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Research Article

Development of a Better Solid Waste Management Program for Sustainable Development in a Residentinal Subdivision

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ABSTRACT

Proper implementation of Solid Waste Management (SWM) is an essential part for the protection of the residents' health, safety and environmental quality. SWM methods have been adapted by many residential subdivisions into a more practical and effective option to establish sustainability based on the reduce, reuse, and recycle principles. This study aims to contribute a solution to the challenging operation of solid waste management in Modena Mactan subdivision (1) to comprehensively describe the homeowner's status classification and demographic characteristics, (2) to evaluate volume of waste produced and recycled waste revenue collected, (3) to recognize homeowner's perception on the current waste management status, and (4) to showcase feasible approaches for sustainable waste management program. The study applied the descriptive research design and was carried out to 93 homeowners who went through the (house-to-house) paper-pencil-questionnaire survey. Results showed that the subdivision produced an average of 33 tons or 16.974 kilograms of solid waste per household per month, and generated an amount of 1,369 PHP or 27.41 USD revenue from the segregated recyclable waste collected from August 1-28, 2021. Moreover, about 87% of the respondents found convenient and sought to change in paperless system. Conclusively, it was revealed that 74% of the respondents found the recycling incentive scheme more inclusive as a feasible approach for waste management strategy to sustain the solid waste management program in Modena Mactan subdivision, Basak, Lapu-Lapu City, Cebu, Philippines.

Keywords: *Social Science, Solid Waste Management Program, Sustainable Development, Descriptive Research Design, Philippines.*

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Introduction

Solid Waste Management (SWM) refers to the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid waste in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes. (National Solid Waste Management Strategy 2012-2016) Effective solid waste management is critical for achieving sustainable development in municipalities and societies in both developing and developed countries. (Kubota, 2020) Presently, there are various projects and activities already implemented and in-progress focusing on solving issues on the garbage disposal. The challenge that derives from the generation of waste is not just coping with the volume, but also its composition and having the ability to design and accomplish its management in an efficient and sustainable manner; waste should be disposed of in a safe way which takes into cognizance the health of environment and that of the public, while ensuring non detrimental effects on generations to come. (Ali, 2004) Sustainable development lies at the heart of our choices, whatever initiatives we would choose to take it's important that we make the decision to be a change maker in this world. (Khatib, 2011) While in developed parts of the world, sustainability encompasses ensuring that future generations are not negatively affected by environmental choices made today; for most developing countries, attention rather lies on what can be currently gained from such choices, especially from the socio- economic standpoint. (Legislature, 2001) Under section 10 of Republic Act No. 9003 or the Ecological Solid Waste Management Act of 2000, pursuant to the relevant provisions of Republic Act 7160, otherwise known as the Local Government Code, the LGUs shall be primarily responsible for the implementation and enforcement of the provisions of this Act within their respective jurisdictions. Segregation and collection of solid waste shall be conducted at the barangay level specifically for biodegradable, compostable and reusable wastes. Provided, that the collection of non-recyclable materials and special wastes shall be the responsibility of the municipality or city. The Lapu-Lapu City government, along with barangay officials, acted to intensify implementation of waste segregation to promote recycling or re-use of resources to reduce the number of waste transferred to the dump site. For this reason, Modena Mactan subdivision homeowner's association under the geographic area of Basak Lapu-Lapu City, enforced covenants agreed by its residents to strengthened its movement on garbage disposal based on its contracted deed of restrictions number 33 to segregate according its type, and started its implementation on the garbage segregation last June 2021 which initially collected used plastic bottles and containers, carton, and metals. Apparently, (Sollano, 2013) funds mostly available were in inadequate quantity to enable efficient service provision by local governments saddled with this responsibility, resulting to some subdivisions in Lapu-Lapu city have employed the services of private garbage collectors because some barangays do not have enough trucks to do the collection, hence garbage fee was added in Modena Mactan subdivision homeowner's monthly dues intended for the contracted private garbage collector. Presently, the Modena Mactan subdivision garbage collections were collected on a regular basis at least three times a week. However, (Magutu & Onsongo, 2011) households were still considered major sources of solid waste in comparison to other sources of generation such as educational and commercial institutions or the municipal (from cleaning of public places such as streets). In addition to generating a large part of the organic waste component especially food, households also generate waste such as plastic, glass, metal, paper and rags, and others which are harmful such as batteries, vehicular parts, etc. (Adeniran et al.) At first and before making decisions regarding improving the current waste practices or proposing new waste management scenarios, it is significant to have an overall perception of various aspects related to waste issues. The first and fundamental point is to know the amount and characteristics of waste generated in order to determine the most successful and efficient waste management plan. Consequently, Modena Mactan subdivision homeowner's association present

board of directors together with the residents pledged to contribute in the movement of improving its current waste practices to protect its investments. *Figure 1,* the conceptual framework displayed the three integrated cycles derived from (Watt, n.d.) the project life cycle in project management: *initial phase, planning phase, and implementation phase* in developing a solid waste management program for sustainable development in Modena Mactan Subdivision, Basak, Lapu-Lapu City, Cebu, Philippines.

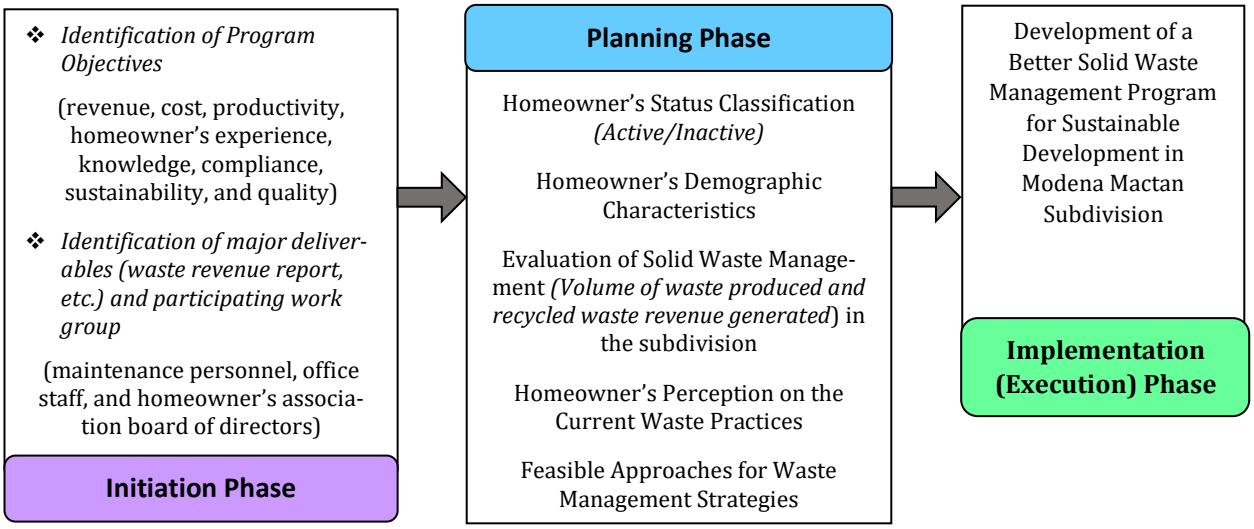

Figure 1: Conceptual Framework

Initiation Phase

Provided with the approval from the homeowner's association elected president, the program was initiated. Program objectives such as revenue, cost, productivity, homeowner's experience, knowledge, compliance, sustainability, and quality were determined. The *revenue*, will specifically look into the prospects on how homeowner's association can generate revenue out from the resident's generated recycled waste. *Cost*, will look into the possibilities on how the current homeowner's association board of directors can reduce its office supplies expense like paper and ink printer. *Productivity*, will evaluate the existing homeowner's monthly dues processing time, which main materials used are paper and ink printer. *Homeowner's Experience*, will evaluate their whole experience towards the current solid waste management set-up and how their concerns, suggestions and feedback were addressed. *Knowledge*, will evaluate existing knowledge on solid waste management and awareness on the initiatives implemented by the homeowner's association board of directors. *Compliance*, will evaluate if the current set-up of the solid waste management adheres to the standard rules, regulations and practices imposed under republic act 9003 or Ecological Solid Waste Management act of 2000. *Sustainability*, will look for opportunities on how the current homeowner's association board of directors can reduce environmental impact or improve the quality of life of Modena Mactan subdivision community. *Quality*, will find ways on how the current homeowner's association board of directors can improve the overall quality of services, processes, environment, experiences, systems, and knowledge. Moreover, needs, major deliverables and participating work groups such as maintenance personnel, office staff and homeowner's association board of directors were identified.

Planning Phase

In the planning phase, the program solution is further developed. In this phase, the researcher identified all the works to be done, making sure that activities, tasks, dependencies, and timeframes were highly observed and monitored. It includes identifying the number of active and inactive homeowners, after which a quantitative data collection was established to gather the homeowner's demographic

characteristics, perceptions, and waste reduction strategies as basis for a successful development program. The researcher verified the volume of waste produce and evaluated the garbage segregation. Furthermore, waste generated in the Modena Mactan homeowner's association office was also assessed.

Implementation Phase

During the last phase, the implementation phase, the developed program on solid waste management for sustainable development was presented to the homeowner's association board of directors and communicated to the residents of the Modena Mactan subdivision during implementation. Progress will still be constantly monitored and appropriate modifications will be made and recorded such as the recycled waste monitoring and revenue progress report as variances from the initial plan of the program through regular homeowner's association board meeting.

Objectives of the Study

This study aims to (1) to comprehensively describe the homeowner's status classification and demographic characteristics, (2) to evaluate volume of waste produced and recycled waste revenue collected, (3) to recognize homeowner's perception on the current waste practices, and (4) to showcase feasible approaches for sustainable waste management program in Modena Mactan subdivision.

Methodology

The study applied the descriptive research design. Modena Mactan subdivision's total population was composed of 214 homeowners. About 70% of the population was classified as active homeowners, and identified non-active homeowners were those who were out-of-the country or living in the provinces, repossession of property, and no updated contact information provided. Raosoft survey software was used in calculating the recommended sample size of 108 respondents based from the identified numbers of active homeowners. Initial survey was conducted through google form to observe Covid-19 preventive and control measures in the subdivision, unfortunately out of the 70% active homeowners only 13% responded in the online survey, hence, house-to-house survey was adopted. About 15% of the sample size declined and reserved their interest to participate the prepared survey. The study was carried out to 93 homeowners who willingly participated the survey targeted either to the head of the household or the spouse, and who went through the paper-pencil-questionnaire survey which was clustered and administered by blocks through convenience sampling. Most of the basic demographic and socioeconomic information was elicited using close-ended questions. The estimated total volume of waste produced report for the entire month of August was provided by the contracted private garbage collector through telephone interview. Moreover, the recycle waste revenue collected was observed and documented for four consecutive weeks. The (house-to-house) questionnaire was completed in 3 consecutive days, which comprised of homeowner's characteristics, perceptions on the current solid waste management practices and initiatives established by the current homeowner's association board of directors. Finally, data and evaluation results on the current solid waste management status were collected and analyzed with the expectation to develop a better solid waste management program for sustainable development in Modena Mactan subdivision.

Result and Discussion

Homeowner's Status Classification and its Demographic Characteristics

Modena Mactan subdivision has a total land area of 32,100 sqm and currently consists of 214 homeowners. About 149 homeowners were classified as active and 65 identified non-active homeowners who were out-of-the country or living in the provinces, repossession of property, and no updated contact information provided. As a requirement to the understanding of the environment issues related to the current waste generation in the subdivision, homeowner's demographic characteristics were considered, including *gender, age, marital status, household size, and education level.* The demographic characteristics of the sample studied were illustrated in Table 1.

Table 1. The Demographic Characteristics of the Sample Studied

n = 93 respondents	Frequency	Percentage (%)
Gender of the household head		
Male	35	38%
Female	58	62%
Age of the household head		
18 - 29	8	9%
30 - 39	38	41%
40 - 49	27	29%
50 - 59	11	12%
60 - 64	5	5%
>65	4	4%
Marital Status		
Single, never married	15	16%
Married or domestic partnership	74	80%
Widowed	2	2%
Separated	1	1%
Annulled	1	1%
Household size		
1-3	27	29%
4-6	49	53%
>6	17	18%
Education Level of the household head		
Some High School, no Diploma	3	3%
High School graduate, diploma or the equivalent (for example: GED)	2	2%
Some College credit, no degree	3	3%
Trade/Technical/Vocational Training	1	1%
Associate Degree	6	6%
Bachelor's Degree	62	67%
Master's Degree	7	8%
Professional Degree	7	8%
Doctorate Degree	2	2%

Approximately 62% of all respondents were females, and the remaining 38% were males, presented with a slight difference on survey participation on the matters of waste disposal. (Circular, 2019) In the Philippines, little variation was seen amongst litterers, binners and recyclers suggesting that both genders could be similarly targeted when attempting to change their disposal patterns. Women were more willing to learn about waste management processes. Many (more men) claimed knowledge of existing processes and although there were few variations between responses from men and women, it was noted that women were more inclined to understand and learn about what happens to the waste after disposal. Moreover, women typically managed household waste. Based on in-person interviews with collectors who interact directly with households, it was women who managed the waste in the households but men may participate in the actual handing over to a formal waste collector or the disposal process. (Handayani, 2018) Moreover, women and older people have higher probability to manage their waste compared to men and younger generation. It may be due to women tend to care more on cleanliness, health, and are more enthusiastic to do waste sorting. The highest response rate was found in the age group of 30-39 (41%), (Struk & Soukopova, 2016) which was expected that their waste generation per capita was

increasing, which would be in accordance with that these people were usually working, and thus able to consumed more, resulting in more generated waste followed by age group of 40-49 (29%), (Struk & Soukopova, 2016) which has a significant results in year 2013, suggesting that their contribution to the municipal solid waste generation was becoming higher than in case of the younger groups, and which was caused by their further extended budget due to their longer job experience. In terms of marital status, the highest percentage of respondents was married or domestic partnership (80%), followed by single, never married (16%), while the lowest percentage was of those who were widowed, separated, and annulled (4%). While results will show different analysis, it somehow relates and agrees with previous findings by (Heberlein, 1971), which suggest that married individuals litter less than single one. However, when asked *"If a better sustainable solid waste program be implemented in the subdivision, would you be willing to participate?"*, it showed that the agreement percentage was higher among the married groups compared to single, widowed, separated and annulled respondents. Overall, about 97% of the people surveyed claimed to be willing to participate in such campaign. With regard to family size, it was known to contribute importance in determining the amount of household waste, about (53%) household consisted of 4-6 people, followed with 1-3 people (29%) and more than 6 people (18%) respectively. Previous studies (Khan et al., 2016) (Trang et al., 2017) (Sankoh et al., 2012) (Senzige et al., 2014) (Sujauddin et al., 2008) (Afon & Okewole, 2007) (Hong, 1999) (Vidanaarachchi et al., 2006) (Bandara et al., 2007) (Sivakumar & Sugirtharan, 2010) (Afroz et al., 2011) (Haider et al., 2013) (Suthar & Singh, 2015) showed that household size had a positive influence on the waste generation rate. While it was apparent for more members of a family to generate more waste, some researchers described the phenomena of "group living" and "common consumption" of the family as the household operates as a unit and most of the food items were shared. Therefore, the fewer amount of food crumbs, leftovers, and packaging waste will be produced. In terms of education level of the household head, showed (67%) of the respondents earned a bachelor's degree, while (17%) earned their masters, professional and doctorate degree. The level of education was directly proportional to household waste management. (Purcell et al., 2010) argued that education was crucial to the effectiveness of waste management strategy and it potentially influences a large number of people both in short and long term. Education will increase the people's awareness and understanding of the importance of waste management. This can be prepared from early stage education and be maintained by applying it in the daily life. Previous studies by (Mwanza et al., 2018) also supported the result that better education level has positive impact on pro–environmental behavior. The result also was supported by the previous findings from (Zakianis et al., 2017) which showed that knowledge was important to influence household to separate their waste.

Volume of Waste Produced and Recycled Waste Revenue Collected

According to the information provided by MRC Trading and Services through telephone interview, the contracted private garbage collector verified that Modena Mactan subdivision produced an average of 33 Tons of garbage or 16.974 Kilograms per household per month. Waste composition analysis showed that most of the waste generated at (22%) were plastics and food waste, followed by paper (21%), tins and cans (18%), glass (8%), metals (5%), fiber bags (4%), and others (2%) like diapers, damaged slippers, shoes, rags or clothes, dried leaves, grass, pet waste, and hazardous materials. According to the surveyed respondents, about (59%) used plastic bags in collecting their waste, followed by waste basket (16%), carton (13%), and (12%) used old bucket and sack bag. And majority of these wastes were put in a plastic bag based from the (59%) of respondents surveyed. Previous studies (World Bank Group, 2021) showed that the Philippines being the third largest contributor with an estimated 0.75 million metric tons of mismanaged plastic entering the ocean every year, which has led to an increased awareness towards plastic waste management, bringing the topic

of plastic pollution to the forefront of consumer consciousness in the Philippines. (Lee, 2020) Despite the implementation of the Ecological Solid Waste Management Act in 2000, it was never taken seriously. Philippine residents were still dumping their garbage anywhere or in any way they want. While (Geyer et al., 2017) a growing number of cities and municipalities in the Philippines have passed ordinances that ban shopping bags and other single-use plastics (SUPs), these initiatives remain woefully inadequate, however, in solving the problem of plastic waste. The country lacks a national plastic policy that will harmonize initiatives and steer it towards a more sustainable, circular economy. (GAIA, n.d.) In 2019, the Global Alliance for Incinerator Alternatives (GAIA-Philippines) commission a Social Weather Stations (SWS) nationwide survey gathering Filipinos' opinions on plastics. When respondents were asked to choose the best way to solve the problem of SUPs among three options (ban the use of plastic at all times, ask the user of plastic to pay a premium, and do nothing)-pluralities to majorities opted for bans, which showed 71% for sando bags; 65% for labo bags (which are commonly used as waste container in the subdivision); 60% for sachets; and 41% for plastic water bottles. (Antonio, 2010) Many members of the older generation claimed that recycling was not new to the Filipino. This was true at the individual household level where food jars are reused, old furniture are refurbished/transformed to other uses, and even leftover lunch was "recycled" into new dinner fare. The advent of modern day lifestyles and a consumer /convenience– oriented society has however spawned a throw away mentality. But recycling was making a comeback. The recycled waste collection in the subdivision went through a four-week observation and monitoring, where it generated the sum of 1369 PHP or 27.39 USD revenue out from the recycled waste rendered by the homeowners starting from August 1-28, 2021 presented in table 2: Recycled Waste Revenue Generated.

Table 2. Rcycled Waste Revenue Generated

Week	Period	Type Of Waste	Weight (Kilo)	Amount (Peso)
1	August 1-7, 2021	Carton/ Paper Box	71	₱ 357.00
2	August 8-14, 2021	Carton/ Paper Box	72	₱ 358.00
3	August 15-21, 2021	Plastic Bottle/Plastic Container	43	₱ 430.00
4	August 22-28, 2021	Plastic Container/Plastic Detergent Bottles	14	₱ 224.00
Total Recycled Waste Revenue Generated			200	₱ 1,369.00

At present term, recycled waste collections was started on June 2021 without revenue reported, hence, all proceeds ownership was assumed directly to the subdivision's maintenance personnel. With the revenue opportunities available in recyclable waste, Modena Mactan homeowner's association board of directors and residents can possibly turn household trash to treasures provided with an all-inclusive, transparency, and sustainable program. Where in fact this method trash to treasure has been adopted already across the country, and just recently that as a starting point (GMA News, 2021) the Department of Environment and Natural Resources in the National Capital Region (NCR) has signed an agreement with Basic Environmental Systems & Technologies, Inc. best to start the trash to cashback program, which promotes proper waste segregation and disposal, also allows Filipinos to trade recyclable trash for environmental points that can be used to redeem consumer goods from program partners.

Homeowner's Perception on Current Solid Waste Management

The solid waste management has been established since the development of the Modena Mactan subdivision under King Properties, grounded from the contracted deed of restrictions number 33 to segregate according its type. It was only then on June 2021, that homeowner's association newly elected board of directors strictly enforced covenants to

strengthen its movement on garbage segregation which initially collected used plastic bottles, containers, cartons, and metals. However, 20% of the surveyed respondents were not aware and 19% showed dissatisfaction of the waste management initiatives implemented by the current administration, and about 31% described the subdivision's garbage disposal bin as rusting, inadequate, and not in good condition which has brought upsetting to the administration. The perception of the homeowners towards current performance was one of the consideration in developing a better solid waste management program for sustainable development. Although, the current administration already provided a recycled waste disposal bin, the homeowner's still hoped to have a much bigger and organize recycling container inside the subdivision and composed pit that can be used for community gardening. It was also discovered that majority of waste category produced in the MMHA office were paper and ink, for this reason, respondents found convenient and sought to change in paperless homeowner's association monthly due statement, as well as with the other documents such as request, resident's feedback, announcement, guidelines, and payments be transacted digitally according to the 87% respondents. While 13% of the respondent's disagreed to online document transaction due to the increasing concerns on digital privacy. Table 3 showed the material and energy cost incurred and process time allocated in preparing the 214 homeowner's monthly dues statement.

Table 3. Material and Energy Cost Inccured and Process

Process	Time (Hrs)	Number Of Bills Process Per Hour	Materials/ Euipment Used	Energy Consumption	Energy Cost	Material Cost
Updating/Encoding of Homeowners Association Fee (Monthly Dues Bill)	15	14.26 Bills/Hour Approx. 15 Bills Per Hour	Computer	2.25 Kw-Hr	₱ 48.11	₱ 1,177.00
Printing Homeowners Association Fee (Monthly Dues Bill)	15	14.26 Bills/Hour Approx. 15 Bills Per Hour	Computer, Printer, Paper, Ink	2.43 Kw-Hr		

The homeowner's association fees were fixed amount charged on a regular basis primarily intended to defray the administrative expenses of the association. Based from the existing process, it showed that it will take four days to manually encode and print the 214 homeowner's monthly dues statement prior signature endorsement to the board of director treasurer in-charge, which summed up five working days in completing the monthly dues statement, and has incurred P1,225.11 for energy and materials cost. Provided with paperless system, the association could save P1, 177.00 for material cost per month in processing the monthly due statement alone. Moreover, in terms of productivity, it has lessened the processing time from 4 days to 2.3 days, and labor productivity increased to (39.53%) with paperless system presented in table 4, existing and new process differences; provided that standardize email message was formulated and homeowner's email address was organized according to block classification in sending individual email.

Table 4. Existing and New Process Differences

	Process	Input (Day)	Process Time (Hr)		Output (Unit)	Labor Productivity	Difference
Existing Process	Updating/Encoding of Homeowners Association Fee (Monthly Dues Bill)	4	14.26 ≈ 15 Bills Updated Or Encoded		214 Bills	53.50	**39.53** Labor Productivity Increased for The Paperless System
	Printing Homeowners Association Fee (Monthly Dues Bill)		14.26 ≈ 15 Printed Bills				
New Process	Updating/Encoding Of Homeowners Association Fee (Monthly Dues Bill)	2.3	14.26 ≈ 15 Bills Updated Or Encoded			93.04	
	Sending Monthly Due Statement To Homeowner's Email Address (Paperless)		(41 Sec Or 0.011 Hour Per Processed Email From Time Study Technique) 2.4 ≈ 3 Hours	89.17 ≈ 90 Processed Bills Through Email			

Having the homeowner's association online collections allows the HOA office in-charge to send statements through email, which incurred little or no expense. Moreover, electronic payments can also lead to more on-time payments most especially those homeowners' who were out of the country or living in the provinces, hence, preventing late payments or lessening the identified 37% delinquent homeowner's presented in table 5, the homeowner's association monthly fee collections from January to August, 2021.

Table 5. The Homeowner's Association Monthly Fee Collections

Month	Number Of Homeowners (N= 214)		
	On-Time	Delinquent	%
January	141	73	34%
February	121	93	43%
March	145	69	32%
April	130	84	39%
May	145	69	32%
June	124	90	42%
July	139	75	35%
August	139	75	35%
	1084	628	37%

The MMHA board of directors already encountered the hardest point in solving this unfailingly growing 37% delinquent homeowners, to the extent that the community was entirely relying on assessments or dues for income to upkeep Modena Mactan subdivision facilities.

Feasible Approaches for Sustainable Waste Management Strategy

Primarily, a feasible approach for waste management strategy must be developed to sustain the solid waste management program in Modena Mactan subdivision. About 98% of the surveyed respondents agreed to the continuation of the MMHA board of director's initiative on waste segregation and 97% of them were even more willing to separate wastes into separate bags for recycling collection purposes. Figure 2 showcased the three approaches for sustainable waste management strategy, anchored from the (Cardinia) Shire of Cardinia, a local government unit in Victoria Autralia, *recycling incentive scheme, deposit refund scheme, and waste rebates and discounts* were benchmarked in this study. Based on the survey gathered, it was revealed that 74% of the respondents found recycling incentive scheme more inclusive since rewards were provided to homeowners for actively participating in the solid waste management program, followed by waste rebates and discounts with 16% where homeowners would enjoy a 50% rebates on products spent based from the waste category initiatives list, and 10% of the respondents chose the deposit refund scheme, where homeowners get refunded on the waste returned to authorize collection points in Lapu-Lapu city.

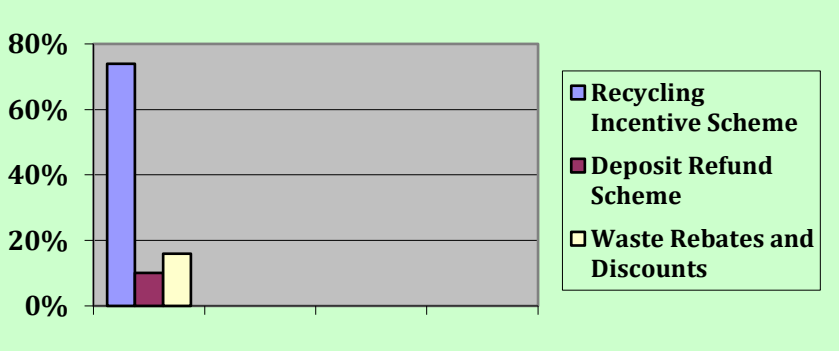

Figure 2: Feasible Approaches for Sustainable Waste Management Strategy

Solid Waste Management Program for Sustainable Development in Modena Mactan Subdivision

Based on the results presented above, the new solid waste management program for Modena Mactan subdivision was developed. Inclusiveness of the homeowner's association board of directors and residents were emphasized towards the implementation of the paperless system and recycling incentive scheme based on the determined program objectives.

The Modena Mactan homeowners were clustered by blocks, producing 11 blocks which was represented by the appointed block leader. Given with high population density in the subdivision, block leaders were given the full extent of delegation in leading, educating, and motivating members in the garbage segregation for biodegradable, non-biodegradable, and hazardous waste. As part of the system, listing and weighing of recycled waste produced by each block must be documented to establish an initial recycle waste monitoring and revenue progress report. And recycled waste materials were transferred to the designated disposal bin in the subdivision and waste monitoring report was endorsed. Record management was also observed and organized accordingly to the MMHA office. These recycled waste materials were dispensed by the subdivision's maintenance personnel in-charge, and revenue were based on the type of waste sold to the accredited recycling centers in Lapu-Lapu city. Together with the current MMHA BOD treasurer and office staff were in-charge for the distribution of waste revenue generated. Derived from the concept of profit-sharing, block leader(s) received the monetary incentive amount. As a starting point of the program, a percentage share of 70/30 rule on managing and investing money was initiated, as it was proven that genuine mutual trust and

reciprocity were the foundation of all human interaction, hence benefitting both parties according to Forbes (Gourani, 2020). Block leaders may consider various methods in the distribution of the monetary incentive share to members, including either equal share or weighted method according to the recycled waste produced by each member. This recycle incentive scheme was a pilot and self-funded incentive scheme to purely increase the number of homeowner's participation in separating and generating more recyclable waste revenue as funding source for the future solid waste management projects in Modena Mactan subdivision such as investment in color coded waste disposal bin, garden composting facility, and for hazardous waste disposal bin.

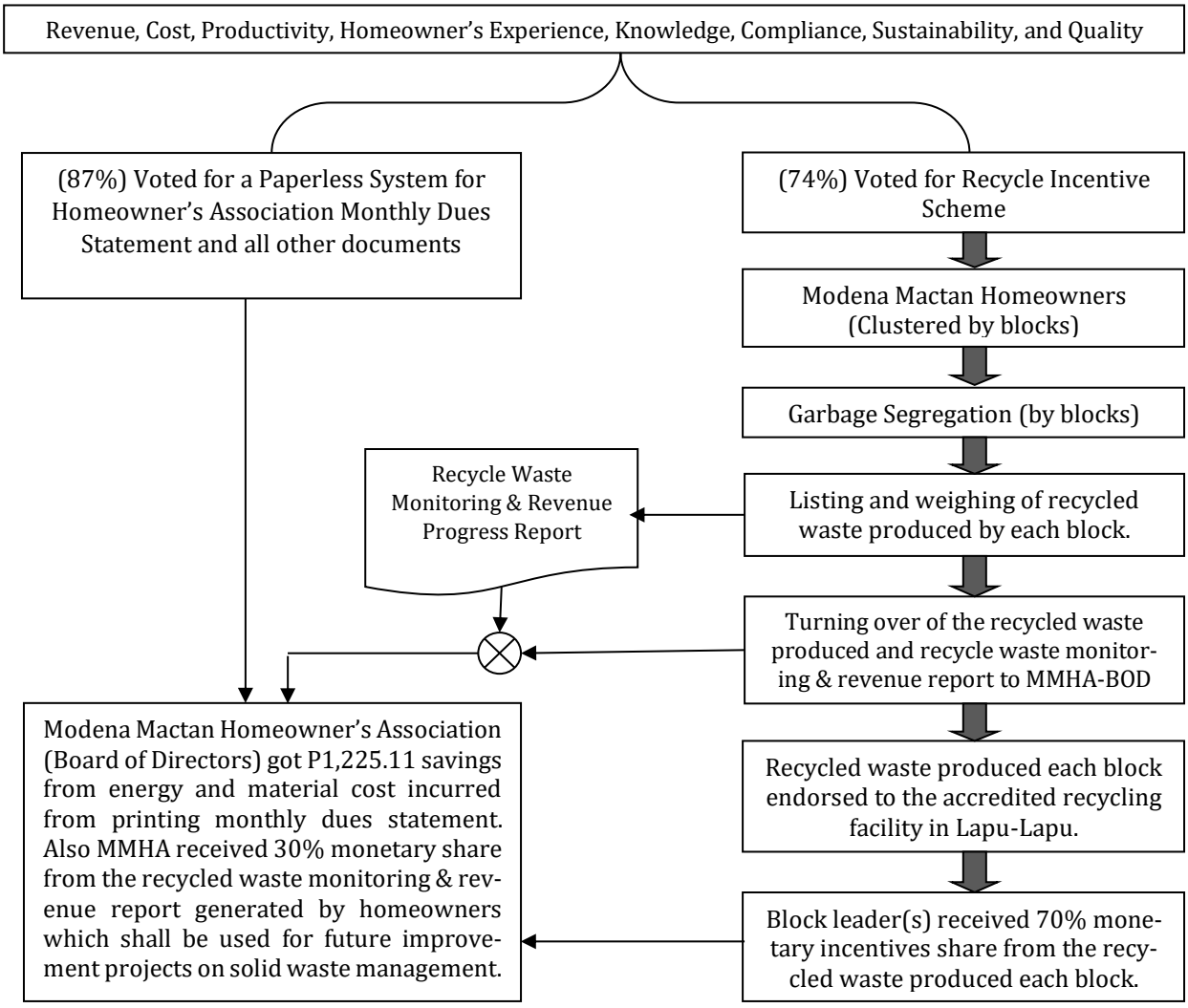

Figure 3: New Solid Waste Management Program for Sustainable Development in Modena Mactan Subdivision

Conclusion

Corresponding to other residential and high-end subdivisions in Cebu, sustainable solid waste management in Modena Mactan subdivision Basak, Lapu-Lapu city still remains a challenging task, especially when new program will be introduced and implemented. To the extent that those with changing household ownership status would be left unenlightened towards changes and/or new development in the subdivision. While it may be said that Modena Mactan Homeowner's Association (MMHA) current board of directors have been making efforts to improve current waste

management status in the subdivision, there were still a lot of untapped opportunities for sustainable solid waste management. Though higher fraction of respondents earned a bachelor's degree, the association should make everyone involved in influencing each household in promoting waste segregation regardless their educational attainment. With higher hopes for improvement, it was apparent that there were many waste management options that can still be employed and sustained. In a span of four-week observation and monitoring, and the nature and components with 16.974 kilograms of solid waste produced per household per month by Modena Mactan homeowners, and collected the sum of 1,369 PHP or 27.39 USD from recycled waste, it was evident that waste segregation at source can contribute greater revenues provided that all homeowners would participate in the movement of reducing, reusing and recycling waste. The idea of monetary incentivize on waste segregation to the active and participative homeowners was a classic motivation strategy among other private entities. Moreover, the intention of developing a better solid waste management program for sustainable development was merely to reduce waste, simplify operation process and reduce cost specifically on the monotonous production of monthly due statement, and most importantly foster and sustain a cooperative community.

Conclusively, the initial study on solid waste management provided significant insights on how continuous improvement can be made in the future, hence, heavily dependent on the leadership roles and duties of Modena Mactan Homeowners Association current board of directors and successors.

Nevertheless, further studies specifically on community garden composting in the subdivision may be worth considering, provided the secondary component contributing to waste segregation with 22% was food waste. Board of directors and local policy makers should work closely together and have a resource guide from the Department of the Environment and Natural Resources (DENR) through its Environmental Management Bureau (EMB) in tailoring a workable composting system that fits Modena Mactan homeowner's community. Also, the infusion of an electronic system of homeowner's association monthly due collections may be worth investing for one sustainable reason: The homeowner's association will be able to decrease material expenses since the HOA office in-charge won't have to spend as much on paper, ink, and postage each month. Therefore, savings can be used in other aspects of community management.

Reference

A. E. Adeniran, A. T. Nubi, and A. O. Adelopo, "Solid waste generation and characterization in the University of Lagos for a sustainable waste management," *Waste Management*, vol. 67, pp. 3–10, 2017.

A. O. Afon and A. Okewole, "Estimating the quantity of solid waste generation in Oyo, Nigeria," *Waste Management & Research*, vol. 25, no. 4, pp. 371–379, 2007.View at: Publisher Site | Google Scholar

Ali, M. (2004). Sustainable Composting: Case Studies and Guidelines for Developing Countries. Hämtat från Water, Engineering and Development Centre, Loughborough University: www.lboro.ac.uk/wedc/den 20 January 2012

Antonio, L. C. (2010), 'Study on Recyclables Collection Trends and Best Practices in the Philippines', in Kojima, M. (ed.), 3R Policies for Southeast and East Asia. ERIA Research Project Report 2009-10, Jakarta: ERIA. pp.40-70.

B.G. Mwanza, C. Mbohwa, and A. Telukdarie, Procedia Manuf. 21, 615–622 (2018)

C. K. Vidanaarachchi, S. T. S. Yuen, and S. Pilapitiya, "Municipal solid waste management in the Southern Province of Sri Lanka: problems, issues and challenges," *Waste Management*, vol. 26, no. 8, pp. 920–930, 2006.View at: Publisher Site | Google Scholar

Cardinia, https://www.cardinia.vic.gov.au/

D. Khan, A. Kumar, and S. R. Samadder, "Impact of socioeconomic status on municipal solid waste generation rate," *Waste Management*, vol. 49, pp. 15–25, 2016. View at: Publisher Site | Google Scholar

F. P. Sankoh, X. Yan, and A. M. H. Conteh, "A situational assessment of socioeconomic factors affecting solid waste generation and composition in Freetown, Sierra Leone," *Journal of Environmental Protection*, vol. 3, no. 7, p. 563, 2012. View at: Google Scholar

GA Circular., June 2019, The Role of Gender in Waste Management., https://oceanconservancy.org/wp-content/uploads/2019/06/The-Role-of-Gender-in-Waste-Management.pdf

GAIA., (January 20.)., Regulating Single-Use Plastics in the Philippines., https://www.no-burn.org/wp-content/uploads/Philippine-Policy-Brief-on-SUPs-Ban-1.pdf

GMA News., August 2021., DENR Opts for Trash-for-Cash program to promote proper segregation, disposal., https://www.gmanetwork.com/news/news/nation/798688/denr-opts-for-trash-for-cash-program-to-promote-proper-segregation-disposal/story/

Gourani, S., (August 12, 2020)., The 30/70 Rule to Gaining Someone's Trust., https://www.forbes.com/sites/soulaima-gourani/2020/08/12/the-3070-rule-to-gaining-someones-trust/?sh=7d5871aa58f4

Handayani, D. et al., (2018)., How does household characteristics influence their waste management?., https://www.e3s-conferences.org/articles/e3sconf/pdf/2018/49/e3sconf_icsolca2018_06005.pdf

Heberlein, D.A., 1971., Moral Norms, Threatened Sanctions, and Littering Behavior. PhD Dissertation, University of Wisconsin (University Microfilms No. 72-2639)

I. Haider, M. Haider, and M. Badami, "Household solid waste generation in urban Pakistan: a case study of Rawalpindi," *pakistan Journal of Urban Affairs*, vol. 1, no. 6, pp. 3–22, 2013.View at: Google Scholar

J. P. Senzige, D. O. Makinde, K. N. Njau et al., "Factors influencing solid waste generation and composition in urban areas of Tanzania: the case of Dar-es-Salaam," *American Journal of Environmental Protection*, vol. 3, no. 4, pp. 172–178, 2014.View at: Publisher Site | Google Scholar

K. Sivakumar and M. Sugirtharan, "Impact of family income and size on per capita solid waste generation: a case study in Manmunai North Divisional Secretariat Division of Batticaloa," *Journal of Science, University of Kelaniya, Sri Lanka*, vol. 5, pp. 13–23, 2010.View at: Google Scholar

Khatib, I. A. (2011). Municipal Solid Waste Management in Developing Countries: Future Challenges and Possible Opportunities. In Kumar S. (Ed.), Integrated Waste Management (Vol. II, pp. 35-51). Rijeka, Croatia: InTech.

Kubota, A., November 7, 2020, Solid Waste Management in Developing Asia: Prioritizing Waste Separation., https://www.adb.org/sites/default/files/publication/652121/adbi-pb2020-7.pdf

Lee. D, (January 2020)., Will Philippines Impose Plastic Ban in 2020? https://international.thenewslens.com/article/130236

Legislature, Republic Acts., (January 26, 2001)., Republic Act No. 9003., https://www.officialgazette.gov.ph/2001/01/26/republic-act-no-9003-s-2001/

M. Purcell, W. L. Magette, Waste Manag. 30, 10, 1997–2006 (2010)

M. Sujauddin, S. M. S. Huda, and A. T. M. R. Hoque, "Household solid waste characteristics and management in Chittagong, Bangladesh," *Waste Management*, vol. 28, no. 9, pp. 1688–1695, 2008. View at: Publisher Site | Google Scholar

Magutu, P. O., & Onsongo, C. O. (2011). Operationalising Municipal Solid Waste Management. In S. Kumar, Integrated Solid Waste Management (Vol. II, pp.. 3-10). Rijeka, Croatia: Infotech.

N. J. Bandara, J. P. A. Hettiaratchi, S. Wirasinghe et al., "Relation of waste generation and composition to socio-economic factors: a case study," *Environmental Monitoring and Assessment*, vol. 135, no. 1–3, pp. 31–39, 2007.View at: Publisher Site | Google Scholar

National Solid Waste Management Strategy 2012-2016. https://nswmc.emb.gov.ph/wp-content/uploads/2016/07/NSWM-Strategy-2012-2016.pdf

P. T. T. Trang, H. Q. Dong, D. Q. Toan, N. T. X. Hanh, and N. T. Thu, "The effects of socio-economic factors on household solid waste generation and composition: a case study in Thu Dau Mot, Vietnam," *Energy Procedia*, vol. 107, pp. 253–258, 2017. View at: Publisher Site | Google Scholar

R. Afroz, R. Tudin, K. Hanaki, and M. M. Masud, "Selected socio-economic factors affecting the willingness to minimise solid waste in Dhaka city, Bangladesh," *Journal of Environmental Planning and Management*, vol. 54, no. 6, pp. 711–731, 2011.View at: Publisher Site | Google Scholar

Roland Geyer, Jenna R Jambeck, and Kara Lavender Law, "Production, Uses, and Fate of All Plastics Ever Made," Science Advances 3, no. 7 (2017): 5, https://doi.org/10.1126/ sciadv.1700782

S. Hong, "The effects of unit pricing system upon household solid waste management: the Korean experience," *Journal of Environmental Management*, vol. 57, no. 1, pp. 1–10, 1999.View at: Publisher Site | Google Scholar

S. Suthar and P. Singh, "Household solid waste generation and composition in different family size and socio-economic groups: a case study," *Sustainable Cities and Society*, vol. 14, pp. 56–63, 2015.View at: Publisher Site | Google Scholar

Sollano, J., August 18, 2013, Some Subdivisions in Lapu-Lapu Utilize Private Trash Collectors., https://www.philstar.com/the-freeman/metro-cebu/2013/08/18/1104651/some-subdivisions-lapu-lapu-utilize-private-trash-collectors

Struk. M., & Soukopova, J. (2016)., Age Structure and Municipal Waste Generation and Recycling – New Challenge for the Circular Economy https://www.researchgate.net/publication/304527247_Age_Structure_and_Municipal_Waste_Generation_and_Recycling_-_New_Challenge_for_the_Circular_Economy

Watt, A.(n.d), Project Management : The Project Life Cycle (Phases), https://opentextbc.ca/projectmanagement/chapter/chapter-3-the-project-life-cycle-phases-project-management/

World Bank Group. 2021. Market Study for the Philippines: Plastics Circularity Opportunities and Barriers. East Asia and Pacific Region Marine Plastics Series;. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/35295 License: CC BY 3.0 IGO.

Zakianis, Sabarina, I.M. Djaja, Int. J. Waste Resour. 07, 04 (2017)