Environment and Ecology Research 12(2): 172-180, 2024
DOI: 10.13189/eer.2024.120208 http://www.hrpub.org

A Community Project on Waste Management Awareness and Livelihood Training of Residents nearby a Polluted Creek: An Impact Study

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Received January 18, 2024; Revised March 8, 2024; Accepted April 22, 2024

Cite This Paper in the Following Citation Styles

(a): *[1] Arian M. Edullantes, Giovanni B. Cagurin, Angelo Mark P. Walag , "A Community Project on Waste Management Awareness and Livelihood Training of Residents nearby a Polluted Creek: An Impact Study," Environment and Ecology Research, Vol. 12, No. 2, pp. 172 - 180, 2024. DOI: 10.13189/eer.2024.120208.*

(b): *Arian M. Edullantes, Giovanni B. Cagurin, Angelo Mark P. Walag (2024). A Community Project on Waste Management Awareness and Livelihood Training of Residents nearby a Polluted Creek: An Impact Study. Environment and Ecology Research, 12(2), 172 - 180. DOI: 10.13189/eer.2024.120208.*

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Abstract Policymakers, leaders of nonprofit organizations, and others have repeatedly demanded proof over the past few decades showing how environmental education significantly improves environmental quality and aids in conservation goals. This study investigated the impact of a community-based project on waste management awareness and livelihood training. The program was specifically designed to capacitate community members on waste segregation, reduction, recycling, reusing, and repurposing with the goal of reducing the pollution of a nearby creek. The present study aims to fill in the gap in our understanding on how community-based programs help improve environmental outcomes. A convergent mixed method parallel design was utilized to quantitatively show the residents' knowledge, attitudes, and practices while simultaneously exploring the benefits derived from the said program through a focus group discussion with barangay residents and barangay leaders. Results demonstrate that the participants have possessed sufficient solid waste management knowledge and desirable attitudes and practices towards solid waste. In addition, participants also reported the importance of incentives, community involvement, and political will toward strengthened waste segregation at-source. These results demonstrate a positive impact on the lives of the community residents as a result of a community-based environmental education campaign. While the results provide meaningful clues on the impact community-based programs, caution must be taken in the interpretation of the finds due to some methodological limitations.

Keywords Community Education, Community Empowerment, Environmental Education, Solid Waste Management, Sustainable Development

1. Introduction

Poor sanitation is a significant contributor to the health issues that Filipinos face. A study shows that the most prevalent causes of morbidity include measles, bronchitis, diarrhea, influenza, pneumonia, TB, and malaria [1]. The poor sanitary conditions could be due to improper waste disposal. Due to rapid industrialization, urbanization, and population expansion, waste output by inhabitants in the Philippines has lately increased, particularly in metropolitan areas. One major cause of this improper waste disposal is the inadequacy or inefficiency of most solid waste management systems [2].

Solid waste management (SWM) services are insufficiently supplied in many municipalities in the developing world even though the ultimate obligation to manage solid waste is a constitutionally mandated

municipal role in most nations [3], [4], [5]. Furthermore, the majority of rural households in developing nations do not consistently adhere to prescribed waste disposal protocols. [6]. This may be due to a lack of environmental awareness [7] or the lack of structural and systemic facilities [8]. Similarly, most disposal facilities are poorly run, and many homeowners do not receive garbage pickup services. Numerous studies conducted worldwide have demonstrated that informal recycling efforts significantly lower the cost of SWM, support the urban poor, and may have good or negative environmental consequences [1], [9].

About 35,580 tons of waste are produced every day in the Philippines. In the country, each person produces around 0.5 kg and 0.3 kg of waste daily in the urban and rural areas, respectively. This is important because disposal sites have the potential to contaminate the surrounding groundwater, soil, air, plants, and scavenger animals [10], [11], [12]. Similar effects may be felt in nearby populations, endangering their health. Dengue, cutaneous, upper respiratory, and gastrointestinal illnesses were probably prevalent. Disposal sites may be unhealthy, but because the community feels economically dependent on jobs and resources, it keeps settling for what is available.

Environmental education, training, and demonstration initiatives are beneficial in raising people's knowledge of the advantages of recycling and trash reduction [13]. It is also a collection of resources that improves environmental attitudes, values, and knowledge while fostering the skills necessary for people and communities to work together to take constructive environmental action [14]. This highlights the importance of using environmental education to develop a sustainable program on sustainable waste management.

Bitan-ag Creek, in Cagayan de Oro City, is a major waterway that cuts across central residential and business districts in the city, from Barangay Camaman-an, Cogon Market, Agora Market, and Barangay Lapasan. This creek also serves a catchment basin of the drainage system of Cogon Market Area, Osmeña Street, Provincial Capitol Ground, Ramonal Village, Barangay Nazareth, and a portion of Divisoria in the City of Cagayan de Oro. More so, it is challenging to keep the river system area clean and maintained since informal settlers have constructed their houses along the stream. The stream has essentially become a waste dump due to years of mismanagement and neglect, and it has been a significant cause of the practically constant flooding that has devastated the city's main commercial and residential areas. Due to its major role as the ultimate catchment, its health and status are of prime importance.

It is for this reason that the University of Science and Technology of Southern Philippines – Department of Environmental Science and Technology (USTP-DEST) conducted a series of community-based projects, which include waste characterization and community livelihood training in 2018, recycling of recyclable materials in the Materials Recovery Facility (MRF) in 2019, Bitan-ag Creek Watch in 2022, and clean-up drive in 2023. These projects aim to improve the solid waste management knowledge and cleanliness in the barangay as part of the environmental education thrust of the department. This study aims to evaluate the impact of community projects as a medium of environmental education on the personal lives of residents in the barangay. Specifically, this study sought to:

1. determine their confidence in their solid waste management knowledge;
2. determine the number of participants who were:
   a. able to use the knowledge gained from the training in their day-to-day life;
   b. able to use the knowledge gained in their workplace;
   c. promoted or earned better income as a result of the training; and
   d. able to develop products as a result of the training
3. explore the changes in the personal and professional lives of the training recipients; and
4. explore the improvement in the barangay as a result of the training program.

2. Materials and Methods

2.1. Research Design

This study utilized a mixed methods research design, particularly the convergent parallel mixed methods variant [15]. In a convergent parallel design, the researcher conducts both the quantitative and qualitative components of the study during the same phase, assigns equal weight to each approach, analyzes each component separately, and interprets the findings together [16]. In this study, the descriptive quantitative component examined the confidence of the residents in terms of their solid waste management knowledge and identified the number of participants who have benefitted from the training in terms of their use of the knowledge gained, their promotion, or for earning better after the training, and for developing products as a result of the livelihood project. On the other hand, the phenomenological qualitative component explored the changes in the participants' personal and professional lives, including their barangay as a whole.

2.2. Environment and Context of the Study

The study was conducted in Barangay 22, Cagayan de Oro City, for both the quantitative and qualitative components. Survey questionnaires were distributed to residents of Barangay 22 with the assistance of Barangay Officials. These were administered in their respective residences to avoid gathering participants in one place. The interview, on the other hand, was conducted in the Barangay Office. Barangay 22 served as a recipient of

community projects on solid waste management from 2018 to 2023 as part of the environmental education thrusts of the USTP-DEST.

2.3. Participants of the Study

For the quantitative component, only the residents were considered as the participants, while for the qualitative component, both the residents and their Barangay Officials were considered. Only those who have participated in the different USTP-DEST projects were considered participants. Table 1 summarizes the socio-demographic characteristics of the participants of the study. The majority of the respondents are females with some formal education, who have resided in the barangay for at least six years, and who have a family income of less than PhP 10,000 (around $ 180.00).

Table 1. Sociodemographic characteristics of the participants (N=28)

	Frequency	Percent
Sex		
Male	9	32.14%
Female	19	67.86%
Education Level		
No formal education	-	
Elementary School	-	
Secondary School	9	32.14%
College level	16	57.14%
Bachelor's degree and above	3	10.72%
Years of Residence in the Barangay		
Less than two years	-	
2 – 5 years	-	
6 – 10 years	4	14.29%
More than 10 years	24	85.71%
Family Size		
One to three members	3	10.72%
Four to six members	12	42.85%
Seven to nine members	5	17.85%
10 members and more	8	28.58%
Average Household Monthly Income (Php)		
Less than 10,000	14	50.00%
10,000 to 15,000	1	3.56%
15,001 to 30,000	3	10.72%
30,001 to 50,000	2	7.14%
More than 50,000	8	28.58%
Occupation		
Government Employee	9	32.14%
Private Employee	2	7.14%
Self-employed	7	25.00%
Unemployed	10	35.72%

2.4. Sampling Procedure

The quantitative component of the study utilized a complete enumeration of all participants of the different projects organized by USTP-DEST. Meanwhile, those who were unavailable during the data collection were no longer considered due to time constraints. In the qualitative component, purposive sampling was utilized to ensure that the key informants included in the study would be able to provide rich data with respect to the objectives of the study.

2.5. Research Instruments

The study utilized a researcher-made questionnaire to ascertain the confidence of the participants in terms of their knowledge of solid waste management. Experts in assessment and community development studies validated this for its face and content validity. Another researcher-made questionnaire was used to determine the number of participants who utilized their knowledge in their day-to-day life and workplace to earn better and develop products due to the community extension projects. Meanwhile, the qualitative component utilized an interview guide. This interview guide was validated to ensure that questions allow rich data to be collected. Member checking was also conducted to ensure the authenticity of the results.

2.6. Ethical Considerations

Participation in the research was voluntary, and participants were provided with informed consent. The goals and objectives of the project were thoroughly discussed with the respondents. No potential harm, physically or psychologically, was anticipated in the study. Participants were also allowed to withdraw from the study at any stage if they wished to do so. Using offensive, discriminatory, or other unacceptable language was avoided in formulating questionnaires and guide questions at all costs. The privacy and anonymity of the respondents were ensured by using a researcher-made code for each respondent. The data was only accessible to the research team alone and will be destroyed after one (1) year. All necessary permissions will be obtained before data collection. These were all compliant with the Ethical Standards of the University of Science and Technology of Southern Philippines.

2.7. Data Analysis

The quantitative data was analyzed using descriptive statistics and reported using mean and standard deviation. The qualitative data was analyzed using Colaizzi's thematic analysis [17]. Recordings were transcribed and coded. Codes were then grouped to form themes. The quantitative and qualitative data were then integrated to provide a bigger picture of the impact of the projects conducted by USTP-DEST.

3. Results and Discussion

The study examined households' knowledge of solid waste management as a result of the livelihood training and waste management awareness programs they conducted. As shown in Figure 1, all participants agree that solid waste is a source of environmental pollution and that improper dumping can eventually lead to pollution of rivers, lakes, and wells. In addition, participants also agree that solid waste can be a source of wealth by sorting and recycling it. This result is also corroborated by the qualitative findings that participants noted a reduction of waste produced and that waste segregation and recycling are already practiced. One participant mentioned that "*The household trash before the training is dumped as one, but after the training, wastes were reduced and are now sorted as biodegradable and recyclable.*" This highlights the development of solid waste management knowledge at the household level. This highlights the importance of community environmental education as it bridges the gap between waste management knowledge and waste sustainability in developing countries [18]. More so, improvement in knowledge will enhance people's awareness and attitudes towards the environment [19].

Participants also agreed that compost or organic fertilizer can be prepared from solid waste. This is also supported by the quote from a participant that *"gardening"* or *"container gardening"* has been one of their significant recycling activity. This is important as adopting and utilizing low-cost techniques, like composting and vermicomposting, would result in better solid waste management [20].

Attitudes towards solid waste management of households were also investigated after completing the program and these are summarized in Figure 2. As shown, most participants strongly agreed that solid wastes can be reduced, recycled, and reused. Qualitative findings also corroborate this result as participants mentioned that "*I really segregate waste, those that are still useable and those which are really considered trash, those that are useable are reused, that is why there is decrease in our waste.*" This highlights the importance of having a positive attitude towards solid waste management as it determines their behavior towards their waste. Similarly, participants also disagree that solid waste is anything without value, and that could be because they use their waste for composting and developing products. The same agreement is also observed that participants find selling plastic waste as one way to address solid waste management. For example, one participant mentioned, "*It has a huge impact because it helped us use plastic wrappers and tetra packs of coffee and other products to develop wallets and other goods.*" This positive attitude towards solid waste management is important since the degree to which individuals believe they are related to nature influences their views about the environment and their care for it [21]. As such, community programs developing positive attitudes towards solid waste management are desirable as these will have consequences for the sustainability level of the entire country [22].

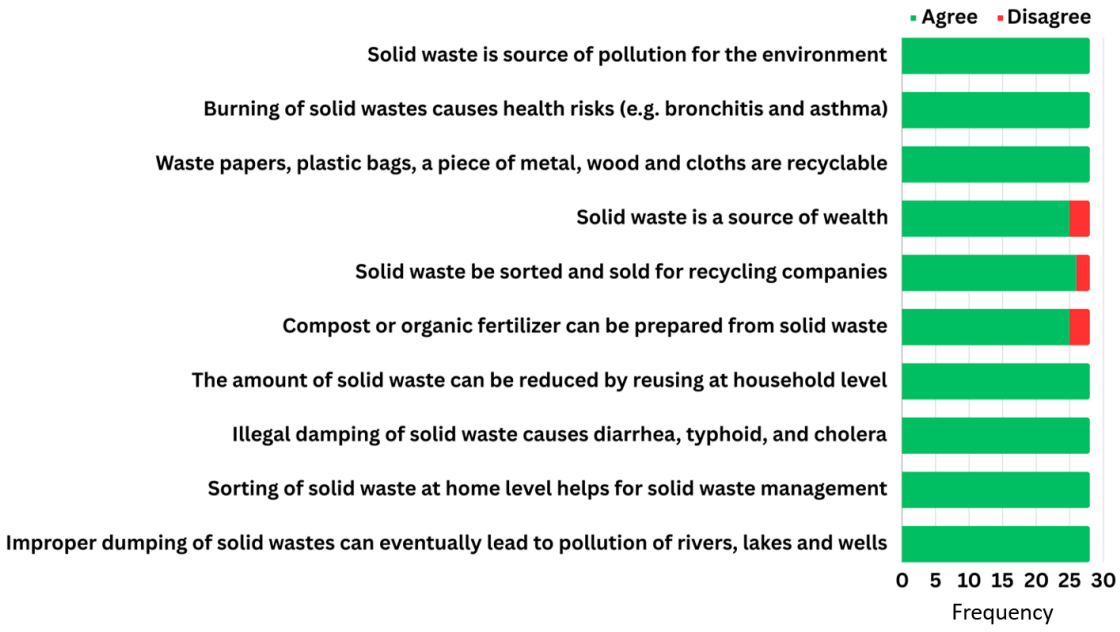

Figure 1. Knowledge of Households towards Solid Waste Management

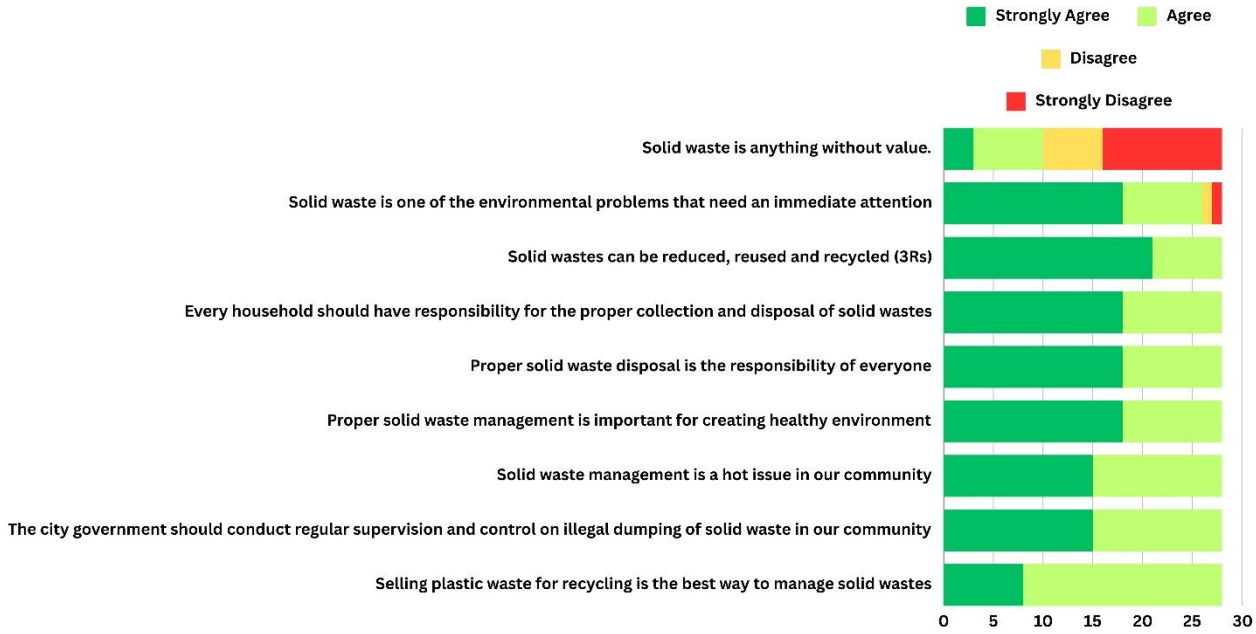

Figure 2. Attitudes of Households towards Solid Waste Management

Solid waste management practices of households were also investigated in this study and are summarized in Table 2. About half of the household waste is from leftover food, and the other half comes from recyclable materials like plastic, beverage cans, and bottles. These types of waste can be recycled and reduced, as shown in the qualitative findings where participants develop goods to sell and use food waste for container gardening. These types of household wastes are also common in other parts of the world. In Turkey and Tehran, food wastes were found to be the highest type of waste produced by households [23], [24].

Desirable practices are also shown in the same table, where most of the participants reported that solid waste is disposed of through a disposal site. This is confirmed in the qualitative findings, where several participants mentioned that "*Our Barangay Captain constructed a Materials Recovery Facility (MRF) where we are expected to dispose of our segregated wastes from 4:00pm to 8:00pm.*" This suggests that community residents will conform to the desired behavior when effective systems and structures are in place. Similarly, participants also noted a significant reduction in waste and that a majority no longer burn their waste. These positive practices may be due to the opportunities brought about by the community training program, where they were taught various ways to reduce waste, like composting for gardening and developing products for livelihood. Composting has been long acknowledged as an effective means to reduce the volume and weight of solid wastes while yielding meaningful revenue [25]. For example, when participants were asked what they benefitted from the program, one responded, "*It's the gardening because we can really make use of it, and we can get produce*", another also mentioned that "*We don't have anything else to say but we are thankful to our Barangay Captain and to USTP that they gave us free livelihood training that did not Only help us but also our community*." This highlights the positive impact of the training in terms of household practices in solid waste management.

Participants also noted that they segregate their wastes at source and that they have a good solid waste collection and disposal facility. However, they don't have a specific waste collection system. This is understandable since household solid wastes are no longer collected door-to-door but are brought to the Barangay MRF. This is clearly explained by one participant when she said that "*We segregate our own household wastes and bring it to the MRF, and they check if it is really segregated correctly before they accept it.*" In addition, at-source segregation allows for easy extraction of recyclable materials, reducing the occupational hazards of waste segregation [26].

Table 2. Household Practices in Solid Waste Management

Household Practices	Frequency	Percent
1. What are the typical components of your household solid wastes?		
A. Food leftovers and food waste	14	50.00%
B. Plastic, beverage cans, glass and bottle	14	50.00%
C. Metal, leather, and textile	-	
D. Paper and cardboard	-	
2. How do you get rid of solid wastes from home		
A. Dump in backyard with sacs	-	
B. Dumped along roadsides or in canal	1	3.60%
C. Dumped in disposal site	27	96.40%
D. Buried in the soil	-	
3. How are the content and volume of solid waste changes from time to time in your community?		
A. Increased	3	10.72%
B. Decreased	23	82.14%
C. No change	2	7.14%
4. Do you burn your solid waste?		
A. Yes	-	
B. No	26	92.86%
C. Sometimes	2	7.14%
5. If you answered yes or sometimes above, what is the frequency of burning your household solid waste?		
A. Daily	-	
B. once in two or three days	-	
C. Weekly	-	
D. Monthly	4	14.28%
6. How is the collection and disposal service of solid waste provided by the city?		
A. Good	21	75.00%
B. Satisfactory	7	25.00%
C. Poor	-	
7. Do you separate solid wastes before disposal?		
A. Yes	28	100.00%
B. No	-	
8. Do you practice reduce, reuse and recycle strategy for SW or not use 3R?		
A. Reduce by compost preparation (R-1)	11	39.29%
B. Reuse (R-2)	8	28.57%
C. Selling for recycling business (R-3)	9	32.14%
D. Burn (Not use 3R)	-	
9. Are there adequate solid waste landfills or dumping sites in the town?		
A. Yes	27	96.40%
B. No	1	3.60%
10. Do you have access to door-to-door waste collection service?		
A. Yes	6	21.42%
B. No	22	78.58%

These positive practices may also result from enabling systems imposed in the community. For example, positive incentives are implemented in the Barangay as noted by a participant that "When the Barangay won in the city-wide contest, the Barangay Captain used the prize money to buy rice and distributed it to residents", another participant commented that "it is a way of returning goodness to the people", which in return motivates them to segregate wastes. Incentives or any form of reward have long been noted to encourage community participation in waste segregation [27]. Aside from the rice that the community provided, the community also practiced other forms of reward. One participant noted that "*when residents participate in the waste segregation, a waste slip is given by the Barangay Captain and is noted in the logbook. Once a resident needs certain documents in the barangay [i.e., barangay clearance, community tax, etc.], the Barangay secretary reviews the logbook for conformance. Those who did not participate must explain where they disposed of their wastes".* While incentives are important, it is also essential for the residents to realize that the greatest motivation for waste segregation is to enjoy a clean environment and a prosperous, healthy lifestyle for present and future generations [28].

Table 3 shows how the participants utilize the knowledge they have gained from the project in their day-to-day lives. As shown, all participants agree that they utilize the knowledge gained in their day-to-day lives through reducing waste, recycling, proper waste disposal, and developing products from waste by upcycling. Similarly, participants also noted increased income through selling upcycled products and vegetables from their gardening projects. These highlight the potential of community projects on solid waste management to help the participants improve their lives.

Community involvement is another means of using the knowledge they gained from the training. Several participants mentioned that *"they take turns in manning the MRF and check whether our neighbors segregate their wastes correctly."* In this way, participants are involved in segregating waste and ensuring this practice's sustainability by having an enabling system. Aside from engaging them, they also apply their knowledge meaningfully

Table 3. Use of Solid Waste Management Knowledge in day-to-day life

Uses of SWM Knowledge	Frequency	Percent
1. Do you use the knowledge (solid waste management and livelihood) gained from the training in your day-to-day life?		
A. Yes How?: *reducing waste, recycling, proper waste disposal, develop products from wastes by upcycling*	28	100.00%
B. No	-	
2. Do you use the knowledge (solid waste management and livelihood) gained from the training in your workplace?		
A. Yes How?: *recycling and waste segregation*	23	82.14%
B. No	-	
3. Has your learning gained from the training helped you get promoted in your job or increased your day-to-day income?		
A. Yes How?: *making and selling products, by composting and planting and selling vegetables*	22	78.58%
B. No Why?: *Only use the knowledge at home*	2	7.14%
4. Has your learning gained from the training helped you develop livelihood products?		
A. Yes How?: *making wallets from recycling, planted vegetables for selling*	22	78.58%
B. No	2	7.14%

4. Conclusions

Environmental education plays a positive role in improving people's awareness of the benefits of recycling and reducing waste. As such, this study investigated the knowledge, attitudes, and practices and explored the benefits derived from a community environmental education program conducted by the USTP-DEST. Results demonstrated that community residents possessed sufficient knowledge and desirable attitudes and practices toward solid waste management. In addition, participants also reported the importance of incentives, community involvement, and political will toward strengthened waste segregation at source. These may be due to the different livelihood activities provided in the program. Participants also reported that they could learn container gardening with the use of food waste as compost material. The residents also produced several recycled products using food wrappers, which they sell and derive additional income. These results demonstrate a positive impact on the lives of the community residents due to a community-based environmental education campaign. While the results provide meaningful clues on the impact of community-based programs, caution must be taken in interpreting the findings due to methodological limitations. Firstly, a descriptive study was conducted, which may not conclusively establish the development and improvement of waste segregation knowledge, attitudes, and practices. Secondly, the sample size for the quantitative phase was limited only to those who were available during the data collection and may not cover the whole picture of the said community. Finally, while the study had some limitations, critical practical implications for improving community-based environmental education programs can still be derived.

Acknowledgments

The authors would like to acknowledge their immense appreciation to the University of Science and Technology of Southern Philippines for the funding received for this project. The same gratitude is also expressed to the administration of Barangay 22, Cagayan de Oro City, for their strong support and permission to conduct this study.

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