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Abstract

The study aimed to assess the effectiveness on the implementation of modified waste segregation scheme in the pilot barangays of Baliwag, Bulacan such as Barangay Tangos, Pinagbarilan and Virgen delas Flores. Quantitative descriptive and correlational research designs were used in the study. The respondents were selected among the barangays with initial implementation of modified waste segregation scheme for at least two years. Based on the results of this study, the level of awareness, attitude and practices of the respondents and significantly affect the effectiveness on the implementation of the modified scheme for waste segregation. As the level of awareness, attitude and practices of household respondent's increases, the perception on the effectiveness on the implementation of modified waste segregation also increases. Likewise, the more information drives and environmental activities conducted by the educators, the higher the level of awareness for effective implementation of modified waste segregation scheme are perceived by the respondents. Results also revealed that there was a significant difference and improvement of SWM practices of the waste segregation before and after implementation of the modified waste segregation scheme. This research has demonstrated that solid waste management awareness, attitude, and practices of households are closely linked, which suggests that one strategic approach to implement successfully a solid waste management program is education, adoption and good governance.

Keywords: *awareness, attitude, practices, solid waste management, waste segregation, household, socio-demographic profile, random sampling*

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Introduction

As the population of the Philippines increases, the generation of solid wastes also becomes higher as standard of living is enriched and advancement in urban areas are being established. Solid waste refers to all discarded household, commercial waste, non-hazardous institutional and industrial waste, street sweepings, construction debris, agricultural waste, and other non-hazardous/non-toxic waste (RA No. 9003). The disposal and management of solid wastes is a major dilemma in both urban and rural areas.

According to a report by the Senate Economic Planning Office (SEPO), the country's waste generation steadily increased from 37,427.46 tons per day in 2012 to 40,087.45 tons in 2016. Meanwhile, solid wastes produced by Philippine cities are expected to increase by 165 percent to 77,776 tons by 2025.

Due to this alarming volume of generated solid wastes in the country, the condition of the Philippine environment has reached critical proportions in relation to solid waste management especially the efficient implementation of waste segregation (Azuelo, Barbado & Reyes, 2016).

According to the Housing and Urban Affairs Ministry Swachh Survekshan 2018 results, the argument that segregation is the key for waste management was only strengthened recently with the result that segregation at source is the heart of the waste management solution. It improves collection efficiency and leads to better efficiency in processing of waste and resource recovery.

Based on a Rappler's article published on September 14, 2018 at their website entitled "Why can't the Philippines solved their trash problem?", Greenpeace Philippines campaigner Abigail Aguilar mentioned that the Philippines has a good solid waste management law, but a lot more can be done in terms of implementation. Henceforth, the implementation of the programs of the Municipal Solid Waste management must be efficient, in fact practical, socially, lawfully worthy and ecologically amicable. Strong waste administration should be strictly implemented.

Baliwag is a first-class highly urban municipality in the province of Bulacan with a population of 153,762 inhabitants in 36,091 households and considered as the economic hub in the westernmost part of the province (2017). The municipality of Baliwag, Bulacan is an active local government unit which firmly value the prioritization for environmental protection. It can be observed through their different solid waste management practices namely: Palit-Basura/May Load sa Basura, Environmental Education Seminar, Weekly Clean up Drive and Baliwag Climate Change Center.

In the initial study conducted by the Municipal Environment and Natural Resources Office (MENRO), it was shown that an average of eighty-five (85) tons of solid wastes are generated daily (10-Year SWMP). As part of the said plan, this solid waste generation of the locality will be lessened as long as the effective implementation of waste segregation at source will be fully attained. As of now, the current waste segregation is divided into two classifications: biodegradable and non-biodegradable.

In order to address this dilemma for waste segregation, the municipality of Baliwag have acquired various solid waste management strategies. However, volume of solid wastes yearly and effectivity of existing solid waste management practices should be likewise considered. This leads to the remodeling of the existing waste segregation practice into modified waste segregation scheme namely:

biodegradable, paper, residuals, plastic, glass, hazardous and others to meet the needs into a much comprehensive implementation of waste segregation in household levels which was initially implemented in three (3) pilot barangays on January 2021.

The objective of this study was to evaluate the implementation of modified waste segregation practices in the pilot barangays of Baliwag, Bulacan. The study specifically aimed to assess the awareness, attitudes, and before-and-after practices of household respondents during the implementation of the modified waste segregation scheme, as well as their perception of its effectiveness.

Materials and Methods

The researcher sought permission from the Municipality of Baliwag, Bulacan through the Municipal Environment and Natural Resources Office (MENRO) to conduct the study. A survey questionnaire was developed to gather the data needed. Face-to-face interview which covers socio-demographic profile, awareness, attitude, practices before and after implementation of modified waste segregation were collected from the respondents. A likert scale was used to measure the respondent's rating on various variables for effective implementation of modified waste segregation.

The content of the survey questionnaire was subjected to validation by a qualified statistician with expertise in survey design and statistical analysis. Prior to data collection, identified potential sources of bias and selected appropriate data analysis methods were identified to ensure the accuracy and generalizability of the study results. This rigorous process significantly improved the questionnaire's reliability and validity, ensuring that the gathered responses were of high quality and suitable for analysis. Additionally, the survey questionnaire was translated to Filipino for better understanding of the respondents.

Moreover, the respondents identified were selected from the pilot barangays of Baliwag, Bulacan wherein the implementation of modified segregation scheme was initially implemented namely: Barangay Pinagbarilan, Tangos and Virgen delas Flores. Using random sampling and Slovin's formula (n = N/(1+Ne2), a total of 362 household respondents were selected for the study.

The gathered data from the survey was collected, summarized, tabulated, and analyzed using a statistical analysis software: percentages, frequencies, and Pearson Product Moment Correlation Coefficient Test are interpreted to present significant response to the specific problems of the study. Coding of data was done to reduce lengthy responses to essential, categorized, quantified, and assigned numerical representations.

Results and Discussion

Socio-Demographic Profile of Household Respondents

The socio-demographic profile of the household respondents was investigated by the researcher in terms of age, sex, civil status and educational attainment. Table 1 below shows that the majority of the respondents were young adults (49.72%) and 241 (66.6%) of the household respondents were females dominating males. A research conducted by Van de Mortel (2008) found that female participants were more likely to respond in survey than males which is attributed by the fact that women are more receptive individuals and more likely to be home-bound, giving them more time to complete surveys.

Based on the respondents' educational attainment, majority of the respondents are high school graduates with a percentage of 46.7%. The least number of respondents which is 17 are respondents from elementary level garnering 4.7%. Several studies have shown that those with a higher level of education are more likely to participate in surveys because they are more likely to have developed strong analytical and critical thinking skills, which may make them more responsive and offer insightful responses (Curtin *et al.*, 2000).

Table 1

Household Respondents Age, Sex and Educational Attainment

Category	Frequency	Percentage
Age		
Young adult (18-35)	180	49.72
Middle-age adults (36-55)	155	42.82
Older adults (56 and above)	27	7.46
Sex		
Male	121	33.4
Female	241	66.6
Educational Attainment		
Elementary Level	17	4.7
Elementary Graduate	22	6.1
High School Level	58	16.0
High School Graduate	169	46.7
College Level	62	17.1
College Graduate	34	9.4

Awareness of Respondents on Waste Segregation

Table 2 shows that the household respondents are strongly aware on waste segregation (mean=4.29; SD=0.67). In a study conducted by Kumar *et al.* (2016), it was indicated that the majority of the household's level of awareness on waste segregation was seen to increase through education and information campaigns.

It was clearly shown that the indicator for awareness such as "Waste segregation is a social responsibility by each citizen and not just by the government" got the highest mean of 4.53; SD=0.63 with a verbal description of strongly aware.

Table 2

Awareness of Household Respondents on Waste Segregation

Awareness on Waste Segregation	Mean	SD	Verbal Description
Mandates and provisions of the Ecological Solid Waste Management Act of 2000 (RA9003)	4.10	0.73	Very much aware
Meaning, purpose and importance of waste segregation	4.41	0.61	Strongly Aware
Existing classification of waste in my municipality: bio, non-bio and recyclable	4.31	0.66	Strongly Aware
Modified classification of waste in my municipality: bio, non-bio, glass, paper, plastic, residuals, hazardous waste	4.09	0.78	Very much aware
Waste segregation is a social responsibility by each citizen and not just by the government	4.53	0.64	Strongly Aware
Schedule of modified waste segregation scheme M/Th: Bio, T: Paper, W: Residuals, F: Plastic Sat: Glass Sun: Hazardous waste	4.15	0.69	Very much aware
Municipality's environmental programs such as clean-up drive and palit-basura store	4.25	0.62	Strongly Aware
There is an organized waste disposal program in my area which is Palit-Basura Store	4.20	0.72	Strongly Aware
Meaning of 3R (Reuse, reduce and recycle)	4.48	0.61	Strongly Aware
Solid waste violators are punishable by law under RA9003	4.35	0.68	Strongly Aware
GRAND MEAN	**4.29**	**0.67**	**Strongly Aware**

Legend: 4.20-5.00 (Strongly Aware); 3.41-4.19 (Very much aware); 2.61-3.40(Moderately Aware); 1.81-2.60(Slightly aware); 1.00-1.80 (Not aware)

On the other hand, the least mean for awareness of respondents on waste segregation falls for "Modified classification of waste in my municipality: bio, non-bio, paper, plastic, residual waste" with a weighted mean of 4.09; SD=0.78 and verbal description of very much aware.

The level of awareness displayed by the respondents shows a positive outcome for the continuous conduct of information drive by MENRO since 2016 at schools and barangay level to promote and strengthen the campaign for proper solid waste management.

Attitude of Respondents on Waste Segregation

Table 3 demonstrates the attitude of the respondents towards segregation wherein the results obtained a grand mean of 4.55; SD=0.69 with verbal description of strongly agree.

Attitude indicator which pointed out that "Through segregation, environmental risks and health related concerns due to waste pollution will be prevented" garnered the highest mean of 4.65; SD=0.612 with verbal description of strongly agree.

Table 3

Attitude of Household Respondents on Waste Segregation

Attitude on Waste Segregation	Mean	SD	Verbal Description
Waste segregation is beneficial in terms of avoiding the mixing of waste in my house and to promote recycling in my community	4.59	0.53	Strongly Agree
As a duty of a responsible citizen, my friends and family believe that segregation should be done	4.60	0.54	Strongly Agree
Waste segregation at source is not a hindrance since it is not that tiring and time-consuming for me	4.48	0.57	Strongly Agree
I am willing to support processing of bio-waste through composting	4.51	0.62	Strongly Agree
In order to support the campaign for solid waste management, we must practice waste segregation at source	4.59	0.57	Strongly Agree
There are earning opportunities when you segregate wastes thru recycling or selling it to junkshops	4.63	0.54	Strongly Agree
Sacks/ nylon bags for waste collection should be provided 'free' to people	4.50	0.61	Strongly Agree
In situations that payment is necessitated, I have the willingness to pay for waste collection services	4.37	0.73	Strongly Agree
There should be available public trash bins in our area	4.58	0.58	Strongly Agree
Through segregation, environmental risks and health related concerns due to waste pollution will be prevented.	4.65	0.61	Strongly Agree
GRAND MEAN	**4.55**	**0.69**	**Strongly Agree**

Legend: 4.20-5.00 (Strongly Agree); 3.41-4.19 (Agree);
2.61-3.40(Neutral); 1.81-2.60 (Slightly Disagree);
1.00-1.80 (Strongly Disagree

Likewise, a verbal description of strongly agree was obtained in indicator such as, "In situations that payment is necessitated, I have the willingness to pay for waste collection services" which resulted the lowest mean of 4.37; SD=0.731. Almost all of the indicators focusing on attitude of respondents on waste segregation obtained a verbal description of strongly agree.

On the other hand, the least mean for awareness of respondents on waste segregation falls for "Modified classification of waste in my municipality: bio, non-bio, paper, plastic, residual waste" with a weighted mean of 4.09; SD=0.78 and verbal description of very much aware.

The level of awareness displayed by the respondents shows a positive outcome for the continuous conduct of information drive by MENRO since 2016 at schools and barangay level to promote and strengthen the campaign for proper solid waste management. The results obtained in the study shows that the increase in household respondents' attitude towards waste segregation has significant effect in the perceived effectiveness of modified waste segregation among household respondents. A study by Davies *et al*. (2013) found that positive attitudes towards waste reduction, recycling, and the

environmental benefits of waste segregation were strong predictors of active participation and compliance with segregation guidelines. Individuals who held favorable attitudes were more likely to engage in proper waste sorting and disposal practices.

Household Practices on Waste Segregation Before and After Implementation of Modified Waste Segregation

Table 4 shows the household practices on waste segregation before and after implementation of the modified waste segregation scheme spearheaded by the MENRO of Baliwag. There was an evident difference in the household practices in terms of waste segregation before (mean=3.09; SD=0.98) with verbal interpretation of every once in a while' and after implementation of the program (mean=3.98; SD=0.81) with verbal interpretation of 'sometimes'

Table 4

Household Practices on Waste Segregation Before and After Implementation of Modified Waste Segregation

Practices on Waste Segregation	Before			After		
	Mean	SD	VD	Mean	SD	VD
I am practicing waste segregation in our households	3.22	0.97	Every once in a while	4.43	0.71	Always
I have allotted enough bins for waste segregation	3.19	0.98	Every once in a while	4.40	0.73	Always
I use biodegradable wastes from our kitchen as compost	3.00	0.97	Every once in a while	4.08	0.82	Sometimes
I used to burn my wastes in the backyard	2.85	0.98	Every once in a while	2.64	1.38	Every once in a while
I am selling recyclable wastes such as paper and glass to junkshops	3.50	0.92	Sometimes	4.23	0.77	Always
I am abiding with the assigned waste collection schedule	3.46	0.88	Every once in a while	4.33	0.71	Always
I am segregating hazardous waste like facemask and face shields in my normal wastes	2.97	1.10	Every once in a while	4.07	0.73	Sometimes
I do attend environmental information campaign in our barangay	2.82	1.01	Every once in a while	3.85	0.76	Sometimes
I have encourage my family and friends to practice waste segregation	2.94	0.97	Every once in a while	3.94	0.73	Sometimes
I am participating in the environmental activities of the locality (clean-up drive/ palit-basura program)	2.93	1.03	Every once in a while	3.78	0.79	Sometimes
GRAND MEAN	**3.09**	**0.98**	**Every once in a while**	**3.98**	**0.81**	**Sometimes**

Legend: 4.20-5.00 (Almost Always); 3.41-4.19 (Sometimes); 2.61-3.40 (Every once in while); 1.81-2.60 (Rarely); 1.00-1.80 (Never)

For the practices of waste segregation before the implementation of modified scheme, the practice such as “I am selling recyclable wastes such as paper and glass to junkshops” gained the highest mean result of 3.50; SD=0.92 with verbal description of every once in a while.

Additionally, before implementation practices such as “I do attend information education campaign in our barangay” obtained the lowest mean of 2.82; SD=1.01 with verbal description of sometimes. In terms of practices after the implementation of modified waste segregation, the practice such as “I am practicing waste segregation in our households” acquired a verbal description of always and a mean of 4.43; SD=0.71 which is considered the highest during the after implementation phase.

However, the practice such as “I used to burn my wastes in the backyard” with verbal description every once in a while obtained a weighted mean of 2.64; SD=1.38 which served as the least mean for practices in the after implementation phase of modified waste segregation.

The findings revealed that the increase in practices on waste segregation has significant effect in the perceived effectiveness of modified waste segregation among household respondents. Research by Tamin *et al.* (2017) revealed that households with well-established waste management routines, such as regular waste sorting and proper container labeling, demonstrated higher levels of adherence to waste segregation guidelines. These practices were found to facilitate the ease and convenience of segregation, making it more likely for households to participate consistently.

Difference of Practices Before and After Implementation of Modified Waste Segregation Scheme

Based on the result of paired sample T-test, Table 5 shows that there is significant difference on the practices of waste segregation before and after implementation of modified waste segregation scheme. Since the value of SD decreases in the after implementation phase, the acquired data became more consistent which implies that waste segregation practices of the household respondents adheres more in the modified waste segregation program. Also, because the mean increased in the after implementation of the modified household waste segregation, it means the number of households practicing waste segregation increased.

This confirms the study of Osaya (2019) which emphasized the need for continuous innovation, policy changes and improvements in waste segregation practices to achieve a cleaner and more sustainable environment.

Table 5

Difference of Practices Before and After Implementation of Modified Waste Segregation Scheme

Practices of Waste Segregation	Mean	SD	P-Value	Interpretation
Practices before implementation of waste segregation	3.09	0.77	0.000**	Highly significant
Practices after implementation of waste segregation	3.98	0.48		

**significant at 0.01 level of significance

Effectiveness of Modified Waste Segregation

In reference to Table 6 below, the researcher has determined that overall, the respondents *strongly agree* with the effectiveness of modified waste segregation scheme (mean=4.38; SD=0.63). The highest mean obtained for effectiveness of modified waste segregation is 4.38; SD=0.63 which falls for "I am aware of the earning (thru junkshops) and recycling opportunities brought by modified waste segregation with verbal description of *strongly agree.*

Since 2016 when the SWM of Baliwag Bulacan was implemented by MENRO, efforts have been made for the proper implementation of the program such as Environmental Awareness Seminar, Palit-Basura, Clean-up Drive, etc. The results of this study suggested that these efforts have not been wasted.

Table 6

Effectiveness of Modified Waste Segregation

Effectiveness of Modified Waste Segregation	Mean	SD	Verbal Description
Unlike the former segregation scheme, it is easier to perform segregation thru modified waste segregation scheme	4.44	0.672	Strongly Agree
The modified waste segregation scheme is effective to strengthen segregation at source	4.44	0.639	Strongly Agree
Modified waste segregation motivates me to be more engage and pro-active in different environmental activities such as Palit-basura Stores	4.35	0.642	Strongly Agree
I am compliant with the collection schedule of modified waste segregation compare to the old segregation scheme	4.37	0.606	Strongly Agree
I am more knowledgeable on proper waste management thru this modified waste segregation	4.36	0.618	Strongly Agree
Thru modified waste segregation, my family and friends are now practicing segregation unlike before implementation	4.28	0.613	Strongly Agree
Modified waste segregation brings positive impact to become a responsible citizen supporting solid waste management as well as protect the environment from waste pollution	4.35	0.620	Strongly Agree
The garbage truck for collection under modified collection is always on time	4.35	0.723	Strongly Agree
I am aware of the earning (thru junkshops) and recycling opportunities brought by modified waste segregation	4.48	0.577	Strongly Agree
Modified waste segregation is easier to follow compare to old segregation and should be fully implemented in our locality	4.36	0.631	Strongly Agree
GRAND MEAN	**4.38**	**0.63**	**Strongly Agree**

Legend: 4.20-5.00 (Strongly Agree); 3.41-4.19 (Agree); 2.61-3.40(Neutral); 1.81-2.60(Slightly Disagree); 1.00-1.80 (Strongly Disagree)

Prior study by Gani (2014) cited that segregation of solid waste at source is a panacea for effective management of solid waste. A high level of awareness and education on sanitation, environmental health matters and benefits of segregation at household level should be created to the entire public so that they can appreciate need for a clean living environment and actively participate in the segregation exercise.

Relationship between Sex and Effectiveness of implementation of the Modified Waste Segregation Scheme

Table 7 below shows that there is a high significant difference (*p*=0.036) in the perceived effectiveness of modified waste segregation between male (mean= 4.45) and female (mean=4.38).

The study of Solomon and Edet (2018) found out that males had higher probabilities of adopting environmental adaptation strategies than females. Hence, Ngigi *et al.* (2017) argued that the adoption of environmental adaptation strategies by gender is interplayed with responsibilities and social norms because women need to be consulted first when improvement schemes are planned so that their insights and status are highly valued & protected.

Table 7

Difference in Terms of Sex to Effectiveness of Implementation

Practices of Waste Segregation	Mean	SD	P-Value	Interpretation
Male	4.45	0.38	0.036**	Highly significant
Female	4.38	0.45		

**significant at 0.01 level of significance

Relationship between Household Awareness, Attitude, Practices and Effectiveness of implementation for modified waste segregation scheme

As observed in Table 8, there is a highly significant relationship (*p*-value=0.000) between the household awareness and attitude and effectiveness of the implementation of modified waste segregation. There is moderate positive correlation (R=0.544) between the two variables. About 29.5% of the variability of the effectiveness of implementation of modified waste segregation can be explained by the level of household awareness and attitude.

Table 8

Relationship between Household Awareness, Attitude and Practices and Effectiveness of Implementation for Modified Waste Segregation Scheme

Variable	Mean	SD	R-Value	R-Square	p-value	Result
Household awareness	4.29	0.45	0.544[a]	0.295	0.000[b]	Significant at 0.01
Household attitude	4.55	0.39				
Household Practices after Implementation of Modified Waste Segregation	3.97	0.48	0.272[a]	0.071	0.000[b]	Significant at 0.01

[a] Predictors: Awareness, Attitude, Practices
[b] Effectiveness of Modified Waste Segregation

Likewise, there is a highly significant relationship (*p*-value=0.000) between the practices and effectiveness of the implementation of modified waste segregation There is negligible positive correlation (R=0.272) between the two variables. About 7% of the variability of the effectiveness of implementation of modified waste segregation can be explained by the level of household awareness and attitude.

As their level of awareness, attitude and segregation practices increases, the perception on the effectiveness of the implementation also increases. This is similar to the study by Zsoka *et al*. (2012) which implies that correlation on awareness and attitude may regulate the course of one's environmental action.

Moreover, the residents' awareness and practices are critical in planning an effective form of solid waste management. A study by Alireza *et al*. (2016) has shown that community participation is an important aspect of solid waste management and solid waste management practices of households were usually related to what they were accustomed to, hence depended on practices found within the household's waste segregation, recycling, and encouragement to participate in environmental programs.

Conclusion

In accordance with the study's result, the awareness, attitude, practices before and after the implementation of modified segregation scheme, roles of linkages such as LGU and barangays significantly affect the perceived effectiveness for the implementation of modified waste segregation. As the level of awareness, attitude and practices of household respondents' increased, the perception on the effectiveness on the implementation of modified waste segregation also increased.

The study findings implied that a modified waste segregation scheme can significantly improve solid waste management practices among households. Furthermore, the study highlighted the importance of a comprehensive approach that includes education, adoption, and good governance practices which are key roles of policymakers and local authorities for effective implementation of solid waste management.

Recommendations

Based on the results of the study, the following are some of the respondent's recommendations to put into consideration.

1. In order to effectively implement the modified waste segregation at barangay level, it is advisable for each barangay to have its own garbage truck and Material Recovery Facility. This will enable the barangays to handle their solid wastes more effectively.

2. The conduct of environmental education about the new segregation scheme is valuable to inculcate the right attitude and practices for segregation at source. Likewise, IEC materials on modified waste collection and public trash bins is recommended to be displayed in prominent locations and online platforms, including social media.

3. It is recommended to include priority programs related to segregation in the annual budget of the barangay for environmental management. Additionally, acknowledging the top

performing barangays that successfully implement good solid waste management practices through incentives, grants, or recognition is beneficial.

4. Further research on this topic may be undertaken for encapsulation of programs and policies that will strengthen the modified segregation rule and household full compliance on waste segregation.

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