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## RESEARCH ARTICLE

# AN EVALUATION STUDY ON FACE MASK WASTE MANAGEMENT OF BARANGAY SIMALA, SIBONGA, CEBU

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## ARTICLE DETAILS

## ABSTRACT

## Article History:

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This study assessed the level of awareness of the National and Local Ordinance among households and LGU personnel, as well as the management of face mask wastes in Barangay Simala, Sibonga Cebu, taking into account the waste segregation, waste collection, and waste disposal. The researchers used the descriptive quantitative design and the research tool that included the modified semi-structured survey questionnaire for the profiling of respondents and checklists to assess the awareness and compliance in terms with the National and Local ordinance of waste management. The statistical analysis of the data gathered from this study showed that respondents are only partially of Ecological Solid Waste Management Act and is aware of Municipal Waste Management System. Furthermore, the level of compliance for waste segregation and waste disposal are always satisfactorily practiced. On the other hand, waste collection is only occasionally practiced by the respondents. Based on the outcomes of the study, it can be stated that the waste management of face masks in Barangay Simala is satisfactory but, in terms of waste collection, Barangay Simala may be regarded as acceptable, given that not all residences are accessible to the garbage collector for waste collection.

## KEYWORDS

Covid-19 Pandemic, Household Waste, Microplastics, Personal Protective Equipment (PPE), Plastic pollution, Solid waste, Waste Management

## 1. INTRODUCTION

Fertilizers are any organic or inorganic materials of natural or synthetic The world is facing a major crisis because of the coronavirus disease 19 (COVID-19) outbreak (Shereen et al., 2020). To combat COVID-19's spread and health risks, the World Health Organization (WHO), the US Centers for Disease Control and Prevention, the National Centers for Disease Control, and local governments have issued several guidelines, including frequent handwashing, social distancing, and quarantine (home, local, and state quarantine). Medical personnel and the general public should wear personal protective equipment (PPE) such as surgical or medical masks, non-medical face masks (including various types of self-made or commercial masks made of cloth, cotton, or other textiles), face shields, aprons, and gloves, according to these institutions (Peng et al., 2020).

Among the PPEs, face masks are the most widely used and discarded personal protective equipment (Torres et al., 2021). Millions of contaminated PPEs (e.g., facemasks and gloves) would end up as waste, posing environmental and health risks if improperly managed (Kamph et al., 2020). Improperly disposed face masks can cause a disease outbreak as they can serve as a medium for spreading of microbes such as invasive pathogens (Thuvi, 2021). Mismanagement of such materials threatens the environment with a new form of plastic pollution (Torres et al., 2021).

As the spread of disease worsened worldwide, there was a rush to buy face masks, particularly the surgical type. As a result of its widespread usage, a massive amount of plastic waste has been generated (Silva et al., 2020). The use of face masks in the Philippines is predicted to be 48,967,769 times per day (Sangkham, 2020). Surgical masks are mostly polypropylene (PP), making them a source of fossil and micro-plastic pollution (Aragaw, 2020). Ultimately, plastic masks could take up to 450 years to degrade and completely disappear from the environment (MIT, 2021). Moreover, disposable face masks have been shown to leach chemical contaminants and microfibers into the environment under laboratory conditions (Sullivan et al., 2021). The pandemic, according to Silva et al. (2020), has

jeopardized legislative efforts against single-use plastics, while recycling operations have been halted owing to the danger of transmission (Zambrano-Monserrate et al., 2020). In light of this situation, a call has been made for proper waste management concerning face masks in order to save the environment.

Little is known about the present development and consequences of face mask waste. Face masks are a looming environmental hazard and as IE students, we are expected to recognize, evaluate and control hazards. Thus, this study intends to evaluate the management of used face masks in Barangay Simala during the COVID-19 pandemic and recommend appropriate solid waste management policies and strategies.

This research makes use of E. R. Pongrác, P. S. Phillips, and L. Keiski's Theory on Waste Management (2004) which examines the study of waste, waste-related activities, and a holistic view of waste management aims.

## 2. METHODS

This study employed the descriptive research design in evaluating the face mask waste management of Barangay Simala. This design is used since the goal of the study is to evaluate the current situation of the management of used face masks in the community.

This study took place in Barangay Simala. Simala is one of the 25 barangays of the municipality of Sibonga, in the province of Cebu that is within Region VII in the Central Visayas area. The household population of Simala in the 2015 Census was 3,023 broken down into 750 households or an average of 4.03 members per household. The barangay has coastal and rural areas.

The population of Simala grew from 2,098 in 1990 to 3,388 in 2020, an increase of 1,290 people over the course of 30 years. The latest census figures in 2020 denote a positive growth rate of 2.41%, or an increase of 363 people, from the previous population of 3,025 in 2015.

The respondents of the study were the residents of Barangay Simala. Two hundred eighty households of 836 households in Barangay Simala will serve as the number of samples that was calculated using Yamane formula with a 5% margin of error, the ideal sample size is calculated to be 264 respondents.

A checklist was provided to assess the awareness and compliance in terms with the National and Local ordinance of waste management and a modified semi- structured survey questionnaire will be utilized.

**2.1 Statistical Treatment of Data**

The research study used the following statistical formula to quantitatively interpret the result of the data that will be gathered:

Frequency Count and Simple Percentage. This was used in determining the types and amount (by product) of face masks waste generated in each households of Barangay Simala.

Formula:

$$\text{Percentage} = (\text{Value} / \text{Total Value}) \times 100$$

Mean. This was utilized in determining the average level of awareness of the respondents on face mask waste management and average level of compliance on waste management practices of each households as to collection, segregation, and disposal.

Formula:

$$x = \frac{\sum fw}{N}$$

where:

$\sum$  = summation w = weighted assigned to each score

f = frequency N = total number of respondent

$\bar{x}$  = weight

**3. RESULTS AND DISCUSSION**

**3.1 Section 1: Demographic Profile of Barangay Simala**

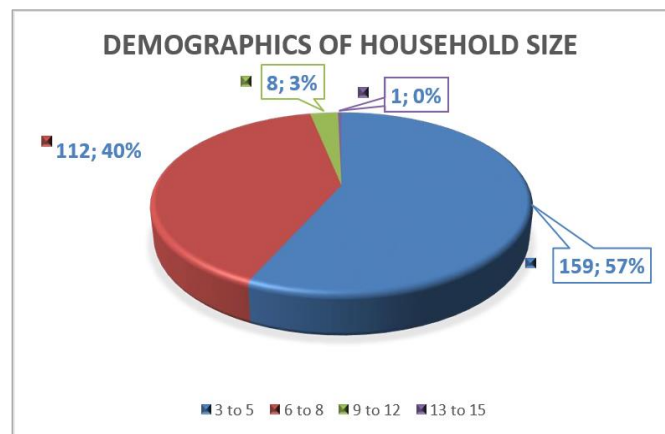
In Barangay Simala, there are a total of eight (8) sitios and (836) households. The researchers invited 35 household respondents in each sitio to participate in the study. This study involves 280 households obtained using Yamane formula.

**3.2 Section 2: Demographic Profile of the Respondents**

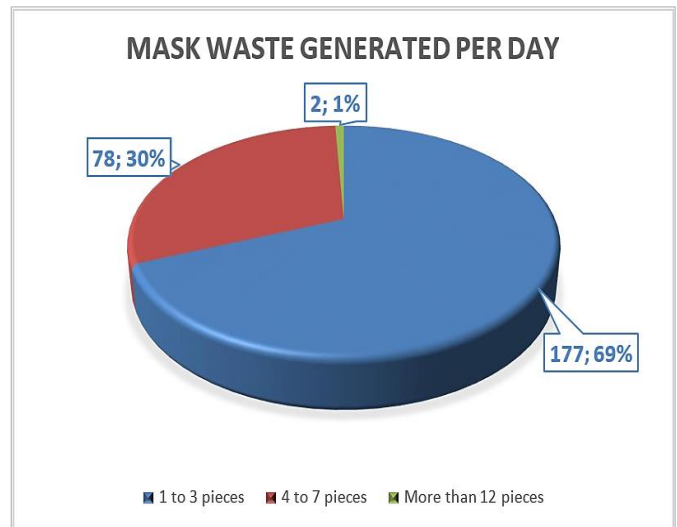
Figure 1 presents an uneven pattern of the statistical distribution of the number of members per household, with 3 to 5 being the most common household size having 57% of the responses. The results also indicated 40% and 3% among the household sizes of 6 to 8 and 9 to 12 members per household, respectively. This means that among the 280 household respondents, 159 households has an average of 3 to 5 members.

**3.2.1 Average no. of Face Masks Used Per Day**

Figure 2 reveals that among the 280 households, 69% generates 1 to 3 pieces of face mask wastes a day and 30% generates 4 to 7 pieces per day. On the other hand, only 1 % of the total households respondents generates more than 12 pieces a day.



**Figure 1:** Average Household Size of Barangay Simala

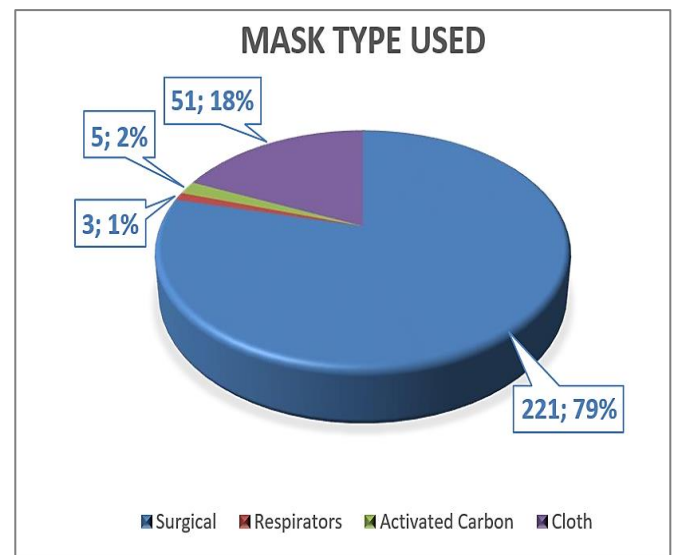


**Figure 2:** Mask Waste Generated Per Day

**3.2.2 Mask Type Used**

The types of masks used varied from Respiratory or KN95 masks, medical surgery masks, cotton masks, and activated carbon masks. As indicated in Figure 3, 79% used medical surgery masks and 18% of respondents wore cloth masks. Other types were used extremely infrequently in comparison to the first two.

Since the evaluation was conducted when covid-19 protocols are not that strictly implemented. Medical surgical masks, on the other hand, were considerably much easier to be purchased. Other types of masks were not favored. The KN95 masks can effectively restrict aerosol transmission, but they are more expensive and inconvenient to wear for extended periods of time. Furthermore, The major benefit of wearing face masks, according to the U.S. CDC, is to prevent the transfer of droplets from infected people and to give individuals with a psychological indication of social distancing. Surgical masks might perform as well in this sense, despite their lower filtering effectiveness when compared to KN95.



**Figure 3:** The Percentage of Usage of Different Types of Masks

**3.2.3 Mask Cleaning and Reuse**

According to the results of the cleaning and re-use questions, 90% of respondents were concerned about environmental pollution caused by abandoned masks. Surprisingly, 72% of respondents agreed with washing and reusing the masks, whereas just 18% of responders cleaned masks as reflected in Figure 4. This shows that the concept of mask reuse has gained widespread acceptance. Of respondents who cleaned and reuse face masks, 83% of them reused cloth masks while 15% cleaned and reused surgical masks. The remaining 2% cleaned Respirators or KN95/ N95 masks and Activated carbon masks.

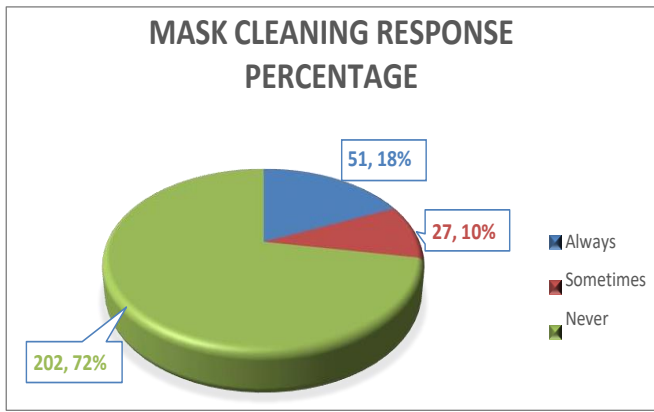


Figure 4: Distribution for Mask Cleaning and Reuse

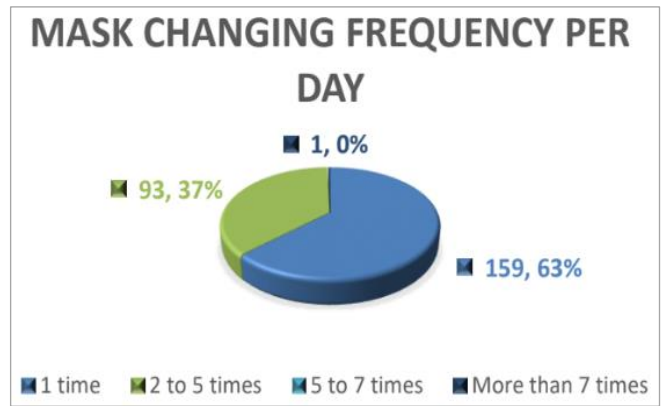


Figure 6: Distribution for mask changing based on using frequency

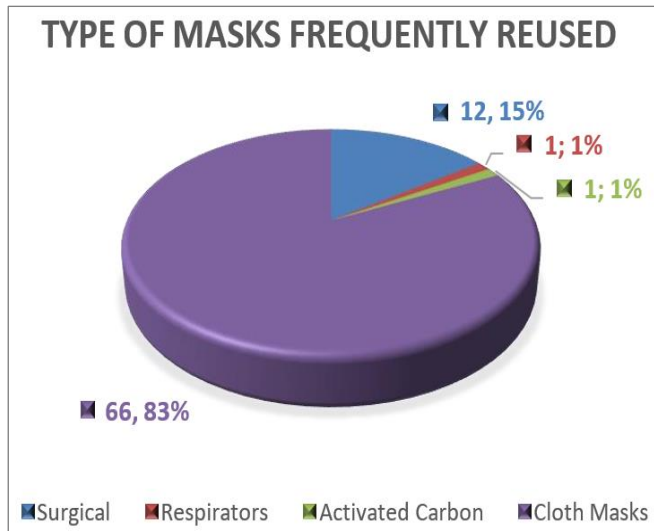


Figure 5: Distribution on Type of Facemask Frequently Reused



Figure 7: Distribution for mask changing based on length of using time

3.2.4 Mask Changing Frequency and Conditions

Figure 6 reveals that 63 % of the respondents changed masks after wearing them only once, whereas 37 % changed after wearing them 2-5 times. Figure 7 demonstrates that 53 % of respondents who changed masks based on usage duration changed after using for one hour. The primary overlap between the two groups of results indicated that one-time usage would be comparable to one hour of accumulated usage and 2 to 5 times usage would be equivalent to one to four hours of accumulated usage, implying the average wearing duration for each mask. This study also revealed that most people would discard waste masks after only one usage, particularly in "risky" circumstances such as crowded areas and public transportation as reflected in Figure 8.

Furthermore, the answer to the question "after visiting which location would you quickly change your facial mask" in Figure 8 illustrates that individuals are typically aware of places with a large population density or a higher risk of infection. The risk factors stated above are clearly present in public transportation, and areas where people gather.

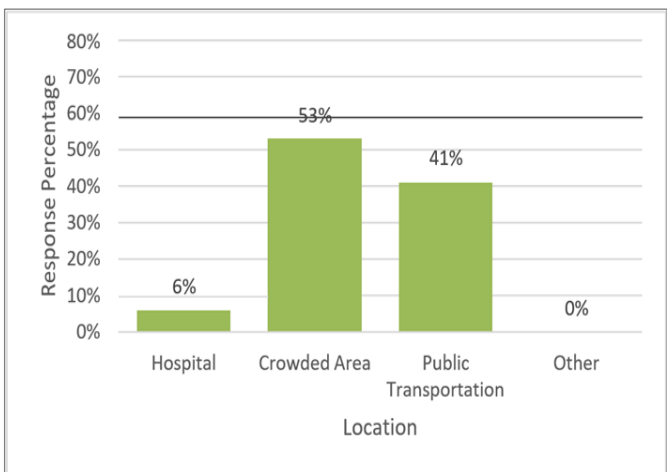


Figure 8: Immediate Mask Changing after visiting certain places

3.2.5 Face Masks Used Per Type of Face Masks

Table 1: Face Masks Used Per Type of Face Masks					
Types of Face Masks	Frequency of Usage	Daily Face Mask Waste		Monthly Face Mask Waste	
		Minimum	Maximum	Minimum	Maximum
Surgical Masks	221	685	1155	20 550	34 650
Respiratory or KN95 masks	3	9	15	270	450
Activated carbon masks	5	18	30	540	900
Cloth masks	51	-	-	-	-
<b>TOTAL</b>	<b>280</b>	<b>712</b>	<b>1 200</b>	<b>21 360</b>	<b>36 000</b>

Among the (280) household respondents, (221) used surgical masks, (3) respondents used Respiratory or KN95 masks, and (5) used activated carbon masks. While (51) respondents utilized cloth masks.

As shown in the table, the minimum amount of face masks waste generated in a month per per type of face masks is 21, 360 pieces while the maximum amount generated is 36, 000 pieces. In a year, there will be 256, 320 pieces to 432, 000 pieces of face mask waste in Barangay Simala, Sibonga, Cebu.

3.2.6 Methods of Face Mask Waste Disposal

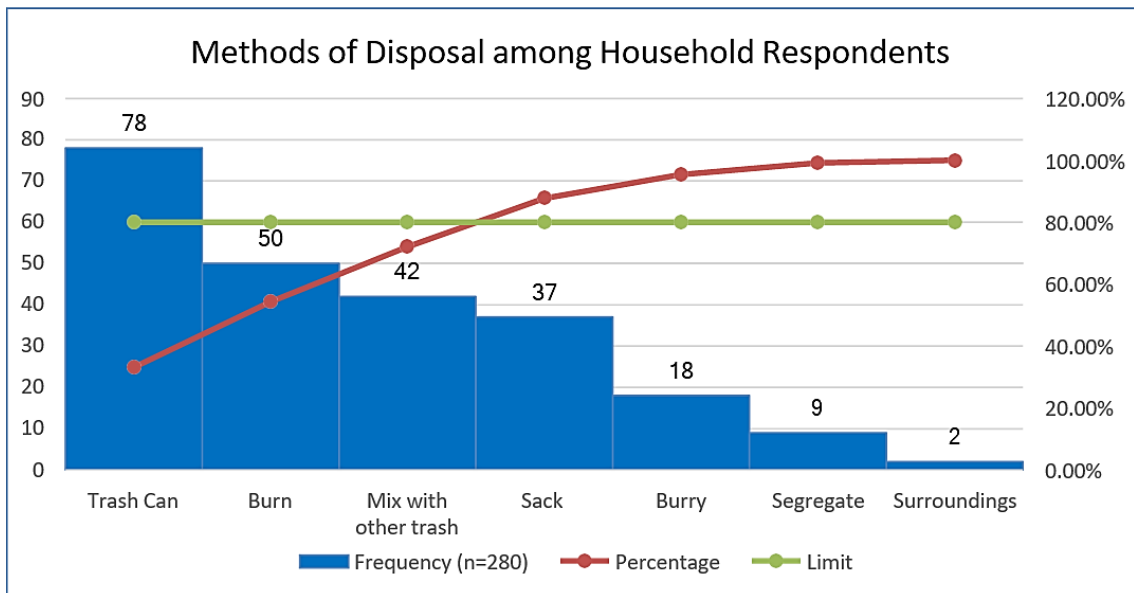


Figure 9: Methods of Face Mask Waste Disposal

As shown in Figure 9, out of two hundred-eighty (280) respondents, 27.86% put their face masks waste in trash cans. Also, 17.86% burn their face mask wastes. And, 15% of the respondents mixed their face masks wastes with the other trash. On the other hand, 0.71% discarded their face masks waste in the surroundings. The top three methods of face mask waste disposal particularly trash can, burning, and mixing with other trash were considered in creating the recommendations of the study.

Many of the masks appeared to be surgical face masks, which are frequently made primarily of the plastic polypropylene. According to Forster (2021), Polypropylene is widely used because it is also considered "food safe" and is found in a wide range of plastic food packaging. However, when many types of plastic are burned, they emit a large amount of toxic and harmful chemicals.

3.3 Section 3: Level of Awareness to the National and Local Governance Ecological Solid Waste Management Act

The respondents were ask to rate their level of awareness. The average level of awareness regarding the Ecological Solid Waste Management Act in Barangay Simala is 1.59 as shown in table 2. While, the average level of awareness regarding the Municipal Solid Waste Management System among respondents is 2.76 as shown in table 3. This signifies that Barangay Simala is only partially aware of the National Ordinance for RA 9003, and cognizant of the Municipal Solid Waste Management System's Local Governance.

Sentiment Level	Numerical Value	Responses	Total
Not Aware	1	198	198
Partially Aware	2	7	14
Aware	3	67	201
Fully Aware	4	8	32
			<b>Mean = 1.59</b>

3.3.1 Municipal Solid Waste Management System

Sentiment Level	Numerical Value	Responses	Total
Not Aware	1	37	37
Partially Aware	2	18	46
Aware	3	210	630
Fully Aware	4	15	60
			<b>Mean = 2.76</b>

3.4 Section 4. Level of Compliance Waste Management Factors

FACTORS	Mean	Level
Waste Segregation	3.68	Always
Waste Collection	2.72	Sometimes
Waste Disposal	3.67	Always

3.4.1 Waste Segregation

The average level of compliance in Barangay Simala for waste segregation is 3.68. This signifies that Barangay Simala has always followed waste segregation regulations in their community.

3.4.2 Waste Collection

The average level of compliance for waste collection in Barangay Simala is 2.72, indicating that their waste is occasionally collected by the garbage truck.

This implies that only those that the garbage collector can reach can be collected and not all face mask waste are regularly collected. In order to stop the spread of the virus, it is crucial to collect garbage properly from homes, hospitals, and quarantine facilities (Oyedotun et al., 2020). The irregularity in waste collection could result to higher risk of infection as used face masks are probable medium for virus transmission (Thuvi, 2021).

3.4.3 Waste Disposal

The average level of compliance in waste disposal in Barangay Simala is 3.67. This signifies that Barangay Simala as a whole always used proper garbage disposal methods.

Barangay Simala has always maintained thorough waste segregation and disposal of their face mask wastes, as demonstrated in Table 8. In terms of waste collection, Barangay Simala conducted adequate waste collection on occasion.

3.5 Section 5. Possible Risk of Improper Face Masks Waste Disposal

According to the consolidated responses of the health workers interviewed, there is a higher chance of infection if the person who used it before was infected with the virus and the used face mask was improperly disposed. Face masks should be disposed of properly as they could spread or aid the SARS-CoV-2 virus (Shiferie, 2021). The health workers interviewed added that unlike surgical or medical face masks, which are being researched to limit the spread of viruses, cotton masks are thought to be ineffective because they do not have enough barriers to give us protection especially if the virus is transmitted through droplets. As to the risk brought by face mask in the environment, the health workers stated



that inappropriate waste disposal of face masks may create canal obstruction, resulting in overflowing and floods in low-lying locations.

#### 4. FINDINGS

The following findings were obtained:

##### 4.1 Demographic Profile of Barangay Simala

- In Barangay Simala, there are a total of eight (8) sitios and (836) households. The researchers invited 35 household respondents in each sitio to participate in the study. This study involves 280 households obtained using Yamane formula.

##### 4.2 Demographic Profile of the Respondents

- The most common household size is 3 to 5 members per household having 57% of the responses. The results also indicated 40% and 3% among the household sizes of 6 to 8 and 9 to 12 members per household, respectively. This means that among the 280 household respondents, 159 households has an average of 3 to 5 members.
- Out of (280) households, 69 percent generates 1 to 3 pieces of face mask waste per day, whereas 30 percent generate 4 to 7 pieces per day. On the other hand, just 1 percent of total household respondents produce more than 12 pieces every day.
- The types of masks used varied from Respiratory or KN95 masks, medical surgery masks, cotton masks, and activated carbon masks. Out of (280) households, 79 percent used medical surgery masks, whereas 18 percent wore cotton masks. Other varieties were used far less frequently than the first two.
- Out of two hundred-eighty (280) respondents, 27.86% put their face masks waste in trash cans. Also, 17.86% burn their face mask wastes. And, 15% of the respondents mixed their face masks wastes with the other trash. In addition, 13.21% put their face mask wastes in a sack that will be collected by the garbage truck to be delivered in the dump site. Eighteen (18) respondents which is equivalent to 6.43% bury their face mask wastes while 3.21% segregate it. On the other hand, 0.71% discarded their face masks waste in the surroundings.

##### 4.3 Level of Awareness to the National and Local Governance

- The average level of awareness regarding the Ecological Solid Waste Management Act in Barangay Simala is 1.59. This obviously demonstrates that respondents are only partially aware of the National Ordinance for RA 9003.
- The average level of awareness regarding the Municipal Solid Waste Management System among respondents is 2.76. This signifies that Barangay Simala is cognizant of the Municipal Solid Waste Management System's Local Governance.

##### 4.4 Level of Compliance

- The average level of compliance in Barangay Simala for waste segregation is 3.68. This signifies that Barangay Simala has always followed waste segregation regulations in their community.
- The average level of compliance for waste collection in Barangay Simala is 2.72, indicating that their waste is occasionally collected by the garbage truck. This result was affected by the location of the households situated.
- The average level of compliance in waste disposal in Barangay Simala is 3.67. This signifies that Barangay Simala as a whole always used proper garbage disposal methods.
- Barangay Simala has always maintained proper waste segregation and disposal of their face mask wastes. In terms of waste collection, Barangay Simala conducted adequate waste collection on occasion.

##### 4.5 Possible Risk of Improper Face Masks Waste Disposal

- According to the cumulative responses of the health workers surveyed, there is a greater risk of infection if the individual who used it before was infected with the virus.

- Infectious waste is classified as any substance suspected of containing pathogens (bacteria, viruses, parasites, or fungus) at a concentration or amount sufficient to cause disease in susceptible hosts. Waste polluted with blood, body fluids, tissues, organs, and sharp objects is also included. According to public health experts, carelessly discarded masks might be a source of the infection if individuals come into touch with them. Poor and insufficient waste management techniques in poorer and least developed nations contribute to a higher risk of COVID-19 community transmission.

#### 5. CONCLUSION

Based on the research findings, it can be concluded that the waste management of face masks in Barangay Simala is satisfactory because, prior to conducting this research study, a seminar was held in Argao and Purok leaders were required to attend and disseminate the information to their members. It was discovered that, in terms of waste collection, Barangay Simala may be regarded as acceptable, given that not all residences are accessible to the garbage collector for waste collection. The findings also revealed that inappropriate waste disposal of discarded face masks poses a health concern since individuals do not know if the person who used the mask before it was disposed of was infected with the COVID-19 virus.

#### 6. RECOMMENDATIONS

For future researchers, the location of the household should be taken into account in order to fully examine the face mask waste disposal each Sitio. Also, consider the amount of face mask wastes generated of the household per Sitio to improve the policies and strategies proposed in this study. Furthermore, future researchers should consider evaluating the face mask waste manage of other barangays in the Municipality of Sibonga.

This section also provides the proposed policies and strategies for Barangay Simala to properly manage their face mask wastes.

#### 7. OBJECTIVES

The proposed policies and actions for Barangay Simala are intended to address the environmental and health concerns caused by face mask wastes.

Futhermore, the changes aim to the following objectives:

- To lessen the harm posed by improper face mask waste disposal both in the environment and health.
- To enhance the status of waste disposal in Barangay Simala.

The researchers recommend the following policies and strategies:

#### 8. POLICIES

- A new protocol called "face mask waste safe disposal," will be implemented in which residents of barangay Simala must dispose their face mask waste in a designated location and trashcan. Those who do not follow the new protocol will be required to perform community service. The barangay officials will also hold a seminar on how to properly dispose of their face mask waste.
- Households can store used face masks in sealed containers before disposing of them in red bins to waste collection vehicles, which have special bins for storing masks while transporting them to the local government (municipality or waste management service provider) in accordance with the local administration organizations' standards for proper disposal.
- Providing a sufficient number of red bins labeled 'For used face mask only' in convenient public places to facilitate easy and safe disposal.
- If there are no red bins in your neighborhood, segregating waste into distinct bags and labeling the bags holding hazardous waste is a must so that disposal personnel can dispose of them securely.
- Encourage residents to record and disclose evidence of mask littering acts to authorities in exchange for a monetary prize equal to 30% of the fines imposed on the violators.

## 9. STRATEGIES

The researcher proposed to collect the face mask wastes from households. Then the face masks will be disinfected and shredded into fibers/strips. They are then ready to be blended with processed building rubble or recycled concrete aggregate (RCA) for road-making materials.

Shredded face masks act as a glue to hold the debris particles together. The addition of randomly dispersed shredded face masks improved the stretching resistance of aggregates. The ductility, flexibility, and strength of the rubble combined with the mask fibers enhanced as a result.

Then seek for a local government or industry partner who is interested in collecting face masks and developing a road prototype.

According to the research study of Professor Jie Li, it was found that make 1 km of a two-lane road, around 3 million masks could be used in the road-making material.

Furthermore, the researchers would like to work with other researchers and industries to disinfect the masks in that specific area. Other researchers have looked into ways to sterilize the masks, and there are several methods available, including the "thermal method" and the "microwave method," both of which can kill 99.9% of viruses.

## 10. COSTING

**Table 5: Budget for Face Mask Waste Management Policies**

Particulars	Quantity	Cost Per Unit	Total Cost
Handout materials	3000	3	₱ 9,000.00
3x4 ft Tarpaulin	16	240	₱ 3,840.00
100L Trash bin	16	576	₱ 9,216.00
Food and beverage for speakers & program committee	10	130	₱ 1,300.00
Speaker fee	3	1200	₱ 3,600.00
Service charge for disseminators	5	400	₱ 2,000.00
Travel expenses for dissemination: <i>Gasoline</i>	2L	95	₱ 190.00
			<b>₱ 29,146.00</b>

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