



Factors influencing appropriate management of household waste in developing country

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Abstract

Household waste generation is a critical problem in Thailand. Effective solutions for resolving the household waste problem need to include improving behaviors vis-à-vis reducing, reusing, and recycling. This study was aimed to determine the factors that influence appropriate household waste management in Thailand. Data were collected between January and November 2018 using a structured questionnaire. The proportion of appropriately household waste management was reported as a percentage with its 95% confidence interval (CI). A Generalized Linear Model (GLM) was used to identify the factors influenced with appropriate household waste management. The proportion of appropriate household waste was only 6.73% (95% CI: 5.04 to 8.78). The results indicate that household waste management was significantly influenced by the respondent's status, the type of recycling waste buyback vehicle, and appropriate behavior in household waste disposal. Based on the findings, Thailand's government should support a new policy for increasing appropriate household waste management by promoting a recyclables buyback and collection vehicle for each community.

Keywords: Household waste management, Buyback and collection vehicle, Generalized Linear Model, Recycle waste, Thailand

1. Introduction

Household waste refers to waste streams generated around human habitation collected and management by municipalities or other local rural authorities. Household waste includes plastics, paper, food waste, wood, glass, textile, electronics waste, and infectious waste [1]. The generation of household waste-its quantities and inappropriate management (storage, collection, transport, and disposal) -adversely affects human health and creates environment harms [2]. The lack of household waste management can be detrimental to the environment, posing a threat to human health from rodents and pathogens [3,4]. In 2013, the World Bank reported that by the year 2100, household waste would exceed 11 million tonnes per day, making household waste management an increasingly important concern especially in developing countries [5,6]. Thailand is classified as a developing country by the International Monetary Fund: IMF. They were dividing the world into two major groups: advanced economies, and emerging and developing economies by using data relating to the domestic economy, whether growth rates or ratios, are weighted by GDP valued at purchasing power parities (PPPs) [7].

Household waste management in Thailand is a significant challenge for policymakers (government) and waste operators (local administrative organizations). The Thai Pollution Control Department reported that household waste in Thailand was generating 28.7 million tonnes pa or 78,657 tonnes per day and that the rate was increasing by 2.86% year-on-year [8]. The Thai government established a waste management plan to tackle household waste problems. One of them is implementing a household waste management system by providing a collection service, disposal system, and 3Rs strategies (Reduce Reuse and Recycle) [9]. Source separation can dramatically impact the waste management system's effectiveness by changing the quantity and quality of waste, reaching final management, and disposal [10,11]. Unfortunately, this approach did not succeed because households did not consistently follow the rules for waste separation and sorting.

The Pollution Control Department reported that the collection and recycling rates in Thailand were meager and that 27% of total household waste continued to be inappropriately disposed of [12,13]. In 2016, the government of Thailand released its Thai National Waste Management Master Plan “Thai Zero Waste” to tackle the problem [14,15]. The primary purpose of the plan was to encourage people to correctly and more efficiently separate household waste. The goal is that by 2021, 50% of total household waste for the whole country be separated at source, and 75% of total household waste should be appropriately managed. To achieve this goal, the government transferred all facilities to local administrative organizations (viz., authorities and facilities) because local administrative organizations are responsible for dealing with household waste [14,16].

Several issues, however, continued to interfere with successful household waste management in Thailand [17]. Therefore, the aims were to determine the proportion of appropriate household waste management in Thailand and explore the influencing factors.

2. Materials and methods

2.1 Study area

The study was conducted in Nakhon Nayok province, Thailand. Nakhon Nayok has three levels of local administrative organization, comprises 1 municipality (city), 5 sub-districts (population concentrations not sufficient for municipal status), and 39 sub-district administrative organizations (rural populations congregated in small villages).

Nakhon Nayok province is one of the smaller provinces of Thailand (72nd of 77), but its household waste volume ranks 28th. The Pollution Control Department reported that Nakhon Nayok generated about 91,000 tonnes of household waste per year and growing year-on-year. Half of the household waste volume is inappropriately managed [18].

2.2 Study method

Ours was a cross-sectional study with a stratified, multi-stage, proportional to size sampling. The sample comprised 743 households, logistic regression formula was used for sample size calculation. [19]. First stage sampling included all local administrative organization levels while second stage sampling focused on each level of local administrative organization, requiring a probability proportional to size sampling of households.

We included: (a) 1 town; (b) one subdistrict (20% of the total 5); and, (c) 14 subdistrict administrative organizations (i.e., 36% of the total 39). Based on information, proportional sampling was used.

2.3 Data collection

A questionnaire was used to elicit data from household respondents. The development of questions was based on household waste management literature, and subject experts validated content. The questionnaire comprised (1) socioeconomic characteristics; (2) household waste separation behavior; (3) household waste management information; (4) local administrative organization support and recyclable waste, buyback vehicle; (5) household waste collection and transportation; (6) household waste management behavior; (7) household waste management attitude; and, (8) household waste management knowledge. The reliability value from pilot study was (Cronbach’s alpha coefficient) of 0.84. A survey was conducted using face-to-face interviews in all of the households involved in the project. Data collection began in January 2018 and was completed in November 2018.

2.4 Outcome variable

“Appropriate household waste management” in this study meant that respondents separated and disposed of household waste correctly. Four statements were used to confirm/deny this behavior. The respondent was asked to label the statement as Appropriate or Not appropriate management of household waste.

(1) Not every household needs a bin for each type of household waste. (i.e., recycle waste bin, hazardous waste bin, organic waste bin, or other waste bin)

a. “Inappropriate” indicates respondent does not understand the need to separate waste into types.

b. “Appropriate” indicates the respondent understands that every home needs all the bins for proper separation of waste.

(2) Each home can burn household waste as a means of disposal.

a. “Inappropriate” indicates a lack of understanding about how to dispose of household waste.

b. “Appropriate” indicates that the respondent understands that burning household waste poses health risks to the community.

(3) Households do not have to reduce household waste.

- a. “Untrue” indicates a lack of understanding about the need to reduce household waste.
 - b. “True” indicates the respondent understands the need to reduce and manage household waste.
- (4) Correct disposal of household waste is difficult.
- a. “Untrue” indicates a lack of awareness of the ways to dispose of household waste.
 - b. “True” indicates the respondent is aware of the different ways to manage household waste.
- The scores were dichotomized to reflect respondents who understood appropriate/proper household waste management (all answers had to be replied positively) versus those who had inappropriate/incorrect household waste management.

2.5 Statistical analyses

Data were compiled and managed using STATA version 10 (Stata Corp, TX). Continuous data were reported as a mean and standard deviation (SD), or a median and range. Categorical data were presented as a frequency or percentage. A Generalized Linear Model was used to estimate the appropriate household waste management factors. The association between factors influencing appropriate household waste management was presented as a crude (COR) and an adjusted odds ratio (AOR) with a 95% confidence interval (CI). A significance of statistical tests at $p\text{-value} < 0.05$.

3. Results and discussion

3.1 Results

Based on 743 respondents, 62% were female, and the average age was 49.6 (SD: 16.0). The median household size was 4 (range, 1 to 14). As for education, 39.3% of respondents attended primary school, 15.9% completed secondary school, and 16.9% completed a bachelor's degree. Most respondents were vendors (42.2%), some were retired (16.3%), and a few were self-employed (11.8%). The average monthly income was US \$748.83 (SD 42.2). The demographic characteristics of the respondents are summarized in Table 1.

Table 1 Socioeconomic characteristics of respondents.

Characteristic	Total, n (%)
1. Sex	739
Male	282 (38.2)
Female	457 (61.8)
2. Age (years)	732
Average mean $\pm$ SD	49.6 $\pm$ 16.0
< 60 years	516 (70.5)
$\geq$ 60 years	216 (29.5)
3. Household size	721
Median (range)	4 (1 - 14)
$\leq$ 4 members	465 (64.5)
> 4 members	256 (35.5)
4. Education level	647
Primary school	254 (39.3)
Secondary school	103 (15.9)
High school	103 (15.9)
Diploma	62 (9.6)
Bachelor's degree	109 (16.9)
Master's degree or higher	16 (2.5)
5. Occupational status	737
Agricultural	43 (5.8)
Vendor	311 (42.2)
Self-employed	87 (11.8)
Government service	45 (6.1)
Craftsmanship	18 (2.4)
Employee	52 (7.1)
Retired	120 (16.3)
Other	61 (8.3)

The knowledge score for household waste management was determined using eight questions (range, 0 to 8). The average mean score was 4.7 (SD 1.4). The overall proportion with appropriate household waste management was 6.7% (95% CI: 5.04 to 8.78). Males as a group had more appropriate household waste

management than females (7.8 (95% CI: 4.95 to 11.57) vs. 6.1 (95% CI: 4.11 to 8.73), respectively). Respondents over 60 in contrast to those under 60 had more appropriate household waste management (i.e., 7.4 (95% CI: 4.29 to 11.75) vs. 6.6 (95% CI: 4.61 to 9.09), respectively). Heads of households had more appropriate household waste management than other household members (i.e., 9.0 (95% CI: 5.98 to 12.95) vs. 5.4 (95% CI: 3.62 to 7.92), respectively). Respondents in households with over four members had more appropriate household waste management than those living in households with four or fewer members (i.e., 7.0 (95% CI: 4.22 to 10.89) vs. 6.0 (95% CI: 4.04 to 8.59), respectively). Respondents who had appropriate behavior in household waste disposal had more appropriate household waste management than who did not (i.e., 8.33 (95% CI: 5.91 to 11.35) vs. 3.51 (95% CI: 1.70 to 6.36)). Respondents with access to a recyclable waste buyback vehicle had more appropriate household waste management behavior than those who did not (i.e., 10.92 (95% CI: 7.59 to 15.07) vs. 3.67 (95% CI: 1.84 to 6.47)) (Table 2).

Table 2 The proportion with appropriate household waste management

Variable	No.	Appropriate household waste management	
		Proportion	95% CI
Overall	743	6.73	5.04 – 8.78
Sex			
Male	282	7.80	4.95 - 11.57
Female	457	6.13	4.11 - 8.73
Age			
< 60 years	516	6.59	4.61 - 9.09
≥60 years	216	7.41	4.29 - 11.75
Status of respondent			
Head household	288	9.03	5.98 - 12.95
Member of household	430	5.35	3.62 - 7.92
Household size			
≤ 4 members	465	6.02	4.04 – 8.59
> 4 members	256	7.03	4.22 – 10.89
Appropriate behavior in household waste disposal			
Inappropriate	285	3.51	1.70 - 6.36
Appropriate	432	8.33	5.91 - 11.35
Recyclable waste buyback vehicle			
No	300	3.67	1.84 – 6.47
Yes	293	10.92	7.59 – 15.07

For, the multivariate analysis represented that the significant factors were (a) household role of the respondent, (b) availability of a recyclable-waste buyback vehicle, and (c) practicing household waste disposal. The results of the final model illustrated that there was a greater likelihood of appropriate household waste management if respondents (a) were the head of a household (AOR: 2.00, 95%CI:1.02 to 3.93); (b) had access to a recyclable-waste buyback vehicle (i.e., 3.24-fold greater) (AOR: 3.24, 95% CI: 1.44 to 7.28); or, (c) had intentional, household waste disposal behavior (i.e., 3.20-fold greater) (AOR: 3.20, 95% CI: 1.70 to 6.03) (Table 3).

Table 3 Generalized linear model of factors influencing appropriate household waste management among residents of Nakhon Nayok province, as crude (COR) and adjusted odds ratio (AOR) and 95% confidence intervals (95% CI).

Variable	n	Appropriate household waste management (%)	COR (95% CI)	AOR (95%CI)
Status of respondent				
Member of household	430	5.4	1	1
Head household	288	9.0	1.76 (1.08 to 2.86)	2.00 (1.02 to 3.93)
Recyclable waste buyback vehicle				
No	300	3.7	1	1
Yes	293	10.9	3.22 (1.31 – 7.91)	3.24 (1.44 – 7.28)
Appropriate behavior in household waste disposal				
Inappropriate	285	3.5	1	1
Appropriate	432	8.3	2.50 (1.88 – 3.23)	3.20 (1.70 – 6.03)

Deviance Null Model: = 366.4, Final model: =259.0

AIC Null Model: = 368.4, Final model: =263.0

3.2 Discussion

The overall proportion of appropriate household waste management was only 6.7%. Inappropriate household waste management can lead to the spread of diseases [20]. In the current study, appropriate household waste management was influenced by (a) the household role of the respondent, (b) the availability of a recyclable waste, buyback vehicle, and (c) intentional, household waste disposal behaviors.

The results suggest that being the head of a household was associated with a management behavior as compared to other members of the household and may be related to household waste management training offered by the local government administration office [21]. In Thailand, training is limited to household heads as space is limited, so not all household members can be included. Thus, if a household has some appreciation of waste disposal, they are more likely to have appropriate household waste management [21,22]. Consequently, it is crucial to increase public awareness by training and education, including details on waste management systems and appropriate waste disposal practices [9,23,24].

The authors found that respondents with access to a recyclable waste buyback vehicle had more appropriate household waste management behavior compared to those who did not. The survey also found that the price of an amount of recyclable materials can be negotiated at the buyback vehicle. Half of household waste composition in Thailand can be sold such as plastic waste and paper waste. The plastics recycling fabrication process can be modified to form various shapes and colors [9]. Zheng et al., 2020 and Timlett & Williams, 2008 reported that increasing the recyclable material is important for encouraging waste sorting and appropriate waste management behavior [7,25]. When respondents learn to separate waste for sale more appropriate waste management behavior is being achieved. Such a finding is consistent with Tonglet et al. (2004), Czajkowski et al. (2014) and Steg & Vlek (2009), who found that pro-environment attitudes were aligned with facilities and buyback vehicles. Having access to a recyclable waste, buyback vehicle thus encourages the community to separate household waste at source, making such a service a critical component of a successful, integrated, waste management system [26-28].

Our findings reveal an association between respondents who had intentional, household waste disposal behaviors and appropriate household waste management. This result in turn suggests that respondents who have appropriate household waste disposal have pro-environmental behaviors, which have a synergistic influence on waste sorting behavior [7].

4. Conclusion

Household waste management is a challenge for the government of Thailand. The current study revealed that appropriate household waste management is strongly associated with respondents who (a) demonstrate intentional household waste disposal behavior, (b) have access a recyclable waste buyback vehicle service, (c) have an awareness of environmental issues, (d) are trained in waste separation, and (e) have a leading household role. In order to increase appropriate household waste management, the government though local administrations should (a) encourage protective environmental behavior through regulatory policy and

compliance enforcement, (b) teach the public how to separate household waste via local government organization, and (c) provide a means of correctly disposing wastes. Since separation of household waste depends on accessibility of a recyclable waste buyback vehicle, this service should be licensed and scheduled both to ensure its availability, and the pursuit of sound environmental standards.

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6. Ethic approval

The study was reviewed and approved by the Srinakharinwirot University Ethics Committee for Human Research, Thailand (Reference No. SWUEC/X-322/2560).

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