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ORIGINAL RESEARCH PAPER

Knowledge, attitudes and practices on household food waste: Bases for formulation of a recycling system

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ABSTRACT

This study assessed the knowledge, attitudes and practices on food waste of selected households in the northern province of the Philippines. The results of the assessment were used as bases for formulation of a recycling system. A total of one hundred rural households were selected using stratified equal allocation sampling technique. Data were collected through the use of researcher-made questionnaire with Cronbach's Alpha at .82, and was supplemented by observations. Factor analysis, Pearson r, and point-biserial correlation were used to yield findings in the study. Results show that a number of factors discourage the respondents' participation in the reduction and recycling of food waste, such as lack of facilities, insufficient training, and information dissemination. Household size ($r=.199$, $p<0.05$), monthly income ($r=.282$, $p<0.01$; $r=-.217$, $p<0.05$), and planning ($r=-.243$, $p<0.05$) influences the way the participants manage household food waste. On the other hand, age, educational attainment, and sex, do not significantly affect the way the household-participants manage food waste. One strategic and feasible solution is a compulsory food waste recycling system (FWRS) for private households to combat this pressing issue on food waste. This proposed framework is composed of four major moves that require the collaboration of various sectors and stakeholders in the community, and is expected to suggest valuable policy amendments including significant decrease in wastage of consumable agricultural products. Without doubt, the ongoing over generation of food waste is a serious global setback that needs to be urgently addressed.

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INTRODUCTION

With the society continually embracing expansion in industry and population, exponential increase in solid waste has emerged as one of the persisting social problems that poses serious ramifications when it comes to public health, safety, productivity, and economy. One type of solid waste is food waste, and the proper and effective management of food waste becomes problematic due to lack of knowledge on proper disposal, insufficiency or absence of recycling resources and services, lack of interest and willingness of households for change and transformations, and inadequate government policies on food waste management and recycling (Schanes *et al.*, 2018). There is enough food for everyone, according to the World Food Program (WFP, 2016), yet one-third of all food is wasted globally while a seventh of the world's population "goes to bed hungry," and 5.6 million children under the age of five die from hunger, in which nearly 15, 000 die daily (WHO, 2019). The world generates roughly 1.3 billion tons of food waste per year (Gustavsson *et al.*, 2011) (roughly US$ 310 billion in developing countries and US$ 680 billion in industrialized countries), equivalent to one-third of the food manufactured for human consumption by United Nations-Food and Agriculture Organization (FAO, 2019a). Aside from economic deflation, food waste can result to environmental problems in which one of the most critical is global warming due to emission of the greenhouse gas methane (UNEP, 2013). In addition, FAO (2019a) reported that in feeding the estimated world population of 7 billion, food production exhausts a large proportion of the earth's resources, making it the single leading cause of biodiversity loss. The foregoing facts present an underlying problem on how to prevent food wastage. Therefore, it is imperative to develop urgent and effective measures on reducing the production of food waste because the demand for food sustains an increasing trend every year (FAO, 2013). A number of Asian countries, such as South Korea, Taiwan, Japan, and Hong Kong started implementing waste minimization strategies as part of their policies, employing various methods of collecting food waste to enable recycling processes. In South Korea, a volume-based waste charge system was established in 1995 (Shin and Hwang, 1997), whereas in Taiwan, the national government provides subsidies to local town and cities thereby establishing in 2001 kitchen waste collection and recycling programs. Japan has implemented a "Food Recycling Law" which requires food businesses to safely convert their food wastage into raw materials for animal feeds or fertilizers (Rodriguez, 2014). Similarly, in Hong Kong, the Food Wise Hong Kong Campaign, established in 2012 (FWHK, 2013), promotes food waste reduction to the public and facilitated food donation of businesses with excess food to community charities (FWHK, 2013). According to Glanz (2008), poor planning and poor food management, personal preferences and daily lifestyle, and ineptness in the process of recycling are the main underlying reasons behind the overwhelming buildup of household food waste. The behavior of people towards food is also contributory to the generation of food waste as reported by Porpino *et al*. (2015); Evans (2011a); Ganglbauer *et al.* (2013); Graham-Rowe *et al*. (2014); Quested *et al.* (2013). According to the above-mentioned studies, food shortages are very rare in developed countries nowadays; and food no longer have a strong emotional linkage to survival unlike in previous centuries. In order to put a halt to the lackadaisical treatment of food and the waste that results from food production and consumption, new policies and strategies must be formulated and implemented, with the goal of modifying the behaviors of households, producers, and other stakeholders in the food system. In the Philippines, one factor that causes generation of food waste is population growth. The country's population increases in an accelerating rate, thus, the Philippines, as reported by Philippine Statistics Authority (PSA, 2015) is considered the sixteenth most populous, out of more than 190 countries. By the year 2045, urban population is expected to reach 142 million of the total population (PSA, 2015). As population growth continues and with the manner of socio-economic development in the Philippines, food waste generation will automatically and rapidly increase in the next few years. One of the most conspicuous manifestations of food wastage is rice wastage. According to the Food and Nutrition Research Institute (FNRI) of the Department of Science and Technology (FNRI, 2014) each Filipino threw away an average of 3.29 kg/y. In 2014, there were 296,869 metric tons (MT) of rice wastage, which accounted for 12.2% of that year's rice imports. The loss amounted to Php 7.3 billion (approximately US$ 14.1

million). With this same amount, more than two million Filipinos could have been fed, in terms of rice, excluding other kinds of household food waste. In all the food chains, private households represent the biggest food waste faction (BIOIS, 2010). If only households are trained in the proper segregation of waste and the corresponding recycling processes, disposal sites would not have to accommodate extremely large volumes of waste, and communities might as well create additional sources of income out of the recycled products. Food waste produced before and after consumption such as fruit and vegetable peel, meat and fish bones, eggshells, excess rice and other food leftovers cannot simply be avoided, and so, it is also unavoidable that people dump this type of waste in designated areas. Consequently, the local government disposes of these food excess in landfills. However, Atienza (2008) opines that sanitary landfill as a facility for final disposal is also deemed problematic because of factors such as social acceptability issues and not-in-my-backyard (NIMBY) syndrome. Many communities have reservations when it comes to the environmental and health hazards of leachates—liquid containing soluble material produced in a landfill from decomposition—that contaminate grounds and surface waters. Therefore, recycling is the most appropriate if not the most feasible form of management as an alternative to sanitary landfills [SLFs]. Surprisingly, in majority of areas in the Philippines, one of which is the Ilocos Norte Province, there is no food waste recycling system enforced by the government. United Nations Food and Agriculture Organization (FAO, 2019b) reported that almost 80% of food waste comes from the household, and approximately 56% of these are still consumable. In Ilocos Norte, a significant amount of household food waste is the result of the increasing patronage of Ilocanos with products and services offered in commercialized food outlets popping up like mushrooms in the province. In the province of Ilocos Norte, more than 50% of the food waste in rural and urban barangays are consumable and recyclable (Busalla *et al*., 2013). Therefore, there is a huge potential in the recycling of household food waste, which would be likely to help in the reduction of food waste generation in the province. Gaining familiarization in various dimensions with regard to the issues and practices on household food waste management and recycling will provide authentic benchmark information needed in the formulation of provisions in the food waste recycling system that this study proposes. This amendment in the provincial and local policies concerning food waste can be a feasible step in reducing the volume of food waste, providing additional source of livelihood for below-average families, maintaining a healthy environment for the members of the community, and creating positive attitude among residents toward food waste. This study, which was carried out in the province of Ilocos Norte, Philippines in 2017, specifically aimed to do a quantitative evaluation of the knowledge, attitudes and practices of households in Ilocos Norte towards management of food waste, and to recommend the formulation of a compulsory food waste recycling system for potential application by every private household in the province of Ilocos Norte. Such a research method provides a comprehensive view and treatment of the issue where the researchers take the readers at a vantage point in which every perspective is assessed. Moreover, with the introduction of a system that seeks to address the issue, this study offers a problem-solution approach that is not espoused by previous studies on food waste.

MATERIALS AND METHODS

Study area

The study was conducted in the province of Ilocos Norte, which is located in the Ilocos Region in the northern part of the country (Fig. 1). Boundaries are formed by the Babuyan channel for the north and Ilocos Sur for the south, South China Sea to the west and its eastern boarders are part of Cagayan Valley, Abra and the Mountain provinces. Laoag City is the capital of the said province and is located at the northwest portion of the Luzon Island. The province has a latitude of 18.1647°N and a longitude of 120.7116°E. It has a land area of 3,504.3 Km^2 with a population of 593.081. It has 21 municipalities with 557 barangays. Ilocano, Tagalog, and English are the languages they speak.

Research design

This study utilized a descriptive survey design, using a total of 100 households selected from the entire population, i.e., 11, 990 people living in 2,024 households of the province of Ilocos Norte.

Data gathering procedure

Permission from the Municipal Mayors and the Barangay Captains of the concerned municipality and barangay to conduct the study in their area, and from the selected respondents in this study were obtained. Copies of the questionnaires were then distributed to the identified respondents. After the questionnaires were retrieved, the researchers observed houses. With the home owner's permission, the researchers observed household practices in managing food waste. This was used to validate the respondents' answers in the questionnaires. After gathering all data needed from the target samples, data were studied, tabulated, interpreted, and inferences were drawn based on the results.

Sample and sampling technique

Stratified sampling method with equal allocation was adopted to select the 100 household-respondents of the study in the Province of Ilocos Norte. To ensure that the sample is a true representation of the total population of families/ households in the barangay, the barangay was divided into five zones which served as strata. This enabled the researcher to achieve data accuracy and precision. The first stage involved the use of stratified sampling procedure to put the study area into five main strata (North, South, East, Center and West zones). The next step dealt with the selection of households from the five zone communities to serve as the study units. For each zone selected, the researcher used simple random technique to select one hundred households for the study. Each household was numbered separately according to zones. These numbers were used in assigning the family's number in preparing the table of random numbers for each zone and 100 families were randomly selected to be studied in each zone. Selected respondents in this study are the ones responsible in maintaining proper food waste management at homes. These groups were asked to answer the survey questionnaires. Table 1 shows the socio-demographic profile of the respondents who participated in the study. The age of the respondents ranged from 23-59 which indicates

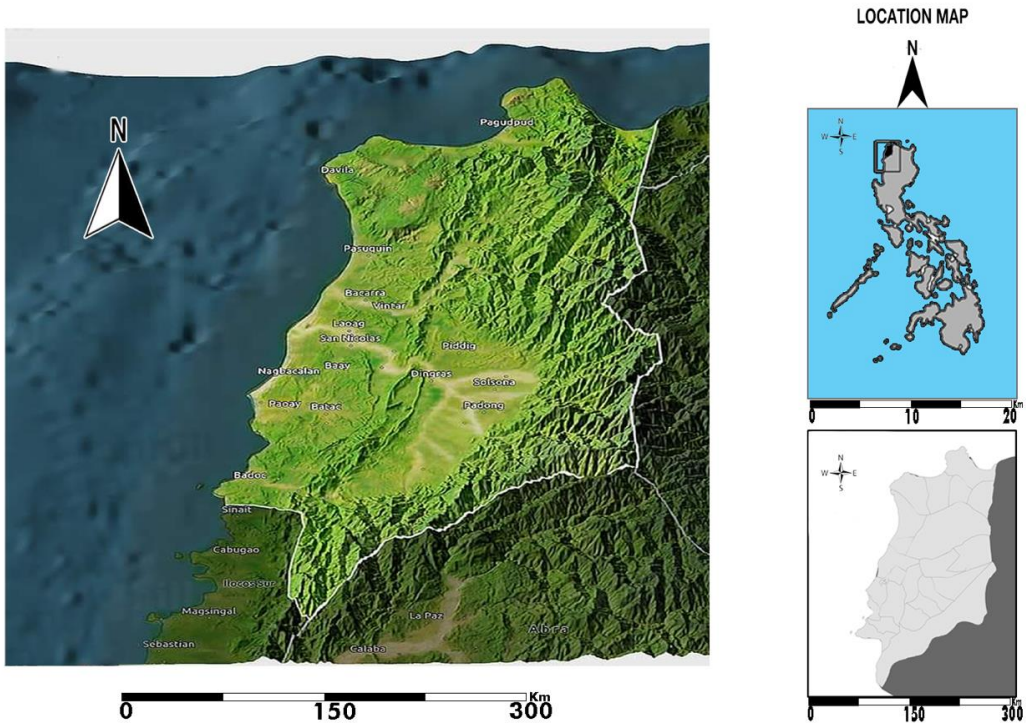


Fig. 1: Geographic location of the study area in Ilocos Norte, Philippines

Table 1: Respondents' socio demographic profile

Personal characteristics		Frequency	Percentage
Sex:			
Female		86	86
Male		14	14
Total		*100*	*100*
Highest Educational Attainment:			
Elementary		0	0
High School		50	50
College (undergraduate)		25	25
College graduate		25	25
Total		*100*	*100*
Type of House:			
Rented		0	0
Owned		100	100
Company provided (Temporary)		0	0
Subsidized (Rend to own)		0	0
Total		*100*	*100*
How often they plan:			
Daily		26	26
Every other day		49	49
Weekly		25	25
Monthly		0	0
Total		*100*	*100*
	Minimum	Maximum	Mean
Age	23	59	40.18
Household size	2	8	4.33
Gross monthly income	15,000 ($292)	140,000 ($2,720)	47,580 ($925)

that they are mature enough to pass judgement on their household food waste knowledge, attitudes and practices. Household size ranged from 2-8 with an average of 4, which indicates that the size belongs to the standard Filipino family size, based on the report of the Philippine Statistics Authority (PSA), 2015. Gross monthly income has a mean of 47, 580, an amount which can sufficiently help support members of the family, as reported by the National Economic and Development Authority (NEDA, 2018). Majority of them are females (86 %). Almost half of the respondents are high school graduates; 25% did not finish their college degree, and the rest are college graduates. Generally, the respondents have their own house, and plan their meals every other day.

Research instruments

Survey questionnaires and observations were utilized to obtain the necessary information for this study. The instrument used in this study was a researcher-developed questionnaire. The first part of the questionnaire asked the respondents to provide personal information and socio-demographic data. The second part contained a scaling statement on the knowledge, attitudes and practices of household on food waste. To measure the knowledge of the participants on food waste, they were asked about their level of agreement on topics like segregation of food waste, recycling of food waste, considering labels on food products, and the resources used in order to grow, process and transport food. When it comes to the participants' attitudes on food waste, they were asked to respond to items that examine their behavior towards purchase, usage, and management of food. Lastly, in order to understand the practices implemented by the respondents in terms of dealing with food waste, their level of agreement on topics such as disposing of food waste and storing of leftover foods was looked into. For the scaling statement type of questions, the respondents were asked to give a rating on a five-point Likert scale: 1) strongly disagree; 2) disagree; 3) neutral; 4) agree; and 5)

Table 2: Reliability measure of the instruments

Variables	Number of Items	Cronbach's Alpha
Knowledge	17	.82
Attitudes	21	.85
Practices	14	.79
TOTAL	52	.82

strongly agree to indicate their level of agreement. Closed-ended questions mainly asked respondents about the proportion of food waste generated, their willingness to pay for implementing food waste recycling facilities, and preferred collection method for food waste recycling at their housing community, hence, the responding choices questionnaire covered the following major aspects: a) level of awareness of the food waste problem; b) involved was numerical choices and categorical choices. The major questions and/or statements in the general behaviors of handling and generation of food waste; a) views and attitudes towards recycling food waste; and b) perceived need of a household food waste recycling scheme. Before the actual survey, the survey questionnaire was subjected to face validation by food science professors. The comments and suggestions of the professors were considered and incorporated in order to significantly improve the instrument. This study tried to make sure that the instrument was clear and understandable and that the questionnaire was tested to five people before it was distributed to all respondents. Moreover, to avoid misunderstanding, all questions do not contain technical terms because the use of such terminologies could result to misunderstanding hence, the consistency and accuracy of the findings and the results could be reduced. In order to secure validity, this study used multiple sources to check the information in order to confirm the findings. Cronbach's Alpha formula was used to analyze the questionnaire's reliability. A reliability coefficient index of .82, as shown in Table 2, was obtained, and based on that, the instrument was adjudged reliable.

Data analysis

Descriptive statistics were used to tabulate data before using the factor analysis. Factor analysis was used to analyze the data (SPSS, 2009). Also, Factor analysis was used to describe the different variability among the observed, correlated variables in terms of a potentially lower number of unobserved variables that are called factors. The factors were extracted using Factor analysis and the Principal Component Method of Analysis with Varimax Kaiser Normalization rotation. Data were analyzed and interpreted based on the results of the statistical treatment. Furthermore, Pearson *r* was used to determine the relationship between the socio-demographic variables and the knowledge, attitudes and practices of the household.

RESULTS AND DISCUSSION

Knowledge of selected household on food waste

The factor analysis of the households' knowledge on food waste resulted in three major themes (Table 3), i.e., knowledge on a) food waste recycling, b) positive benefits of food waste management, and c) minimizing food waste/food waste as a source of livelihood. Most of the respondents knew that: 1) recycling food waste is a solution to food shortage similar to those reported by Mourad (2016); Tielens and Candel (2014).

Likewise, the respondents considered that their community has no concrete food waste recycling system that the local government unit (LGU) should implement (ADB, 2017). Food waste management, according to the respondents, has positive benefits specifically towards reduction of harmful gas emissions to the atmosphere, and as a means to solve food shortage in the community. This finding is similar to those observed by Abeliotis *et al.* (2014); Schanes *et al*. (2018); Yoada *et al.* (2014). In factor 1, it can be inferred that recycling food waste is a solution to food shortage, they are aware that their community has no concrete food waste recycling system, which the LGU should implement. Respondents have knowledge on the positive benefits of food waste management, which specifies that this reduces the release of harmful gases, food waste recycling is a solution to food shortage in the community. The factor analysis further revealed that if the respondents are taught appropriate food recycling practices, particularly in managing their food waste, this could help them minimize their food waste, hence, a recycling system on food waste is necessary. The creation of a recycling system is supported by Busalla *et al*., (2013); Serrano (2005); Parfitt *et al.* (2010) who emphasized that there is a need to localize Republic Act [RA] 9003 specifically

Table 3. Result of factor analysis on the knowledge of the households towards food waste

	Variables	Factor		
		1	2	3
1.	More food waste in the household means wastage in money.	-.111	.253	-.087
2.	Segregation of food waste helps in identifying materials that can still be recycled and reused.	-.329	.389	-.367
3.	Recycling food waste can become a source of livelihood.	.198	.253	-.531
4.	Food (meat, fruits and vegetables) bought in reduced price are already not fresh.	.055	.278	-.306
5.	Recycling reduces the volume of food waste disposed/dumped in landfills.	-.089	-.069	.521
6.	Food waste recycling reduces the release of harmful gasses, such as methane that can cause extreme weather events.	-.368	.517	.305
7.	Food waste recycling is a solution to food shortage.	.401	.546	.216
8.	Specifying the expiry date on food products is important to avoid food poisoning and getting sick.	-.109	-.685	-.155
9.	Food waste is segregated from other wastes, and is contained in a separate bin or bag.	.046	.341	-.002
10.	If our community will have a food waste recycling system, then I will have positive attitude towards food waste.	.509	.286	.040
11.	Local government should shoulder full subsidy of efforts on food waste recycling.	.069	-.243	-.214
12.	The local government personnel should be trained to follow a system of food waste recycling.	.682	-.074	-.303
13.	Food that could have been eaten by people is not wasted if it is fed to the pets or composted.	.353	-.210	.477
14.	Wasting food contributes to frequent occurrence of extreme weather events like super typhoon and el Niño.	.526	-.179	-.021
15.	The energy, water and nutrients that are used to grow, process and transport food are wasted if food is purchased but not eaten.	-.325	.098	.348
16.	As long as cooked food items remain frozen they can be stored for one month or more in the freezer.	-.508	-.186	-.160
17.	Leftovers from cooked dishes that have been kept in the refrigerator for 2 or more days are unsafe to eat.	.260	-.031	.471

(Factor 1: Knowledge on food waste recycling
Factor 2: Knowledge on the positive benefits of food recycling
Factor 3: Knowledge on minimizing food waste/food waste as a source of livelihood)

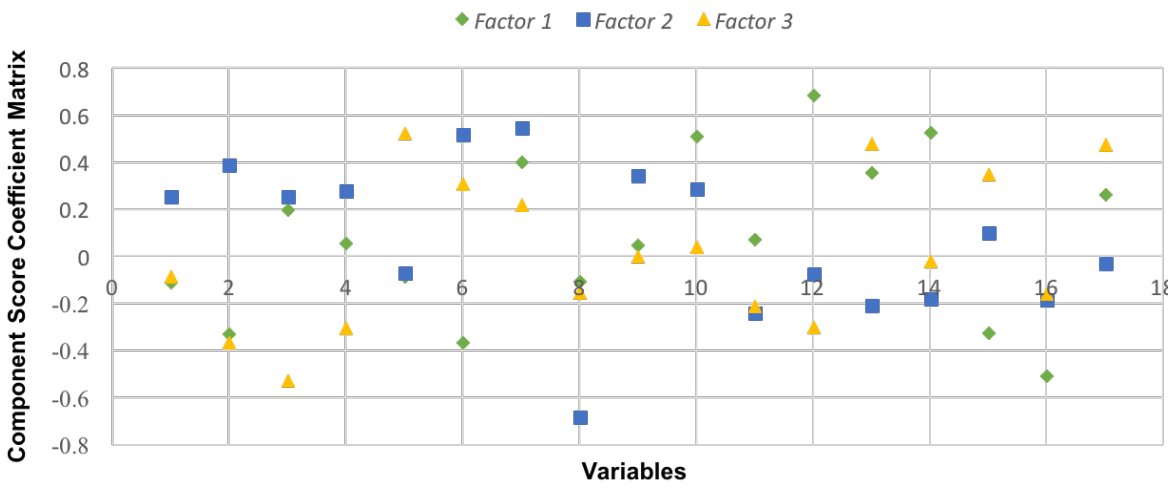


Table 4: Result of factor analysis on the attitude of the households towards food waste

	Variables	Factor		
		1	2	3
1.	We immediately throw excess food into the trashcan after every meal.	.069	.559	-.457
2.	We spend enough time to segregate food waste that can be reused and recycled from those that cannot.	-.107	.798	-.026
3.	We participate in food waste recycling if it's convenient to do it.	.004	.055	-.011
4.	We will participate in food waste recycling if facilities for this purpose will be provided in our community.	.059	-.015	.022
5.	We are discouraged to participate in recycling food waste if there is no available waste bin or bag into which we can throw them.	.488	-.005	.021
6.	We are discouraged to participate in recycling food waste because we only produce small amount of food waste.	-.541	-.275	.033
7.	We are concerned about catching diseases because of improper collection and storing of food waste.	.039	-.177	.633
8.	We are concerned about how food waste will be collected, transported, and disposed.	.324	.566	.179
9.	We believe that planning a weekly meal is thrifty for household budget.	-.555	-.181	.435
10.	We believe that a grocery list is important when shopping food.	.039	-.175	.135
11.	We believe that buying only the food that is listed will economize our budget.	-.054	-.099	-.210
12.	We consider buying food products after our family has consumed whatever we have at home.	.109	.167	.119
13.	We cook leftovers from yesterday's meal.	.749	-.047	.291
14.	We estimate the food portions that we can consume within a week.	.750	-.051	-.081
15.	We buy more local food products.	.055	.214	-.246
16.	We judge how long it takes for a food item to get rotten.	.166	-.084	.021
17.	We refer to the labels "best before" and "expiration date" when buying food products.	-.209	.030	-.007
18.	We estimate how much food to prepare in order to reduce food waste.	-.127	.226	.184
19.	Ilocanos generally don't waste much food.	.289	.091	-.029
20.	People who are disorganized or lazy waste more food than organized people.	.363	.428	.183
21.	We serve leftover foods if it's not yet spoiled.	-.046	-.153	.777

(Factor 1- Thriftiness and proper budget allotment
Factor 2 - Attitude on food wastage
Factor 3 - Health consciousness)

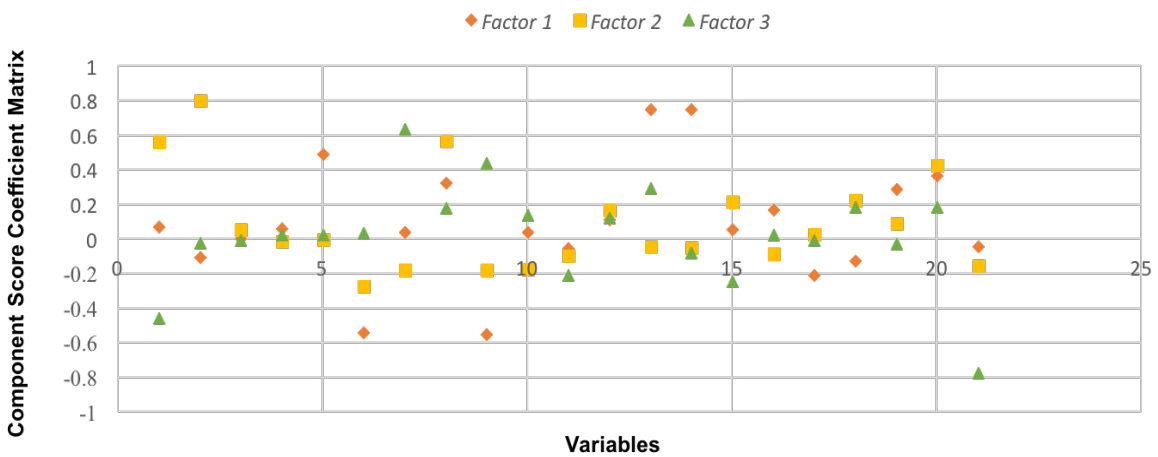
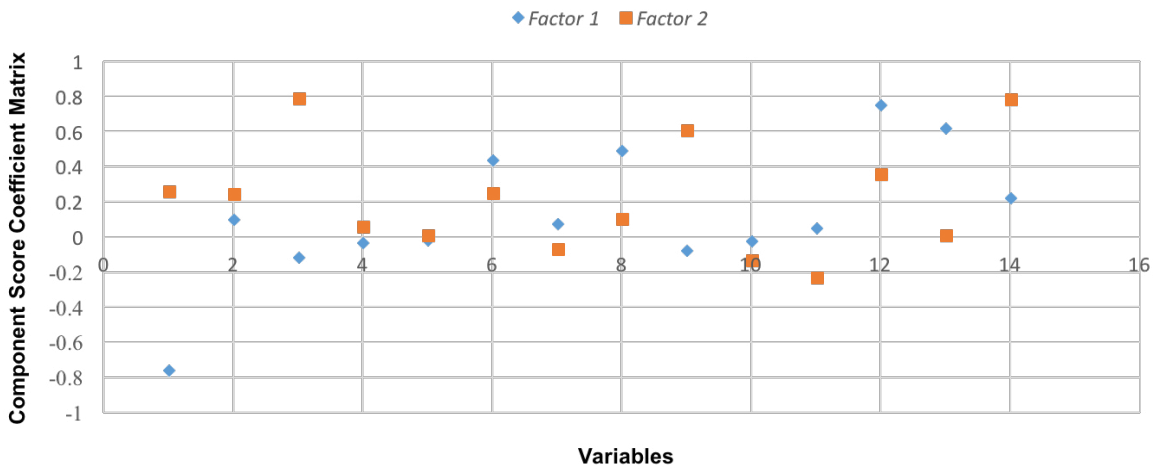


Table 5: Result of factor analysis on the practices of the households towards food waste

	Variables	Factor	
		1	2
1.	We throw out food stuff that are blemished, wilted, moldy, dry or anything that has signs of spoilage.	-.760	.260
2.	We throw out packaged food that has passed the 'best before' date even if it has not been opened yet.	.097	.245
3.	When we go shopping, we buy small amounts regularly.	-.118	.790
4.	We eat meals bought from restaurants, food chains or mobile stalls.	-.037	.060
5.	We save leftovers in the refrigerator and throw them out later.	-.020	.011
6.	We save leftovers in the refrigerator and consume them afterwards.	.433	.249
7.	Some household members do not always eat all of their food.	.073	-.070
8.	We have leftovers in every meal mainly because of too many foods cooked.	.488	.100
9.	We like to eat fresh food as much as possible.	-.081	.605
10.	We do not plan meals for the day.	-.024	-.134
11.	We are generally too busy to cook meals that we planned.	.047	-.230
12.	We are knowledgeable about the best way to store different food types.	.747	.356
13.	We have storage containers for food stuff and leftovers.	.617	.008
14.	We read storage instructions.	.221	.782

(Factor 1: Practice on food storage
Factor 2: Practice on fresh food consumption)



the administration of solid waste management that should start from the barangay. The finding is consistent with the results of the study of Reyes and Furto (2013). In their study, the residents of Batangas City encountered problems in the implementation of Solid Waste Management to a moderate level such as lack of training on proper solid waste segregation, public indifference, increasing population and inadequate government policies. People in the locality should be educated on solid waste management through information dissemination activities, such as the conduct of symposia or mini-conferences, and the distribution of instructional brochures or pamphlets on how to dispose food wastes properly. Additionally, trainings that engage participants in roundtable discussions and open forums could be conducted; such a setup would offer platforms for identifying prevailing issues in food waste management and for the proposal of feasible problems that would address the gaps and problems identified.

Attitudes of selected household on food waste

Three major themes were generated from the factor analysis of the household's attitude (Table 4). These themes were: (a) thriftiness and proper

budget allotment, (b) attitude on food waste, and (c) health consciousness. It can be inferred that attitudes of the household have something to do with their family budget and their eating lifestyle. For Ilocanos, managing family budget well and eating only what is healthy and needed could decrease food waste generation (Mattar *et al.*, 2018). Ilocanos are naturally thrifty in which every centavo counts that is why their budgeting is a significant factor in managing their household resources. This finding is supported by Cappellini, (2009) and Cappellini and Parsons (2012). Budgeting techniques could be applied in other contexts, apart from the Ilocos Region, by encouraging people to participate in educational activities that seek to heighten one's knowledge and skills in financial management, and to immerse oneself in online resources that teach people to perform effective budgeting techniques. The Department of Education in the Philippines also plans to incorporate financial literacy in its present K to 12 curriculum, which eventually hopes to produce high school graduates who are financially responsible and accountable. The results also showed that the respondents threw excess food in the trashcan after every meal (Neff *et al.,* 2015; Santos, 2017; Yoada *et al.*, 2014), and that they also discarded their food wastes without segregating them (Neff *et al.*, 2015). Respondents who are aged 50-60 years old are health conscious and are cautious on how the food is stored, prepared, and cooked (Bielak *et al.*, 2018; Hoque *et al.*, 2018; Lanfranchi *et al.*, 2016). In the year 2000, Hickman pointed out that one of the key factors that contribute to solid waste problem is public indifference where people's attitudes show no concern and care on the possible effects of improper solid waste management. This claim is supported by the studies conducted by Mallinson *et al.* (2016); Neff *et al*. (2015); Porpino (2016).

Practices of selected household on food waste

On household food waste practices, three themes were created after performing the factor analysis (Table 5). They were; 1) practice on food storage, 2) practice on fresh food consumption, and 3) practice of not consuming all served food that is presented in Table 5. Household practices like storing food correctly, eating fresh food and serving only what is presented contribute less to food waste generation (Abeliotis *et al.*, 2014; Mattar *et al*., 2018). It can be inferred from the table that the respondents practice the proper way of storing food and they have enough storage containers for food stuff and leftovers, thus avoiding food waste has been a part of their household routine practices. The respondents also shared their daily practices on consuming fresh foods—buying what is needed (Lanfranchi *et al.*, 2016). However, households that buy fresh foods at once, in advance, are expected to buy more (Mallinson *et al*., 2016; Mattar *et al*., 2018), therefore, more food waste is expectedly generated. Factor 3 indicates that one of the respondents' inevitable practices is failure to consume all the food on their plates, thus resulted in throwing them. The findings are substantiated by the FNRI (2014) report, that each Filipino threw away an average of 3.29 kg/year. The estimated rice wastage that year was 296, 869 MT, which accounted for 12.2% of the year's rice imports. The loss amounted to Php 7.3 billion. With this same amount, more than two million Filipinos could have been fed, in terms of rice, excluding other kinds of household food waste.

Test for significant differences are used to

Table 6: Results of the correlation analysis between each of the personal characteristics and their knowledge, attitudes, and practices

Personal Characteristics	Coefficient of correlation							
	Knowledge			Attitudes			Practices	
	F1	F2	F3	F1	F2	F3	F1	F2
Age	.145	.076	.066	-.041	-.052	.063	-.095	.021
Educational Attainment	.136	-.125	.079	-.173	-.019	-.056	-.149	.152
Household Size	.016	-.124	-.042	.199*	.071	-.012	-.018	-.040
Monthly Income	-.070	.009	.049	.282**	-.217*	.026	.186	-.116
Planning	.120	-.111	.063	.123	-.243*	-.028	.056	-.051
Sex	.026	-.126	.107	-.136	.067	.101	.015	.081

*p<.05; **p<.01

determine if there is difference in the score with respect to the demographic characteristics or covariates. Pearson *r* and point-biserial correlation were used (Table 6). The decision criterion is to reject the null hypothesis if the p-value is less than or equal to the level of significance. Age, educational attainment, and sex have no correlation at all with any of the factors of knowledge, attitudes and practices. It can be inferred from the table that household size has a weak positive significant ($p<0.05$) correlation with attitude F1 at 5% level of significance. This means that household size significantly contributed to the generation of household food waste. This is supported by the study made by Abeliotis *et al*. (2014); Jorissen *et al,*. (2015); Koivupuro *et al*., (2012); Mattar *et al*. (2018); Parizeau *et al*., (2015); Quested *et al*., (2013); Silvennoinen *et al*., (2014); Stancu *et al.,* (2016); Tucker and Farrelly, (2015); Visschers *et al.,* (2016); saying that education and number of household members affect food waste volume. At 5% and 1% levels of significance, the table shows that there is a weak positive and negative significant correlation between monthly income and attitude for F1 and F2, respectively. This shows that, the more the income of the households, the more the food waste they can generate. Recent studies show that wealthier households generate more food waste than households with lesser income (Hamilton, 2005; Koivupuro *et al*., 2012; Mattar *et al*., 2018; Jorissen *et al.*, 2015; Skourides *et al.*, 2008). Household planning for menu has also a difference in the Attitude F2 with respect to "how often they plan" at 5% level of significance. Those who plan every other day have higher scores than those who plan weekly. Similar findings have the same results with the studies conducted by Abeliotis *et al*., (2014); Grandhi *et al.,* (2016); Koivupuro *et al*., (2012); Lanfranchi *et al*., (2016); Mattar *et al*., (2018). Accurate planning in buying and shopping is an effective tool to avert overbuying, and consequently, reduce food waste levels (Parizeau *et al*., 2015; Stancu *et al*., 2016; Secondi *et al*., 2015; Visschers *et al*., 2016). The table also shows that there is no difference in the scores with respect to

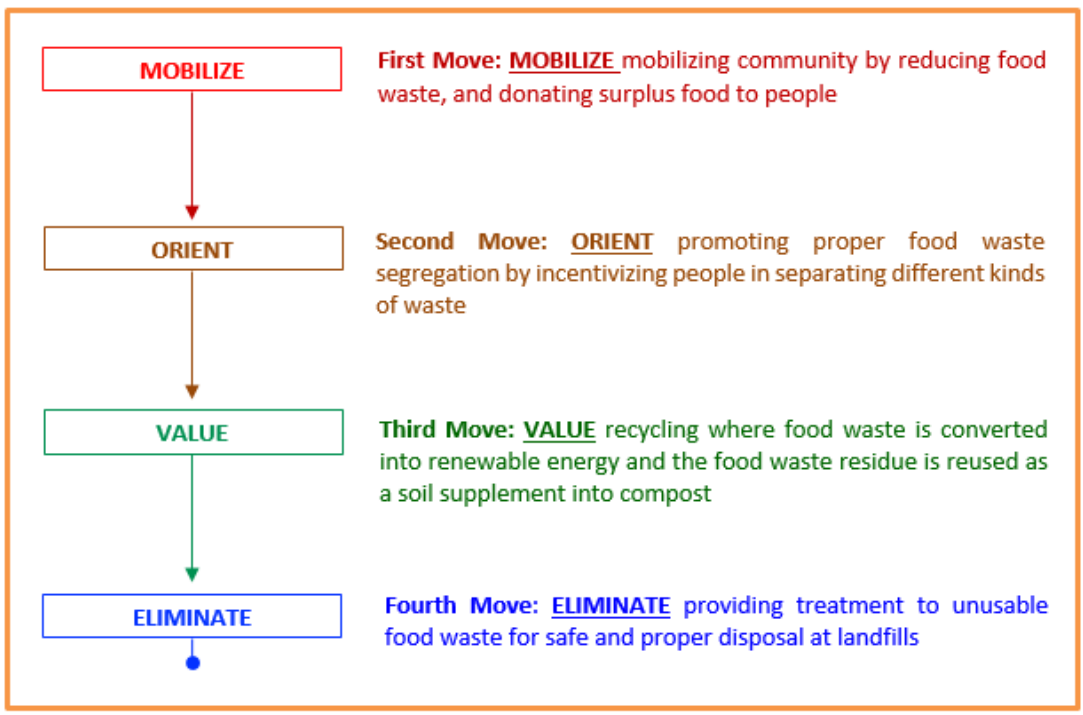


Fig. 2: Four MOVEs (Mobilize, Orient, Value, and Eliminate) in food waste recycling system

sex, which means that sex has nothing to do with the generation of household food waste. This finding is supported by the finding of Koivupuro, *et al*., (2012); Mallinson *et al*., (2016); Principato *et al*., (2015); Qi and Roe, (2016).

Proposed compulsory food waste recycling system for every private household

The Ilocos province is currently facing pressing issues concerning food waste management. One example is the incapability of landfills to accommodate large volume of food waste, which households exponentially generate each year. However, there is a possibility of turning these challenges into opportunities of suggesting and implementing reforms in order to redirect food waste management into a sustainable system. With the vast amount of domestic food waste produced, there is potential to introduce a food waste recycling system primarily intended for private households of the different municipalities of the province of Ilocos Norte.

The local government already has a system of waste management; however, this does not focus on how to systematically manage and eventually decrease household food waste, rather, the prevailing system is a very simplistic process of collection and disposal. Certainly, a more concrete and specialized waste management system is needed to improve the present situation; the researcher proposes a system that is centered on reducing household food waste. It is expected that this intervention could lessen cases of food waste disposal to landfill by 50% in the year 2025 (Mourad, 2016), using 2016 as the baseline. The proposed food waste recycling system, which the local government is expected to implement, is composed of four major moves as shown in Fig. 2. The first move involves the community in which people are encouraged to lessen volume of food waste and prepare surplus foods for charitable donations. The second move employs a reward system where people in the community who carry out proper segregation of food waste will be given monetary incentives. The third move entails the conversion of food waste into renewable energy and reusing food waste residue as soil supplement in composting. Finally, the fourth move is aimed at a nontoxic and environment-friendly disposal of food waste into landfills by the use of safe and approved chemical treatments (Fig. 2).

First Move: In order to incite involvement from the community members, information dissemination through posters, people's charter and brochures will be implemented (Qi and Roe, 2016; Tucker and Farrelly, 2015). These informative materials will stimulate the community to reconsider their practices in handling food waste, and to veer away from regular activities that contribute to the generation of food waste, such as irresponsible purchase (Parizeau *et al*., 2015; Ganglbauer *et al*., 2013; Farr-Wharton *et al*., 2014; Graham-Rowe *et al*., 2014; Mondejar-Jimenez *et al*., 2016; Porpino *et al*., 2015), and preparation (Ganglbauer *et al*., 2013; Graham-Rowe *et al*., 2014; Porpino *et al*., 2015; Silvennoinen *et al*., 2014; Watson and Mead, 2012) and consumption (Cappellini and Parsons, 2012; Evans, 2011a, 2011b; Ganglbauer *et al*., 2013) of foods. Barangay officials will be assigned as authorities-in-charge who will disseminate practical information on food waste management and reduction. In addition, the local government will coordinate with non-governmental organizations (NGOs), especially in charitable cases, where safe and edible surplus foods are donated to disadvantaged people provided that they follow food safety standard and rule (Farr-Wharton *et al*., 2014; Graham-Rowe *et al*., 2014; Meah, 2014; Waitt and Phillips, 2016).

Second Move: *T*he provincial government will send a pool of experts to the local governments and then to the barangays which will conduct trainings on how to carry out effective and efficient household segregation procedures. Also, in order to promote positive attitude towards waste segregation, community members will be given monetary incentives for properly doing the procedure. By contrary, the producers-pay-principle will be applied to those who produce large volumes of food waste, which means that the more food waste is generated (exceeding the baseline), the more a household is going to pay as charge. This scheme has been proven effective in Taiwan and South Korea in which providing financial reward enhances the act of food waste segregation and imposing charges minimizes the generation of household food waste

(Graham-Rowe *et al*., 2014; Neff *et al*., 2015; Shin and Hwang, 1997; Watson and Mead, 2012). These moves require the municipality to establish a food waste management center where the aforesaid transactions will take place.

Third Move: This phase requires support from the local representatives of the DOST since food waste will be converted into soil supplement for compost (Neff *et al*., 2015; Pearson *et al*., 2016; Porpino *et al*., 2015) or into renewable energy, such as biodiesel, through the use of chemical treatments and scientific procedures (Cecere *et al*., 2014; Secondi *et al*., 2015; Tucker and Farrelly, 2015). This is proven to be the most effective method in combating food waste at the household level (Secondi *et al*., 2015; Stancu *et al*., 2016; Stefan *et al*., 2013). For these to be realized, the municipality should procure necessary facilities to carry out the processes; and that these facilities will be set up in the food waste management center, where authorized personnel will assume responsibility in the maintenance and operation of facilities.

Fourth Move: The remaining food waste that cannot be avoided, separated, recycled and recovered would be disposed of, or can be fed to animals (Neff *et al*., 2015; Pearson *et al*., 2016; Porpino *et al*., 2015). The last resort would be at landfills where these will undergo treatment technologies in order to ensure that the manner by which these are disposed do not pose health risks and do not raise environmental issues (Evans, 2011b; Lazell, 2016). The implementation of the Four MOVEs in food waste recycling system adheres to the policy development plan suggested by the Office of the Auditor General OAG (2003), which begins with a) issue identification—in the context of this study, b) issue analysis by collecting data from primary and secondary sources that includes the distribution of questionnaires to the respondents, recommendations of related studies, theoretical assumptions, and identified gaps from existing laws and regulations. The process then proceeds to c) generating solutions–identifying and soliciting inputs from experts, such as food science and technology practitioners or specialists. After which, d) consultation–a debate at the level of the governing body, which includes the barangay captain, members of the rural health unit and officials of the local government unit. The policy development plan culminates at the e) writing of the policy based on the written consensus generated by concerned authorities.

Implications for policy amendments

This study aimed at establishing feasibility in relation to the introduction of a food waste recycling system to private households in the municipalities of Ilocos Norte. This intervention resulted from a review of the existing knowledge, attitudes, and practices of the community members with regard to food waste. It was found out that, at present, the municipalities of the province do not follow a food waste recycling system dedicated to households, but that the manner by which wastes are managed is through a simple collect-and-dump process. The local governments do not have any specialized campaign in order to reduce the volume of household food waste generated within the context, and this is alarming since the amount of food wastes produced by each family in the said community exponentially increases every year. Therefore, it is imperative to introduce and carry out a household food waste recycling system, which is a sustainable measure to solve the ongoing problem on food waste. But for this system to fully materialize, the local government and the community members, including non-governmental organizations, should make up a strong support system. Community stakeholders, specifically spearheaded by the barangay officials should monitor the implementation of the proposed food waste recycling system. However, this should not only entail overseeing the effective operation of the aforesaid system but should also involve examining the results of the process, whether these are in the affirmative or not. The findings in the study suggest that the attitudes of the respondents, who come from the municipalities in Ilocos Norte, do not correlate with their actions; even if most of the respondents agree that food waste should be reduced and managed well, they still exercise malpractices in the handling of food waste. According to Donnges (2003), people fail to behave in the way of their positive attitudes because of several contributory

factors, such as culture, socio-economic standing, and educational profile. Moreover, based on the results of the survey, the respondents are not fully aware of the various means of recycling food waste, and how to prevent its generation (Graham-Rowe *et al.*, 2014; Quested *et al.*, 2013; Stefan *et al.*, 2013). In addition to this, the participants' attitudes towards food waste is primarily based on lifestyle and their immediate social environment, thus, other important concerns, such as health, nature, and economy are not taken into account. These findings put much weight on effective information dissemination strategies from the local government—more resources should be allotted to the production of campaign paraphernalia and in the conduct of symposiums and seminar-trainings that heavily underscore proper education on food waste and how the public could help in putting a halt to its increasing generation (Qi and Roe, 2016; Tucker and Farrelly, 2015; Pricipanto *et al.*, 2015). By means of establishing a food waste management center equipped with modern facilities to carry out proper segregation, income-generating recycling processes, and eco-friendly treatment procedures to food waste, then respondents would be encouraged to actively participate in the campaign (Chalak *et al.*, 2016; Dahlen and Lagerkvist, 2010; EEA, 2009). Although, it was revealed in the study that there are a number of factors that discourage respondents to participate in recycling their food waste, including lack of food waste recycling facilities, hygiene and public health issues, and other social issues such as convenience, if the local government would direct sufficient resources towards fulfilling the aforesaid actions, the reservation among community members when it comes to managing their food waste would decline, thus, more people would be willing to join in the campaign. The local governments in the province should perform benchmarking (Porpino *et al.*, 2015) from neighboring towns, from other parts of the country, or even from international communities, which have successfully implemented food waste reduction programs involving private household. How the local government in those areas functioned in the process should be examined, and how the community is mobilized in order to meet the objectives of the program should also be noted. This would ensure that policy amendments or reforms will be carried out more efficiently, and will bring about desirable results with a high probability rating.

CONCLUSION

The findings show the heterogeneous levels of the respondents in terms of their knowledge, attitudes, and practices on food waste. However, the majority of respondents are clustered in the belief that managing food waste involves a systematic measure that operates in a cyclical process of reducing, reusing and recycling, in order to alleviate the problem resulting from inappropriate, hence, problematic handling of waste generated from food preparation in the household. Although, the overall attitude of the respondents gravitates toward the positive, it does not correlate with their current practices on handling food waste, which do not adhere to acceptable international standards. Furthermore, there are a number of factors, such as lack of equipment and facilities to conduct a methodical treatment for generated food waste, and insufficient training and information dissemination among members of the community that discourage them to proactively participate in the reduction and recycling of food waste; these require urgent action from the local government. Respondents' reservation to be closely involved in food waste management, caused by lack of interventions from the local government, is further heightened by their unfamiliarity with the systematized, technical procedures employed in the recycling of food waste. As a result, respondents have this faulty notion that recycling technologies might risk the health and security of the community. Nevertheless, they generally agree to the recommendation that a compulsory food waste recycling system for private households should be immediately implemented, and once carried out, consistently monitored by authorities, in order to efficiently and effectively combat the pressing issue on food waste.

AUTHOR CONTRIBUTIONS

M.R. Limon performed the literature review, gathered data, compiled the data, analyzed and interpreted the data, prepared the manuscript text. C.B.J. Villarino performed manuscript edition.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this manuscript. In addition, ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy were completely observed by the authors.

ABBREVIATIONS

A	Attitude
ADB	Asian Development Bank
ANOVA	Analysis of Variance
BIOIS	Bio Intelligence Service
CPH	Census of Population and Housing
DOST	Department of Science and Technology
EEA	European Environment Agency
FAO	Food Agriculture Office
FAOUN	Food and Agriculture Organization of the United Nations
FNRI	Food and Nutrition Research Institute
FWHK	Food Wise Hong Kong
FWRS	Food Waste Recycling System
K	Knowledge
Kg	Kilogram
Km²	Square Kilometer
MMDA	Metro Manila Development Authority
MOVE	Mobilize, Orient, Value, & Eliminate
MT	Metric tons
NEDA	National Economic Development Authority
NGOs	Non-government organizations
NIMBY	Not-in-my-backyard
OAG	Office of the Auditor General
P	Practices
PSA	Philippine Statistical Authority
RA	Republic Act
SLFs	Sanitary land fills
SSPS	Statistical Package for the Social Sciences
UNEP	United Nations Environment Program
WFP	World Food Program
Y	Year

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