Full length article

Modeling home composting behavior toward sustainable municipal organic waste management at the source in developing countries

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ABSTRACT

Home composting (HC) has become an increasingly important consideration in the framework of sustainable municipal organic waste (MOW) management in developing countries. We develop, for the first time, two HC behavior models, which include households' decisions to participate in a HC scheme and the level of HC participation. By applying Logit and Ordered logit models, a survey of 202 respondents in rural areas of Hoi An, Vietnam, indicates that households' decisions to get involved in a HC scheme and the level of HC participation are affected by motivational factors such as knowledge about HC, attitude toward it, and owning a garden. We then explore the differences between the influencing factors for the two models. Interestingly, while participation in the HC training program influence the decision to participate in the HC scheme, the factor appears unimportant in increasing the level of HC practice. In addition, once the HC participation decision has been made, we find that pro-environmental behavior (such as habit of reusing plastic bags and reducing wastefulness) could promote a higher level of HC practice. These findings could help policy makers in promoting HC behavior to enhance a sustainable MOW management strategy at the household level.

1. Background of research

1.1. Introduction to home composting

Home composting, or backyard composting, includes biodegradation of municipal organic waste (MOW) (including food waste and garden waste) as well as the use of compost in a private garden at household scale (Colón et al., 2010). In terms of sustainable waste management strategies, home composting is a productive option for treating MOW at source, recognized for its many benefits such as reducing pressure on landfills, minimizing garbage collection and transportation costs (Tanaka, 1999, 2007), reducing loss of organic resources derived from landfilling (Smith and Jasim, 2009), generating products with intrinsic value by improving soil structure and fertility (Andersen et al., 2012, 2011; Barrena et al., 2014; Colón et al., 2010), as well as conducting fun experiments and enjoying an eco-friendly lifestyle (J.D.G et al., 2013). Although home composting is not seen as a treatment option for all MOW (Andersen et al., 2011), this methodology can be considered the best waste management strategy at the household level (Faverial and Sierra, 2014; Getahun et al., 2012). In other words,

home composting facilitates sustainable recycling for individual home owners (Andersen et al., 2011). Many countries have been promoting home composting; however, most of them are developed nations: the UK (Edgerton et al., 2009), Spain (Colón et al., 2010), Sweden (Sterner and Bartelings, 1999), Denmark (Andersen et al., 2012), Japan (Tanaka, 2007, 1999; Ueta and Koizumi, 2001), and Germany (Ueta and Koizumi, 2001). There is no doubt that home composting have not become a focus in developing countries (Scheinberg and Zheng, 2010).

Hoi An, a Vietnamese city within a developing state with a population of approximately 91,993 people, generated 68.97 tons of municipal solid waste (MSW) per day in 2012. The city's landfill, measuring only about 1.34 ha is poorly designed, uncontrolled, and overloaded and will be closed in the near future. Remarkably, food waste and garden waste account for 38% and 20%, respectively, of Hoi An's total MSW (Hoang et al., 2017). However, in rural areas, due to municipal budget constraints, Hoi An authorities are able to collect only part of the waste. Therefore, a part of MOW will be treated at the household level, mostly through illegal burning as well as illegal dumping on the street or other public spaces. Moreover, between August 2012 to July 2015, Hoi An adopted a MOW separation at source (MOW-SAS)

program in response to Vietnam's *National Strategy for Integrated Management of Solid Waste until 2025 and Vision towards 2050.* This program originally introduced MOW-SAS to the main four wards—the pilot areas—in the first stage (2012–2013), and it was rolled out to the rest of the city (eight communes and one island commune) in the second stage (2014–2015). It is worth mentioning that, in the second stage of the MOW-SAS program, Hoi An implemented a home composting program in rural areas which included Cam Thanh and Cam Ha communes that aims to help local authority to achieve targets to divert MOW from landfill. The residents are guided to practice home composting by composted food waste and garden waste through some methods such as digging hole and burying MOW, composted MOW in a simple wire compost bins, or using plastic storage compost bins (Department of Natural Resources and Environment of Hoi An city, 2015).

1.2. Research gaps in understanding home composting behavior

Previous research has considered home composting behavior (also called home composting acceptance as well as home composting participation) in order to determine what affects the behavior of composter groups and non-composter groups. Some major factors that support home composting acceptance were suggested: knowledge about home composting (Edgerton et al., 2009), attitude toward home composting (Edgerton et al., 2009; Tucker and Speirs, 2003), presence of a garden or yard (Bennagen et al., 2002; Sterner and Bartelings, 1999), total quantity of food waste generated (Bennagen et al., 2002), and time spent on home composting (Bennagen et al., 2002; Edgerton et al., 2009; Sterner and Bartelings, 1999).

Moreover, the willingness of residents to participate in the composting program was previously measured in terms of composting behavior categories. Sussman et al. (2013) investigated the level of correctly putting food waste into compost bins by cafeteria patrons. There were several types of composters, for example, non-composters (individuals did not dispose of any of compostable waste in the compost bin); partial composters (individuals appropriately composted some, but not all, compostable waste); and ideal composters (individuals perfectly composted everything they could). Using this measurement was very important in order to reduce composting mistakes. However, it relied on the field experimental study which is extremely costly and difficulty for household survey. While, Taylor and Todd (1995), Taylor (1997) and Karkanias et al. (2016) recorded home composting behavior in terms of the frequency of home composting participation, such as minimal, moderate, and frequent. Increasing the frequency of home composting participation plays an important role in reducing unsuitable MOW treatment at source, including burning MOW as well as illegal dumping. Generally speaking, practicing home composting frequently should be recommended by municipalities to avoid environmental pollution. However, Karkanias et al. (2016) did not investigate the factors driving frequency of home composting behavior, as well as Taylor and Todd (1995) and Taylor (1997) models were not able to show whether determinants of home composting acceptance difference from the determinant of the home composting practice frequently. In other words, the distinction between home composting acceptance and the level of home composting participation is needed to answer in order to fill the research gaps.

1.3. Purpose and expected results of this study

To this end, we carry out an empirical study to fill research gaps in understanding home composting behavior. We develop and analyze the determinants of two models of home composting behavior that include home composting participation decision and the frequency of home composting participation. Understanding home composting behavior is key to achieving sustainable waste management at source in rural households in developing countries.

2. Study design

2.1. Survey area

Hoi An in Quang Nam province is located in central Vietnam. The solid waste generated threatens this relatively small city, with organic waste accounting for 58% of MSW (Hoang et al., 2017). Composting is a great potential treatment of MOW. However, facing budget constraints, the city is able to collect only a portion of MSW in rural areas and Hoi An's local authorities have campaigned to encourage residents in rural areas to treat MOW by themselves in order to divert it from landfills. Between 2012 and 2015, Hoi An implemented a project of MOW separation at source (MOW-SAS). During the first stage (2012–2013), this program introduced MOW-SAS to the main four wards: Minh An, Cam Pho, Son Phong, and Tan An, which represented the pilot areas. The rest of the city (eight communes and one island commune) participated in the second stage (2014–2015). During the second stage of the MOW-SAS program, local authorities implemented a home composting program in rural areas (Cam Thanh and Cam Ha communes) to help reduce the amount of disposable MOW (Department of Natural Resources and Environment of Hoi An city, 2015).

Data used in the analysis was collected through direct face-to-face interviews with self-reported questionnaires in August and September 2015 with a pre-test survey which was conducted in March 2015 for 15 households. We hire carefully trained enumerators who are local students of Hoi An city. Only one individual per household was targeted to complete a survey. Finally, two hundred and four respondents were randomly selected from the lists of households in Cam Thanh communes (105 persons) and Cam Ha communes (97 persons), rural areas communities of Hoi An where the home composting scheme has been introduced. Among them, 2 people did not fill in the questionnaires completely. Thus, the remaining 202 questionnaires were coded for analysis.

Accordingly, participants in the survey were broadly demographically representative of the population sampled in term of household size (no significant difference among groups) (Table 1). Household size is a very important indicator for household's demographic because it indicates the amount of waste generated. Normally, more people in the house will generate more waste. There is a bias in the sample towards female (74%) (higher than of 50.49% in Cam Thanh commune and of 52% in Cam Ha commune). This bias can be explained because the targeted interviewee was the person in charge of waste management in their house which is similar with previous researches such as Tonglet et al., (2004a,b).

2.2. Measures

2.2.1. Home composting participation and the level of home composting participation

Home composting participation is constructed in dichotomous form, on whether they participate in home composting scheme or not (*participation = 1, 0 = otherwise*) and the level of home composting

Table 1
Representative socio-demographic characteristics of samples.

Characteristics	Unit	Sample of survey	Cam Thanh commune[a]	Cam Ha commune[a]	Hoi An city[a]
Population	Persons	202	7,860	7,455	93,060
Households	Households	202	1,984	1,755	22,261
Sample	Persons	202	105	97	202
Household size[b]	Persons	4.46	3.96	4.24	4.18
Female	%	74.00	50.49	52.00	51.53

Note: [a] Data of 2013 Census; [b] In term of household size, there are no significant difference among the present study' sample and the two survey areas (Cam Thanh and Cam Ha commune) at the significance level of 1%.