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Empowering society and culinary MSMEs for sustainable development goals initiatives in West Java

Nadia Amanah[1], Boni Sena[2], Bobie Suhendra[3], Ardiansyah Yatim[4], Sheikh Ahmad Zaki[5]
University of Singaperbangsa Karawang, Indonesia[1-4]
Universiti Teknologi Malaysia, Malaysia[5]
nadia.amanah@ft.unsika.ac.id[1], boni.sena@ft.unsika.ac.id[2], bobie.suhendra@ft.unsika.ac.id[3], ardiansyah@eng.u.ac.id[4], sheikh.kl@utm.my[5]

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Abstract
Purpose: This study aimed to explore the impact of empowering society and culinary MSMEs on Sustainable Development Goals (SDGs) in West Java, focusing on Sindangmukti Village, Karawang Regency. While prior research has often used a top-down approach, neglecting direct societal impact, this study takes a bottom-up perspective, aligning with implicit SDG principles observed in community services.
Research Methodology: The study employed online questionnaires with 505 households in West Java to evaluate water consumption, waste generation, and energy usage patterns. Specific investigations in Sindangmukti Village have measured community service effectiveness regarding SDGs.
Results: The study found that Only 19.1% of the participants set AC temperatures within the recommended ranges. Additionally, initiatives to promote a sustainable city strategy and establish energy-efficient culinary MSMEs in Sindangmukti Village resulted in a 29% increase in knowledge among 70 participants and generated $36.71 income from bitter melon chip production within two months.
Limitations: However, the study focused solely on Sindangmukti Village, neglecting the diverse cultural and problem landscapes of other villages in the Karawang Regency.
Contributions: The findings of this study can inform future efforts to enhance energy, water, and waste efficiency in residential buildings in West Java, thereby fostering awareness of energy conservation, environmental sustainability, and economic resilience.
Keywords: *Questionnaire survey, energy conservation, environment sustainability, socialization, culinary MSME*
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1. Introduction

The Sustainable Development Goals (SDGs) are a set of 17 goals adopted by the United Nations in 2015. These goals aim to address a range of global challenges including poverty, hunger, climate change, and inequality. One of the SDGs is to "ensure sustainable consumption and production patterns." This goal can be achieved by reducing the environmental impact of everyday activities such as the way we use energy, water, and waste. Environmental sustainability lies at the core of the SDGs, emphasizing the importance of preserving and protecting Earth's ecosystems and natural resources. Energy conservation is a fundamental aspect of sustainable development and intricately linked to environmental sustainability. Economic resilience entails building robust and adaptive economic

systems that can withstand shocks and disruptions, while maintaining sustainable development trajectories. By integrating economic resilience into development practices, communities and nations can be enhanced to withstand environmental, social, and economic challenges and ensure their long-term well-being (Kleespies & Dierkes, 2022).

Over 768 million cases of COVID-19 have been officially identified, resulting in over six million fatalities (WHO, 2023). While many countries worldwide have transitioned into the post-pandemic phase of COVID-19, the consequences of this phase continue to persist. These consequences include widespread unemployment and displacement of millions into extreme poverty and malnourishment (Jiang et al., 2022). The building sector plays a significant role in global energy consumption. Consequently, countries worldwide prioritize building energy efficiency (Zhussupbekov et al., 2023). Furthermore, the management of solid waste on a global scale is encountering significant difficulties, as the annual generation of domestic waste exceeds 3 billion tonnes (Llanquileo-Melgarejo & Molinos-Senante, 2022)The domestic sector accounts for one of the largest portions of water usage. Households use water for various purposes, including drinking, cooking, bathing, sanitation, cleaning, and watering lawns or gardens. These activities collectively contribute to significant water consumption in the domestic sector (Cominola et al., 2023).

The post-pandemic phase of COVID-19 led to widespread unemployment, extreme poverty, and malnourishment, impeding progress towards SDG 1 (No Poverty) and SDG 2 (Zero Hunger). The building sector's substantial energy consumption poses challenges to SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action), as inefficient buildings contribute to high energy demand and greenhouse gas emissions. Difficulties in managing global solid waste generation have hindered SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production), thus affecting environmental sustainability. Additionally, the domestic sector's significant water usage for various activities restricted progress towards SDG 6 (Clean Water and Sanitation) and SDG 12, emphasizing the need for sustainable water management and responsible consumption practices. Addressing these challenges is crucial for advancing SDGs and promoting sustainable development.

Most previous studies focusing on Sustainable Development Goals (SDGs) adopted a top-down approach, resulting in findings that had limited direct contributions to society. Malsa et al. (2022) investigated the execution of the SDGs in Semarang, focusing on health and well-being in response to the COVID-19 pandemic. Challenges were identified in reducing maternal and infant mortality, controlling diseases, improving reproductive health, and addressing noncommunicable diseases. Nauli (022) studied the impact of the pandemic on SDG 9 (industry, innovation, and infrastructure) in Indonesia, observing a decline in progress due to redirected resources and reduced budgets. Safitri et al. (2022) explored the use of SDG strategies to enhance educational quality in Indonesia, particularly in remote and underprivileged areas, through various governmental programs. Sasmito et al.(2023) examined the potential of restoring Indonesia's mangroves in achieving multiple SDGs, including poverty eradication, hunger reduction, climate action, and marine conservation. Wicaksono (2023) analyzed the disclosure of SDGs in Indonesian companies, revealing low levels of implementation disclosure based on business actions and SDG targets.

Most community services following a bottom-up approach implicitly aligned with the SDGs Barusman et al. (2023) did so to enhance packaging for brown sugar MSME producers in Sendang Baru Village, Central Lampung, which involves providing information or identification to MSMEs about the importance of packaging, training to MSMEs in designing packaging, and selecting materials for packaging. Ersa et al. (2023) implemented a waste bank to enhance community sanitation awareness in Ceubrek Pirak Village, North Aceh. The multi-stage process of community services included location observations, awareness-raising, waste collection, and sales, preceded by initiatives to enhance community understanding and awareness of waste and environmental management. Karim et al. (2023) applied an agrivoltaic-based urban farming system using agricultural technology aims to enhance productivity and empower the community of female farmers which aims to empower women and enhance agricultural productivity in KWT CHF, using agrivoltaic hydroponics with a vertical concept,

while minimizing energy costs and maximizing land use in urban areas. Sufiyanto et al. (2023) utilized Bokashi composting system for organic kitchen waste processing as an effort to enhance public health in Bunder village. The community service activities involved the conversion of organic waste into compost, effectively addressing waste reduction at the household level.

Conversely, studies that explicitly incorporate SDGs through a bottom-up approach are scarce. Dewi et al. (2023) prepared students with communication and public speaking skills, recognizing their crucial role in achieving the SDGs. The community service program followed a three-stage approach, consisting of training, mentoring, and evaluation. Sena et al. (2023) concentrated on establishing micro, small, and medium enterprises and implementing engaging learning methods for children in Sindangmukti Village, leading to economic growth and improved education quality.

The objective of this research is to address this research gap by conducting a comprehensive survey to understand the current situation in the region before implementing community services in villages. Additionally, this study aims to explore and evaluate the effectiveness of a bottom-up approach in explicitly addressing Sustainable Development Goals (SDGs) within the context of community services. The goal is to provide actionable findings that directly contribute to the betterment of society and promote the integration of the SDGs in community-driven initiatives.

2. Literature Review

The Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 represent a comprehensive framework aimed at addressing global challenges and promoting sustainable development across social, economic, and environmental dimensions. The implementation of SDGs can be classified into two approaches: top-down and bottom-up. The top-down approach in the implementation of Sustainable Development Goals (SDGs) refers to a strategy in which overarching goals and targets are set at the international or national level and then cascaded down to lower levels of governance, such as regional, local, or organizational levels, for implementation. The top-down approach starts with the formulation and adoption of SDGs by international bodies, such as the United Nations. These goals and targets are intended to be universally applicable and to provide a framework for sustainable development in these countries. The bottom-up approach in the implementation of Sustainable Development Goals (SDGs) refers to a strategy that starts at the local level, empowering communities, grassroots organizations, and local actors to identify their own sustainable development priorities and take action to achieve the SDGs. The bottom-up approach begins with engaging local communities and stakeholders in a participatory manner. This involves consultations, dialogue, and engagement activities to understand the needs, aspirations, and challenges faced by the communities. It recognizes that local communities have valuable knowledge and insights about their own contexts, and their active involvement is crucial for sustainable development (Espey, 2021).

Previous studies have investigated the implementation of SDGs using a top-down approach. The implementation of SDGs has highlighted the importance of synchronizing national agendas with SDGs to advance a nation (Irhamsyah, 2019). Positive progress and synergies have been observed in the SDGs related to poverty reduction, health, clean energy, economic growth, and innovation (Kroll et al. 2019). However, certain SDGs, such as sustainable cities, climate action, and partnerships for the goals, present challenges and lack strong connections with other SDGs. Evaluations of policies and practices in various regions, such as the Bantul Regency in Indonesia (Khairina et al., 2020) and the Special Region of Yogyakarta in Indonesia (Pratama et al., 2020), have shed light on the successful implementation of sustainable development principles, while also identifying challenges in areas such as education and energy needs. Liu et al. (2021) emphasize the need for comprehensive understanding and appropriate actions aligned with the right goals for achieving sustainable development, highlighting the influence of regional contexts on SDG prioritization. ASEAN countries have showcased significant environment-related policies in their Voluntary National Reviews (Elder & Ellis, 2022), and the classification of SDGs into factors aligned with social, economic, and environmental sustainability varies across countries (Kleespies & Dierkes, 2022). The COVID-19 pandemic has impacted progress towards SDGs, including health and infrastructure goals in Indonesia (Malsa et al., 2022; Nauli, 2022). Efforts to

enhance educational quality in Indonesia include various government programmes (Safitri et al., 2022). A framework involving classification, coordination, and collaboration is recommended for post-pandemic SDG actions (Zhao et al., 2022). Restoring mangroves in Indonesia can positively affect multiple SDGs (Sasmito et al., 2023). An analysis of SDG disclosure in Indonesian companies revealed low levels of implementation disclosure (Wicaksono, 2023). Furthermore, Asad et al.(2023) analyzed the parliament's role in SDG implementation in Pakistan, while Tang et al. (2023) explored infrastructure growth in Ukraine through green energy and SDG focus.

Previous studies have employed a bottom-up approach to implementing SDGs, which can be categorized into two groups: explicit and implicit SDGs activities. Explicit SDGs programs focus on directly addressing SDGs through deliberate identification, implementation, and monitoring of projects and activities that align with specific goals. On the other hand, implicit SDGs programs do not directly target SDGs but involve the implementation of activities that indirectly contribute to their achievement. The primary objective of the implicit program may not be SDG-related; these programs yield secondary or ancillary benefits that align with one or more of the SDGs. Some studies categorized as explicit SDGs programs include that of Arwildayanto. et al. (2021) and Budhy et al. (2022); Meilinda et al. (2021); Putrawan et al. (2021) and Rahmayani et al. (2022) and Dewi et al. (2023) ; Sena et al. (2023).

Arwildayanto et al. (2021) implemented a village-based SDGs-driven management mentoring program in Desa Potanga and Desa Gandasari, Gorontalo Regency, resulting in enhanced productivity and sustainable management of natural and human resources. Meilinda et al. (2021) empowered female cadres in Suak Village to contribute to decision-making processes and SDGs achievements. Putrawan et al. (2021) improved village operations through the establishment of an official website, digitalization of data and public services, and training, leading to enhanced service quality and data-driven decision-making. Budhy S et al. (2022)conducted education on clean water management in Kalimas Village, emphasizing the importance of clean water for good health. Rahmayani et al. (2022) promoted a green economy and sustainable business management in Gedangan Tourism Village through educational initiatives. Dewi et al. (2023) prepared students with communication and public speaking skills to contribute to SDGs attainment. Sena et al. (2023) focused on establishing micro, small, and medium enterprises and implementing engaging learning methods for children in Sindangmukti Village, leading to economic growth and quality education.

Some studies categorized as explicit SDGs activities were conducted by Fidela et al. (2021) and Uripi et al. (2022), Barusman et al. (2023), Ersa et al. (2023), Karim et al. (2023), Sufiyanto et al. (2023). Fidela et al. (2020) implemented a marketing program in Guava Village to foster the growth of micro, small, and medium enterprises (MSMEs) by utilizing Instagram and implementing a simple accountancy system. Mudjijah and Anggraini (2021) conducted entrepreneurship mentoring for MSMEs in the Ciledug Subdistrict, resulting in improved business identification, feasibility assessment, compliance with market and legal requirements, expanded sales networks, and increased motivation. Uripi et al. (2022) provided training for the Kerupuk Gendar Mirasa MSMEs, focusing on enhancing marketing performance and product development. Barusman et al. (2023) enhanced packaging for brown sugar MSMEs, emphasizing the importance of packaging and providing training on design and material selection. Ersa et al. (2023) implemented a waste bank to raise sanitation awareness and promote waste management in villages. Karim et al. (2023) applied an agrivoltaic-based urban farming system to empower female farmers and enhance agricultural productivity. Sufiyanto et al. (2023) utilized the Bokashi composting system to process organic kitchen waste, effectively reducing waste volume.

Budianto et al. (2022) reviewed the country which conducted technological innovation such as the United Kingdom, Singapore and the United States. Uchinlayen et al. (2023) quantified the determinant factors to promote sustainable tourism in Bangladesh and concluded that the benefits of natural variety, complications inherent in nature, harmonious coexistence, the chance for multiple cultures to thrive, a wide array of life forms, employment prospects, contributions to GDP, and opportunities for income generation. Aidoo (2023) investigated the growth of MSME in Ghana during the pandemic Covid-19

which confirmed that reduced sales income is the foremost issue, accompanied by a scarcity of raw materials, inadequate funds, cash flow constraints, and the least impactful challenge related to a lack of advanced technology. Sulistiowati et al. (2021) found that stakeholder synergy falls short due to one-sided communication, resulting in coordination being limited to the initial stages. The obstacles hindering the revival of the Way Tebabeng destination were the absence of sufficient budget allocation, leadership, and human resource-related factors. Ulfa et al. (2022) found that stakeholder synergy falls short due to one-sided communication, resulting in coordination being limited to the initial stages. The obstacles hindering the revival of the Way Tebabeng destination were the absence of sufficient budget allocation, leadership, and human resource-related factors.

Most previous studies have only performed community services in the village without prior knowledge of the current situation from a comprehensive survey of the region. Furthermore, most previous studies on SDGs only considered a top-down approach; therefore, the findings did not directly contribute to society. Previous bottom-up studies on the explicit alignment of the Sustainable Development Goals (SDGs) were limited. Community services predominantly adopted an implicit approach towards the SDGs.

3. Research Methodology

Figure 1 presents an overview of the research methodology. The research process begins with an examination of the literature from previous studies. The main objective of conducting a literature review is to acquire a comprehensive understanding of the current knowledge and research findings in the field and to identify any gaps, inconsistencies, or unresolved matters that the present study aims to address. The current study examined 35 literature sources to identify the research gap from previous studies. A questionnaire survey is a method used to collect data from individuals by utilizing a predetermined set of questions. This approach was employed to gather both quantitative and qualitative information, as well as to capture opinions, attitudes, beliefs, and behaviors from a specific group of participants. The survey was conducted based on an indirect questionnaire survey, which means that the author will give the Google form link and the video tutorial on YouTube to the students. The students filled out the Google form and confirmed the answer to the family in the houses.

The field questionnaire survey was conducted at the Faculty of Engineering, University of Singaperbangsa Karawang, using Google Forms between April 2022 and December 2022. A total of 505 volunteer students participated in the survey and provided responses based on their families or parental households. The sample consisted of 383 males (75.8%) and 122 females (24.2%), with an average age of 21 years and a standard deviation of 3 years. Most of the surveyed houses were located in Bandung (35.2%), Bekasi (33.4%), Karawang (25.2%), and other areas (6.2%).

The findings derived from the questionnaire survey were effectively communicated to a group of 70 students enrolled at the University of Singaperbangsa Karawang, consisting of 55 males (79%) and 15 females (21%). The objective of this socialization process was to ensure that the participants were equipped with a clear understanding of the various strategies necessary for the realization of sustainable cities in West Java. Furthermore, the socialization of the survey can be used to empower participants with knowledge and awareness of the significance of sustainable practices and the role they can play in achieving these objectives. By fostering a better understanding of the challenges and opportunities associated with sustainable cities, participants were encouraged to become proactive agents of change and contribute to the implementation of sustainable initiatives in their respective communities.

The socialization process was conducted using the Zoom platform, a popular video-conferencing tool that facilitated effective communication and engagement with the participants. Through Zoom, participants were able to actively participate in the socialization sessions, ask questions, and engage in discussions. The pre-socialization quiz was administered to the participants at the beginning of socialization. This quiz served as a baseline assessment of their knowledge and understanding of the subject matter before the information was presented. The quiz consisted of questions related to strategies and concepts associated with achieving sustainable cities in West Java. The socialization quiz was

designed based on a Likert scale. Each question in the quiz was accompanied by a Likert scale ranging from do not know (score 1) to excellent (score 5).

A post-socialization quiz was administered to the participants. This quiz served as an evaluation tool to measure the participants' comprehension and retention of the information presented during the socialization process. By comparing the results of the pre- and post-socialization quizzes, the facilitators were able to assess the effectiveness of socialization in enhancing participants' understanding of the strategies for achieving sustainable cities. This assessment also helped to identify gaps in knowledge or areas that required additional follow-up or reinforcement. Table 1 shows the structured questions on the socialization quiz.

Table 1. Structured question on the socialization quiz

Number	Structured questions
Q1	Do you know about the sustainable development?
Q2	Do you know about the smart cities?
Q3	Are you familiar with the aspects of smart city?
Q4	Do you understand the stages of smart building?
Q5	How knowledgeable are you about the impact of smart buildings?

The findings derived from the questionnaire survey were used to conduct experiments on refrigerators. The experiment in the refrigerator aimed to enhance the distribution temperature of food stored inside. To achieve this, an Arduino Uno microcontroller and DHT-11 sensor were combined, as shown in Figure 2. The Arduino Uno served as the control system, whereas the DHT-11 sensor was used to measure the temperature of the food. The impact of incorporating phase change material on the food temperature inside the refrigerator was observed. Ice gel has the ability to absorb or release heat energy during its phase change, which can potentially influence the cooling process and improve the temperature distribution. The experiment involved collecting temperature data in both scenarios, that is, without the use of ice gel and with the addition of ice gel. The researchers aimed to evaluate the effectiveness of incorporating ice gel in maintaining a stable and optimal temperature for stored food by comparing the temperatures. The experiment was conducted repeatedly until the temperature was observed to be lower when ice gel was added than when ice gel was not used.

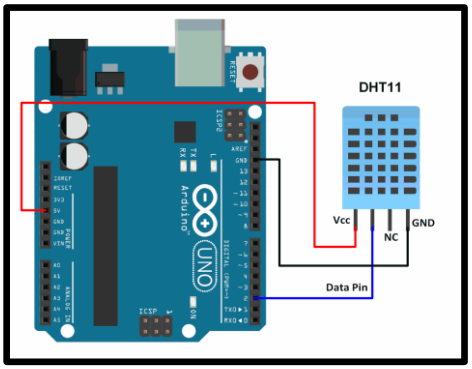


Figure 2. The connection diagram Arduino Uno and Sensor DHT-11 (ElectronicWings, n.d)

Empowerment of culinary Micro, Small, and Medium Enterprises (MSMEs) refers to the process of providing support, resources, and opportunities to small-scale culinary businesses to enhance their skills, capacities, and overall growth. This involves equipping these enterprises with the necessary tools, knowledge, and platforms to thrive in the culinary industry and contribute to economic development. Once the experiment on the temperature of the ice gel in the refrigerator is confirmed to be suitable, the culinary MSME is eligible to receive the refrigerator. However, since there are a limited number of culinary MSMEs in Sindangmukti village, it is necessary to promote the development of culinary MSMEs before granting them a refrigerator. Sena, Diawati, Alfakihuddin, Mavianti, and Sulistyani (2023) provided a detailed explanation of the comprehensive approach employed in conducting

community service in Sindangmukti village to foster the development of culinary MSMEs specializing in the production of bitter melon chips.

Once culinary MSMEs in Sindangmukti village have been established, important equipment such as vacuum packaging machines, non-vacuum packaging machines, refrigerators, and ice gel will be granted to support their operations. In addition, training programs should be conducted to ensure that culinary MSMEs possess the necessary skills to consistently produce high-quality bitter melon chips. These training sessions would encompass various aspects of chip production, including the proper handling and preparation of bitter melon, precise cooking techniques, seasoning and flavoring methods, packaging standards, and quality control measures. Equipping culinary MSME teams with the required expertise and equipment would enable them to better meet consumer demands and maintain product consistency.

The monitoring of MSMEs based on the previous explanation involves overseeing and evaluating the progress and performance of culinary businesses in Sindangmukti village, which has been empowered and provided with equipment and training. Monitoring would involve regular assessment of the culinary MSMEs' operations, including their utilization of the granted equipment, such as vacuum packaging machines, non-vacuum packaging machines, refrigerators, and ice gel. This ensures that the equipment is effectively used to support their production processes and enhance the efficiency and quality of bitter melon chips. The monitoring process involves checking whether the equipment is properly maintained and utilized in accordance with the recommended standards and guidelines. Monitoring MSMEs would also include regular feedback sessions, where the MSMEs could provide insights, challenges, and suggestions regarding the granted equipment and training received. This feedback would help to identify any issues or areas that require further support or improvement.

The final products, the chips of bitter melon, were the result of culinary MSMEs to meet consumer demands and maintain product consistency. The chips are a specific product that the culinary MSMEs in Sindangmukti Village aim to produce with the support of their training and granted equipment. With the support of granted equipment such as vacuum packaging machines, non-vacuum packaging machines, refrigerators, and ice gel, MSMEs could efficiently process bitter melon into chips. Vacuum packaging machines help preserve the freshness of chips and extend their shelf life, whereas refrigerators and ice gel aid in maintaining optimal storage temperatures. Furthermore, culinary MSMEs would establish their own brand for bitter melon chips, allowing them to effectively distribute the product to various markets and consumers.

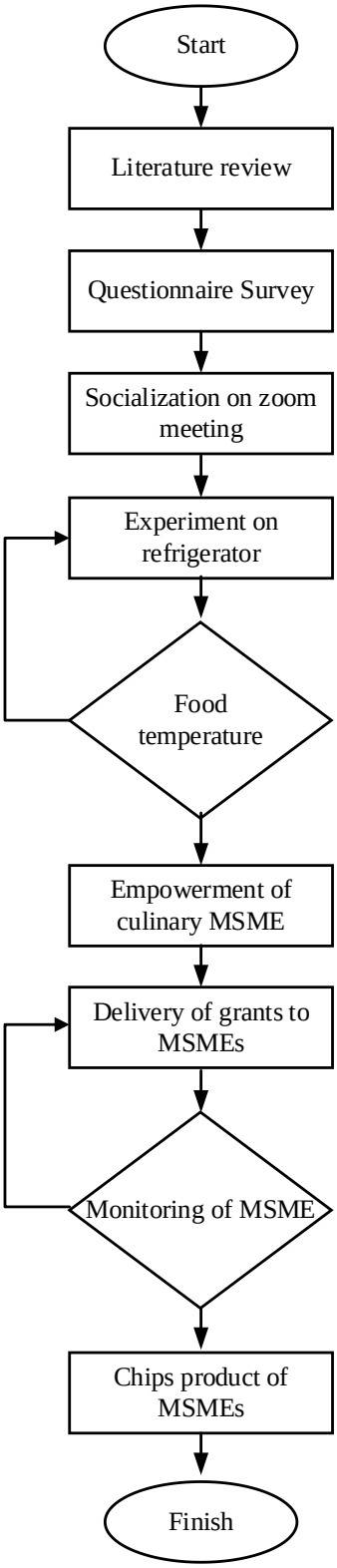


Figure 1. Overview of research methodology

4. Results and discussions

This section presents the findings of the questionnaire survey conducted as part of our research, the improvement of participants in the socialization of sustainable cities, initial experiments on refrigerators using ice gel, empowerment of culinary MSME in Sindangmukti Village, and the products of bitter melon chips.

4.1. Overview of questionnaire survey

Figure 3 shows the distribution of monthly income from households in West Java, categorized into different income ranges. The highest income range, ranging from $66.69 to $200, accounts for 37.2% of the total households in West Java. By contrast, the lowest income range, exceeding $668, constitutes 5.5% of all households. The lower proportion (5.5%) of households in the highest income range (exceeding $668) implies that a smaller percentage of households in West Java have higher incomes. This may indicate the economic challenges or limitations faced by a considerable portion of the population in achieving higher income levels. Similar findings were reported by Suprapto and Saleh (2022), who found that the average per capita income in West Java amounted to approximately $85.50 in 2018.

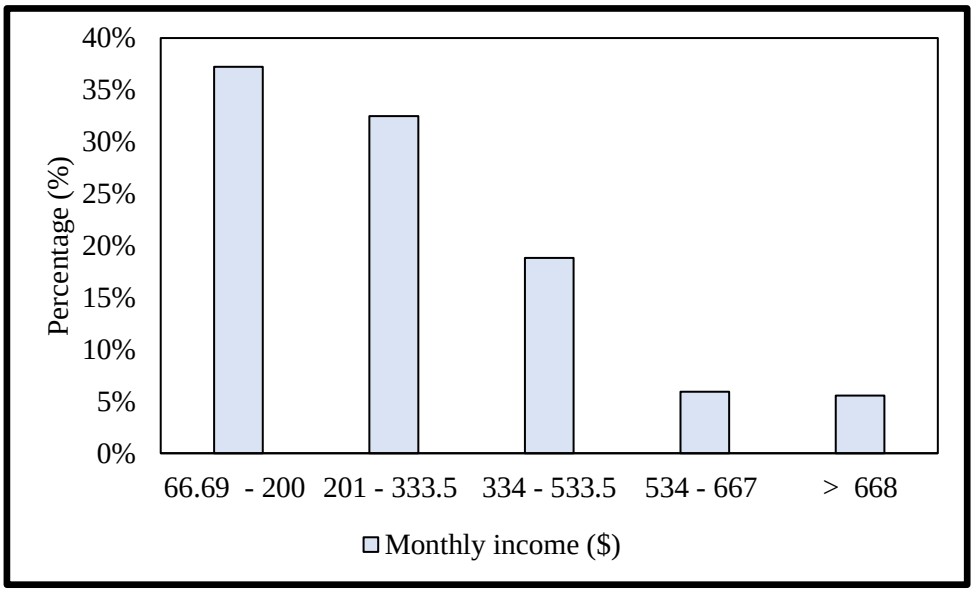


Figure 3. Monthly income distribution of household in West Java

Figure 4 shows the ownership percentages of various electrical appliances among the households in West Java. Mobile phone chargers are prevalent, with 98.40% of the households possessing them. Lamps follow closely behind (97 %), while fans are owned by a significant majority of households (94.90 %). Refrigerators were found in 93.70% of households, while TV was present in 92.30%. Other commonly owned appliances included iron (Iron) at 91.30%), rice cookers (90.70%), chapter laptops (85.30%), and washing machines (77%). The ownership percentage decreases for appliances such as Internet modems by 55.60%, water pumps by 51.10%, air conditioning units by 41.40%, water dispensers and blenders by 37%, and personal computers by 31.90%. The findings were similar to which conveyed that the appliance ownership of refrigerator was 88%, washing machine was 75%, and small kitchen appliances (blender, food processor, juicer) was 67%.

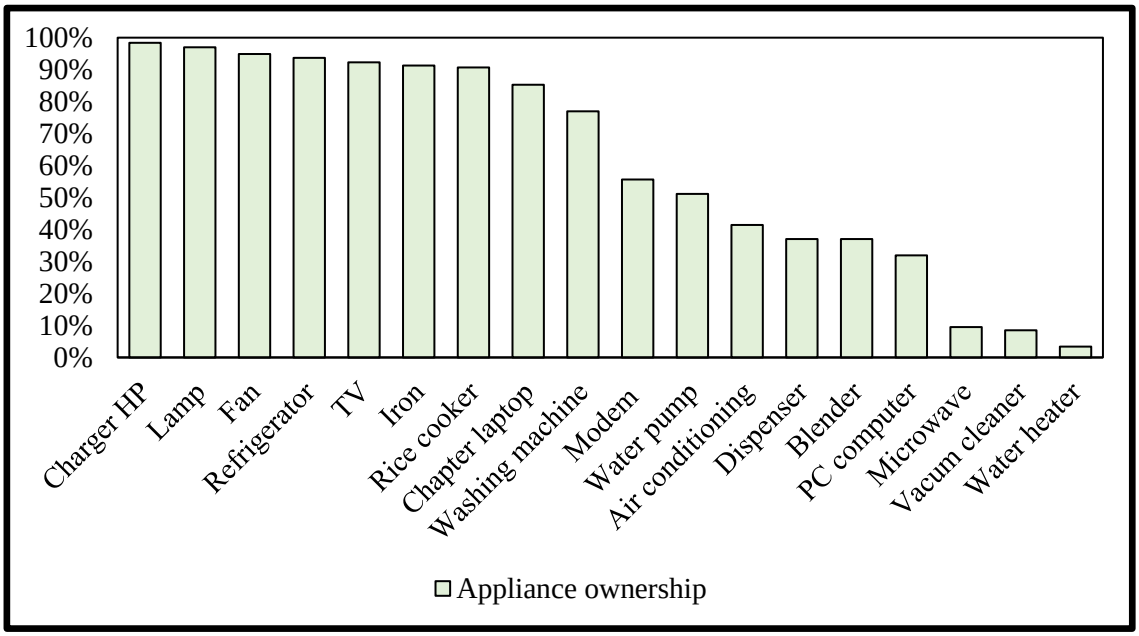


Figure 4. Appliance ownership distribution of household in West Java

Figure 5 provides insights into the distribution of the temperature settings for air conditioning (AC). The data show that 13.4% of households set the AC temperature below 16°C. Interestingly, the temperature settings between 17°C-20°C and 25°C-27°C were almost similar, accounting for 27.8% and 28.2%, respectively. However, only 11.5% of the households set temperatures above 27°C. The findings contradict those of who found that the temperature settings for AC in Malaysian households were mostly between 19.1°C and 25°C, accounting for 68.4%.

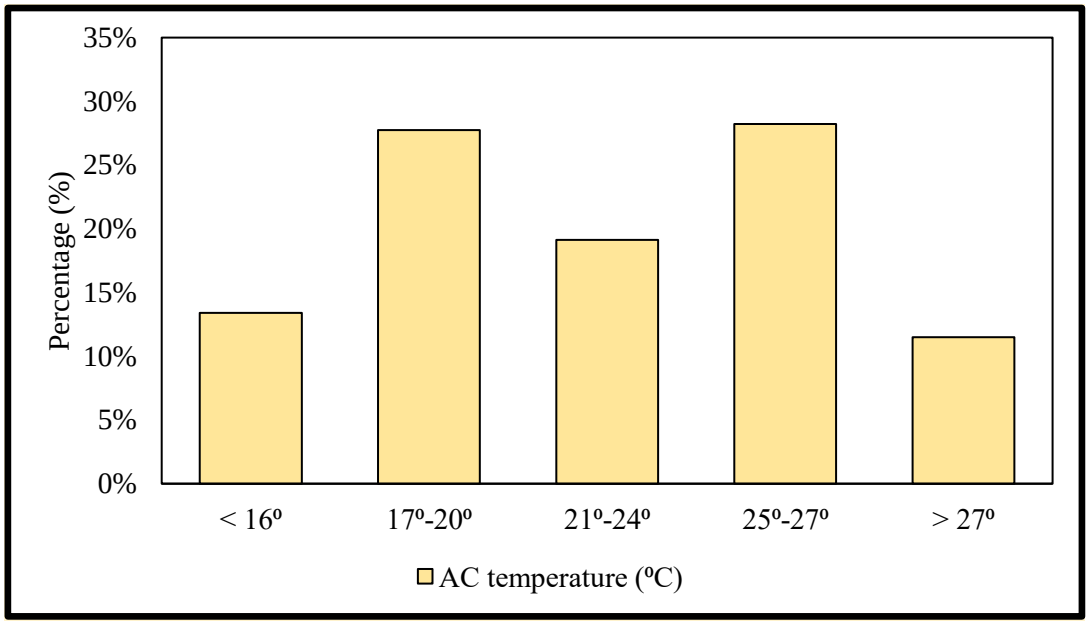


Figure 5. Distribution of temperature setting for AC in West Java

Figure 6 provides the time durations for opening a faucet during a single usage. Approximately 8.90% of households opened the faucet for one minute, indicating a relatively short usage period. Furthermore, around 18% of households kept the faucet open for three minutes, suggesting a slightly longer duration of usage. Approximately 36% of households used faucets for five minutes, indicating a moderately extended period of usage. Finally, the largest percentage (37 %) of households kept the faucet open for ten minutes, suggesting that a considerable number of individuals prefer a more prolonged usage

duration. In contrast, the findings from , which investigated water usage during the ablution ritual before prayer, confirmed that the time duration for opening a faucet ranged from 0.5 to 2 minutes. The different results were influenced by various household uses, such as washing, cleaning, and cooking, whereas the ablution rituals specifically focused on a single activity.

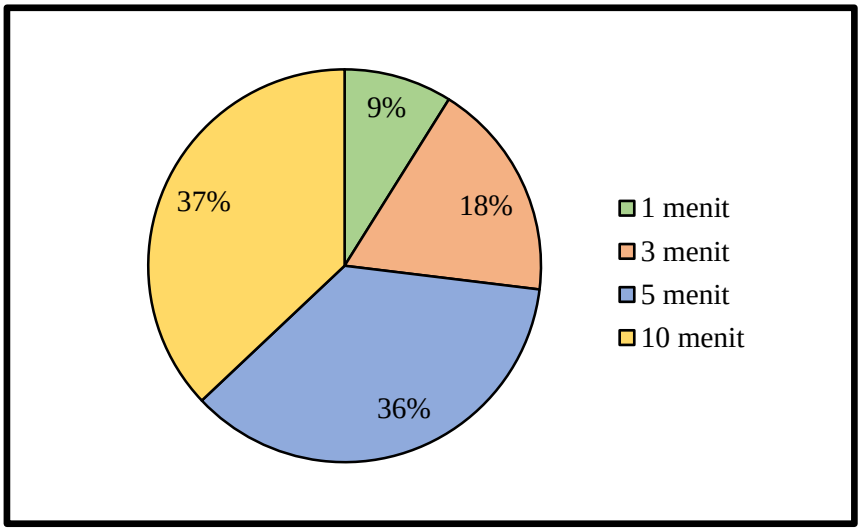


Figure 6. Time duration of opening the faucet during a single usage

Figure 7 shows the characteristics of household waste based on different categories. The majority of household waste consisted of plastic, accounting for approximately 91.20% of the total waste generated. Leftovers from food consumption were also a significant portion, accounting for 84.10% of household waste. Paper waste was the next most prominent category, accounting for 73.30% of the total waste. Foliage trash, such as leaves and plant clippings, represented a relatively lower proportion (42.40 %). Metal waste accounted for 28.10% of household waste, while rubber waste accounted for 19.30%. Glass waste was relatively low, constituting only 12% of the total waste. Finally, cloth waste was the smallest category, representing 8.60% of household waste generated. Different findings were confirmed by who investigated household waste in Sukolilo, Surabaya. They found that the majority of the household waste consisted of 75% composted waste, 11% plastic, 7% paper, and 1% metal. The disparity in results can be attributed to the difference in survey locations, as the current study mostly focused on urban areas, while conducted their research in a village.

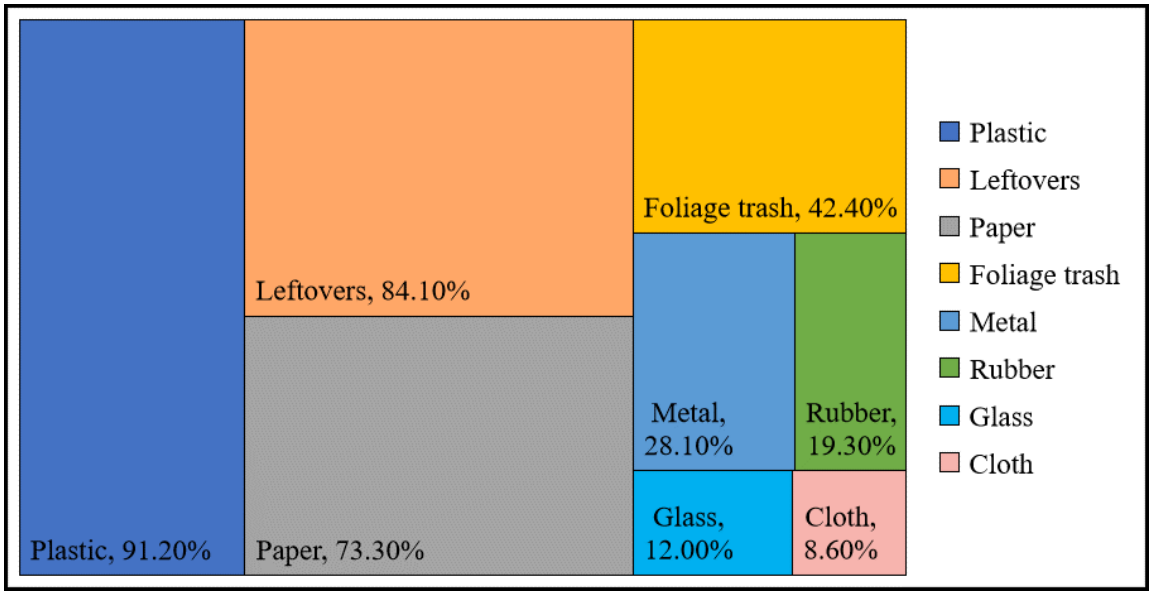


Figure 7. Characteristics of household waste

4.2. Empowerment of society through socialization

The findings from the questionnaire survey will be disseminated to the participants during the socialization event regarding the development of smart buildings to achieve sustainable cities. The socialization event occurred on February 16, 2023, as shown in Figures 8. The dissemination of the survey findings aimed to provide valuable insights to support participants' understanding of the importance of sustainable practices.

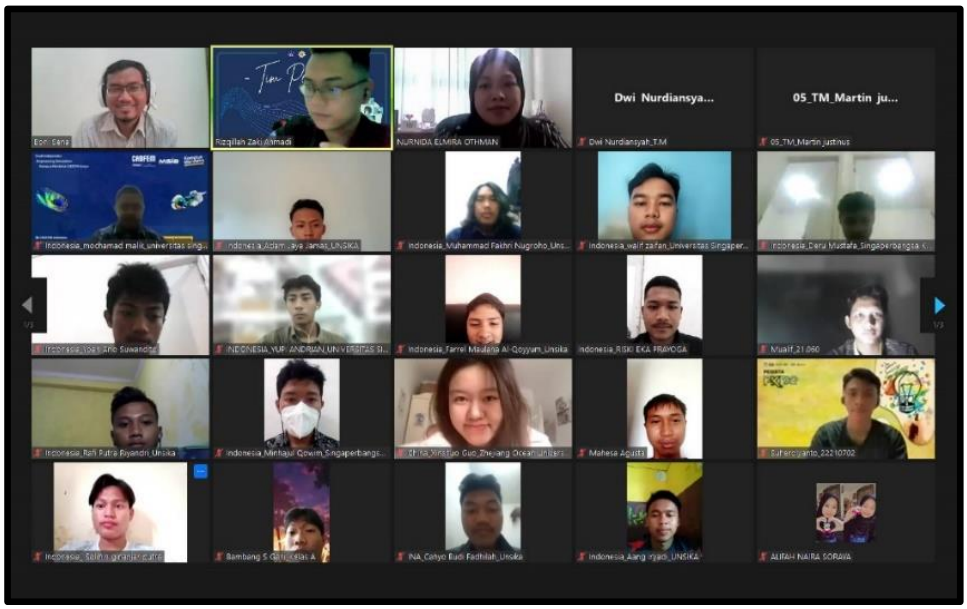
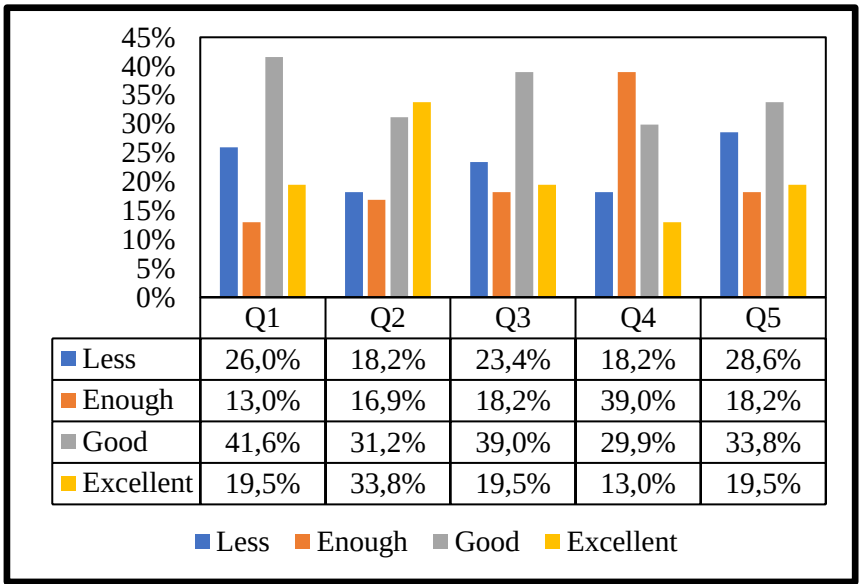


Figure 8. Socialization of sustainable development

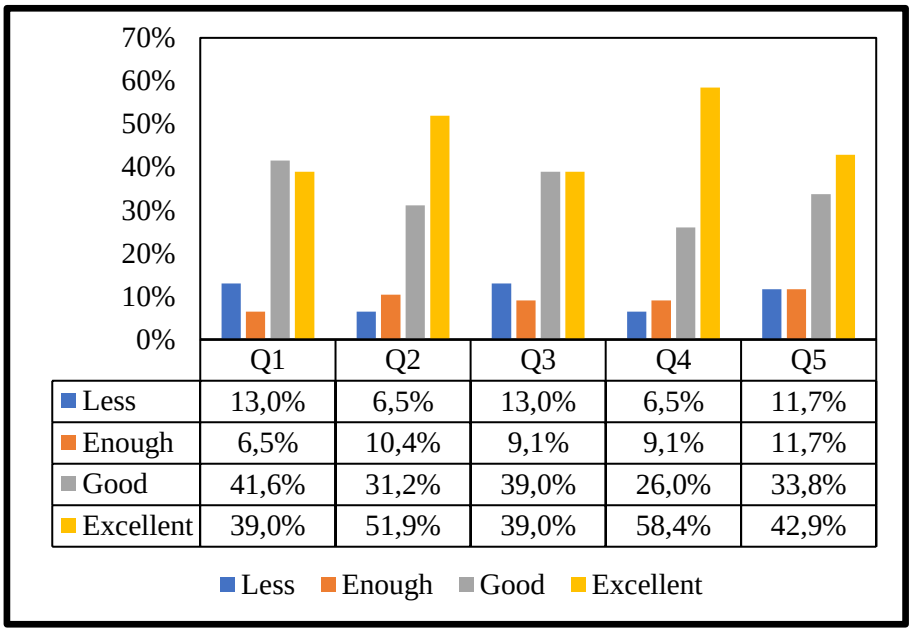
A quiz was administered during the socialization event to assess the participants' understanding before and after the session. The questions were labelled Q1, Q2, Q3, Q4, and Q5, corresponding to the numbers assigned in Table 1. The participants responded before socialization regarding their understanding of sustainability development (Q1), smart cities (Q2), specific aspects of smart cities (Q3), stages of smart building (Q4), and the impact of smart buildings (Q5), as shown in Figure 9, indicating varying levels of knowledge; some participants demonstrated lower knowledge (26%), others displayed good understanding (ranging from 29.9% to 41.6%), and a significant percentage exhibited excellent knowledge (ranging from 18.2% to 39%).



	Q1	Q2	Q3	Q4	Q5
Less	26,0%	18,2%	23,4%	18,2%	28,6%
Enough	13,0%	16,9%	18,2%	39,0%	18,2%
Good	41,6%	31,2%	39,0%	29,9%	33,8%
Excellent	19,5%	33,8%	19,5%	13,0%	19,5%

Figure 9. The assessment of participant before socialization

The participants responded after socialization regarding their understanding of sustainability development (Q1), smart cities (Q2), specific aspects of smart cities (Q3), stages of smart building (Q4), and the impact of smart buildings (Q5), as shown in Figure 10, indicating varying levels of understanding: some participants demonstrated lower knowledge (13%), others displayed good understanding (ranging from 26% to 41.6%), and a significant percentage exhibited excellent knowledge (ranging from 39% to 58.4%).



	Q1	Q2	Q3	Q4	Q5
Less	13,0%	6,5%	13,0%	6,5%	11,7%
Enough	6,5%	10,4%	9,1%	9,1%	11,7%
Good	41,6%	31,2%	39,0%	26,0%	33,8%
Excellent	39,0%	51,9%	39,0%	58,4%	42,9%

Figure 10. The assessment of participant after socialization

4.3 Initial experiment on refrigerator

The findings from the questionnaire survey on appliance ownership revealed that refrigerators were the most commonly owned appliance among 93.7% of the surveyed households. Consequently, an investigation was conducted to assess the effectiveness of using ice gels to improve the refrigerator efficiency. In this initial experiment, a commercialized ice gel was employed, and frozen food was used as the object of the experiment, as shown in Figure 11. To measure the temperature difference between the ice gel and non-ice gel, an Arduino Uno microcontroller and a DHT11 sensor were utilized, as shown in Figure 12.

Figure 11. Initial experiment on refrigerator on frozen food

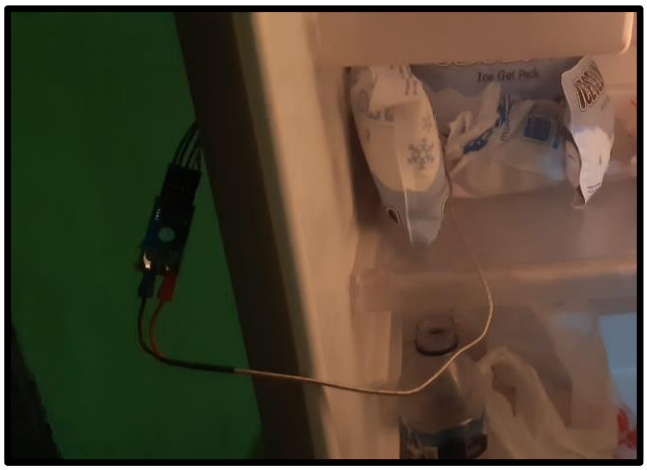


Figure 12. Measurement temperature on frozen food with ice gel

Figure 13 shows that the use of ice gel in the refrigerator has a significant impact on temperature. The maximum temperature recorded with ice gel was 19.75 degrees Celsius, whereas without ice gel, it was 23.5 degrees Celsius at 4:00. Similarly, the minimum temperature was recorded as 0.25 degrees Celsius with ice gel and 6 °C without ice gel at 8:00. Furthermore, the average temperature was lower with the use of ice gel, with an average temperature of 3.04 degrees Celsius compared to 8.6 degrees Celsius without ice gel. It can be concluded that ice gel helps to maintain the temperature of the refrigerator at a lower level, thereby ensuring the freshness and longevity of frozen food.

The impact of ice gel on a refrigerator is substantial in terms of enhancing its cooling efficiency and preserving stored items. The ice gel acted as a thermal buffer, absorbing heat from the surroundings and maintaining a consistently low temperature inside the refrigerator. This cooling effect helps to extend the freshness and shelf life of perishable goods, as well as reducing the growth of bacteria and enzymes that cause food spoilage.

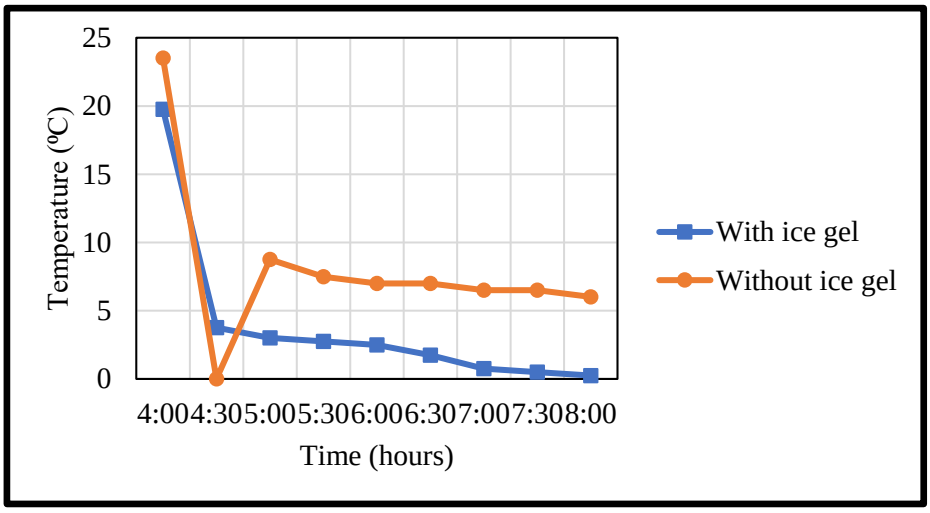


Figure 13. Comparison of temperature on frozen food with ice gel and without ice gel

4.4. Empowerment of culinary MSME

The findings from the questionnaire survey confirmed that the income range that was the highest, which spans from $66.69 to $200, represents 37.2% of households in West Java. Furthermore, income ranged from $201 to $333.5, accounting for 32.5% of households. Therefore, MSMEs are essential for the development of any economy, as they create jobs, increase people's income levels, and contribute to economic growth. The development of culinary micro, small, and medium enterprises (MSMEs) was chosen in Sindangmukti Village, Karawang Regency due to the issue of inadequate numbers of MSMEs

in the village . The UMKM developed in the PkM program in Sindangmukti Village is a bitter melon chip UMKM. Pare was frequently used in traditional medicine . Bitter melon was also widely utilized for treating diabetes and obesity .

The establishment of the UMKM began by conducting training on chip preparation. Seven residents were selected for the study. The residents were provided with training and guidance on creating chips using their agricultural produce, ensuring that the chips had a delicious taste without the bitterness of the pare . The training process for creating chips from bitter melons is illustrated in Figure 14.

Figure 14. Training of making in creating chips from bitter melon

Village residents who had undergone training in making bitter melon chips would also be guided towards establishing UMKM, aiming for the existing product to become a flagship product of Sindangmukti Village and enhance the economic well-being of the residents. UMKM produces bitter melon chips under the product name "Kripya," as depicted in Figure 15. The results of monitoring after the establishment of the UMKM showed that other residents became more actively involved in learning how to process bitter melon chips. The monitoring of establishment of UMKM were performed within two months during the community services conducted by KKN team 90. Additionally, the chips were successfully sold in the local shops in Sindangmukti Village . The formation of UMKM, which produces bitter melon chips, is expected to improve the economic conditions of residents. The positive impact of UMKM on the community's economy has been proven and previously explained by .

Figure 15. Establishment of Culinary MSME on Sindangmukti village

The refrigerator, which was enhanced by incorporating ice gel, demonstrated excellent performance by maintaining lower temperatures, as shown in Figure 13. To support the newly established culinary MSME, a modified refrigerator, as shown in Figure 17, along with vacuum and non-vacuum packaging methods, was provided to the culinary MSME in Sindangmukti village, as shown in Figure 16. The total equipment grants given to culinary micro-, small-, and medium-sized enterprises (MSMEs) amounted to $133.47.

Figure 16. Refrigerator grants and food packaging equipment

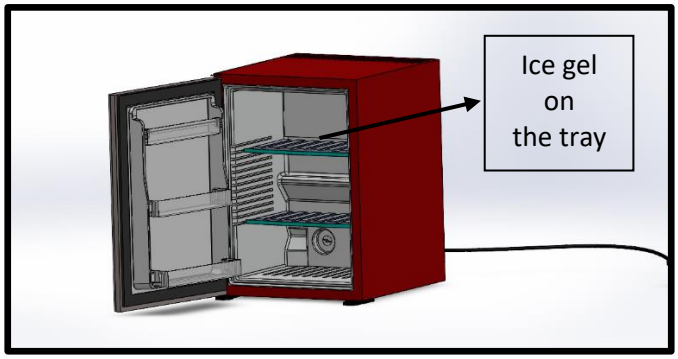


Figure 17. Modified refrigerator with ice gel on the tray

4.5. Chips of bitter melon as product of culinary MSME

The culinary MSMEs in Sindangmukti Village produced chips made from bitter melon as their product, as shown in Figure 18. The chips were available in four different flavors, each offering a distinct taste experience. The original flavor preserved the authentic taste of the chips, showcasing the natural essence of bitter melon. For those who preferred a smoky and tangy profile, the barbeque flavor provided a delightful combination of grilled notes and savory spices. For those seeking an extra taste, the spicy variant delivered a fiery sensation with bold and zesty seasonings. With these four flavors available, consumers can select their preferred tastes and enjoy a variety of delightful chip options.

Figure 19. Chips of bitter melon as product of culinary MSME

Culinary MSME produced chips of bitter melon with the brand “Kripya’. In the first stage, 65 units of Kripya were produced, and each unit was priced at $0.33. Therefore, the total revenue generated from the initial production was $21.69. In the second stage, 45 Kripya units were produced. As a result, the total revenue from the second production amounted to USD 15.02. In conclusion, the first production generated higher revenue than the second production, amounting to $21.69 versus $15.02. This

difference is due to the larger quantity of products in the first production, despite identical unit prices. Chips of bitter melon, as a product of culinary Micro, Small, and Medium Enterprises (MSMEs), have the potential to improve the economic conditions of people in Sindangmukti Village in several ways. First, by utilizing bitter melon, which is commonly found in villages and often goes to waste, MSMEs can create value-added products that generate income and employment opportunities within the community. The production and sale of these chips can create a local market, attracting tourists and visitors interested in trying unique culinary experiences. Additionally, the expansion of the bitter melon chip business can lead to an increase in demand for bitter melons, thereby benefitting local farmers and encouraging agricultural growth. Overall, the establishment of a bitter melon chip enterprise can enhance economic resilience, empower local communities, and contribute to the sustainable development of Sindangmukti Village.

5. Conclusion

This section presents the conclusions and highlights the objectives of the current study. The conclusion also considers the limitations encountered during the study, which may include factors such as the sample size or time constraints. Furthermore, suggestions for future research and improvements to the bitter melon chip enterprise are provided to enhance its economic benefits and address any identified limitations.

5.1. Conclusion

The implementation of sustainable development goals initiatives involves three key programs. First, a questionnaire survey was conducted to gather data and insights from the households in West Java. The purpose of this survey was to investigate various household characteristics including monthly income, appliance ownership, AC setting temperature, duration of faucet usage, and types of household waste. The results of the questionnaire survey were then used in the socialization program and the formation of micro-, small-, and medium-sized enterprises (MSMEs). Second, an empowerment program was introduced that leveraged online socialization platforms to engage and educate society. This initiative aims to raise awareness, foster collaboration, and encourage active participation in sustainable practices. Pre- and post-socialization quizzes were administered to measure the effectiveness of the program. The results indicated that the participants exhibited a higher level of understanding of sustainable development after socialization activities. Finally, culinary MSME was established to promote local entrepreneurship and provide economic opportunities. This initiative not only contributed to the village's economic growth, but also highlighted the potential of sustainable practices within the culinary industry. Culinary MSME demonstrated a strong performance by successfully producing bitter melon chips. The present study effectively examined and enhanced the efficiency of a grassroots approach in explicitly addressing the SDGs within the domain of community services. By conducting a questionnaire survey, engaging in socialization efforts, and empowering culinary MSME, the study has yielded actionable insights that directly contribute to societal improvement and advance the integration of SDGs in community-driven initiatives

5.2. Limitation

The questionnaire survey conducted in this study has certain limitations. It was not possible to include all results from the survey in the study, which means that some information might not be fully explained. Therefore, it is possible that certain aspects of the questionnaire were not clearly understood. The questionnaire survey only covered a limited region in West Java, and many cities in West Java were still not included in the survey. Additionally, socialization activities exclusively engaged students as participants, thereby limiting the dissemination of the questionnaire survey information to other members of the family. The assessment of the socialization of sustainable development may not have been comprehensive because only specific aspects were measured. Regarding the establishment of the culinary MSME, monitoring was carried out for a period of three months, but regular monitoring of the program's sustainability was not conducted.

5.3. Suggestion

Some suggestions were provided based on the conclusions and limitations of this study. First, it is recommended that the next paper comprehensively explains the results of the questionnaire survey to ensure a clear understanding of the entire survey. Additionally, the next questionnaire survey should cover all cities in West Java. Second, socialization efforts should be extended to include other family members such as fathers, mothers, and other individuals. Furthermore, it is advisable to expand the assessment of the socialization program by measuring a broader range of aspects and incorporating methods, such as focus group discussions or interviews. Third, the next community service team in Sindangmukti village should be suggested to monitor the development of culinary MSMEs (Micro, Small, and Medium Enterprises) to track their long-term sustainability.

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