at Semai School produced positive results. Students directly participated in producing MOL solutions using local materials such as banana peels, rice-washing water, and molasses. Over two months, the school's organic waste volume decreased by 35%, while plastic waste dropped by 20% due to improved sorting awareness.

Teachers and canteen managers reported that these activities fostered students' sense of environmental responsibility. Observations showed that students were able to explain the fermentation process and the benefits of the resulting organic fertilizer, which was used in the school's vegetable garden, creating a closed-loop food system.

These findings support Sulaiman (2020) and Arifin et al. (2022), who stated that MOL use is both ecologically and educationally effective, as it trains students to think systemically about waste, soil, and plant growth.

Resilient School of Food and Agriculture: Development of School and Canteen Waste Management Systems

C. Knowledge Evaluation (Pre-test and Post-test)

The evaluation showed an increase in total knowledge scores from 2415 to 2540. Item analysis revealed significant improvement in topics related to nutrition composition, MOL benefits, and the 3R (Reduce, Reuse, Recycle) practices. However, understanding of government policies and the basic principles of waste management remained low.

These results align with Putra et al. (2021), who found that improving environmental literacy among students requires repeated learning and reinforcement within local contexts. Therefore, further training and curriculum integration are needed for deeper learning impact.

Active student involvement was a key factor in improved learning outcomes. By engaging them in the action-reflection cycle, the PAR approach provided authentic experiences as the foundation for conceptual understanding (Kemmis & McTaggart, 2014).

D. Environmental and Health Impacts on the School

From an environmental perspective, the school saw significant improvement in cleanliness and waste management. The canteen and schoolyard became cleaner, and foul odors from organic waste were eliminated. Teachers observed improved student discipline in waste sorting and maintaining hygiene.

From a health perspective, the school reported fewer complaints of stomachaches from unhygienic food. The canteen implemented basic sanitation procedures based on simple Good Manufacturing Practices (GMP). This demonstrated the integration of nutritional and hygiene aspects that holistically promote student well-being. These findings align with Rahmawati and Suryanto (2019), who stated that healthy canteens improve learning focus and reduce diet-related illnesses.

E. Development of a Sustainable Healthy Canteen

Semai School's canteen now applies the eco-canteen concept, emphasizing the use of non-plastic containers, kitchen waste management, and locally sourced nutritious meals. This change not only provided ecological benefits but also strengthened economic values through raw material efficiency and waste reduction.

Socially, the canteen has become a cross-disciplinary learning hub. Students are involved in menu planning, nutrition calculation, and waste management. This approach reinforces learning by doing within the context of sustainable education (UNESCO, 2020).

The program also created a domino effect in the surrounding community. Parents began adopting similar practices at home, such as using small composters and serving balanced meals. Thus, the school functions as a catalyst for behavioral change toward a healthy and sustainable lifestyle.

F. Implications for Food Security and SDGs

The *Resilient School of Food and Agriculture* program directly supports the achievement of SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 12 (Responsible Consumption and Production). By creating a miniature food system within the school, students learn to understand the relationship between production, consumption, and waste.

Academically, this approach reinforces the concept of food citizenship, individual responsibility for a sustainable food system (Renting et al., 2012). In the Indonesian context, schools can serve as micro-models of community-based resilient food systems.

The program also contributes to human capacity development and collective awareness of the importance of local food. It opens opportunities for cross-sector collaboration between schools, universities, local governments, and private sectors to expand program impact.

IV. CONCLUSION AND RECOMMENDATIONS

This study demonstrates that the participatory approach through the *Resilient School of Food and Agriculture* program effectively enhances students' nutrition literacy and environmental awareness at Semai School, Jepara. The implementation of *Isi Piringku* and MOL not only improved consumption and waste management behavior but also created an action-oriented, community-collaborative learning system.

It is recommended that other schools adopt this model with strong support from local government policies. The government can integrate resilient school indicators into the *Adiwiyata* and character education programs. Additionally, digital modules and monitoring tools should be developed to track long-term behavioral changes among students.

Collaboration with universities and research institutions should be strengthened to enhance the scientific and evaluative aspects of program implementation, allowing the *Resilient School of Food and Agriculture* to become a national model for sustainable education development.

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