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Empowering Women of 'Aisyiyah Wonosari in Preventing Microplastics Impacts on Reproductive Health

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Abstract

Microplastics have emerged as a significant threat to human health, particularly affecting the female reproductive system. This community service program aimed to increase the knowledge of 'Aisyiyah Members in Wonosari, Bondowoso, about the dangers of microplastics and to encourage the adoption of a healthy and environmentally friendly lifestyle. The program employed a participatory, community-based approach that included socialization, education, and training sessions focusing on reproductive health and household waste management. The team employed interactive methods, including PowerPoint presentations, posters, and guidebooks, to enhance engagement and foster a deeper understanding. They implemented a pre- and post-test design to measure the improvement in knowledge among 51 participants. The results showed an 80% increase in participants' knowledge regarding the dangers of microplastics and their impacts on reproductive health. The establishment of the "Emak EcoCare" community further ensured program sustainability by empowering women as environmental cadres to promote waste sorting and healthy lifestyle practices. This program demonstrated that community-based education can effectively raise awareness and foster behavioral change in managing household waste and reducing microplastic exposure. Continued mentoring and replication are recommended to ensure the long-term sustainability of these efforts.

Keywords 'Aisyiyah Wonosari; Community Empowerment; Environmental Health; Microplastics; Reproductive Health

1. INTRODUCTION

Microplastics pose an increasingly serious environmental and health threat in modern human life (Al Mamun et al., 2023a; De-la-Torre, 2020; Ghosh et al., 2023; Sharma & Kaushik, 2021; Ziani et al., 2023a). Microplastics are defined as plastic particles measuring less than 5 mm in diameter that are formed from the degradation of plastic or originate from consumer products such as cosmetics, synthetic clothing, and food packaging materials (Acharya et al., 2021; da Costa et al., 2017; Ziani et al., 2023b). Exposure to microplastics can occur through various pathways, including drinking water, food, air, and household products, many of which are managed by women of reproductive age who play a role as household managers in their daily lives (Al Mamun et al., 2023b; Kannan & Vimalkumar, 2021; Peñate, 2021; Pironti et al., 2021; Tan et al., 2024).

Recent studies have demonstrated that microplastics can disrupt the human hormonal system, particularly the endocrine system, which has a significant impact on women's reproductive health (Ali et al., 2024; Amereh et al., 2020; Balali et al., 2024; Inam, 2025a; Pathak, 2025; Piazza & Urbanetz, 2019; M. Wang et al., 2024a). Long-term exposure to microplastics can lead to decreased ovarian function, hormonal changes, and even cancer risk (Inam, 2025b; Solleiro-Villavicencio et al., 2020; M. Wang et al., 2024b; Z. Wang et al., 2025). These findings underscore the importance of systematic education and preventive measures, particularly among vulnerable groups, such as women of reproductive age who serve as household managers in their daily lives (Hossain, 2024; Lynn et al., 2017; Seifi et al., 2025).

The 'Aisyiyah Member in Wonosari, Bondowoso is a Muhammadiyah women's organization active in Wonosari District, Bondowoso Regency, East Java. This organization comprises a group of women, most of whom are productive-age women who play roles as household managers, kindergarten teachers, healthcare workers, and activists in religious study groups. The organization actively engages in Islamic outreach, early childhood education, and socio-religious programs; however, it has not yet incorporated environmental health issues—particularly microplastics and their impact on reproductive health—into its community agenda.

Wonosari District is characterized by mountainous terrain, agriculture, and densely populated settlements. The community relies heavily on single-use plastics for food packaging, shopping, and household storage. Waste management practices remain limited, with most households depending on burning methods and lacking routine waste sorting. The frequent use of plastic containers and bottled drinking water increases the risk of microplastic exposure in daily life.

Preliminary observations and discussions with the leaders and members of the ‘Aisyiyah in Wonosari, Bondowoso revealed several problems: low awareness regarding microplastic hazards and their connection to women’s reproductive health; an absence of environmental health education programs; limited adoption of healthy and environmentally friendly household practices; and an underdeveloped role of productive-age women who play a role as household managers as potential agents of environmental education. The target beneficiaries of this program are productive-age women who play a role as household managers within the organizational structure and community network of the ‘Aisyiyah Member in Wonosari, Bondowoso. Although economically non-productive, this group is socially active and possesses strong potential to become agents of change through religious and culturally rooted approaches. Preliminary assessments also indicate that most women in this community are aged 30–55, have an elementary to high school education level, have never received training on microplastic hazards, and are actively involved in religious gatherings and *Posyandu* activities. Their strong involvement in community life and concern for family health make them an ideal target for sustainable environmental education initiatives.

The ‘Aisyiyah Wonosari Branch also has structural strengths as a cadre-based organization with regular activities in mosques and schools, creating opportunities for sustainable program implementation. With proper empowerment, these women can effectively disseminate knowledge about microplastic hazards and promote healthier, environmentally friendly household behaviors.

Despite the growing scientific evidence on microplastics and their dangers, a significant gap remains at the community level—particularly among women in Wonosari. Most productive-age women who play a role as household managers have limited knowledge regarding microplastic exposure and its implications for reproductive health, despite being among the most vulnerable due to their daily household activities. No existing programs specifically address household-based environmental health or incorporate education that connects microplastic hazards with women’s reproductive well-being. Behavioral gaps are also apparent, including a high dependence on single-use plastics, the routine use of plastic containers, and improper waste disposal practices such as burning. Moreover, although ‘Aisyiyah possesses strong organizational capacity and a wide social network, this potential has not yet been utilized to promote environmental health literacy. These gaps emphasize the need for a structured, context-specific, and community-based intervention.

The novelty of this community service program lies in its integrated approach, combining scientific education on microplastics with a reproductive health perspective, an intersection seldom explored in rural community empowerment initiatives. This program also adopts a culturally responsive and religion-based framework aligned with the values of 'Aisyiyah, enabling more effective and sustainable behavior change. Unlike typical health education programs, this initiative transforms productive-age women who play a role as household managers into active environmental health educators, enabling them to disseminate knowledge within their families and communities. Furthermore, the development of a practical and culturally relevant educational module tailored to local household routines provides an innovative tool for long-term awareness and behavior improvement. This integrated model addresses an unmet educational need and offers a replicable approach for other women's organizations in similar rural settings.

The primary purpose of this community service program is to increase the knowledge and awareness of productive-age women who play a role as household managers within the Wonosari Branch of 'Aisyiyah regarding the health risks posed by microplastics, particularly their impact on women's reproductive health. Through structured education sessions, interactive discussions, and practical demonstrations, the program aims to promote healthier and more environmentally responsible household practices, particularly in reducing plastic use and enhancing waste management. Another essential objective is to empower women as community-based agents of change, enabling them to promote environmental health within their social and religious networks. By strengthening the organizational capacity of 'Aisyiyah to integrate environmental health issues into their routine activities, the program seeks to foster long-term sustainability and support the creation of healthier home environments that minimize microplastic exposure for women and their families.

2. METHODS

This study employed a participatory, community-based educational method because it is well-suited for empowering economically disadvantaged groups, such as the 'Aisyiyah productive-age women who serve as household managers in Wonosari. The approach combines lectures, demonstrations, and hands-on practice using simple, low-cost technology, such as SiTapis, making complex issues, including microplastic exposure and reproductive health, easier to understand and apply in daily life. This method also supports sustainable empowerment by engaging women as active participants and future agents of change within their households and communities.

The implementation stages of this Community Service program include Preparation and coordination with partners, program socialization, implementation of training and education, application of technology and field practice, and Monitoring, evaluation, and program sustainability.

The activity began with a socialization session aimed at introducing the program's objectives, benefits, and plans to partners, specifically productive-age women who serve as household managers from the 'Aisyiyah Member in Wonosari, Bondowoso. The training consisted of two main sessions: Reproductive Health and the Dangers of Microplastics, as well as Education and Training on a Healthy and Environmentally Friendly Lifestyle.

The Reproductive Health and Dangers of Microplastics Education material was delivered verbally using PowerPoint presentations by Rizqie Putri Novembriani, S.Keb., Bd., M.K.M. This material explained how microplastic exposure occurs and its impact on the body. Integrating health education in community-based settings has been shown to raise awareness and change attitudes, particularly among women effectively: a recent community-service study found that interactive lectures significantly increased participants' environmental health literacy and readiness to adopt safer household practices (Kusumaningrum, 2023).

In the Healthy and Environmentally Friendly Lifestyle Training, participants gained an understanding of the basic concepts of waste management. They introduced Annisa Wigati Rozifa, S.Keb., Bd., M.Keb, to the simple household waste filter, SiTapis (*Saringan Tahan Plastik*), a simple domestic waste filter made from locally available materials like sand, charcoal, and gravel—an approach consistent with findings from earlier community-based waste-management programs that emphasize low-cost, locally-adaptable technologies (Muarief et al., 2023).

The next session is a presentation on Household Waste Processing (Domestic Waste) by Sylvia Andriani, S.KM., M.KL. Participants were trained in waste sorting, reducing plastic use, and producing Eco Enzymes. At this stage, the Partners participated by providing the activity location, namely, the classroom space for the education and training. 'Aisyiyah administrators and members were involved as active participants and facilitators in the educational activities and environmentally friendly lifestyle practices. This component reflects practices found effective in other community-service initiatives; for example, a recent study demonstrated that training on eco-enzyme production significantly improved participants' skills and environmental behaviors in managing household organic waste (Novita et al., 2024). The hands-on demonstrations and group involvement during training mirror the

participatory action approach recommended for sustainable behavior change in environmental health interventions (Ernawati et al., 2023).

The technology used was SiTapis (*Saringan Tahan Plastik*). This simple household waste filter, made from local materials such as sand, charcoal, and gravel, is designed to filter microplastic particles from kitchen waste. We value the resources of our community and have designed our technology to maximize their potential. This technology was provided directly to participants, who were then trained to install and use the device in their homes.

The community service team and students provided mentoring. The mentoring lasted for three months, involving home visits and direct observation. Evaluation included pre- and post-tests to measure participants' knowledge gains, observation forms (structured documents used to track changes in household behavior, such as waste management practices and plastic use), and focus group discussions as a means of reflection and further recommendations. This sustained mentoring component aligns with best practices: research shows that continuous community engagement and follow-up significantly enhance the adoption and maintenance of eco-friendly habits post-intervention (Muarief et al., 2023). To ensure sustainability, the Emak EcoCare environmental cadre community was formed under the guidance of Aisyiyah. These cadres will continue to educate and monitor other residents regularly. In addition, educational booklets and filtering tools will be handed over to the Aisyiyah secretariat for use in da'wah and other social activities. This commitment to sustainability is a key aspect of our program, ensuring that our efforts will have a lasting impact on the community and the environment.

Table 1. Participants, Presenters, and Elements Involved in the Community Service Program

Category	Name / Group	Role / Description
Participants	Productive-age women who play a role as household managers of 'Aisyiyah members in Wonosari, Bondowoso	Main beneficiaries: attended education, training, technology application, and mentoring sessions
	51 participants	Participated in pre-post-test, interactive discussions, waste management practice, and SiTapis installation
	Emak EcoCare Cadres (10 members)	Environmental cadres formed to ensure program sustainability and peer education

Presenters / Trainers	Rizqie Putri Novembriani, S.Keb., Bd., M.K.M.	Delivered education on Reproductive Health and the Dangers of Microplastics
	Annisa' Wigati Rozifa, S.Keb., Bd., M.Keb.	Presented Healthy and Environmentally Friendly Lifestyle materials; introduced SiTapis technology
	Sylvia Andriani, S.KM., M.KL.	Delivered material on Household Waste Processing (Domestic Waste)
Implementation Team	Community Service Team	Coordinated program stages, prepared materials, facilitated training, and conducted evaluation
	Students	Assisted with field activities, documentation, data entry, and mentoring
Partner Organization	'Aisyiyah Member in Wonosari, Bondowoso	Provided venue, mobilized participants, facilitated activities, and supported cadre formation
Supporting Elements	Mosques and Schools under 'Aisyiyah	Provided activity spaces and institutional support
	Secretariat of 'Aisyiyah Wonosari	Responsible for storing educational booklets and SiTapis for future activities

This community service activity is not just about us, but about the community as a whole. It employs a community-based, participatory educational approach, simplifying the concept of microplastics through clear and accessible language and simple tools utilizing local resources. The program is tailored to the partners' capacities through small-group meetings, with materials and technology selected based on the needs identified in the initial survey results. Partners are not just participants, but active contributors from planning through implementation to evaluation, providing space and mentoring for the activities. Evaluation is conducted both qualitatively (through discussions) and quantitatively (using pretest and post-tests), while sustainability is ensured through the formation of cadres and the distribution of educational materials.

The team leader is responsible for developing modules, coordinating their implementation, and evaluating the results. Team members serve as resource persons, educational media managers, plastic substitution trainers, cadre mentors, and field coordinators. Two students are also involved as field assistants, documentation specialists, data input specialists, and discussion facilitators.

Partners in this program are economically non-productive community groups. The aspects addressed focus on health and social education. The Health aspect involves increasing understanding of reproductive health through microplastic education. The Social Education aspect consists of the formation of environmental education cadres to drive behavior change at the community level.

3. FINDINGS AND DISCUSSION

3.1. Program Socialization and Initial Coordination

The implementing team held an initial socialization session with management and Aisyiyah Members in Wonosari, Bondowoso, on Monday, 1 September 2025. Two participants attended, comprising two Community Service teams and four members of the 'Aisyiyah in Wonosari, Bondowoso. The socialization covered the following topics: background, partner profiles, implementer profiles, priority issues, solutions, target outputs, implementation methods, appropriate technology, activity plans, expected outputs, roles and expectations for partners, and the role of the community service team. The team and partners also coordinated the concept and technical aspects of the activity. The participant's response was positive, as evidenced by the enthusiasm in the question-and-answer discussion regarding daily habits and input for the upcoming community service activities.

3.2. Reproductive Health Education and the Dangers of Microplastics

Education activities were conducted through interactive outreach, utilizing PowerPoint presentations, posters, and educational guidebooks. Educational materials on Reproductive Health and the Dangers of Microplastics were delivered orally by Rizqie Putri Novembriani, S.Keb., Bd., M.K.M. The material covered: Definition and sources of microplastic exposure; Routes of entry of microplastics into the human body; Impacts on health, especially the female reproductive system; and Principles of household-based prevention.

Numerous studies have shown that microplastics can enter the human body through food, drinking water, and air, then accumulate in organs, including the reproductive system. Ragusa et al. (2021) identified microplastic particles in human placental tissue, indicating that these particles could influence fetal development (Ragusa et al., 2021). Xunsi et al. (2024) detected microplastics in women's endometrial tissue, suggesting that exposure to microplastics can disrupt hormonal function and fertility (Qin et al., 2024). Furthermore, animal studies by Wang et al. (2023) demonstrated that microplastics can induce oxidative stress, granulosa cell apoptosis, and disruption of reproductive hormones (Wang et al., 2023). Therefore, educating

women of childbearing age about the dangers of microplastics is crucial as an early preventative measure against the risk of reproductive health problems.

This educational activity included pre- and post-tests administered to 51 participants. Evaluation instruments, including pre- and post-tests, were administered to participants during the activity. Data analysis showed an 80 percent increase in knowledge regarding the dangers of microplastics to reproductive health.

PowerPoint presentations, posters, and educational guidebooks proved effective in enhancing participants' understanding of the risks associated with microplastics to reproductive health. Based on the pre- and post-test results, there was a significant increase in participants' knowledge after participating in the activity.

However, this increased knowledge needs to be accompanied by mentoring and habit-building efforts to achieve long-term behavioral changes in plastic use and household waste management.

Figure 1. Participants from the ‘Aisyiyah Member in Wonosari, Bondowoso, Attended an Educational Session on the Dangers of Microplastics to Reproductive Health

3.3. Healthy and Environmentally Friendly Lifestyle Training

The implementing team organized the Healthy and Environmentally Friendly Lifestyle Training on Sunday, 21 September 2025, at Building 1 of Aisyiyah Cindogo Elementary School (SDAC) Tapen, Bondowoso. The training began with a presentation by Annisa' Wigati Rozifa, S.Keb., Bd., M.Keb., covering the following topics: why household waste management is important, how microplastics enter the body and their impact on reproduction, the basic concept of household waste management, the technological and innovative tool Si Tapis (Plastic-Resistant Filter), and the relationship between waste management and reproductive protection. Additionally, this session included a workshop on the 10 habits of "low-plastic living" in the household. This session was followed by a presentation on Household Waste Management (Domestic Waste) by the Practical Facilitator (Sylvia Andriani, S.KM,

M.KL), as well as hands-on practice on waste sorting, reducing plastic use, and producing Eco Enzyme. Five participants agreed to participate in the practice.

The healthy and environmentally friendly lifestyle training conducted with members of 'Aisyiyah demonstrated high enthusiasm from participants, particularly during the hands-on sessions involving making Eco Enzymes and assembling the SiTapis (Plastic-Resistant Filter) technology. This simple technology is an innovative way to reduce household plastic waste. However, implementation in the field encountered several obstacles. Some participants considered single-use plastics more practical, limited space and household infrastructure hindered installation of the device, and not all families could afford environmentally friendly alternatives. A similar phenomenon was also found in research by Deus et al. (2022), which found that the adoption of appropriate technology was strongly shaped by cost factors, usability, and community social support (Deus et al., 2022). To overcome these obstacles, modifications to the SiTapis design were necessary to make it lighter and more flexible, as well as further training to enhance routine maintenance skills.

(a) (b)

Figure 2. (a) The Community Service Team Demonstrates the Use of Sitapis (Plastic-Resistant Filter) as A Simple Innovation for Filtering Household Waste. **(b)** Presentation of Household Waste Processing (Domestic Waste) Material by the Practice Facilitator

3.4. Manufacturing and Implementation of SiTapis Technology (Plastic-Resistant Filter)

The team trained participants to assemble SiTapis using locally available materials, including used paint buckets, sand, activated charcoal, and gravel**.** The team successfully manufactured 17 SiTapis units and will install them in the homes of selected Aisyiyah members. The implementing team instructed participants on how to assemble the equipment, carry out routine maintenance (including weekly backwashing and charcoal media replacement every 2–3 months), and safely dispose of the filtered sludge.

3.5. Establishment of an Environmentally Conscious Women's Community

The formation of the "Emak EcoCare" environmental cadre, guided by Aisyiyah, is a strategy to ensure the sustainability of the program, with 10 active cadres. The cadres' duties include disseminating information through religious studies, monitoring the continued use of SiTapis, and assisting productive-age women who play a role in household waste sorting practices.

This approach aligns with the results of a study by Lindsay (2019) that found that the presence of community champions significantly increased participation and sustainability in household-based environmental programs (Lindsay et al., 2019). Furthermore, a national study by Rahmawati et al. (2023) also confirmed the strategic role of women in building ecological awareness and habits to reduce single-use plastics in the domestic environment (Rahmawati et al., 2023). Therefore, the Emak EcoCare community can be a driving force for behavioral change toward a healthier and more environmentally friendly lifestyle.

(a) **(b)**

Figure 3. (a) Handover of Educational Media and Appropriate Technology (Si Tapis) from the Community Service Team to Partners (b) Formation of the Emak Ecocare Community

3.6. Obstacles and Solutions

The obstacles encountered during program implementation can be understood through a multidimensional analytical framework encompassing technical, economic, social, and cultural factors. From a technical perspective, the installation of SiTapis was hindered by limited household infrastructure, such as permanently blocked drains, narrow washing areas, and insufficient space for additional equipment, which reduced the feasibility of immediate adoption. From an economic standpoint, some families were unable to purchase environmentally friendly alternatives or maintain

the SiTapis unit due to financial constraints, a finding that aligns with the literature, which suggests that low-income households often face structural barriers to implementing sustainable technologies. Social factors, including entrenched behavioral preferences for single-use plastics due to their convenience, also pose challenges; this aligns with behavior change theories, which indicate that daily habits and perceived ease strongly influence environmental decision-making. Finally, cultural consumption practices, such as routine reliance on plastic packaging, contributed to resistance to change, consistent with research showing that cultural norms can shape the acceptance of new technologies.

The solutions implemented follow best practices in community-based environmental programs. Adapting the SiTapis design to be lighter, smaller, and easier to install aimed to improve compatibility and reduce perceived complexity, as recommended in the literature on the adoption of appropriate technology. Recurring training and reinforcement, delivered through interactive sessions and ongoing mentoring, align with evidence that repeated exposure and guided practice strengthen self-efficacy and support long-term behavior change. Additionally, the formation of the Emak EcoCare community reflects global best practices emphasizing the creation of local champions and peer-support networks to enhance sustainability, knowledge diffusion, and community ownership. These integrated strategies demonstrate that addressing technical, economic, social, and cultural barriers simultaneously is essential for fostering durable and meaningful environmental behavior change.

4. CONCLUSION

This community service initiative has demonstrated significant potential to enhance the understanding of health risks associated with microplastics among women of reproductive age who play a key role as household managers, while equipping them with practical skills to reduce exposure through healthier and more environmentally responsible household practices. The SiTapis technology, designed as a simple and low-cost filtration tool, proved feasible for community use. The formation of the Emak EcoCare group reflects strong community involvement that supports the long-term sustainability of the program. Continued mentoring is necessary to strengthen cadres' ability to replicate the activities independently, and further development should focus on enhancing basic technologies and reinforcing education on household waste management. Additional research is also needed to assess the effectiveness of microplastic filtration in various household settings. The originality of this program lies in combining reproductive health education with the use of simple household technology and establishing a women-led sustainability

group. This approach remains uncommon in Indonesian community service initiatives.

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