Journal of Environmental Science and Management 25-1: 1-8 (June 2022) ISSN 0119-1144

Knowledge, Attitude and Practices on Solid Waste Management Among Households in the Urban Communities of Butuan City, Philippines

ABSTRACT

Urban agglomeration in Butuan City led to issues on solid waste management (SWM). The socioeconomic profile and effectiveness of SWM programs were assessed and evaluated through a survey questionnaire. A two-stage random sampling at 95% level of confidence was employed to determine the sample size (n=427) and a 5-point Likert scale to measure the knowledge, attitude, and practices towards SWM. Key informant interviews and focused group discussions were also conducted. Respondents showed very high SWM knowledge (3.80) and attitude (4.52) which was attributed to high educational attainment and income. Majority of the respondents practice waste segregation (97.9%), reusing (83.8%), recycling (70.4%) and composting (61.3%). However, low knowledge on the location (35.6%), functionality (33.7%), and utilization (51.3%) of the materials recovery facilities was noted, an indication of low compliance by local government units to SWM laws and policies. A significant number of respondents do not practice composting (38.7%) due to lack of facilities and available space. Clustered materials recovery and composting facilities, and appropriate provisions for waste collection, storage, and disposal systems must be established and implemented. Incentive programs, awareness campaigns, and public participation are key elements of an efficient SWM system.

Keywords: *Urban, solid waste management, knowledge, attitude, practice, Butuan*

Evaristo Niño T. Cando III[1*]
Karen B. Burdeos[2]
Desiree F. Gonzales[3]
Erwin N. Arlan[2]
Sheila Rae E. Permanes[2]
Chime M. Garcia[4]

[1] School of Environmental Science and Management, University of the Philippines Los Baños
[2] Mathematics Department, Caraga State University, Butuan City, Philippines
[3] College of Humanities and Social Sciences, Caraga State University, Butuan City, Philippines
[4] College of Forestry and Environmental Science, Caraga State University, Butuan City, Philippines

*Corresponding author: etcando@up.edu.ph

INTRODUCTION

Urban agglomeration is directly correlated with economic growth and efficiency. Globally, economic and service-oriented activities are largely concentrated in cities and urban districts providing opportunities, jobs, and innovation. In Southeast Asia (SEA), metropolitan and mega-urban districts characterized by industries and commerce have emerged particularly in Malaysia, Indonesia, Thailand, and the Philippines. In 2015, urban agglomeration in the Philippines reached approximately 51.73 million population (51.2%) and was projected to increase by as much as 102 million population (65%) by 2050. While urban agglomeration improved the economy and reduced poverty in the SEA region, it also resulted in issues concerning congestion, pollution, and waste generation (*World Bank Group 2017*).

The Ecological Solid Waste Management Act of 2000 (R.A. 9003) provided the legal basis for the formulation of a systematic, comprehensive and practical approach to solid waste management for local government units (LGUs) in the Philippines. It covered not only the social, economic and technological aspects but also the political and administrative components of solid waste management. It mandated the formulation of a National Solid Waste Management Framework (NSWMF) which provided guidelines and standards for local government units (LGUs) in formulating their 10-year ecological solid waste management (SWM) plans as well as the conduct of a waste analysis and characterization study (WACS) necessary to determine the city/municipality's waste generation projections. These programs are intended to facilitate efficient and participatory SWM planning, monitoring, and implementation (*NSWMC 2015*).

Butuan City, the capital of Caraga Region in Northeastern Mindanao, has an estimated population of 337,063 with an annual growth rate of 1.6% (*PSA 2015*). The increasing population is largely attributed to the growing economic activities and high level of commercialization in the city's central business district. Consequently, urban agglomeration and population increase brought issues associated with SWM at the

community level. This was worsened by insufficient funding from the internal revenue allotment (IRA) of the city for SWM management programs, projects, activities and policy enforcement.

A 10-year projection from the waste analysis and quantification study (WAQS) (2019-2029) revealed that an estimated 354,953.73 kg of wastes will be generated in the urban areas by the year 2029. This will result in a 100% increase of generated wastes within a decade if urban development will remain unregulated and unplanned. Meanwhile, this projection also showed that the current capacity (74,528 m^3) of the city's six ha sanitary landfill facility (SLF) in Barangay Dumalagan could not accommodate such a quantity of wastes within the next 5-10 years. An approximately 3.91 ha of land per year is required to manage and dispose of such waste (*Butuan CENRO 2019*).

In the past years, the SWM program of the city was regarded to be ineffective and inefficient since it is focused only in mixed-waste collection and final disposal (*Butuan CENRO 2020*). The proliferation of illegally-dumped mixed waste and backyard burning despite the existence of SWM-related local ordinances and policies (anti-littering, anti-illegal dumping, segregation at source, waste segregation and waste burning) are indicators of the urban population's level of awareness, appreciation, behavior and compliance to the city-wide SWM program (*Butuan CENRO 2020*). As a solution to this emerging SWM problem, apart from providing SWM equipment and infrastructure, the inherent characteristics of various stakeholders must also be assessed and examined prior to the formulation of an SWM intervention. The factors influencing the behavior of a community such as knowledge, attitude, and practices (KAP) must be thoroughly evaluated to assess the baseline levels of awareness, beliefs, and behavioral patterns about SWM prior to designing and implementing effective SWM interventions. The KAP assessment will also provide both quantitative and qualitative information on the performance of existing SWM-related programs based on its expected outcomes and impacts necessary for gap identification as well as project enhancement and modification (*Andrade et al. 2020*).

This study generally aims to describe the KAP on SWM among the households in the urban barangays of Butuan City. Results of the study can be instrumental in crafting solid waste management strategies and policies for community implementation and provide necessary solutions to this particular environmental dilemma. This will also aid in promoting the successful application of RA 9003 in the concerned communities and contribute to achieving Sustainable Development Goal (SDG) No. 12 on responsible consumption and production and SDG No. 17 that fosters collaboration and work in partnership with various stakeholders.

MATERIALS AND METHODS

Location of the Study

The study was conducted during the third quarter (July to September) of 2019 in Butuan City, a highly urbanized city (HUC) located in the central portion of the province of Agusan del Norte in Northern Mindanao. The city serves as the regional economic center of Caraga Region with a total land area of 81,728 ha. It is geographically located at 8044' and 9003' latitude, and 125026' and 125043' longitude bounded on the north by the Butuan bay, on the east by the Municipality of Sibagat, on the west by Municipality of Buenavista and on the south by Municipality of Las Nieves. A total of 44 barangays (27 urban and 17 urbanizing barangays) out of 86 were considered to participate in the study (**Figure 1**).

Based on the 2015 census of population, the recorded population of Butuan City was 337, 063 with a growth rate of 1.62% per annum. The growth of Butuan City's population has consistently been driven by natural increase and net migration from 2010-2015. The proportion of urban population in the city with respect to its total population was observed to have increased by 200% which can be associated to the actual increase in the number of inhabitants and the urban-rural barangay reclassifications undertaken by the PSA. Meanwhile, rural population share was also projected to increase in the succeeding years due to the movement and expansion of residential and housing projects from the urban centers to the peripheries as well as the improvements in infrastructures that enhances transport and mobility. These suggest future reclassification of additional rural barangays as urban areas (*OCPDC 2018*).

In terms of employment, 64% or roughly 210, 351 of its population were considered in the labor force, 80.5% of which were fully and partially employed. The 11.5% unemployment contributed to the 26.1% poverty incidence of the city. This was due to the total log ban policy imposed by the national government which affected the livelihood of households relying on the operations of the wood industry (*OCPDC 2019*).

The City Environment and Natural Resources Office (CENRO), through its Ecological Solid

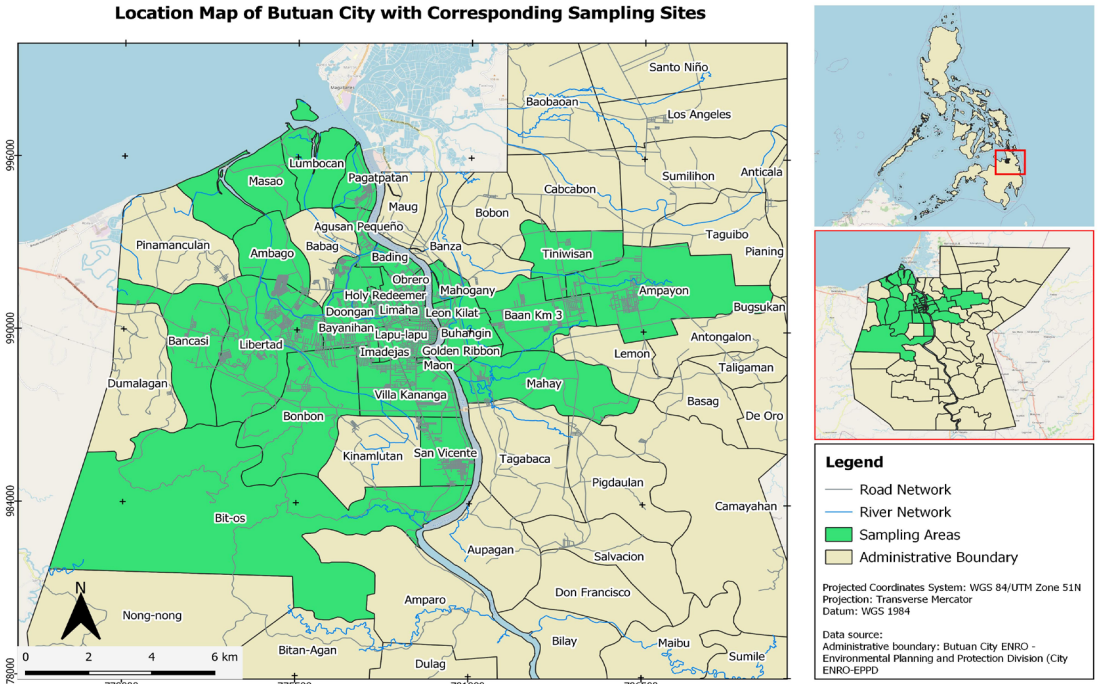

Figure 1. Location map of Butuan City with corresponding sampling sites.

Waste Management Division (ESWMD) is the office mandated to manage the collection and disposal of the city's generated solid wastes. It has a complement of 104 personnel comprising of waste collectors and truck drivers, 53 street sweepers, nine units of collection vehicles, and 1 excavator. Solid wastes in the city emanates from residential areas, public markets, commercial establishments, institutions, industrial, and tourism-related activities. The city generates an estimated 182 tons of solid wastes daily comprising mostly of biodegradable (52.31%), recyclables (27.78%), residuals (17.98%), and special wastes (1.93%). Households and establishments utilize the MRF and containers of various sizes and types to contain wastes prior to collection due to the lack of weather-resistant high-density polyethylene (HDPE) bins in strategic areas. Waste collection only covers 44 of the 86 barangays with no definite collection schedule. In addition, the city also lacks a centralized composting facility to process large volumes of organic solid wastes. These conditions favor, littering, burning of wastes, and illegal dumping (*NEDA Caraga 2020*).

Data Collection and Analysis

A two-stage random sampling design was employed to determine the number of household samples for each othe 44 urban and urbanizing barangays using the sample size formula (Equation 1) for estimating proportion:

$$n = \frac{N(z_{\alpha/2})^2 pq}{(N-1)ME^2 + (z_{\alpha/2})^2 pq} \quad (1)$$

where:
n is the sample size
N is the total number of households
za/2 is a standard normal variation with value depends on the level of confidence is set
p = q = 0.5 (gives the highest sample size), and
ME as the margin of error

From the 52,340 total number of households of the 44 urban and urbanizing barangays (*PSA 2015*), a total of 385 samples (n) was calculated using 95% level of confidence (za/2 = 1.96), p = q = 0.5, with a margin of error of 5%. However, the calculated sample size was further adjusted to avoid zero results for barangays with a smaller number of households. Using proportional allocation, the adjusted household sample size was n= 427 (**Table 1**).

A structured survey instrument was developed to assess the household's socio-economic profile while a 5-point Likert Scale was employed to measure their (1) knowledge and awareness, (2) attitude and perception, and (3) practices when it comes to solid waste management (**Table 2**). The survey instrument was pre-tested to 30 respondents prior to the survey proper. This was conducted to ensure its quality, clarity, and content validity.

Key informant interview (KII) and focused group discussion (FGD) were also conducted to obtain relevant information on the existing waste management system at the community level and to have an in-depth analysis

Table 1. Sample size allocation and proportions for urban and urbanizing barangays at 95% level of confidence.

Barangay Classification	Number	Total No. of Households*	Proportion relative to the Total No. of Households	No. of Samples	Adjusted No. of Samples
				(based on 95% level of confidence and 5% margin of error)	
Urban	27	20, 047	0.383	146	188
Urbanizing	17	32, 293	0.617	236	239
TOTAL	44	52, 340	1.000	382	427

Table 2. Five-point Likert rating scale with mean range and verbal interpretation for KAP analysis.

Range of Values (mean)	Interpretation
4.01 – 5.00	Very High
3.01 – 4.00	High
2.01 – 3.00	Moderate
1.01 – 2.00	Low
0.01 – 1.00	Very Low

on the key results of the survey. Guide questions were formulated reflecting the sectoral issues pertaining to waste management and all existing SWM policies, programs, projects and services that were being implemented by the Local Government Unit. Subsequently, SWM practices and access to various SWM facilities at the community level was also captured during the interviews. Key informants identified were the local officials comprising of the representatives from the Committee on Environment, City ENRO Ecological SWM Division and Enforcement and RegulationDivision, Liga ng mga Punong Barangay, the M&E Division of the Planning and Development Coordinator, the City SWM Board, and the City SWM Technical Working Group. Meanwhile, at most eight members from the City ENRO and five representatives for each of the following organizations: waste recycling centers, accredited environmental group, and the academe (private and SUCs) were invited as respondents for the FGD. Descriptive statistics (e.g., frequency and mean) was used to analyze the demographics and socio-economic characteristics of all household respondents. Categorical data were numerically coded and its results were expressed in percentages and proportions. SPSS Statistics package version 20 was used for all analysis.

RESULTS AND DISCUSSIONS

Demographic and Socio-economic Profile

Majority of the respondents are married (73.8%) and female (61.4%). The high number of female respondents in the survey can be attributed to the inherent gender roles and socio-economic characteristics which dictates the division of labor in most societies where males are expected to work, earn and provide for the basic needs of the family and the females are in-charge of managing the household chores and taking care of the children (*Wood and Eagly 2010*). Education level is moderately high in the urban areas of Butuan City. Most of the respondents attended college (52%) while 18.7% finished high school and 18% took vocational courses. The high educational attainment of the households is attributed to urban agglomeration factors (*Baum-Snow et al. 2018*), cost and access to education, information, educational facilities and institutions (*Hoxby and Turner 2013*) (**Table 3**).

The results of the survey revealed that most of the households (65.8%) have an average monthly income of PhP 10, 000 – 40, 000. This can be due to the positive urban agglomeration effects wherein spatial clustering of industries, commercial establishments and concentration of livelihood opportunities within the urban area are evident (*Castells-Quintana and Royuela 2014*). As a result, household income may increase due to available opportunities for employment, business, and trade (*Behrens and Robert-Nicoud 2014*). Income in urban areas can also be associated and reflected in terms of household expenditures (*Sagala et al. 2014*), privateproperty ownerships (*Oyva 2016*) and population density (*Angeles 2010*). Higher household income also correlates to desirable behaviors and perceptions towards a clean, healthy, and safe environment (*Brotosusilo and Handayani 2020*) (**Table 4**).

Knowledge on Waste Management Regulations

The LGU through the City ENRO is strictly implementing local SWM policies and ordinances in compliance with RA 9003 otherwise known as the Ecological Solid Waste Management Act of 2000. Local policies include plastic regulation, anti-littering, illegal waste dumping, waste segregation at source, segregated collection, and annual SWM seminar requirement for commercial establishments. These policies constituted the SWM Plans of constituent barangays. Prior to enforcement of these policies, massive IEC campaigns are conducted quarterly to various sectors (e.g. households, commercial establishments, industries, institutions, public markets and SUCs) (*Butuan CENRO 2020*). The awareness of urban households to existing waste management laws, policies, ordinances, and other related

issuances ranges from high to very-high (3.21 –4.19) (**Table 5**). This can be attributed to the household's high level of education and the sectoral information, education and communication (IEC) activities conducted by the Butuan City Environment and Natural Resources Office (ENRO) as mandated by Section 17(i) of R.A. 9003. The presence of higher educational institutions and environmental education programs increases environmental awareness (*Edsand and Broich 2019*).

Meanwhile, the households recorded very high awareness in terms of waste classification (96.9%), collection capabilities (93.2%) and schedule (92.0%). However, a considerable number of households were unaware of the information pertaining to the location (35.6%) and functionality (33.7%) of the materials recovery facility (MRF) within their community (**Table 6**). The high cost of construction, operation and the availability of suitable land especially in the urban areas, hinder LGUs from establishing MRFs in every barangay.

A total of 8,843 (21%) out of 42, 046 barangays in the Philippines have functional MRFs (*Castillo and Otoma 2013*).

Attitude and perception towards SWM

Assessing attitude and perception towards SWM provides qualitative information in determining the urban household's SWM choices, predicting responses to SWM-related interventions, and providing qualitative data in the behavioral process of SWM decision-making. These dimensions also identifies SWM demands with respect to household location and guide decisions related to a number of SWM infrastructure design and investment, collection and disposal schemes, waste diversion and processing, recycling, and other SWM strategies (*Swesi et al. 2019*)

On the average, the attitude and perception of urban households towards the implications of SWM on cleanliness (4.62) and public health (4.56) were very high. It should be noted that the households were fully aware that improper SWM in the community level may result to unsanitary conditions which could lead to the prevalence of illnesses and diseases (*Ejaz et al. 2010*).

Meanwhile, the importance of recycling (4.46) and proper waste disposal (4.55) among the households were also very high. The households also have a very high perception on the aspects of generating additional income (4.48) and community participation (4.52) to effectively manage solid wastes. This was similar to the observations of *Sinthumule and Mkumbuzi* (*2019*) in their study in Buluwayo, Zimbabwe wherein they concluded that incentives and benefits from SWM activities encourage the community toactively participate in waste management, making the SWM program efficient and successful (**Table 7**).

Table 3. Socio-demographic characteristics of household respondents in the urban barangays of Butuan City, Philippines (2019).

Socio-Demographic Parameters	Characteristics	Responses (f)		Total	Percent
		Urban	Urbanizing		
Sex	Male	73	92	165	38.6
	Female	115	147	262	61.4
Civil Status	Single	29	40	69	16.1
	Married	134	181	315	73.8
	Widowed	25	18	43	10.1
Education	None	5	17	22	5.2
	Elementary	3	23	26	6.1
	Secondary	15	65	80	18.7
	College	143	79	222	52.0
	Vocational	22	55	77	18.0

Table 4. Income classification and mean monthly income of household respondents in the urban barangays of Butuan City, Philippines (2019).

Income Class	Income Range (PhP)	Frequency (f)	Mean	Standard Deviation
High income	40, 001 and above	43	113,042.70	78,792.06
Middle income	10, 001 – 40, 000	281	25,784.89	15,099.04
Low income	10, 000 and below	103	6,517.69	2,216.04
Total		427		

Table 5. Knowledge on waste management laws, policies, and ordinances of household respondents in the urban barangays of Butuan City, Philippines (2019).

Number	Key Indicators	Mean Likert Score	Interpretation
1	How familiar are you with the Republic Act No. 9003, also known as the "Ecological Solid Wastes Management Act of 2000"?	3.21	High
2	Are you aware that households and non-household establishments are mandated to segregate wastes and be familiar with the segregated waste collection mechanisms (Executive Order No. 39 – 2010)?	3.92	High
3	Are you aware that households are required to construct compost pits (Executive Order No. 161 – 2007)?	3.73	High
4	Are you aware that the use of plastics bags and Styrofoam as packaging materials on selected wet and dry goods are prohibited (SP Ordinance No. 5064 – 2016)?	3.85	High
5	Are you aware that the regulation on the use of plastics gives emphasis on the utilization of eco-bags (SP Ordinance No. 5334 – 2017)?	3.76	High
6	Are you aware of the city's anti-littering policy, also known as the "Butuan City Anti-littering Ordinance" (SP Ordinance No. 3617- 2010, SP Ordinance 2380 -2002)?	4.09	Very High
7	Are you aware that illegal dumping of wastes is prohibited (SP Ordinance No. 5445 – 2017)?	4.19	Very High
8	How aware are you of the corresponding sanction of any violations of the ecological SWM ordinances and orders?	4.16	Very High
9	How aware are you of the Materials Recovery Facility (MRF) in your community?	3.31	High

Table 6. Awareness on waste collection and MRF operation among household respondents in the urban barangays of Butuan City, Philippines (2019).

Key Indicators		f	%
Do you know the location of the MRF?	Yes	275	64.4
	No	152	35.6
Do you think the MRF is operational/functional?	Yes	283	66.3
	No	144	33.7
Are you aware of the classification of wastes (biodegradable, recyclable, residual, special, hazardous)?	Yes	414	96.9
	No	13	3.1
Do you know the schedule of waste collection in your area?	Yes	393	92.0
	No	34	8.0
Is there a regular schedule of waste collection in your community?	Yes	370	86.7
	No	57	13.3
Does your barangay have a designated vehicle for waste collection and disposal purposes?	Yes	398	93.2
	No	29	6.8

Waste Management Practices Among Households

In terms of SWM practices (**Table 8**), almost all of the households practice waste segregation (97.9%). This could be the result of the segregation at source policy implemented by the LGU. However, this effort was undermined by improper waste collection and disposal strategies in the barangay level. Due to financial constraints, the barangays only utilize one unit of dump truck in the collection and transport of all types of wastes to the final disposal facility at the same schedule thus mixing the already segregated wastes. Inadequate waste practices in the community level are consequences of improper planning and zoning of cities and neighborhoods (*Mamady 2016*). On the other hand, reusing (83.8%) and recycling (70.4%) of waste materials were also practiced by a relatively high number of households. These practices enable the households to save and generate additional income out of the waste materials (*Amparado and Saladaga 2020*). Meanwhile, composting was also practiced by a considerable number of households (61.3%) to manage biodegradable wastes, while others do not practice composting due to the lack of available parcels of land within their property while others were due to lack of appropriate composting technology.

Results also revealed that only half of the households (51.3%) utilize the MRF in disposing of their recyclable waste materials. Consequently, it was found out during the FGD and KII sessions that MRF facilities are actually lacking while some were already converted to a junk shop or a common area for waste collection.

CONCLUSIONS AND RECOMMENDATIONS

The high educational attainment in urban communities and the intensified IEC campaign by the LGU contributed to the "high – very high" knowledge and awareness of households in terms of SWM laws, policies and

Table 7. Attitude and perception on SWM among household respondents in the urban barangays of Butuan City, Philippines (2019).

Number	Key Indicators	Mean Likert Score	Interpretation
1	Management of solid wastes is a big help in achieving a clean and green environment.	4.57	Very High
2	Practicing SWM saves money and energy.	4.44	Very High
3	Self-discipline on managing wastes matters a lot.	4.53	Very High
4	Internalizing SWM begins at home.	4.56	Very High
5	Community participation ensures the effective and successful implementation of SWMP.	4.46	Very High
6	Illnesses can be avoided whenever trash is properly disposed of.	4.56	Very High
7	It is a must to throw the trash into its appropriate segregation bins.	4.54	Very High
8	It is necessary to recognize and practice the importance of recycling/ reusing of wastes.	4.44	Very High
9	Wastes can be minimized through reusing, recycling and reducing.	4.48	Very High
10	There is cash in the trash.	4.52	Very High
11	Cleanliness is next to Godliness.	4.67	Very High

Table 8. SWM strategies and practices among household respondents in the urban barangays of Butuan City, Philippines (2019).

SWM Strategies	SWM Practices by Households (%)				
	Never	Rarely (Semi-monthly)	Sometimes (Weekly basis)	Often (Every other day)	Always (Daily or Regularly)
Segregation	2.1	5.9	15.4	13.1	63.5
Recycling	29.3	20.3	24.6	8.0	17.8
Reusing	16.2	26.6	28.1	11.5	17.6
Composting	38.7	14.5	18.0	9.4	19.4
Utilize MRF	48.7	6.6	17.1	8.4	19.2

ordinances. They also have "very high" attitude and perception towards the sanitary and health implications of SWM as well as "very high" regard on the importance of incorporating waste recycling, segregation at source, appropriate disposal, incentives, and public participation to ensure sustainability of any waste management systems at the community level. Strict enforcement of SWM laws, policies and ordinances must be executed. Organizing and deputization of volunteer enforcers at the community level must be explored.

Majority of the households practice waste segregationat source. However, such initiative is deemed ineffective if mixed waste collection and disposal strategies are being employed at the community level. Therefore, it is recommended that separate collection schedules for each type of wastes must be implemented. Appropriate waste collection fees must also be imposed to generate funds for maintenance and other operating expenses.

The households also generate additional income from reusing and recycling waste materials while few practice composting of their biodegradable wastes. Composting remains a challenge due to the lack of available space in urban communities. It can also be concluded that only few urban communities were compliant in establishing a standardized and functional MRF as reflected on the low awareness of urban households as to the location, functionality and utilization of such facilities in their communities. As such, the benefits from waste recycling and diversion at the community-level are not being optimized. Therefore, establishing a centralized community-based materials recovery and composting facility for clustered communities must be prioritized by the LGU.

REFERENCES

Andrade, C., Menon, V., Ameen, S., and Praharaj, S. K. 2020. "Designing and Conducting Knowledge, Attitude, and Practice Surveys in Psychiatry: Practical Guidance". *Indian Journal of Psychological Medicine*. Volume 42 p. 478-481 https://doi.org/10.1177%2F0253717620946111

Amparado, M. A. P. and Saladaga, M. K. A. (2020). Money from Wastes (Pera sa Basura) Program of a University in Central Visayas, Philippines: An Impact Study. Cebu *Journal of Business and Accountancy*, 2(1), 74-87, 2020. https://doi.org/10.31219/osf.io/4tzq2

Angeles, L. 2010. "An alternative test of Kuznets' hypothesis". *The Journal of Economic Inequality* 8: 463–73.

Baum-Snow, N., Freedman, M., & Pavan, R. 2018. "Why Has Urban Inequality Increased?" *American Economic Journal: Applied Economics* 10(4), 1-42.

Behrens, K., and Robert-Nicoud. F. 2014. "Survival of the fittest in cities: agglomeration, polarization, and

inequality". *The Economic Journal* 124: 1371–400.

Brotosusilo, A. and Handayani, D. 2020. "Dataset on Waste Management Behavios of Urban Cities in Large Cities of Indonesia". *Science Direct* 32: 106053https://doi.org/10.1016/j.dib.2020.106053.

Butuan City Environment and Natural Resources Office (CENRO). 2020. Butuan City 10-year Integrated Solid Waste Management Plan (2019-2029). City Hall Compound, Doongan, Butuan City. Unpublished.

Butuan City Environment and Natural Resources Office (CENRO). 2019. Waste Analysis and Quantification Study. City Hall Compound, Doongan, Butuan City. Unpublished.

Castells-Quintana, D. and Royuela, V. 2014. "Agglomeration, inequality and economic growth." *The Annals of Regional Science* vol. 52, issue 2, pp. 343-366.

Castillo, A.L. and Otoma. S. 2013. "Status of solid waste management in the Philippines". Paper presented at the 24th annual conference of Japan Society of Material Cycles and Waste Management. Asahikawa, Japan. 2013.

Edsand, H. and Broich, T. 2020. "The Impact of Environmental Education on Environmental and Renewable Energy Technology Awareness: Empirical Evidence from Columbia". *International Journal of Science and Mathematics Education* (2020) 18:611 – 634.

Ejaz, N., Akhtar, N., Nisar, H., Ali Naeem U. 2010. Transactions on Ecology and the Environment: Environmental Impacts of Improper Solid Waste Management in Developing Countries: A Case Study of Rawalpindi City. Wesset Institute of Technology (WIT) Press. 2010, Volume 142 p.380.

Hoxby, C., & Turner, S. 2013. "Expanding college opportunities for high-achieving, low income students". StanfordInstitute for Economic Policy Research Discussion Paper (12-014). Lister, J. 2018. There's a growing educational gap between rural and urban areas, connectivity could help solve it. Accessed from https://hundred.org/en/articles/there-s-a-growing-educational-gap-between-rural-and-urban-areas-connectivity-could-help-solve-it on 12 April 2021.

Lister, J. 2018. There's a growing educational gap between rural and urban areas, connectivity could help solve it. Accessed from https://hundred.org/en/articles/there-s-a-growing-educational-gap-between-rural-and-urban-areas-connectivity-could-help-solve-it on 12 April 2021.

Mamady K. 2016. "Factors Influencing Attitude, Safety Behavior, and Knowledge regarding Household Waste Management in Guinea: A Cross-Sectional Study". *Journal of Environmental and Public Health* vol.2016. 9305768. https://doi.org/10.115/2016/9305768

National Economic and Development Authority-Caraga (NEDA Caraga). 2020. Masterplan for Sustainable Urban Infrastructure Development in Butuan City: Final Master Plan Report. p X24-X26

National Solid Waste Management Commission. 2015. "National Solid Waste Management Status Report 2008-2014". p.38

Oyvat, C. 2016. "Agrarian Structures, Urbanization, and Inequality". *EconPapers World Development* 83: 207–30

Philippine Statistics Authority. 2015. "Population of Butuan, City". Accessed from https://psa.gov.ph/tags/popcen-2015 on 11 April 2021.

Sagala P.., Akita T., and Yusuf, A.A. 2014. "Urbanization and expenditure inequality in Indonesia: Testing the Kuznets hypothesis with provincial panel data". *Letters in Spatial and Resource Sciences* 7: 133–47.

Sinthumule, N., Mkumbuzi, S. 2019. Participation in Community-based Solid Waste Management in Nkulumane Suburb, Bulawayo, Zimbabwe. MDPI, Basel, Switzerland, p. 12.

Swesi, A. E. M., Mallak, S. K., and Tendulkar, Akalpita. 2019. "Community Attitude, Perception and Willingness Towards Solid Waste Management in Malaysia, Case Study". *Journal of Wastes and Biomass Management* 1(1): 9-14.https://doi.org/10.26480/jwbm.01.2019.09.14

Wood, W., and Eagly, A. H. 2010. Handbook of social psychology. John Wiley & Sons, Inc. 629-667pp.

World Bank Group. 2017. Philippines Urbanization Review: Fostering Competitive, Sustainable and Inclusive Cities. Publishing and Knowledge Division, World Bank, 1818 H Street NW, Washington, DC. 2017 Chapter 2, p.8

ACKNOWLEDGMENT

This research output was part of the project "Waste Analysis and Characterization Study of Butuan City" funded by the City Government of Butuan and implemented by the Butuan City Environment and Natural Resources Office (City ENRO) through the Mathematical and Statistical Computing and Research Center (MSCRC) of Caraga State University (CarSU). The author is thankful to the funder, partners – Butuan LGU and the local communities for their assistance and participation during the conduct of the study. The author is also thankful to the technical assistance provided by En.P. Jessa O. Aquino and Ms. Unice A. Roa during the development of this manuscript.