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Waste Analysis and Characterization, Knowledge and Practices of Students at Isuc: Basis for Solid Waste Management Planning

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Abstract:
An e-learning is overtaking conventional classroom teaching The prevalent waste problem in the Campus has come up with a study on students' knowledge and practices on Solid Waste Management (SWS)simultaneously with Waste Analysis and Characterization (WACS) and photo-documentation of the SWM.The survey employed cross-sectionaldesign and descriptive-correlational method. A WACS protocol by the Department of Environment and Natural Resources-Environmental Management Bureau (ENR-EMB) with slight modification was adopted. Results revealed that student-respondents have moderate to high level of knowledge on SWM (weighted mean=2.89-4.44).Generally, students are strongly responsible in their practices butarealso responsible in burning uncollected wastes (mean=2.20) and illegal dumping(mean=1.70). No significant difference was found on students' extent of practices from various colleges (p-value=0.101123). Further, Spearman's rho resultsrevealed weak correlation (coefficient=0.209) between students' level of knowledge and extent ofSWM practices. WACS results show that majority (77.03%) of generated wastes is biodegradable,residual=12.31%, recyclable=10.49%, and special=0.17%. Residential generates the highest (14.38kg/day). Per capita waste generation is 0.012kg. Unfortunately, all generated wastes are being disposed. Moreover, waste diversion strategy is burning whilesaleable scraps are sold. Projected waste generationis expected to increase in the next 10 years (2019-2028, mean=60.153kg/yr). Photo-documented Campus initiatives include:Segregation and Reduction; Collection; Processing; Recycling; and Marketing of Saleable/Recyclables. Results reveal the necessity of adoption for the development of short-to-long termCampusESWMPlan and WACS Methodological Guidelines.

Keywords: *Waste Analysis and Characterization Study (WACS), Knowledge, Practices, Solid*

INTRODUCTION

It has been very evident in some places within the campus about the scattered solid wastes mainly due to mismanagement and poor discipline.These practices of campus constituents are not allowed by local and even national level policies, regulations, ordinances, and laws because of the interconnected impacts that it give to the other component of the environment such as the air, soil, water, and even to other organisms, including human beings.One of the major laws that tackle the concern on solid waste is R.A. 9003, otherwise known as the Ecological Solid Waste Management Act of 2000. It gives the

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mandate about how to manage solid waste from waste generation, segregation, storage, collection, transfer and transport, and to final disposal.Nevertheless, it is a topic that is rarely at the forefront of discussion, by the media or by the general public. It is usually only during a crisis that much attention is given to waste management. In the absence of a crisis, people prefer not to think about waste problem.

In the study of Arora and Agarwal (2011), they mentioned that the problems of waste management are predominant in developing countries without substantial environmental awareness programs.Licy et al. (2013) mentioned that while most people are aware of the negative impacts of mismanaged wastes on the environment, their negative attitude coupled with insufficient environmental knowledge usually corresponds to poor practices towards maintaining good environmental conditions.

Quality education does not only mean having exemplified instructors and sophisticated school facilities, it also include a clean and orderly areas conducive for learning and for the people to stay. Hence, there is a need to ensure agood quality of the environment.However, in order to achieve sound environmental quality, knowledge on environmental protection and preservation coupled with improved practice should primarily originate from the school constituencies. There is therefore a need to evaluate the level of knowledge coupled with the practices of campus constituencies.

Meanwhile, an accurate characterization of the waste stream in the campus is crucial in order to design an effective ecological solid waste management system that will meet the needs of the school. An understanding of waste generation rates and characteristics is also critical in determining present and future needs and in designing the facilities/equipment that will provide effective waste management. Accurate information on the quantity of waste that is generated (recycled and disposed) in the campus is not available as of the moment and quantities of disposed waste are not measured.

It is for these reasons that this research undertaking was conducted. One of its goal is to surface the roots of continuing problems on solid wastes in the campus which could serve as basis in coming up for decision support platforms for the promotion of a cleaner and greener Isabela State University Cabagan (ISUC) Campus. Moreover, it will provide baseline assessment that would suggest areas for improvement, i.e. a "form of needs", and analysis for subsequent education and awareness initiatives.

OBJECTIVES OF THE STUDY

The overall objective of this researchwas to conduct waste analysis and characterization study (WACS) and ascertain the knowledge and practices of students on solid waste management in the campus which could serve as an input for the development of short-to-long term Ecological Solid Waste Management Plan for ISU Cabagan Campus.

Specifically, the research aimed to:

1. Develop methodological guidelines for the conduct of WACS at academic institutions;
2. Conduct waste quantity analysis and determine the composition of waste generated in the campus;
3. Ascertain the knowledge and practices of students on solid waste management; and
4. Document the situation of solid waste management in the campus.

METHODOLOGY

The research was conducted from May 2018 to April 2019 (one year) at Isabela State University in the Municipality of Cabagan, Province of Isabela, Philippines.

The approach for the conduct of WACS started with the consultation with Key Informants

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who are mainly involved in the conduct of WACS in the Municipal Level. These Key Informants were usually consulted by various Local Government Units (LGUs) in the preparation of their 10-Year Ecological Solid Waste Management (ESWM) Plan. Such Plan is required to all LGUs in the Philippines concordant to the mandates of RA 9003. The protocol that was used in this research was based from the guidelines set by the Department of Environment and Natural Resources-Environmental Management Bureau (DENR-EMB). The protocol was discussed so as to evaluate its suitability since it will be conducted in an academic institution set up. The methodological approach that was adopted is hereby discussed.

Methodological Guidelines for the conduct of Waste Analysis and Characterization Study (WACS)

The first part of the research was the conduct of Waste Analysis and Characterization Study(WACS) which had the following methods as applied in the campus:

- Planning and mobilization – identification of possible sources of solid wastes within the campus. The identified sources in this study are: Academic Units; Non-academic Units; Commercial Establishments; and Residential Areas. After identifying the potential sources of solid wastes, determination of samples proceeded. Under the Academic Units, solid wastes were collected from the College of Forestry and Environmental Management (CFEM), the Institute of Business Management (IBM), and the College of Education (CEd). On the other hand, under the Non-Academic Units, the Administration Building, the Campus Prints and Publishing Solutions, the Environmental Information Center Building, and the Extension Office were included. Meanwhile, under Commercial Establishments, general stores and canteens were considered. Lastly, under Residential, dormitories, staff housing, and boarding houses were considered. The WACS was conducted in the Campus on February 18-20, 2019. For the persons involved (e.g. staff and students) in the conduct of WACS, detailed lecture was conducted so as to fully capacitate them. The site for the field work, preparation of schedule for sampling and the materials to be used,provision of supplies as well as other logistics related to the field study were considered.
- Waste quantity analysis –the solid wastes collected from the identified sources were brought into the identified site (i.e. CFEM compound) for the proper recording of daily waste generation. The volume of solid waste generated in the campus were logged into data sheets and eventually inputted into Microsoft Excel.
- Waste composition study – the collected samples were manually sorted into different categories, and the data were recorded accordingly. All the collected generated solid wastes in the campus were broadly classified into four (4) classifications, namely: Biodegradable, Recyclable, Residual, and Special. Each of these classifications is composed of various types of solid wastes. All the information were analyzed to determine an average composition for each category/type and subsequently computed with the four major classifications

The Approach for the survey on the Knowledge and Practices of Students on Solid Waste Management

For the assessment of knowledge and practices of students, the following were conducted:

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Respondents of the Study

The respondents in this study were students from the seven (7) colleges in the campus.According to Ahmad et al. (2015), students are particularly targeted since they are regarded as the future of the nation and schools are expected to develop their potential as advocates of sustainable environment. In fact, several community surveys have sought to capture the level of knowledge, attitude, practices (KAP) among students regarding the environment.

The study involved college students enrolled in various courses offered in several Colleges in Isabela State University Cabagan Campus. The number of officially enrolled students was acquired from the database system of the Campus Registrar. A total of 346 studentswereconsidered as respondents in this research. The participation of the student-respondents was purely voluntary and they were allowed to withdraw at any stage of the interview. Again, the final number of students included in this study was 346 based on completeness and validity of their responses in the structured questionnaire.

Research Design

Cross-sectional survey research design was employed in this study. According to Kazdin (2003), as cited by Dung, et al. (undated), a cross-sectional survey research design is a study in which participants are selected and assessed on a current or present variable of interest at a time. The participants were studentsfromvariouscolleges in ISU Cabagan, whose knowledge and practices toward solid waste management were assessed at a particular time. The design is, therefore, best suited for this study. Moreover, this study is descriptive-correlational in nature.

Research Instrument

Structured questionnaire was constructed to gather information relative to the study. An interview schedule coupled with distribution of the survey questionnaires weredone to gather both qualitative and quantitative data. Ocular observation was also used in order to verify some statements mentioned by the respondents (triangulation). The use of documents from the study. Moreover, this study is descriptive-correlational in nature. The study involved college students enrolled in various courses offered in several Colleges in Isabela State University Cabagan Campus. The number of officially enrolled students was acquired from the database system of the Campus Registrar. A total of 346 studentswereconsidered as respondents in this research. Upon determination of the desired sample size, non-probability sampling procedure (opportunistic sample technique) was employed for the determination of the student-respondents. According to Kazdin (2003), as cited by Dung, et al. (undated), a cross-sectional survey research design is a study in which participants are selected and assessed on a current or present variable of interest at a time. The participants were studentsfromvariouscolleges in ISU Cabagan, whose knowledge and practices toward solid waste management were assessed at a particular time. The design is, therefore, best suited for this study. Moreover, this study is descriptive-correlational in nature.

Table 1. Sample Size Distribution per College/Unit.

UNIT	NO. OF STUDENTS PER COLLEGE	SAMPLE SIZE PER COLLEGE
CEd	1099	114
CDCAS	228	24
PTIA	322	33
CFEM	269	28
IBM	599	62
CCJE	444	46
CCSICT	378	39

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existing files from the administrationwas also considered to gather secondary data.

Statistical Analysis

Data generated from the field works were logged using database-retrieving system in Microsoft Excel where all statistical procedures were performed. The different sets of information were statistically analyzed using both descriptive (weighted mean) and inferential statistics (Single Factor ANOVA and non-parametric correlation e.g. Spearman's rho). A 5-point and 3-point Likert scales were used to determine the level of knowledge and the practices, respectively, of the student-respondents. Table 2 and 3show the Arbitrary levels for the Likert Scale used in this study.

Table 2. Arbitrary levels for the knowledge of student-respondents.

SCALE	QUALITATIVE DESCRIPTION
1.00- 1.79	VERY LOW
1.80- 2.59	LOW
2.60- 3.39	MODERATE
3.40- 4.19	HIGH
4.20- 5.00	VERY HIGH

Table 3. Arbitrary levels for the practices of student-respondents.

SCALE	QUALITATIVE DESCRIPTION
1.00- 1.66	NOT RESPONSIBLE
1.67- 2.33	RESPONSIBLE
2.34- 3.00	STRONGLY RESPONSIBLE

RESULTS AND DISCUSSION

WASTE ANALYSIS AND CHARACTERIZATION STUDY (WACS)

Waste Characteristics

This part presents the quantity and the composition including other characteristics of wastes generated within the premises of Isabela State University in Cabagan, Isabela. It also describes the projected solid wastes generation in the Campus for a period of ten years.

Waste Analysis and Characterization Study (WACS) was conducted in the 3-day series in order to identify, quantify and further analyze the solid wastes being generated from various sources within the Campus. The sources include: Academic Units which include the College of Forestry and Environmental Management (CFEM), the Institute of Business Management (IBM), and the College of Education (CEd); Non-Academic Units which include the Administration Building, the Campus Prints and Publishing Solutions, the Environmental Information Center Building, and the Extension Office; Commercial Establishments (general stores and canteens); and Residential which include dormitories, staff housing, and boarding houses. The WACS was conducted in the Campus on February 18-20, 2019.

Generated Waste

Generated waste is defined as the total quantity or volume of waste disposed and diverted based on the WACS that was conducted. The table below gives a detailed presentation on the waste generated in the Campus.

Most of the generated wastes in the Campus are biodegradable wastes, which comprise about 77.03percent of the total solid wastes generated followed by residual wastes at 12.31%, recyclable wastes at 10.49%, and special wastes at 0.17%. Among the sources, residential areas was found to have the highest generated wastes with a total of 14.38 kilograms per day representing 33.74 percent of the total solid wastes generated in the campus.

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SOURCE	Composition of waste generated (kg/day)				Total	Percentage
	Biodegradable	Recyclable	Residual	Special		
ACADEMIC UNIT	9.34	2.33	1.23	0.00	12.90	30.26
NON-ACADEMIC UNIT	5.67	0.53	0.61	0.04	6.85	16.07
COMMERCIAL	6.47	0.52	1.51	0.00	8.50	19.94
RESIDENTIAL	11.36	1.09	1.90	0.04	14.38	33.74
TOTAL	32.84	4.47	5.25	0.07	42.63	100.00
PERCENTAGE	77.03	10.49	12.31	0.17	100.00	

Table 4. Waste Generation by source (kg/day).

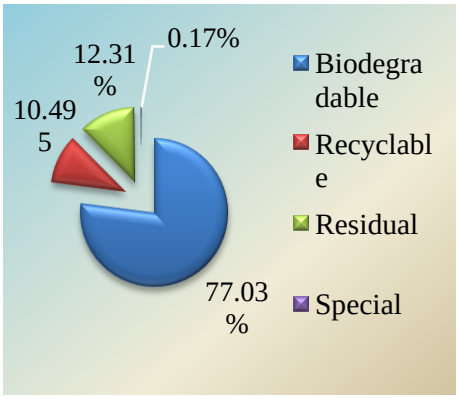

Figure 2.Percentage composition of generated waste by classification.

The per capita waste generation per day is 0.012 kilograms. This was computed using the school year 2018-2019 population of about 3, 570 people.

Disposed Waste

Practically, the volume of solid wastes disposed in the campus on a daily basis is equal to the volume of solid wastes generated per day as discussed above. Table 5 below shows that there are about 32.84 kilograms of biodegradable wastes is disposed per day. This implies that organic fertilizer production using the biodegradable/organic wastes should be promoted. There are about 4.47 kilograms of recyclable wastes are disposed on a daily basis. These solid wastes have good

potential for recycling activities in order to produce innovative recycled products that can be utilized for beautification along roadsides, offices and/or in student centers. Otherwise, recyclables should be stored and be accumulated which can then be sold to itinerant buyers or to junkshops accordingly. Meanwhile, it can be deduced from the same table that majority of the solid wastes being disposed comes from residential areas. This implies that promotional activities pertaining to solid waste management concerns should be prioritized in this source.

Table 5. Disposed Waste by Sector and Classification (in kilograms per day).

SOURCE	Composition of waste disposed (kg/day)				Total	Percentage
	Biodegradable	Recyclable	Residual	Special		
ACADEMIC UNIT	9.34	2.33	1.23	0.00	12.90	30.26
NON-ACADEMIC UNIT	5.67	0.53	0.61	0.04	6.85	16.07
COMMERCIAL	6.47	0.52	1.51	0.00	8.50	19.94
RESIDENTIAL	11.36	1.09	1.90	0.04	14.38	33.74
TOTAL	32.84	4.47	5.25	0.07	42.63	100.00

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PERCENTAGE	77.03	10.49	12.31	0.17	100.00

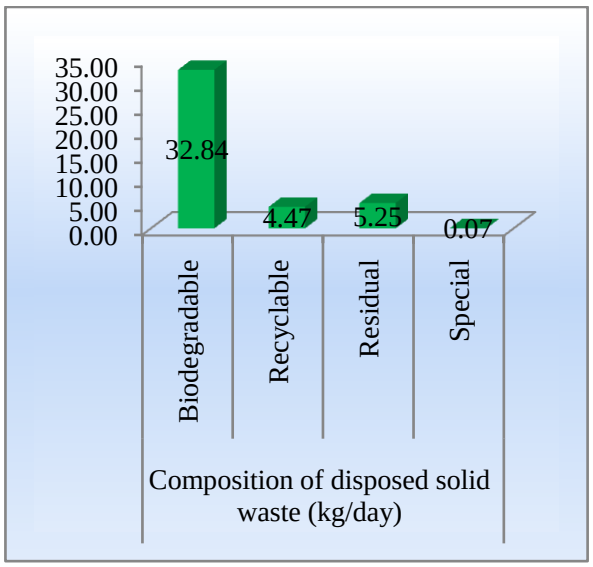

Figure 3. Composition of solid waste disposed per day (in kilograms).

Diverted Waste

Diverted waste is the quantity of waste currently re-used, recycled, sold to junkshops and composted or processed based on existing information. To gather data on the estimated quantity or volume of waste currently diverted, review of existing office files and personal observation from all waste sources were conducted.

Result of the direct observation and personal interviews with the employees and studentsrevealed that the most common waste diversion strategy is burning of wastes and selling of scraps. Quantity of wastes being burned, however, was not accurately estimated by the respondents. Hence they were no longer included in the results.

As seen in the documents provided by the administration, service centers and junkshop agents (bidders) went to the campus in order to buy and eventually collectvaluable recyclable and/or resalable materials such as scraps/crafts materials, condemned equipment and vehicles, and the like. On the other hand, those stored PET bottles, glass bottles, cans, metals, including newspapers, cartons, among others, are bought by itinerant buyers.

Projected Waste Generation

As shown in Table 6, waste generation in the Campus is expected to increase in the next ten (10) years due to slight increase in population as well. At the end of the ten-year period (2019-2029), the estimated average waste generation of the whole Campus is about 662.349 kilogramsper year. The estimated average annual generation of biodegradable materials is about 47.706 kilograms per year. Biodegradable wastes can be a focus of investments in organic fertilizer production in the Campus.

For the recyclable wastes, recovery and processing should be intensified and alternative and/or innovative technology to divert the residual wastes to be generated should be implemented. Likewise, the projected residual and special wastes generation must be handled properly as well as necessary actions should still be done to avoid the dangerous and irreversible impacts of these wastes materials.

Recovery and processing of recyclable wastes should be intensified and alternative innovative and cutting-edge technologies to divert residual wastes to be generated should be implemented. Although projected residual and special wastes generation is not very significant compared to the projected biodegradable wastes, it still requires necessary actions to avoid complications in the future. The table below presents the details of projected waste generation by classification of wastes per year in the next 10 years:

Table 6. Projected Waste Generation in the Campus (kg/year).

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YEAR	CLASSIFICATION				TOTAL
	Biodegradable	Recyclable	Residual	Special	
2019	36.021	4.905	5.756	0.080	46.762
2020	37.999	5.174	6.072	0.085	49.330
2021	40.077	5.457	6.405	0.089	52.029
2022	42.276	5.756	6.756	0.094	54.883
2023	44.594	6.072	7.126	0.100	57.892
2024	47.031	6.404	7.516	0.105	61.056
2025	49.607	6.755	7.927	0.111	64.400
2026	52.330	7.125	8.362	0.117	67.934
2027	55.200	7.516	8.821	0.123	71.660
2028	58.226	7.928	9.305	0.130	75.589
Average Annual Generation	46.336	6.309	7.405	0.103	60.153
Waste Generation per capita/day	0.009198	0.001252	0.001470	0.000021	0.012
Cumulative Total	463.361	63.092	74.046	1.035	601.534

Knowledge and Practices of Students on Solid Waste Management

In ISU Cabagan, the student-respondents have very high knowledge on very few of the indicators and these are: solid wastes are the most visible environmental problem; there is a law governing solid wastes management in the country; there is money in wastes; and improper waste disposal can cause flooding, spread of diseases, and can pollute the soil/water/air. Surprisingly, the student-respondents in the campus have high knowledge on most of the indicators that were asked from them. However, the students are have moderate knowledge on the following indicators: Example of RESIDUAL WASTES are Sanitary napkins, disposable diapers, worn-out rugs, ceramics, candy wrappers/sachets, cartons which contain a plastic lining usually used for milk and juice containers, etc.; Example of SPECIAL WASTES are Fluorescent lamps, containers of: Toilet Cleaners and Bleaches; Paint Thinners, solvents; Pesticides, sprays; Medical/clinic waste; Used lead-acid batteries; Used engine/motor oils; Segregation and collection shall be conducted at the barangay level; Collection of the non-recyclable and residual wastes is the responsibility of the municipality or city; Waste storage facilities should be secured and its place must be strategically identified; There is an existing collection of garbage by the Municipality. These signify that students have little knowledge along these variables, hence, promotion is necessary.

Among the indicators presented from the students, "There is money in wastes" (Indicator No. 22) has the highest weighted mean with 4.44. This is followed by Indicator No. 12 (There is a law governing solid wastes management in the country). Meanwhile, Indicator No. 17 (There is an existing collection of garbage by the Municipality) got the lowest weighted mean with 2.89 followed by Indicator No. 11 (Collection of the non-recyclable and residual wastes is the responsibility of the municipality or city) with a weighted mean of 2.93 (Table 7).

Table 7.Level of knowledge of ISUC student-respondents on solid waste management.

INDICATORS	Very High	High	Moderate	Low	Very Low	Weighted Mean	Qualitative Description
1) ISUC has solid waste	80	169	77	18	2	3.89	HIGH

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problem							
2) There exist a Center in the campus with primary concern on wastes and its management	122	154	44	17	9	4.05	HIGH
3) Solid wastes are the most visible environmental problem	140	154	46	5	1	4.23	VERYHIGH
4) In urban areas, people generate 0.50-0.70 kg/capita/day of solid waste, whereas in rural areas, people produce 0.30 kg/capita/day	73	132	109	29	3	3.7	HIGH
5) LGUs are primarily responsible for the implementation and enforcement of the provisions of RA 9003 in their respective jurisdictions	100	153	72	19	2	3.95	HIGH
6) Example of BIODEGRADABLE WASTES are Fruit and vegetable peelings, leftover foods, vegetable trims, fish/fowl/meat/animal entrails/ soft shells, seeds, leaves, etc.,	112	171	47	13	3	4.09	HIGH
7) Example of RECYCLABLE WASTES are Newspaper, ferrous and non-ferrous scrap metals, corrugated cardboard, aluminum, tin cans, glass, papers, etc.,	89	127	45	59	26	3.56	HIGH
8) Example of RESIDUAL WASTES are Sanitary napkins, disposable diapers, worn-out rugs, ceramics, candy wrappers/sachets, cartons which contain a plastic lining usually	80	82	88	77	19	3.37	MODERATE

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used for milk and juice containers, etc.,							
9) Example of SPECIAL WASTES are Fluorescent lamps, containers of: Toilet Cleaners and Bleaches; Paint Thinners, solvents; Pesticides, sprays; Medical/clinic waste; Used lead-acid batteries; Used engine/motor oils	60	70	85	111	20	3.11	MODERATE
10) Segregation and collection shall be conducted at the barangay level	54	121	98	53	20	3.39	MODERATE
11) Collection of the non-recyclable and residual wastes is the responsibility of the municipality or city.	28	89	86	118	25	2.93	MODERATE
12) There is a law governing solid wastes management in the country	140	154	52	-	-	4.25	VERYHIGH
13) Reduce in waste generation is encouraged	79	117	90	51	9	3.6	HIGH
14) Segregation at source is encouraged	81	129	84	40	12	3.66	HIGH
15) Waste storage facilities should be secured and its place must be strategically identified	45	119	80	73	29	3.23	MODERATE
16) The use of durable yet cost-effective garbage bins is promoted	131	160	55	-	-	4.22	HIGH
17) There is an existing collection of garbage by the Municipality	33	85	75	118	35	2.89	MODERATE
18) There is ordinance pertaining to Solid waste management in the municipality	71	123	83	60	9	3.54	HIGH
19) Recycling of solid wastes could generate income	112	99	85	40	10	3.76	HIGH

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20) Recycled products can beautify surroundings	118	108	89	28	3	3.9	HIGH
21) Composting of biodegradable wastes is promoted	71	125	90	51	9	3.57	HIGH
22) There is money in wastes	185	129	32	-	-	4.44	VERYHIGH
23) Burning of solid wastes is prohibited	77	119	85	62	3	3.59	HIGH
24) Improper waste disposal can cause flooding, spread of diseases, and can pollute the soil/water/air	128	171	47	-	-	4.23	VERYHIGH

Solid Waste Management Practices of Students

It can be gleaned from table 8 that the students in ISU Cabagan Campus are strongly responsible in terms of: wastes reduction in their home; use durable yet cost-effective garbage bins in their house; practice of waste recycling and selling the products; practice of waste recycling and use to beautify surroundings; composting of biodegradable wastes; regularly clean our surroundings to get rid of diseases. These imply that the students are conforming to the practices and principles of solid waste management. However, the students of ISUC are found to be responsible in burning the uncollected solid wastes in their homes with a mean of 2.20. Further, with a weighted mean of 1.70, it is very unfortunate that there are student-respondents who practice throwing of garbage into the river or everywhere their uncollected wastes. According to them, they don't have other choice but to do so in order to maintain the cleanliness of their homes and get rid of possible diseases due to the presence of uncollected solid wastes. Moreover, there were students who mentioned that there is no collection of garbage by the authorities in their localities.

Various studies have shown that students exhibit moderate to unsatisfactory practice level on waste management (Desa et al., 2011; Adeolu et al., 2014; Ahmad et al., 2015). In the study conducted among the secondary schools in the Division of Leyte, Ramos and Pecajas (2016) concluded that the solid waste management practices are moderately and fairly practiced by the respondents which need more supervision by the school administrators.

Table 8. Solid waste management practices of student-respondents

SWM PRACTICES OF STUDENTS	WEIGHTED MEAN							
	PTIA	CCJE	CFEM	CED	CCSICT	IBM	CDCAS	ISUC
1) I practice wastes reduction in our home	2.36	2.46	2.21	2.52	2.49	2.63	2.21	2.47
2) I do waste segregation	2.18	2.39	2.21	2.37	2.31	2.32	2.33	2.32
3) I use durable yet cost-effective garbage bins in our	2.09	2.39	2.29	2.40	2.28	2.40	2.29	2.34

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	house							
4)	I practice waste recycling and sell the products	2.33	2.54	2.29	2.29	2.23	2.48	2.25	2.35
5)	I practice waste recycling and use to beautify surroundings	2.36	2.59	2.00	2.41	2.26	2.44	2.13	2.36
6)	I do composting of biodegradable wastes	2.30	2.30	2.18	2.40	2.36	2.40	2.17	2.34
7)	I regularly clean our surroundings to get rid of diseases	2.30	2.61	2.18	2.46	2.33	2.40	2.33	2.41
8)	I burn the uncollected solid wastes	2.09	2.50	2.18	2.24	2.05	2.19	1.83	2.20
9)	I throw into the river or everywhere our uncollected solid wastes	1.79	2.09	2.04	1.61	1.67	1.56	1.29	1.70

Difference in SWM Practices of students from various colleges

The table below shows the Analysis of Variance of the SWM practices of students from various colleges. As presented, it revealed that the F-value which is 1.875836 is less than the critical value of 2.265567. It generally means that there is no significant difference on the practices of the students from various colleges on solid waste management. Moreover, the p-value is 0.101123 which is way above at 0.05 level of significance.

Table 9. Analysis of Variance: Single Factor.

SUMMARY

Groups	Count	Sum	Average	Variance
PTIA	9	19.81818	2.20202	0.035813
CCJ	9	21.86957	2.429952	0.026439
CFEM	9	19.57143	2.174603	0.009708
CED	9	20.71053	2.30117	0.073484
CCSICT	9	19.97436	2.219373	0.056396
IBM	9	20.83871	2.315412	0.092879
CDCAS	9	18.83333	2.092593	0.113619

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.656549	6	0.109425	1.875836	0.101123	2.265567
Within Groups	3.266699	56	0.058334			
Total	3.923248	62				

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Relationship between Level of Knowledge and the Practices of Students on Solid Waste Management

The results of non-parametric correlational analysis show no significant relationship or weak correlation between the level of knowledge and the extent of practices of students on solid waste management with correlation coefficient of 0.209 with p-value of 0.589 which is way higher than 0.05 level of significance (Table 10). This supports the findings of Barloa et al. (2016) who found out that the relatively higher average rating for knowledge (87.8%) (and attitude (87.0%)) of the students were both inconsistent with the lower average practice rating (72.5%)

Table 10. Correlation analysis between level of knowledge and the extent of practices of students toward solid waste management.

Spearman's rho		SWM Practices	Level of Knowledge
SWM Practices	Correlation Coefficient	1	0.209
	Sig. (2-tailed)	.	0.589
	N	9	9
Level of Knowledge	Correlation Coefficient	0.209	1
	Sig. (2-tailed)	0.589	.
	N	9	24

Documentation of the Situation of Solid Waste Management in the Campus

Source Reduction and Segregation-at-source

Although the campus constituencies are doing their usual practice in handling and disposing their generated wastes i.e. thrown anywhere and/or practice open burning. That is what they normally do. However, common to all is the segregation of recyclables/saleable solid wastes like metals, cans, plastics, bottles, and the like. These are somehow bringing benefit to them as these are being sold to junkshops or to itinerant buyers. Furthermore, biodegradable materials are not normally collected as these materials are left untouched until they become fully decomposed. Some are also collected for the vermi-composting technology of the Provincial Technical Institute of Agriculture (PTIA).

Collection

At present, there is an existing collection system in the campus since the collection equipment is already in place,

although there is a need for an effective collection scheme to be implemented once the Centralized MRF will become operational. The construction of the Centralized MRF of the campus has been initiated/launched during the celebration of Earth Day on April 22, 2019.

Processing Facilities

The processing of biodegradable waste into compost materials are conventionally done as biodegradable wastes are left untouched on ground. Meanwhile, the present recovery facility of the campus is situated near the Administration building. Vermi-composting facility is also available and this is being maintained in the PTIA.

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Recycling Programs

Recycled products prepared by the students are outputs from their classes and/or campus/college-based competition programs.

Markets for Recyclables/Saleable Solid Wastes

Junkshop agents (bidders) and ambulant scrap buyers roam in order to buy valuable recyclable and/or resalable materials such as PET bottles, glass bottles, cans, metals, newspapers, cartons, other scrap/crafts materials, condemned equipment and vehicles, compost, and the like.

CONCLUSION

Based on the findings of the study, it was concluded that in ISU Cabagan,most of the generated wastes are biodegradable wastes followed by residual wastes and recyclable wastes. There is a minimal generation of special wastes in the campus. Residential areas have the highest generated wastes. There is also a minimal per capita generation among campus constituencies. The volume of solid wastes disposed in the campus on a daily basis is the same to the volume of solid wastes generated per day. Majority of the solid wastes being disposed comes from residential areas. It is also concluded that the most common waste diversion strategy is burning of wastes and selling of scraps. There are service centers and junkshop agents (bidders) that visit the campus to buy collectvaluable recyclable and/or resalable materials. PET bottles, glass bottles, cans, metals, including newspapers, cartons, among others, are bought by itinerant buyers. Further, waste generation in the Campus will increase in the next ten (10) years due to slight increase in population as well. Moreover, there is minimal generation of solid wastes as compared with municipal solid wastes (MSW) generation.

Meanwhile, the student-respondents have moderate to strong level of knowledge on solid waste management. There is no significant difference on the practices of the students from various colleges on solid waste management.More so, it was concluded that there was no significant relationship between the level of knowledge and the extent of practices of students on solid waste management as revealed in the results of the non-parametric correlation analysis made. Lastly, it was also concluded that the Campus has a lot of initiatives in relation to solid waste management programs like: Source Reduction and Segregation-at-source; Collection; Processing Facilities; Recycling Programs; and Markets for Recyclables/Saleable Solid Wastes, among others.

The foregoing conclusions provide strong baseline information that would serve as basis for decision-support platforms for the effective solid waste management program of the campus i.e. this be considered as an input for the development of a short (3-5 years) to long term (e.g. 10 years) ecological solid waste management plan of the Campus. The Plan that can be formulated may have features such as: Introduction, Campus Profile, Current Solid Waste Management Condition, Waste Characteristics, Legal Institutional Framework, Plan Strategy, Solid Waste Management System, Implementation Strategy, Institutional Aspects, Social and Environmental Aspects, Financial Aspects, and Plan Implementation.

Biodegradable wastes can be one of the focus of investments (e.g. organic fertilizer production). Recyclable wastes have good potential for recycling activities in order to produce innovative recycled products that can be utilized for beautification along campus roadsides, offices and/or in student centers or products that can be marketed. Otherwise, recyclables should be stored and be accumulated which can then be sold to itinerant buyers or to junkshops accordingly. Alternative and/or innovative technology (e.g. residual containment area, septic vault, production of eco-hallow blocks, eco-bricks, briquetted charcoal, among others) to divert the residual wastes to be generated should be implemented.

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Likewise, the projected residual and special wastes generation must be handled properly as well as necessary actions should still be done to avoid the dangerous and irreversible impacts of these wastes materials. Although projected residual and special wastes generation is not very significant compared to the projected biodegradable wastes, it still requires necessary actions to avoid complications in the future.

Further, it is highly recommended that Information, Education and Communication (IEC) or Advocacies, Communication, and Education (ACE) programs for the students (and also for the employees) should be in place and sustainably be implemented in order to elevate their level of knowledge on SWM. Moreover, contested events relative to SWM matters should be organized in order to increase awareness and promote participation among students. Once the students are involved/engaged, they'll soon start to appreciate every effort made in the campus. Moreover, once the students' level of knowledge is strengthened, their practices would significantly improve. Meanwhile, LGUs' role cannot be overlooked since they play significant role in influencing the practices of the students. It was revealed that students have little to no knowledge about LGUs waste collection system which forced them to even practice the prohibited acts of which these are being carried over when the students go and stay in the school premises. Therefore, LGU plans, programs and projects on SWM should be prepared, printed and distributed to their local constituencies.

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