



One Step Towards a Green Environment: Education on Dry and Wet Waste Sorting and Innovation in Low-Smoke Combustion

Angelica Maulani Poetri Chantika^{1*}, Muhamad Isya Ar-Rasyid², Muhammad Izaaz Mughoffar³, Najya Nurul Aulia⁴, Philana Zulfah Rachmawati⁵, Siti Muslikah⁶

^{1,2,3,4,5,6} Universitas Islam Negeri Sunan Gunung Djati Bandung, Indonesia

* Corresponding Author, Email: angelicaampcc@gmail.com

| ARTICLE INFO | ABSTRACT |
|---|--|
| <p>Keywords:</p> <p>Ecological awareness; education; Environment; Green lifestyle; Participation; Social behavior; Sustainability; Waste management.</p> | <p>This study aims to examine strategies and community actions in fostering a green environment as part of ecological sustainability efforts. A green environment is conceptualized as a lifestyle emphasizing ecological awareness, wise resource management, and the reduction of negative impacts on nature. The study employed a qualitative descriptive approach through observation, interviews, and documentation with a local community actively engaged in environmental initiatives. The findings reveal that simple practices such as waste management, tree planting, and reducing plastic usage significantly improve environmental quality while fostering ecological awareness among community members. The main challenges identified include inconsistent eco-friendly behavior, limited waste management infrastructure, and insufficient support from local policies. Practical implications highlight the need for continuous environmental education, strengthening youth involvement as agents of change, and integrating eco-friendly programs into local development policies.</p> <p>Contribution: This study contributes to the academic discourse on the relationship between social behavior, ecological awareness, and sustainability, while offering a community-based model for environmental movements that can be replicated in various social contexts.</p> |
| <p>Article history:</p> <p>Received 2025-09-05 Revised 2026-02-24 Accepted 2026-02-24</p> | <p><i>This is an open access article under the CC BY-SA license.</i></p>  |

1. INTRODUCTION

Globally, waste management is becoming an increasingly pressing issue due to population growth, urbanization, and changes in modern lifestyles. The World Bank (2018) report, "What a Waste 2.0," estimates that global waste production reaches 2.01 billion tons per year, and this figure has the potential to increase to 3.40 billion tons by 2050 if not addressed seriously (Bano, 2025). The biggest challenge lies not only in the ever-increasing volume of waste, but also in the low recycling rates and limited management systems in many developing countries. In Europe, for example, the European Union has implemented a circular economy policy that emphasizes reduction, reuse, and recycling as the primary waste management strategy (Chioatto & Sospiro, 2023). Meanwhile, Japan is known for its 3R concept (Reduce, Reuse, Recycle), which has successfully raised public awareness through strict regulations and public education (Sakai et al., 2011).

Participatory approaches are also becoming a global trend in environmental management. Studies in India have shown that citizen participation through village community forums has been shown to increase the effectiveness of domestic waste management programs, as decisions are made based on deliberations involving all stakeholders (Kandpal & Saizen, 2022). In Africa, community-based programs involving local leaders and youth groups in household waste management have successfully reduced littering and created economic opportunities through recycling (Leknoi et al., 2024). These international experiences demonstrate that successful waste management depends not only on technology or regulations, but also on the extent to which communities are actively involved in every stage of program planning, implementation, and evaluation.

The Participatory Community Development System (SISDAMAS) is an empowerment approach that emphasizes active community involvement in every stage of program planning and implementation. In the first cycle, activities began with initial outreach, community discussions, and social reflection in Hamlet 03 as a step to establish initial communication between the Community Service Program (KKN) team and the community. This stage not only serves to introduce the work program but also serves as a means to explore local potential and identify real problems faced by residents in a participatory manner (Ramdani, 2019).

This approach has proven effective in various regions. For example, research in RW 01, Neglasari Village, showed that the implementation of SISDAMAS in four cycles was able to increase community awareness through waste sorting education and the use of digital media as a means of outreach (Nurohman & Gunawan, 2019). Similarly, in RW 10, Jongor Hamlet, participatory methods such as community discussions, community service, and the installation of information media proved effective in building collective awareness in waste management.

A community discussion forum in Hamlet 03, attended by 47 people, including community leaders and local stakeholders, focused on one dominant issue: waste management. The open discussion revealed the lack of a proper waste disposal site (TPS), the absence of a waste collection system, and the lack of operational facilities. Consequently, most household waste is burned openly or dumped into rivers. This situation has led to various negative impacts, ranging from environmental pollution and health risks to a decline in the area's aesthetics.

Public awareness of wise waste management is also considered low. The lack of ongoing education regarding the separation of organic and inorganic waste, as well as the absence of management schemes such as waste banks or 3R waste disposal sites, further exacerbates the situation. This problem is not only related to the availability of facilities and infrastructure, but also to residents' mindsets and behaviors regarding environmental cleanliness. A study in Baturetno even showed that simple innovations such as a "sodaqoh sampah" system and the provision of waste bins can increase community engagement when combined with ongoing education (Nurlaela et al., 2023).

Through social reflection, it was agreed that solutions to the waste problem must be collaborative and sustainable. Initial steps include waste sorting education, the formation of environmental volunteer teams, and the planning of small-scale integrated waste management facilities. One alternative being discussed is the innovation of low-smoke incineration, which could be a temporary solution for non-leaf dry waste while waiting for the management facility to be built.

The next stage in Cycle 2 focused on social mapping and community organization in RW 08, Hamlet 03. This activity identified urgent needs, including adequate polling stations (TPS), waste collection officers, and operational vehicles such as Viar motorcycles. The mapping also revealed shifts in socio-cultural values, infrastructure development, youth organization dynamics, increased religious activities, and economic challenges.

In response, the KangRaLing (Environmentally Friendly Village) community was formed as a vehicle for local participation-based change. The results of these two initial SISDAMAS cycles served as the foundation for designing relevant, participatory, and sustainable empowerment programs, particularly in achieving a clean environment through education, simple technological innovation, and strengthening community institutions. Experience in Probolinggo City also confirms that program sustainability can be ensured if supported by an incentive system that encourages active citizen participation in the sorting, collecting, and processing scheme (Nurohman & Gunawan, 2019).

In Cycle 3, the community, through the KangRaLing community, together with the KKN team, developed an activity plan based on the priority needs that had been proposed, such as the construction of a Waste Management Site (TPS), waste sorting education, and household-based waste management training. This process included identifying local potential, collaborating with stakeholders (DKM, Karang Taruna, PKK, village government), and developing a concrete action plan. According to Putri Anggun (2024), the official SISDAMAS syllabus includes four stages: Cycle 1 (initial socialization), Cycle 2 (social mapping), Cycle 3 (participatory planning and program synergy), and Cycle 4 (implementation and monitoring and evaluation). In Cycle 4, the

agreed-upon plan was then concretely implemented through operational assistance of the TPS by the KangRaLing volunteer team, ongoing socialization of waste sorting through information boards, WhatsApp groups, and door-to-door approaches, as well as the procurement of simple facilities such as 3R sorting baskets, visual educational media, and temporary TPS. Evaluations are conducted routinely at the first month, quarterly, and six-month intervals to assess the effectiveness of the intervention, which then informs program SOP updates, educational materials updates, and participation-based incentive designs. The SISDAMAS guidelines from UIN Sunan Gunung Djati Bandung emphasize that the development of volunteers and key drivers is a crucial prerequisite for sustainable community empowerment even after KKN students have completed their assignments (Ramdani Wahyu et al., 2016).

Furthermore, the results of the SISDAMAS program at the local level should be synergized with the village Musrenbang. The Dorantif (documentation of alternative program plans) produced by the KangRaLing community can be used as a reference in the preparation of village development plans so that community-generated programs do not stop at the campus level but can be officially adopted by the village government. Wahyu Ramdani (2016) emphasized that the results of the SISDAMAS Community Service Program (KKN) should ideally serve as the primary reference for the village Musrenbang so that participatory programs gain legitimacy and budget support (Ramdani Wahyu et al., 2016). To enhance effectiveness, students can also introduce the use of simple digital technologies, such as WhatsApp, Google Forms, or Google Sheets, which function to monitor waste collection schedules, gather community aspirations, and disseminate environmental education materials interactively. Experience in Mekarsari Village shows that SISDAMAS can be combined with the Religious Moderation Community Service Program (KKN) through Islamic-based parenting seminars for parents in kindergartens, which can strengthen parents' understanding of child education from an Islamic perspective and encourage the creation of a culture of shared environmental concern.

2. METHOD

This study uses the Participatory Community Development System (SISDAMAS) approach, which emphasizes active community involvement at every stage of the planning, implementation, and evaluation of empowerment programs. This method was chosen because it aligns with the research focus, which examines participatory waste management in Hamlet 03, Mekarsari Village, Selaawi District. The basic principles of SISDAMAS include participation, democratization, and sustainability, placing the community as the primary subject, while students act as facilitators (Silverman & Patterson, 2023).

The research was conducted through four main cycles of SISDAMAS. The first cycle began with initial outreach activities, community discussions, and social reflections involving 47 participants, consisting of residents, community leaders, and local stakeholders. This stage aimed to establish initial communication, introduce the Community Service Program (KKN) team work program, and explore potential and real problems. The results of the discussions showed that the dominant issue faced by the community was waste management, characterized by the lack of proper waste disposal sites (TPS), open waste burning practices, and dumping into rivers, which resulted in pollution, reduced environmental aesthetics, and health risks.

The second cycle focused on social mapping and community organizing. Mapping was conducted through observation, interviews, and group discussions to identify local needs and potential. Several key issues were identified, including the lack of adequate waste disposal facilities (TPS), the absence of a waste collection system, and a weakening spirit of mutual cooperation. However, positive potential also existed, including increased religious activities and the availability of public spaces. As a follow-up, the community, along with students, formed the Environmentally Friendly Village (KangRaLing) community as a driving force for change based on local participation.

The third cycle focused on participatory planning and program synergy. Community deliberation forums were used to rank the issues, with waste management being the top priority, followed by improving integrated health post (Posyandu) services and holding seminars in kindergartens. Based on the agreement, the priority program of building a smoke-free waste incineration unit was chosen as the urgent solution. The construction site was determined to be the cemetery area of RW 08, with initial funding of Rp 1,490,000 sourced from the RW treasury. The implementation process was carried out through mutual cooperation, with the RW head as the person in charge. Community Service Program (KKN) students supported the development of technical designs and budget plans, while fieldwork was carried out collaboratively with residents.

Each stage of this research is designed to ensure active community involvement, build a sense of collective ownership, and ensure program sustainability. Thus, the SISDAMAS method serves not only as an operational framework for research but also as a relevant empowerment tool for addressing environmental issues through local participation.

3. RESULTS AND DISCUSSION

Lack of public awareness of waste management remains a major challenge in various regions, including Hamlet 03. Research shows that most residents are not yet accustomed to separating organic and inorganic waste. This phenomenon aligns with the Theory of Planned Behavior, which states that a person's behavior is influenced by attitudes, subjective norms, and perceived control (Acikgoz et al., 2023). In this context, low public awareness is not only a matter of technical knowledge but also a reflection of social norms that have not yet internalized the importance of waste management as part of collective responsibility. When the habit of sorting waste does not become a valued standard of behavior within a community, it is difficult to sustain in the long term.

The habit of littering, whether in rivers or on vacant lots, demonstrates a lack of public ecological awareness. The Tragedy of the Commons concept explains that when shared resources (in this case, rivers and public spaces) are not managed collectively, individuals tend to exploit them without considering the long-term impacts (Cashore & Bernstein, 2023). The practice of dumping waste into rivers not only degrades environmental quality but also triggers health risks and ecological disasters such as flooding. This suggests that without educational intervention and community-based regulation, destructive habits will continue to recur.

In response, the smoke-free combustion innovation program has become a relevant technical solution. This echoes Appropriate Technology, which utilizes simple, inexpensive, and easily implemented technology tailored to the local context (Bera & Rahut, 2024). Unlike traditional combustion, which produces air pollution, the smoke-free combustion innovation is designed to allow for smoother airflow, resulting in a more complete combustion process. Thus, this technology not only reduces the volume of household waste but also minimizes health risks from smoke exposure (Kumar et al., 2024). The presence of this kind of appropriate technology demonstrates that environmental solutions don't always have to be expensive or sophisticated; rather, they must be tailored to the conditions and needs of the community.

Furthermore, the implementation of smoke-free burning offers more than just a technical solution but also an educational function. According to Mezirow's Transformative Learning theory, behavioral change can occur when individuals critically reflect on their habits (Mezirow, 2018). Through outreach and mentoring, communities are encouraged to understand that the traditional method of indiscriminately burning waste is not only inefficient but also dangerous. Smoke-free burning technology provides an entry point for residents to shift to more responsible behaviors, such as sorting waste at home, composting organic waste, or recycling inorganic waste (Krysiński et al., 2024).

The success of an innovation depends not only on the technology but also on the trust, networks, and norms established within the community. Mutual cooperation in the construction of the combustion units, community participation in community discussions, and effective local leadership demonstrate that social capital is a key factor in program sustainability (Pylypenko et al., 2023). When communities feel ownership of the program, they are more committed to maintaining and developing the initiative.

Figure 1 Material Preparation



(Source: Researchers' documentation, 2025).

Tahap awal pembangunan unit pembakaran minim asap dimulai dengan persiapan material utama yang terdiri atas batako ringan (hebel), semen, pasir, besi, dan kayu penyangga. Pemilihan material tidak dilakukan secara acak, tetapi mempertimbangkan aspek kekuatan, ketahanan terhadap panas, ketersediaan lokal, serta keterjangkauan biaya. Prinsip ini sesuai dengan konsep *appropriate technology*, bahwa teknologi sebaiknya sederhana, hemat biaya, dan sesuai dengan kondisi masyarakat setempat (Bera & Rahut, 2024).

Lightweight bricks were chosen because they are lighter than conventional bricks, yet remain sturdy and heat-resistant. This characteristic is important considering the high temperatures during the firing process can potentially damage unsuitable materials. Meanwhile, cement and sand are used as adhesive and to fill the gaps between the bricks. The precise mixture proportions not only increase structural stability but also help suppress excess smoke, thus aligning with the primary goal of this innovation (Aboalhamayie et al., 2025). Iron is added as a framework reinforcement in areas that bear greater stress, while wooden supports are used as temporary supports during the initial construction phase to prevent the building from shifting before the mixture has fully hardened.

In addition to material selection, site planning is also crucial in the initial stages. The location was decided through discussions between students and the community, reflecting the principle of participation at the heart of the SISDAMAS approach. The primary consideration in determining the location was distance from residential areas to reduce the risk of smoke exposure to residents' homes. Other factors such as wind direction, land conditions, space availability, and accessibility were also considered to ensure optimal use of the facility by residents. From a participatory environmental planning perspective, the success of a public facility is determined not only by technical aspects but also by the extent to which the community is involved in the decision-making process (Abas et al., 2023). In this context, community discussions ensure a sense of collective ownership, thus increasing the likelihood of sustainable use and maintenance of the incineration facility.

Figure 2 Process of Moving Materials to the Location



(Source: Researchers' documentation, 2025).

The process of moving building materials to the site was carried out collaboratively by residents and students. This activity has a deeper meaning than simply moving materials. In the context of community development, mutual cooperation can be understood as a social capital practice that strengthens networks of solidarity, trust, and cooperation between individuals (Julsrud, 2023). Through direct involvement, the community not only contributes physically but also gains an understanding of the function of each material and the purpose of building a smoke-free combustion unit. This participation aligns with the concept of collective efficacy, which is the capacity of a community to work together to achieve shared goals (Gülsün et al., 2023). Thus, early community involvement creates a stronger sense of ownership and responsibility for the facility being built.

After the material preparation phase is complete, the activity continues with the installation of the basic foundation. The foundation is a vital element that determines the stability and lifespan of a building. A good foundation quality can distribute the building load evenly, preventing cracks and collapse (Kacker et al., 2024). In the context of building a smoke-free combustion unit, a solid foundation is essential because the building will withstand repeated high temperatures. Therefore, precision in arranging materials, mixing cement, and laying bricks during the foundation stage is key to successful construction. From a community empowerment perspective, involving residents in this technical process not only expedites the completion of the work but also fosters practical understanding that can be applied to other future developments (Sharp et al., 2022).

Figure 3 Initial Foundation



(Source: Researchers' documentation, 2025).

Foundation installation begins with the installation of a steel frame as the basic framework of the structure. The use of steel in foundations is common practice in civil engineering due to its high resistance to both compressive and tensile loads (Tipu et al., 2024). The steel frame is positioned to blend with the cement and sand mixture, resulting in a denser and more solid structure. Afterward, the concrete blocks are layered with cement adhesive between them. Parallel and neat arrangement is essential, as even the slightest imbalance can potentially compromise the overall stability of the structure. This basic principle aligns with the theory of structural integrity in building engineering, which emphasizes the importance of balance and material bonding to ensure long-term strength (Liang et al., 2024).

In addition to technical considerations, land conditions are also a crucial factor in foundation construction. Pre-compacting the soil can prevent differential settlement, which can lead to tilting or cracking of the structure later (Chen & Zhang, 2024). This aligns with geotechnical principles, which emphasize the need for soil testing and compaction prior to construction (Kodikara et al., 2018). Although smoke-free combustion units are constructed with simple materials, this step demonstrates the need to adhere to basic construction standards for optimal results and longevity. This ensures that the facility is not merely temporary but also maintains sustainability.

The foundation installation phase also carries a strong social value. Students act as technical facilitators, providing guidance on the proper placement of the steel, mortar composition, and brick-laying methods. Meanwhile, local residents actively participate in preparing materials, mixing cement, and ensuring the process runs smoothly. This collaborative approach reflects the concept of community-based development, where construction success is determined not only by technical expertise but also by the level of community participation as project owners (Moayerian et al., 2022). The mutual cooperation fostered during this phase not only expedites the work but also strengthens social bonds and fosters a sense of ownership in the facility being constructed.

After the foundation is complete, the next stage is the base casting. A mixture of cement and sand is mixed until homogeneous to produce a solid and durable cast layer. The base casting serves to unite the iron frame with the brick structure, while also sealing small gaps that could potentially weaken the structure. Functionally, this cast layer is crucial, considering that the combustion unit will be repeatedly exposed to high temperatures (Boretti, 2025). Without a reinforcing layer, heat can damage the foundation structure more quickly. Thus, the casting is not only technically functional but also provides a crucial foundation for the long-term sustainability of the smoke-free combustion unit (Foell, 2019).

Figure 4 Basic casting



(Source: Researchers' documentation, 2025).

Foundation casting is a crucial step in smoke-free combustion construction because it serves both structural and environmental purposes. Structurally, foundation casting serves to strengthen the foundation, making it more stable against shocks, loads, and temperature changes that occur during the combustion process. The heat generated when waste is burned can trigger thermal expansion in the surrounding material, resulting in a high risk of cracking or shifting of the structure (Vishwakarma & Ramachandran, 2018). With a flat and solid foundation, heat can be better controlled and distributed evenly, thus increasing the building's durability. Environmentally, foundation casting also acts as a waterproof layer that prevents ash and combustion residue from seeping into the soil, maintaining the cleanliness and health of the surrounding ecosystem. This principle aligns with the concept of environmental engineering, which emphasizes the importance of technical design that is not only mechanically robust but also environmentally friendly (Haque & Sharif, 2021).

The casting process involves mixing cement and sand in a specific composition to produce a thick, homogeneous, and crack-resistant mixture. The mixture is then poured evenly over the foundation and leveled using simple tools such as a trowel or wooden plank. This leveling step is crucial because a sloping base surface can affect the stability of the wall in subsequent stages. After pouring, the casting is allowed to dry naturally to ensure optimal cement hydration. The drying time should not be shortened, as it directly impacts the final strength of the structure. In building construction, this principle is known as the curing process, which is a determining factor in the quality and durability of concrete (J. Wang et al., 2022).

Like the previous stage, the foundation casting also involved close collaboration between students and the local community. Students ensured the workmanship adhered to standards, including mix proportions and leveling procedures, while the community actively provided labor, water, and took turns mixing. Community involvement not only expedited the completion of the project but also fostered a sense of ownership in the facility under construction. This participatory process demonstrated the practical application of participatory development, where the program's success is not solely the result of technical expertise but also the direct involvement of the community at every stage (Bødker et al., 2022).

With the completion of the base casting, the smoke-free combustion structure now has a solid and hygienic foundation, ready to support the main components, the combustion chamber walls. This stage can be called a critical bridge between the foundation and the vertical structure above it. The stability of the base casting ensures that subsequent wall construction can be carried out vertically, neatly, and precisely. Therefore, the base casting is not merely an additional layer, but one of the keys to the success of the smoke-free combustion structure, ensuring its effective and sustainable use (Zikulnig et al., 2025).

Figure 5 Furnace Wall Arrangement



(Source: Researchers' documentation, 2025).

The furnace wall construction stage is a crucial step in building a smoke-free combustion system, as the quality of this construction directly impacts the effectiveness of the combustion process. Bricks are stacked tightly and in layers, using cement mortar as both an adhesive and a sealant. According to the principles of heat-resistant building construction, open gaps can become escape routes for smoke and fire, reducing combustion efficiency and potentially polluting the surrounding environment (Modi et al., 2025). Therefore, each brick joint must be tightly sealed with sufficient cement mortar, ensuring the structure is not only mechanically sound but also smoke-proof.

In addition to careful consideration of gap sealing, wall construction also considers the balance and symmetry of the building. A well-proportioned furnace shape allows for optimal air circulation. This aligns with the principle of airflow management, where inflow and outflow affect combustion quality and the amount of smoke

produced (Lim & Chang, 2021). To maintain neatness and dimensional accuracy, students and community members use simple tools such as string and a spirit level to ensure the walls remain straight, balanced, and even. Small errors in slope can cause uneven stress on the structure, which can lead to cracks when the furnace is used at high temperatures.

More than just physical construction, this stage also serves as an educational tool for the community. Through hands-on practice, residents learn the importance of sealing wall gaps, maintaining building balance, and creating an effective combustion chamber. This participation not only enhances technical skills but also strengthens the value of mutual cooperation and a collective awareness of the importance of environmentally friendly solutions (S. Wang & Zhang, 2024).

The neatly arranged and sturdy furnace walls serve a dual purpose: concentrating heat within the combustion chamber while minimizing smoke release. This design allows the incinerated waste to decompose more completely through complete combustion, producing maximum heat energy with significantly less smoke than open combustion (Kaya et al., 2021). Indirectly, this construction supports the principle of cleaner production by reducing emissions that could potentially harm health and the environment (Chojnacka et al., 2021).

After the walls are completed, the construction phase continues with the installation of the upper frame. This section consists of a combination of an iron frame and lightweight concrete blocks (hebel). The iron acts as a heat-resistant and sturdy support, while the concrete blocks partially enclose the furnace chamber, creating a dedicated path for air and smoke flow. This combination not only strengthens the structure but also ensures optimal combustion, with more controlled smoke flow.

Figure 6 Trimming the Upper Frame



(Sumber: Dokumentasi peneliti, 2025).

The upper frame of a smoke-free furnace plays a strategic role in creating a more efficient and environmentally friendly combustion process. Technically, this frame acts as a partition that divides the combustion chamber so that the fire is not concentrated at the bottom but is able to reach all areas of the waste being fed. The partition allows for more even heat distribution, bringing the combustion process closer to complete combustion (Kaya et al., 2021). This is important because uneven combustion tends to produce more smoke due to the remaining organic material not being completely burned.

Furthermore, the upper frame also serves as a transition path for smoke flow toward the chimney. This design aligns with the basic principle of the chimney effect, where the difference in air pressure inside and outside the furnace forces smoke out through a more directed channel (Lan et al., 2022). With this system, smoke does not immediately spread into the surrounding area but is instead directed in a controlled manner toward the chimney, thus minimizing the impact of air pollution.

In its design, the balance between air circulation and smoke control is a determining factor. The gaps in the upper frame must be designed to be proportionally sized. If the gaps are too tight, air will be restricted and the fire will not receive enough oxygen, resulting in inefficient combustion. Conversely, if the gaps are too large, smoke can escape freely before reaching the chimney, reducing the effectiveness of the smoke-free concept. Therefore, the upper frame installation stage is carried out with great care, adhering to airflow management principles to ensure circulation is maintained (Lim & Chang, 2021).

The construction process was carried out through close collaboration between students and the community. Steel was cut to size and crisscrossed to reinforce the frame, then lightweight concrete blocks were placed on top with cement mortar as a binder. Students provided technical guidance regarding the position and spacing of the

frames, while the community actively participated in material preparation, transportation, and even the assembly of the concrete blocks. This collaborative approach not only accelerated the construction process but also fostered a sense of ownership in the shared facility (Johnson & Mehta, 2024).

With the completion of the upper frame installation, the smoke-free furnace now has an internal system capable of supporting more even combustion while simultaneously directing smoke flow in a controlled manner. This stage lays the foundation for the final stage of construction, namely the installation of the chimney. The chimney serves as the final outlet, not only channeling smoke into the atmosphere but also helping to reduce smoke density through pressure and temperature differences (Lan et al., 2022).

The next step is the finishing step, which involves applying cement plaster to the entire surface of the furnace walls. This plaster layer serves to fill any small gaps left after the bricks are laid and also provides additional protection to make the walls more resistant to high heat exposure. This ensures that the furnace is not only structurally sound but also offers long-term durability, making it suitable for use as a smoke-free and environmentally friendly waste incinerator (Mehetre et al., 2017).

Figure 7 Final Solution and Chimney Installation



(Source: Researcher documentation, 2025).

final finishing stage begins with the plastering process, which serves as a covering and structural reinforcement for the furnace walls. A fairly thick cement mortar is applied evenly to the entire surface, both inside and outside the furnace. On the inside, the plaster layer serves as an additional coating that directs heat back to the center of the combustion chamber. This reflective effect concentrates the heat energy, accelerates the decomposition of organic waste, and brings the combustion process closer to complete combustion (Zheng et al., 2018). As a result, the volume of smoke produced is significantly reduced. Meanwhile, on the outside, the plaster provides additional stability to the structure while providing a neat and clean appearance. Construction aesthetics, while often considered secondary, significantly influence community acceptance (Crawford et al., 2022). A furnace that appears sturdy and well-maintained is more likely to be maintained by residents than a poorly maintained structure. Thus, plastering combines technical functions, protection, and socio-aesthetic aspects in one essential step.

Once the plastering is complete, attention turns to the installation of the chimney, a vital component that serves as the primary route for smoke to escape. The chimney addresses the classic problem of open combustion, where thick smoke often spreads rapidly and disrupts air quality. With a chimney, the smoke flow is directed vertically upwards, preventing it from being directly inhaled by nearby residents. Furthermore, the chimney operates on the principle of the stack effect, a phenomenon characterized by a pressure difference between the hot air inside the furnace and the cooler outside air (Song et al., 2025). This difference creates a natural thrust that accelerates the upward movement of smoke while stabilizing the flame in the combustion chamber. A fresh air supply from below is also maintained, making the system more efficient without the need for additional mechanical equipment.

However, the effectiveness of a chimney is determined not only by its presence but also by its design balance, particularly its height. A chimney that is too short tends to fail to properly vent smoke, causing pollution to persist around the furnace. Conversely, a chimney that is too tall can reduce internal pressure, weakening the flame due to a lack of oxygen supply. Therefore, chimney height planning must take into account both the size of the furnace and the surrounding environmental conditions. In densely populated areas, a chimney with a greater height is needed to ensure smoke is released at a safe point. However, the height must remain within reasonable

limits to maintain optimal draft effect (Y. Wang et al., 2024). This demonstrates that the chimney is not merely an addition, but an integral part of the air circulation system that supports combustion efficiency.

From an environmental perspective, chimneys play a significant role in controlling air pollution. Combustion smoke contains hazardous particles such as PM_{2.5}, carbon monoxide, and volatile compounds that pose a risk of health problems, ranging from respiratory to cardiovascular diseases (Alzahrani et al., 2024). Chimneys help reduce direct exposure by releasing smoke at a high altitude, allowing pollutants to undergo a natural dilution process before reaching the human respiratory tract. The chimney's long path also allows some heavy particles to adhere to the inner walls before reaching the top, creating a kind of "simple filtration" mechanism that, while limited, significantly reduces smoke density. Furthermore, by channeling smoke upwards, combustion residues do not fall directly onto the soil around the furnace, thus maintaining soil quality and preventing changes in pH due to the accumulation of ash and fine particles.

Furthermore, the chimney installation phase has a social dimension that is as important as the technical aspects. The process is carried out collaboratively between students and the community. Students play a role in ensuring technical details are in accordance with the design, while residents actively provide labor, support the chimney, mix the mortar, and ensure the structure remains stable. This collaboration fosters a sense of shared ownership, as the stove being built is not simply a technical facility but the result of collective effort (Smale et al., 2019). When residents feel part of the process, their level of concern for the facility's maintenance and use tends to increase. This sense of togetherness is what distinguishes community-based projects from top-down projects, which often fail to achieve sustainability due to minimal community participation.

From an academic perspective, this final finishing stage can be understood as the intersection of civil engineering, thermodynamics, and environmental health. In civil engineering, plastering strengthens walls and increases heat resistance, while chimneys add structural stability (Ben Ghida, 2024). From a thermodynamic perspective, chimney design leverages the principles of hot fluid flow, enabling more efficient combustion without additional energy (Mohtaram et al., 2023). In the context of environmental health, chimneys serve as a simple yet effective tool for reducing public exposure to hazardous pollutants (Odubo & Kosoe, 2024). These three perspectives demonstrate that smokeless stoves are not merely functional constructions but also a form of science-based innovation adapted to local conditions.

With the chimney installation complete, the smoke-free stove can be considered complete and ready for use. This milestone marks not only a technical success but also a social one, born of close collaboration between students and the community. Furthermore, the stove serves as an educational tool, introducing the public to simple, environmentally friendly technology, while simultaneously raising collective awareness of the importance of maintaining a clean and healthy environment (Awewomom et al., 2024).

Looking ahead, there are still ample opportunities for development. Simple innovations such as adding a layer of fire-resistant insulation to the chimney, implementing additional filters, or integrating with other waste management systems like composting can enhance the stove's effectiveness. With these developments, smokeless stoves will not only be a temporary solution to pollution caused by open burning but also part of a more sustainable integrated waste management system (Nayak & Roul, 2022).

Figure 8 Demonstration of Low Smoke Burning



(Source: Researcher documentation, 2025).

The demonstration conducted by the UIN Bandung 190 Community Service Program team was a key moment that transformed the technical design into a shared learning experience. After the construction process, from the foundation to the chimney, was completed, knowledge of the function of each component needed to be brought to life for the residents. At this point, the demonstration was not simply an operational demonstration, but

rather a pedagogical strategy that positioned residents as active learners (Patiño et al., 2023). Theoretically, this approach aligns with experiential learning: adults tend to understand and remember better through seeing, touching, and practicing (Dong et al., 2021). When residents witnessed firsthand the difference between open burning with its thick smoke and burning in a stove with its directed, thin smoke, they not only accepted the explanation but also developed a new "scheme" of what was possible and what was safer to do in their environment.

In terms of behavior change, demonstrations highlight three key elements: capability, opportunity, and motivation. Within the COM-B framework, capability is built through simple instructions on how to light, manage fuel, and plug gaps; opportunity is reinforced by the presence of stove infrastructure in accessible locations; and motivation is fostered through shared experiences of success, where the flame is stable, smoke is controlled, and neighbors are no longer disturbed (Willmott et al., 2021). At the same time, principles of the Theory of Planned Behavior help explain why the debriefing sessions during demonstrations are so crucial: technical knowledge changes attitudes, discussions about neighbor support shape subjective norms, and hands-on practice enhances perceptions of self-control. All three work together to drive adoption (Black et al., 2022).

The power of demonstrations also lies in the observability and trialability of the Diffusion of Innovation. Residents see the "results" of the innovation within the first few minutes: the fire doesn't spread wildly, the combustion chamber remains clean, and the chimney works to lift smoke away. They are also given the opportunity to try filling the fuel, adjusting the air gap, and inspecting the walls, thus reducing psychological barriers. When innovations are frugal and locally relevant, the principles of appropriate technology work to increase acceptance: materials are readily available, repairs can be made locally, and operation requires no additional energy (Mbatha, 2024).

The social momentum generated by these shared sessions is crucial for sustainability. Mutual cooperation is not just about labor, but also about social capital that strengthens trust, regulates social sanctions, and forms new habits (Brand, 2010). In the language of social practice, waste management is not simply about "individuals putting trash in the stove," but about the intersection of meaning (the belief that burning properly is healthier and more respectful to neighbors), competence (skills in organizing materials and regulating air), and materialities (the availability of the appropriate stove, tools, and fuel). When these three elements converge, a new practice is born and has the potential to endure (Nguyen et al., 2023).

Technically, the demonstration demonstrated how the design developed in the previous phase worked as a single system. The dense walls maintained heat concentration; the upper frame served as a partition for even heat distribution; and the chimney utilized the stack effect to create a steady upward smoke flow. Residents could observe that the combustion was not of wet residue or chlorinated materials, but rather of dry, non-leaf fractions that are difficult to compost, thus minimizing the risk of hazardous smoke (Song et al., 2025). This precautionary principle was repeatedly emphasized: wet organics were directed to the composter, valuable inorganics to the waste bank, and only a limited amount of remaining residue was fed into the stove. In other words, the demonstration consciously positioned the stove as a "bridge" in the waste management hierarchy, not a replacement for the 3Rs.

The connection to the global agenda becomes clearer when these local practices are viewed through the lens of sustainable cities and environmental health. In many regions of the world, open burning remains a spontaneous response to piles of residue and limited waste management services. Its impacts are felt in two domains: micro-air quality, which impacts daily health, and short-term emissions, which exacerbate local warming. In this context, the demonstration of smokeless stoves offers a significant harm reduction contribution (Levengood et al., 2021). It does not whitewash the systemic problems of the lack of landfills, transportation logistics, and a weak circular economy, but it does provide tangible risk reduction while waiting for more established systems to take hold. This risk-reduction-based approach is common in health policy and is relevant for environmental issues where ideal options are not yet fully available to citizens.

The implementation framework also helps assess the program's leverage. Using the RE-AIM lens, reach is determined by the number of households present, interested, and trying it out; effectiveness is demonstrated by the reduction in smoke complaints and the perception of cleanliness in the surrounding area; adoption is measured by the number of neighborhood associations (RTs) or community groups willing to build similar units; implementation is measured by consistent use according to standard operating procedures (SOPs), including fuel sorting; and maintenance is tested by regular maintenance, the availability of simple spare parts, and the sustainability of the volunteer team (Yu et al., 2025). Demonstrations serve as a gateway to filling each of these

dimensions with data, not just stories. This scientific approach strengthens the program's position when entering the Musrenbang (Research and Development Planning) or seeking funding, as public decisions tend to require verifiable evidence (Kim et al., 2021).

At the governance level, the demonstration served as an arena for policy co-production. Student teams brought designs, residents brought context, and both agreed on usage rules, operating hours, and safety protocols. This process narrowed the gap between designs on paper and reality on the ground. It also reduced the risk of policy failure, which often occurs when solutions are imported without adaptation (Hudson et al., 2019). This is where the relevance of the research became apparent: not just writing a report, but designing a mechanism that could be transferred to other hamlets with minimal adaptation, complete with a brief guide, a list of materials, mixing ratios, fuel options, and the most frequently needed troubleshooting steps.

Global contextualization also requires sensitivity to environmental justice. The demonstration emphasized that burning, no matter how minimal, has a safe limit (K. Wang et al., 2021). Some materials should not be burned at all due to the potential for toxic emissions; some operating hours should be avoided when the wind blows toward densely populated areas; and vulnerable groups such as children, the elderly, and asthmatics should be protected. By incorporating these elements into the demonstration materials, the program takes the correct ethical stance: teaching technology while prioritizing the safety and dignity of residents.

Equally important is the microeconomic dimension behind adoption. Demonstrations open up conversations about realistic costs: who provides the building materials, how maintenance fees are structured, and what incentives encourage compliance with SOPs (Vinther Daugaard et al., 2024). Incentives don't have to be monetary; reduced neighbor complaints, a cleaner environment, or social recognition for volunteers are often powerful motivators. When residents see that stove management isn't a "burden," but rather facilitates community service and improves neighborly relations, they are more likely to stick with the new practice.

To ensure measurable impact, the team encouraged simple post-demonstration monitoring. A usage logbook recorded the date, type of material burned, duration of the burn, and smoke notes. A text message group became a quick reporting channel for any issues, such as fine cracks in the walls or an unstable chimney. Qualitative indicators of fewer complaints, cleaner yards, and fewer strong odors were collected as evidence of change (Caffyn, 2021). When seeking further support. This monitoring scheme moves the program from "just an action" to "adaptive learning."

On a broader scale, the demonstration demonstrates how low-tech can contribute to the agenda of sustainable cities and settlements, responsible consumption and production, and health (Arora & Mishra, 2023). It does not replace the need for 3R facilities, waste banks, or scheduled transportation, but rather fills the gap between policy ideals and budgetary realities. International experience shows that such bridge technologies often serve as stepping stones: they mitigate adverse impacts in the transition phase while simultaneously building a new culture that facilitates the later adoption of more advanced systems. Thus, the research contribution is not simply stove design, but rather an intervention model that integrates design, behavior, and institutions (Xiang et al., 2023).

At the practical level, demonstrations spark a learning ecosystem. Women learn to sort residue, youth manage schedules and maintenance, and village leaders mediate usage rules (Ariyadasa, 2018). Clear role patterns increase the chances of sustainability because responsibility is distributed and not pinned on one person. When social structures converge with technical structures, the stove is no longer seen as a "KKN (Community Service) project," but rather as the property of the village. This collective identity is often the strongest buffer against a relapse into old practices.

However, methodological honesty must be maintained. The demonstration also provides a space to acknowledge limitations: not all residues are suitable for burning; the rainy season demands drying of the material; and chimney maintenance is necessary to prevent particle deposits from blocking the flow (Pathak et al., 2023). This transparency builds trust. Rather than promising a one-size-fits-all solution, the team emphasized the stove's function as part of a portfolio of strategies: compost for organics, a waste bank for valuable inorganic materials, and a stove for the remaining dry residue. This portfolio framework connects local practices with the circular economy, which is becoming a global discourse.

In the medium term, the replication route is a concern. The first demonstration provided teaching materials for training community trainers, who, after becoming proficient, could then train other neighborhood associations. A simple one-page document with a schematic, mixing measurements, a list of ingredients, and safety protocols facilitated duplication without sacrificing quality (Harlan et al., 2023). Linking to village planning through alternative

program documents generated by residents provided a pathway to legitimacy and funding, ensuring that each new unit emerged not as a "wild initiative" but as part of a recognized plan.

Ultimately, the smoke-free combustion demonstration demonstrates that relevant innovations emerge from a dialogue between science, context, and collaboration. It emphasizes that sustainability is not simply a product of technology, but rather the result of functional alignment with local values, tangible social support, and governance that fosters learning (Andriyani et al., 2024). When residents observe, experiment, ask questions, and feel supported, they become not merely users but stewards of new practices. This is where this research contributes: not simply adding another "tool" to the list of solutions, but demonstrating how these tools are brought to life through participatory processes, informed by cutting-edge behavioral change theory, and connected to a broader global agenda.

From this demonstration, the research's relevance gains twofold ground. Locally, it offers a healthier, more orderly, and more manageable way to deal with residues that have traditionally been burned openly. Globally, it provides a concrete example of how a community-based approach, simple technology, and a scientific implementation framework can combine to cut unnecessary emissions while improving quality of life. Both are mutually reinforcing: the world needs proven practices at the grassroots level, and the village needs inspiration that acknowledges its limitations while still offering hope. In this way, this demonstration deserves to be recorded, replicated closely, and continually refined as the residents who operate and maintain it gain experience on a daily basis (Jaß et al., 2024).

1. CONCLUSION

This research demonstrates that simple strategies for maintaining environmental sustainability, such as waste management, reforestation, and reducing plastic use, can have a tangible impact on creating a healthier and more sustainable environment. The research question is clearly answered: ecological awareness built through education and daily practice plays a crucial role in fostering a culture of green living at the family and community level. The key findings emphasize that environmental conservation efforts are not solely the responsibility of the state or formal institutions but can also grow from the active participation of the community, especially the younger generation, as agents of change.

Theoretically, this research expands the academic discourse on the relationship between social behavior, ecological awareness, and environmental sustainability. The results reinforce the relevance of behavioral change theory and social ecology theory, which emphasize the importance of interactions between individuals, communities, and their environments in shaping environmentally friendly lifestyles. These findings provide a basis for developing a more contextual theoretical model of community-based environmental movements.

From a practical perspective, this research offers insight that building a green environment doesn't always require major interventions, but can instead begin with small, consistent steps. Environmental education, youth engagement, and local policy support have proven to be a crucial combination for strengthening sustainable practices. This underscores the need for multi-stakeholder collaboration involving families, schools, communities, and local governments to create a sustainable green movement.

This study's limitations lie in its limited scope within a specific community, requiring generalizability of the results to be tested in a broader social context. Different socioeconomic, cultural, and geographic factors also potentially influence the effectiveness of the strategies used. Therefore, further research is recommended to expand the scope of study, utilize digital approaches in environmental education, and examine the role of public policy in strengthening green practices in communities.

REFERENCES

- Abas, A., Arifin, K., Ali, M. A. M., & Khairil, M. (2023). A systematic literature review on public participation in decision-making for local authority planning: A decade of progress and challenges. *Environmental Development*, 46, 100853. <https://doi.org/10.1016/j.envdev.2023.100853>
- Aboalhamayie, A., Zhang, Y., & Ghamari, M. (2025). Iron particle in liquid fuel combustion technology for nonoxidative storage and easy burning. *Fuel*, 380, 133240. <https://doi.org/10.1016/j.fuel.2024.133240>
- Acikgoz, F., Elwalda, A., & De Oliveira, M. J. (2023). Curiosity on Cutting-Edge Technology via Theory of Planned

- Behavior and Diffusion of Innovation Theory. *International Journal of Information Management Data Insights*, 3(1), 100152. <https://doi.org/10.1016/j.jjime.2022.100152>
- Alzahrani, A., Hassan, M. A., & Alsubaie, S. (2024). Evaluating the properties that affect the quality of the charcoal product, determining the limits of toxic emissions during combustion, and studying their impact on human health. *Environmental Geochemistry and Health*, 46(8), 295. <https://doi.org/10.1007/s10653-024-02065-5>
- Andriyani, Y., Suropto, Yohanitas, W. A., Kartika, R. S., & Marsono. (2024). Adaptive innovation model design: Integrating agile and open innovation in regional areas innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(1), 100197. <https://doi.org/10.1016/j.joitmc.2023.100197>
- Ariyadasa, E. (2018). *Educating and Empowering Children for Governing the Anthropocene: A Case Study of Children's Homes in Sri Lanka BT - Balancing Individualism and Collectivism: Social and Environmental Justice* (J. McIntyre-Mills, N. Romm, & Y. Corcoran-Nantes (eds.); pp. 141–162). Springer International Publishing. https://doi.org/10.1007/978-3-319-58014-2_7
- Arora, N. K., & Mishra, I. (2023). Responsible consumption and production: a roadmap to sustainable development. *Environmental Sustainability*, 6(1), 1–6. <https://doi.org/10.1007/s42398-023-00266-9>
- Awewomom, J., Dzeble, F., Takyi, Y. D., Ashie, W. B., Ettey, E. N. Y. O., Afua, P. E., Sackey, L. N. A., Opoku, F., & Akoto, O. (2024). Addressing global environmental pollution using environmental control techniques: a focus on environmental policy and preventive environmental management. *Discover Environment*, 2(1), 8. <https://doi.org/10.1007/s44274-024-00033-5>
- Bano, A. (2025). 1 - A summary of solid waste generation and management strategy. In P. Sharma, Y. W. Tong, S. Mohapatra, D. Purchase, H. K. Khuntia, & S. P. B. T.-W.-E. Singh (Eds.), *Waste And The Environment: Underlying Burdens And Management Strategies* (pp. 3–29). Elsevier. <https://doi.org/10.1016/B978-0-443-22356-3.00001-4>
- Ben Ghida, D. (2024). Organic stabilization in earthen plaster: Eco-compatible architecture and ancient techniques in Tata Somba homes. *Frontiers of Architectural Research*, 13(3), 625–638. <https://doi.org/10.1016/j.foar.2024.02.004>
- Bera, S., & Rahut, D. (2024). Technology development pathways: enigmas of appropriate technology choice. *Discover Sustainability*, 5(1), 45. <https://doi.org/10.1007/s43621-024-00222-5>
- Black, E. L., Burton, F. G., & Cieslewicz, J. K. (2022). Improving Ethics: Extending the Theory of Planned Behavior to Include Moral Disengagement. *Journal of Business Ethics*, 181(4), 945–978. <https://doi.org/10.1007/s10551-021-04896-z>
- Bødker, S., Dindler, C., Iversen, O. S., & Smith, R. C. (2022). *What Is Participatory Design? BT - Participatory Design* (S. Bødker, C. Dindler, O. S. Iversen, & R. C. Smith (eds.); pp. 5–13). Springer International Publishing. https://doi.org/10.1007/978-3-031-02235-7_2
- Boretti, A. (2025). Metal additive manufacturing for internal combustion engine components: a narrative review of applications, materials, processes, challenges, and future directions. *The International Journal of Advanced Manufacturing Technology*, 139(11), 6355–6397. <https://doi.org/10.1007/s00170-025-16219-x>
- Brand, K.-W. (2010). *Social Practices and Sustainable Consumption: Benefits and Limitations of a New Theoretical Approach BT - Environmental Sociology: European Perspectives and Interdisciplinary Challenges* (M. Gross & H. Heinrichs (eds.); pp. 217–235). Springer Netherlands. https://doi.org/10.1007/978-90-481-8730-0_13
- Caffyn, A. (2021). Contesting countryside smells: The power of intensive livestock odours. *Journal of Rural Studies*, 86, 554–565. <https://doi.org/10.1016/j.jrurstud.2021.07.021>
- Cashore, B., & Bernstein, S. (2023). Bringing the Environment Back In: Overcoming the Tragedy of the Diffusion of the Commons Metaphor. *Perspectives on Politics*, 21(2), 478–501. <https://doi.org/10.1017/S1537592721002553>
- Chen, T., & Zhang, G. (2024). Centrifuge modeling of pile-supported embankment on soft soil base for highway widening. *Soils and Foundations*, 64(1), 101422. <https://doi.org/10.1016/j.sandf.2023.101422>
- Chioatto, E., & Sospiro, P. (2023). Transition from waste management to circular economy: the European Union roadmap. *Environment, Development and Sustainability*, 25(1), 249–276. <https://doi.org/10.1007/s10668-021-02050-3>
- Chojnacka, K., Mikula, K., Izydorczyk, G., Skrzypczak, D., Witek-Krowiak, A., Moustakas, K., Ludwig, W., &

- Kulażyński, M. (2021). Improvements in drying technologies - Efficient solutions for cleaner production with higher energy efficiency and reduced emission. *Journal of Cleaner Production*, 320, 128706. <https://doi.org/10.1016/j.jclepro.2021.128706>
- Crawford, J., Bessette, D., & Mills, S. B. (2022). Rallying the anti-crowd: Organized opposition, democratic deficit, and a potential social gap in large-scale solar energy. *Energy Research & Social Science*, 90, 102597. <https://doi.org/10.1016/j.erss.2022.102597>
- Dong, H., Lio, J., Sherer, R., & Jiang, I. (2021). Some Learning Theories for Medical Educators. *Medical Science Educator*, 31(3), 1157–1172. <https://doi.org/10.1007/s40670-021-01270-6>
- Foell, W. K. (2019). A two-century analysis of household energy transitions in Europe and the United States: From the Swiss Alps to Wisconsin. *Energy Research & Social Science*, 54, 96–112. <https://doi.org/10.1016/j.erss.2019.03.009>
- Gülsün, İ., Malinen, O.-P., Yada, A., & Savolainen, H. (2023). Exploring the role of teachers' attitudes towards inclusive education, their self-efficacy, and collective efficacy in behaviour management in teacher behaviour. *Teaching and Teacher Education*, 132, 104228. <https://doi.org/10.1016/j.tate.2023.104228>
- Haque, M. S., & Sharif, S. (2021). The need for an effective environmental engineering education to meet the growing environmental pollution in Bangladesh. *Cleaner Engineering and Technology*, 4, 100114. <https://doi.org/10.1016/j.clet.2021.100114>
- Harlan, T. S., Gow, R. V., Kornstädt, A., Alderson, P. W., & Lustig, R. H. (2023). The Metabolic Matrix: Re-engineering ultraprocessed foods to feed the gut, protect the liver, and support the brain. *Frontiers in Nutrition*, Volume 10. <https://doi.org/10.3389/fnut.2023.1098453>
- Hudson, B., Hunter, D., & Peckham, S. (2019). Policy failure and the policy-implementation gap: can policy support programs help? *Policy Design and Practice*, 2(1), 1–14. <https://doi.org/10.1080/25741292.2018.1540378>
- Jaß, L., Klußmann, A., Harth, V., & Mache, S. (2024). Job demands and resources perceived by hybrid working employees in German public administration: a qualitative study. *Journal of Occupational Medicine and Toxicology*, 19(1), 28. <https://doi.org/10.1186/s12995-024-00426-5>
- Johnson, A.-G., & Mehta, B. (2024). Fostering the inclusion of women as entrepreneurs in the sharing economy through collaboration: a commons approach using the institutional analysis and development framework. *Journal of Sustainable Tourism*, 32(3), 560–578. <https://doi.org/10.1080/09669582.2022.2091582>
- Julsrud, T. E. (2023). Sustainable sharing in local communities: exploring the role of social capital. *Local Environment*, 28(6), 811–827. <https://doi.org/10.1080/13549839.2023.2179611>
- Kacker, R., Singh, S. K., & Kasar, A. A. (2024). Understanding and Addressing Multi-faceted Failures in Building Structures. *Journal of Failure Analysis and Prevention*, 24(4), 1542–1558. <https://doi.org/10.1007/s11668-024-01994-8>
- Kandpal, R., & Saizen, I. (2022). Self-help group participation towards sustainable solid waste management in peri-urban villages: evidence from Mumbai Metropolitan Region, India. *Environment, Development and Sustainability*, 24(3), 3791–3814. <https://doi.org/10.1007/s10668-021-01588-6>
- Kaya, D., Çanka Kılıç, F., & Öztürk, H. H. (2021). *Fuels and Combustion BT - Energy Management and Energy Efficiency in Industry: Practical Examples* (D. Kaya, F. Çanka Kılıç, & H. H. Öztürk (eds.); pp. 227–263). Springer International Publishing. https://doi.org/10.1007/978-3-030-25995-2_8
- Kim, B. H., Li, K., Kim, J.-T., Park, Y., Jang, H., Wang, X., Xie, Z., Won, S. M., Yoon, H.-J., Lee, G., Jang, W. J., Lee, K. H., Chung, T. S., Jung, Y. H., Heo, S. Y., Lee, Y., Kim, J., Cai, T., Kim, Y., ... Rogers, J. A. (2021). Three-dimensional electronic microfliers inspired by wind-dispersed seeds. *Nature*, 597(7877), 503–510. <https://doi.org/10.1038/s41586-021-03847-y>
- Kodikara, J., Islam, T., & Sountharajah, A. (2018). Review of soil compaction: History and recent developments. *Transportation Geotechnics*, 17, 24–34. <https://doi.org/10.1016/j.trgeo.2018.09.006>
- Krysiński, A., Russo, C., Campagna, D., Di Pino, A., John, S., Belsey, J., Caponnetto, P., Vudu, L., Lim, C. W., Di Ciaula, A., Veronese, N., Barbagallo, M., Iqbal, F., Fluck, D., Franek, E., Polosa, R., Sharma, P., & Investigators, the D. (2024). A multicenter prospective randomized controlled trial investigating the effects of

- combustion-free nicotine alternatives on cardiovascular risk factors and metabolic parameters in individuals with type 2 diabetes who smoke: the DiaSmokeFree study protocol. *Internal and Emergency Medicine*, 19(2), 321–332. <https://doi.org/10.1007/s11739-023-03467-6>
- Kumar, G., Vyas, S., Sharma, S. N., & Dehalwar, K. (2024). *Challenges of Environmental Health in Waste Management for Peri-urban Areas BT - Solid Waste Management: Advances and Trends to Tackle the SDGs* (M. Nasr & A. Negm (eds.); pp. 149–168). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-60684-7_9
- Lan, B., Li, Y.-R., Li, P.-C., & Gong, H.-F. (2022). Numerical simulation of the chimney effect on smoke spread behavior in subway station fires. *Case Studies in Thermal Engineering*, 39, 102446. <https://doi.org/10.1016/j.csite.2022.102446>
- Leknoi, U., Painmanakul, P., Chawaloesphonsiya, N., Wimolsakcharoen, W., Samritthinanta, C., & Yiengthaisong, A. (2024). Building sustainable community: Insight from successful waste management initiative. *Resources, Conservation & Recycling Advances*, 24, 200238. <https://doi.org/10.1016/j.rcradv.2024.200238>
- Levengood, T. W., Yoon, G. H., Davoust, M. J., Ogden, S. N., Marshall, B. D. L., Cahill, S. R., & Bazzi, A. R. (2021). Supervised Injection Facilities as Harm Reduction: A Systematic Review. *American Journal of Preventive Medicine*, 61(5), 738–749. <https://doi.org/10.1016/j.amepre.2021.04.017>
- Liang, G., Wen, Y., Chen, W., Li, X., Zeng, M., He, Z., Goff, H. D., Chen, J., & Wang, Z. (2024). Enhancing soy protein isolate gels: Combined control of pH and surface charge for improved structural integrity and gel strength. *Food Bioscience*, 59, 103934. <https://doi.org/10.1016/j.fbio.2024.103934>
- Lim, S.-Y., & Chang, H.-J. (2021). Airflow management analysis to suppress data center hot spots. *Building and Environment*, 197, 107843. <https://doi.org/10.1016/j.buildenv.2021.107843>
- Mbatha, B. (2024). *Diffusion of Innovations: How Adoption of New Technology Spreads in Society BT - Information, Knowledge, and Technology for Teaching and Research in Africa: Human Machine Interaction and User Interfaces* (D. Ocholla, O. B. Onyancha, & A. O. Adesina (eds.); pp. 1–18). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-60267-2_1
- Mehetre, S. A., Panwar, N. L., Sharma, D., & Kumar, H. (2017). Improved biomass cookstoves for sustainable development: A review. *Renewable and Sustainable Energy Reviews*, 73, 672–687. <https://doi.org/10.1016/j.rser.2017.01.150>
- Mezirow, J. (2018). Transformative learning theory. In *Contemporary theories of learning* (pp. 114–128). Routledge.
- Moayerian, N., McGehee, N. G., & Stephenson, M. O. (2022). Community cultural development: Exploring the connections between collective art making, capacity building and sustainable community-based tourism. *Annals of Tourism Research*, 93, 103355. <https://doi.org/10.1016/j.annals.2022.103355>
- Modi, K., Upadhyay, D. S., Chaudhary, A., & Shah, N. (2025). Methodical review of biomass cookstoves: history, design, testing procedures and fuel characterization. *Biomass Conversion and Biorefinery*. <https://doi.org/10.1007/s13399-024-06477-2>
- Mohtaram, S., Aryanfar, Y., Ghazy, A., Wu, W., Kaaniche, K., & Luis García Alcaraz, J. (2023). An innovative approach for utilizing waste heat of a triple-pressure cogeneration combined cycle power plant by employing TRR method and thermodynamic analysis. *Case Studies in Thermal Engineering*, 49, 103198. <https://doi.org/10.1016/j.csite.2023.103198>
- Nayak, R. C., & Roul, M. K. (2022). Technology to Develop a Smokeless Stove for Sustainable Future of Rural Women and also to Develop a Green Environment. *Journal of The Institution of Engineers (India): Series A*, 103(1), 97–104. <https://doi.org/10.1007/s40030-021-00595-0>
- Nguyen, A. T., Nguyen, N., Phung, P., & Yến-Khanh, N. (2023). Residents' waste management practices in a developing country: A social practice theory analysis. *Environmental Challenges*, 13, 100770. <https://doi.org/10.1016/j.envc.2023.100770>
- Nurlaela, S., Wijoyo, A. K., Putri, A. M. R., Melinda, D., Sasan, C. Y., Resta, A. V, Hadi, D. P., Ashianti, O. A., Heriansyah, M. T., Permadi, A., & Kadarso, K. (2023). Strategi Membangun Sistem Pengelolaan Sampah Mandiri Berbasis Komunitas [Strategies for Building a Community-Based Independent Waste Management System]. *Jurnal*

- Pengabdian Masyarakat Indonesia*, 3(5), 605–611. <https://doi.org/10.52436/1.jpmi.988> [in Indonesian]
- Nurohman, T., & Gunawan, H. (2019). Konstruksi Identitas Nasional Pada Masyarakat Adat: (Studi Kasus Di Kampung Naga Desa Neglasari Kecamatan Salawu Kabupaten Tasikmalaya) [Construction of National Identity in Indigenous Communities: (Case Study in Naga Village, Neglasari Village, Salawu Dis. *Journal of Politics and Policy*, 125–154.
- Odubo, T. C., & Kosoe, E. A. (2024). *Sources of Air Pollutants: Impacts and Solutions BT - Air Pollutants in the Context of One Health : Fundamentals, Sources, and Impacts* (S. C. Izah, M. C. Ogwu, & A. Shamsavani (eds.); pp. 75–121). Springer Nature Switzerland. https://doi.org/10.1007/698_2024_1127
- Pathak, G., Nichter, M., Hardon, A., Moyer, E., Latkar, A., Simbaya, J., Pakasi, D., Taqeban, E., & Love, J. (2023). Plastic pollution and the open burning of plastic wastes. *Global Environmental Change*, 80, 102648. <https://doi.org/10.1016/j.gloenvcha.2023.102648>
- Patiño, A., Ramírez-Montoya, M. S., & Buenestado-Fernández, M. (2023). Active learning and education 4.0 for complex thinking training: analysis of two case studies in open education. *Smart Learning Environments*, 10(1), 8. <https://doi.org/10.1186/s40561-023-00229-x>
- Pylypenko, H. M., Pylypenko, Y. I., Dubiei, Y. V., Solianyk, L. G., Pazynich, Y. M., Buketov, V., Smoliński, A., & Magdziarczyk, M. (2023). Social capital as a factor of innovative development. *Journal of Open Innovation: Technology, Market, and Complexity*, 9(3), 100118. <https://doi.org/10.1016/j.joitmc.2023.100118>
- Ramdani. (2019). *Melalui KKN Sisdamas, UIN SGD Dorong Digitalisasi Desa di Sumedang*. Kemenag.Go.Id.
- Ramdani Wahyu, S., Aziz Ronaz, R., Fridayanti, F., Mardiyansyah, Y., Dulqiah, D., & Uriawan, W. (2016). *Paradigma dan Siklus KKN SISDAMAS [Paradigm and Cycle of KKN SISDAMAS]*. Lembaga Penelitian dan Pengabdian kepada Masyarakat.
- Sakai, S., Yoshida, H., Hirai, Y., Asari, M., Takigami, H., Takahashi, S., Tomoda, K., Peeler, M. V., Wejchert, J., Schmid-Unterseh, T., Douvan, A. R., Hathaway, R., Hylander, L. D., Fischer, C., Oh, G. J., Jinhui, L., & Chi, N. K. (2011). International comparative study of 3R and waste management policy developments. *Journal of Material Cycles and Waste Management*, 13(2), 86–102. <https://doi.org/10.1007/s10163-011-0009-x>
- Sharp, D., Anwar, M., Goodwin, S., Raven, R., Bartram, L., & Kamruzzaman, L. (2022). A participatory approach for empowering community engagement in data governance: The Monash Net Zero Precinct. *Data & Policy*, 4, e5. <https://doi.org/10.1017/dap.2021.33>
- Silverman, R. M., & Patterson, K. (2023). *Qualitative Research Methods for Community Development* (2nd ed.). Routledge. <https://doi.org/10.4324/9781003172925>
- Smale, R., Spaargaren, G., & van Vliet, B. (2019). Householders co-managing energy systems: space for collaboration? *Building Research & Information*, 47(5), 585–597. <https://doi.org/10.1080/09613218.2019.1540548>
- Song, J., Kim, J., Jo, J., Kang, K., & Yoon, S. (2025). Identifying occupant behavioral impacts on stack effect in high-rise residential buildings: Field measurements. *Building and Environment*, 277, 112866. <https://doi.org/10.1016/j.buildenv.2025.112866>
- Tipu, R. K., Batra, V., Suman, Panchal, V. R., Pandya, K. S., & Patel, G. A. (2024). Optimizing compressive strength in sustainable concrete: a machine learning approach with iron waste integration. *Asian Journal of Civil Engineering*, 25(6), 4487–4512. <https://doi.org/10.1007/s42107-024-01061-5>
- Vinther Daugaard, T., Bisgaard Jensen, J., Kauffman, R. J., & Kim, K. (2024). Blockchain solutions with consensus algorithms and immediate finality: Toward Panopticon-style monitoring to enhance anti-money laundering. *Electronic Commerce Research and Applications*, 65, 101386. <https://doi.org/10.1016/j.elerap.2024.101386>
- Vishwakarma, V., & Ramachandran, D. (2018). Green Concrete mix using solid waste and nanoparticles as alternatives – A review. *Construction and Building Materials*, 162, 96–103. <https://doi.org/10.1016/j.conbuildmat.2017.11.174>
- Wang, J., Long, G., Xiang, Y., Dong, R., Tang, Z., Xiao, Q., Yang, Z., & Ma, K. (2022). Influence of rapid curing methods on concrete microstructure and properties: A review. *Case Studies in Construction Materials*, 17, e01600. <https://doi.org/10.1016/j.cscm.2022.e01600>
- Wang, K., Cai, W., Zhang, Y., Hao, H., & Wang, Z. (2021). Numerical simulation of fire smoke control methods in

- subway stations and collaborative control system for emergency rescue. *Process Safety and Environmental Protection*, 147, 146–161. <https://doi.org/10.1016/j.psep.2020.09.033>
- Wang, S., & Zhang, H. (2024). Inter-organizational cooperation in digital green supply chains: A catalyst for eco-innovations and sustainable business practices. *Journal of Cleaner Production*, 472, 143383. <https://doi.org/10.1016/j.jclepro.2024.143383>
- Wang, Y., Liu, Y., Yuan, X., Niu, P., He, S., Gao, M., Jiang, G., & Sun, G. (2024). Crosswind effects on thermal performance improvement of mechanical draft cooling towers with deflector plates. *Applied Thermal Engineering*, 253, 123839. <https://doi.org/10.1016/j.applthermaleng.2024.123839>
- Willmott, T. J., Pang, B., & Rundle-Thiele, S. (2021). Capability, opportunity, and motivation: an across contexts empirical examination of the COM-B model. *BMC Public Health*, 21(1), 1014. <https://doi.org/10.1186/s12889-021-11019-w>
- Xiang, Z., Xu, W., Liu, A., & Meng, F. (2023). *Making Technological Breakthrough and Becoming a World Power in Bridge Technology BT - 70 Years of China's Bridges* (Z. Xiang, W. Xu, A. Liu, & F. Meng (eds.); pp. 103–236). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-2878-1_6
- Yu, J., Burns, J. K., Mikhail, E., Solmi, M., Hatcher, S., Smith, A. L., Robillard, R., Nguyen, T., Edgar, N., Kendzerska, T., Kaluziński, M., Bardell, A., & Fiedorowicz, J. G. (2025). The feasibility of conducting non-pharmacological research studies in participants with mania: a grounded theory qualitative analysis of the Ottawa Sunglasses at Night study. *International Journal of Qualitative Studies on Health and Well-Being*, 20(1), 2540795. <https://doi.org/10.1080/17482631.2025.2540795>
- Zheng, Y., Liu, Y., Zhou, H., Huang, W., & Pu, Z. (2018). Complete combustion of methane over Co₃O₄ catalysts: Influence of pH values. *Journal of Alloys and Compounds*, 734, 112–120. <https://doi.org/10.1016/j.jallcom.2017.11.008>
- Zikulnig, J., Carrara, S., & Kosel, J. (2025). A life cycle assessment approach to minimize environmental impact for sustainable printed sensors. *Scientific Reports*, 15(1), 10866. <https://doi.org/10.1038/s41598-025-95682-8>