REVIEW PAPER

Increasing resident participation in waste management through intrinsic factors cultivation

Sunarti^{1*}, J.H. Tjakraatmadja¹, A. Ghazali¹, B. Rahardyan²¹School of Business and Management, Institut Teknologi Bandung, Indonesia²Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia

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ABSTRACT

BACKGROUND AND OBJECTIVES: Resident participation in waste management is essential to overcome waste problems effectively. In many developing countries, the local government has been struggling to encourage resident involvement in the waste management process, but the participation rate is still low. Thus, it requires a system that can encourage residents to participate effectively and sustainably. Therefore, this study aimed to determine what determinant factors, either extrinsic or intrinsic, significantly improve resident participation by changing behaviour toward waste management.

METHODS: This study tried to get insights from previous studies about key determinant factors affecting resident behaviour toward waste management to improve participation, significantly using a literature review method.

FINDINGS: Educational setting for residents is crucial to improve waste management participation by cultivating key intrinsic factors with support from extrinsic factors that lead to changing behaviour. This study identified eight types of key contents shared in the educational setting to ensure its improvement. Key intrinsic factors should be cultivated, including six kinds of knowledge and five emotional domain factors. The six critical types of knowledge include technical experience, waste management performance knowledge, perception of benefits, environmental awareness, understanding of individual and social responsibility, and understanding the social norms and regulations. The five intrinsic factors in the emotional domain include environmental efficacy, motivation, personal moral norms, PBC, and Attitude toward waste management. All the critical determinant factors, including intrinsic and extrinsic factors, should support each other to improve residents' behaviour, leading to sustainable participation.

CONCLUSION: Relevance of educational content to the residents is crucial to ensure educational intervention effectiveness. With full support from the antecedent factors, waste management behaviour can be nurtured sustainably, significantly increasing the participation rate. Combining extrinsic and intrinsic factors is recommended to ensure the effectiveness of the improvement of resident participation.

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*Corresponding Author:

Email: sunarti@sbm-itb.ac.id

Phone: +62 813 2511 5551

Fax: +6222 2510102

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INTRODUCTION

The accumulation of municipal waste generation is one of the main problems in every country throughout the world. Its number keeps increasing parallel with population growth, urbanization, industrialization, and economic growth (Borongan and Okumura, 2010). The waste generation will increase up to 70% from 2016 to 2050 due to massive population growth and urbanization (World Bank, 2018). Household waste commonly dominates compositional characteristics of Municipal Solid Waste (MSW) (Aleluia and Ferrão, 2016), presented by a high percentage of vegetable and food waste in the MSW composition. Table 1 shows some examples of compositional characteristics of MSW in several developing countries.

Due to their contribution to the domination of MSW, residents become one of the critical stakeholders in the waste management process (Kamaruddin et al., 2017; Owamah et al., 2017). Residents play various roles in the waste management process, including waste reduction (Abbasi, 2018), waste separation at source (Areeprasert et al., 2018; Heidari et al., 2018; Boonrod et al., 2019; Priti and Mandal, 2019), and waste recycling (Kamaruddin et al., 2017; Ma et al., 2018). Moreover, 3 R (Reuse, Reduce, Recycle) is the most preferred solution for diverse countries due to its effectiveness in controlling waste generation (Borongan and Okumura, 2010; Modak et al., 2016). Therefore, encouraging resident participation is vital (Mukama et al., 2016; Song et al., 2016; Sekito et al., 2018) for sustainable waste management (Kawai et al., 2016; Ma et al., 2018; Boonrod et al., 2019). Resident participation can succeed in the waste

management system in many countries (Zahra et al., 2012; Nmere et al., 2020). Even though it is vital to involve residents in waste management process from the source, resident participation in developing countries is mostly lacking, far behind developed countries. Banerjee and Sarkhel (2019) found that 60% of cities from developed countries practice more complicated separation at source, while 87 % of cities in developing countries mix their waste and rely on authorities to handle it, implying gaps in various aspects of the waste management system (Marshall and Farahbakhsh, 2013). Furthermore, only about 20% of cities in the developing countries can process the waste further, showing a lack of knowledge and skill on waste management (Borongan and Okumura, 2010; Banerjee and Sarkhel, 2019). Thus, developing countries are still struggling in improving waste participation, especially in separation at the source step. Local governments in developing countries should find effective ways to encourage resident participation, not only on the waste separation but also in waste reduction and recycling (Kawai et al., 2016). To find the strategies, it is not merely by adopting the system implemented in developed countries due to its difference in the context. Instead, there should be some consideration toward various factors, including residents' characteristics, economic, cultural, and so forth (Kawai et al., 2016). Some studies showed that most developing countries relied on extrinsic strategies as the determinant factors to encourage participation and improve their behaviour toward waste management. For instance, the extrinsic approaches are policy enforcement (Heidari et al., 2018; Ma et al., 2018; Putri et al., 2018), incentives

Table 1: MSW compositional characteristics from various cities in developing countries

Composition	Esmailizadeh et al. (2020) (Iran)	Speier et al. (2018) (Bangalore City, India)	Sekito et al. (2018) (Malang City, Indonesia)	Xu et al. (2016) (Xiamen, China)	Laohalidanond et al. (2015) (Bangkok, Thailand)
Vegetable and food waste	68,40%	56,43%	41,00%	66,19%	49,90%
Paper/cardboard	7,31%	7,67%	8,50%	9,89%	8,50%
Plastics	9,80%	8,50%	26,00%	13,17%	28,50%
PET (plastic bottle)	0,99%	-	-	-	-
Metal	1,59%	0,23%	3,60%	1,06%	1,40%
Rubber	1,09%	-	-	-	-
Textile	3,02%	4%	6%	4,38%	5,20%
Glass	2,33%	1,27%	-	3,61%	4,40%
Wood/leaves	0,97%	0,33%	9,20%	0,6%	-
Others	4,48%	21,47%	6,00%	1,10%	2,10%

For More Pages, Please Go To
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constructs, Ajzen viewed these two constructs are similar because PBC consists of self-efficacy and controllability toward the intended behaviour (Sujata *et al.*, 2019). Among waste management behaviour being studied in the previous studies, PBC was dominantly investigated in studies related to waste separation behaviour. The reasons can be due to the less popularity of the recycling activity in developing countries because they are commonly encouraged to conduct waste separation. In contrast, recycling is handled by the authorities (Marshall and Farahbakhsh, 2013). On the other hand, recycling activity is commonly related to waste separation to valuable inorganic waste being sold, which does not require any treatment in advance. PBC was proven to be significant in affecting waste separation behaviour of residents in various cities in China (Yuan *et al.*, 2016; Xu *et al.*, 2017, 2018; Wang *et al.*, 2020b), residents in Ghana Millenium City (Alhassan *et al.*, 2020) and also university students in University Teknologi Malaysia (Ayob *et al.*, 2017). The main reason of perception that affected their intention to conduct waste separation is perceived time availability (Song *et al.*, 2016; Choon *et al.*, 2017; Trihadiningrum *et al.*, 2017; Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Loan *et al.*, 2017; Alhassan *et al.*, 2020; Setiawan, 2020; Ma *et al.*, 2020). Also, the perception toward time cost-burdened the residents in Klang Valley, Malaysia (Choon *et al.*, 2017) and residents in Surabaya City, Indonesia (Trihadiningrum *et al.*, 2017), causing laziness to change their past behaviour. It can be the indication that they perceived waste separation to be not easy to do (Ramadan *et al.*, 2016; Trihadiningrum *et al.*, 2017; Xiao *et al.*, 2017; Heidari *et al.*, 2018; Sekito *et al.*, 2018; Ma *et al.*, 2020). When residents think the waste separation procedure is easy, they tend to do it. Similarly, when they believe it is hard to do the separation, they tend to leave it (Choon *et al.*, 2017). Moreover, Trihadiningrum *et al.* (2017) contended that a lack of environmental concern might cause laziness toward waste separation. Besides time availability and perceived difficulty, space, as well as facilities availability, also affected residents' PBC, which eventually affect their behaviour toward waste separation as shown by the findings from various studies (Loan *et al.*, 2017; Trihadiningrum *et al.*, 2017; Gyimah *et al.*, 2019; Kattoua *et al.*, 2019; Sujata *et al.*, 2019; Alhassan *et al.*, 2020). However, the study conducted by Xu *et al.* (2017) and Zhang

et al. (2019) showed an insignificant effect of PBC on intention in China. It can be because their behaviour toward waste separation was more influenced by subjective norms and past behaviour, instead of their capability and convenience to do it (Zhang *et al.*, 2019). It implies that regardless of their perception of their incapability in doing waste separation, they may still conduct it because it has been their habit and becomes their social culture. As a result, they may practice improperly. Accordingly, to improve PBC toward waste management behaviour, Choon *et al.* (2017) suggested that Malaysian authorities make sure that their residents have sufficient knowledge toward simple waste separation methods to lessen residents' reluctance to do the separation. Similarly, when investigating Waste Bank as a communal-based recycling system implemented in Malang City, Indonesia, in 2013, Sekito *et al.* (2018) suggested more simplicity on the separation process to elevate residents' motivation to participate. Furthermore, Liu *et al.* (2019) and Xu *et al.* (2018) suggested external factor completion such as availability of facilities, while Yuan *et al.* (2016) recommended raising resident's consciousness toward their responsibility toward waste problems to support the formation of PBC. Furthermore, personalised feedback in the form of exposure toward recyclable implementation and monitoring data dissemination is also required (Fan *et al.*, 2019; Xu *et al.*, 2018), to improve their confidence toward their capacity in implementing waste management (Wang *et al.*, 2020b; Xu *et al.*, 2018).

Intention

The intention factor is discussed mainly in the studies focusing on waste separation behaviour (Janmaimool and Denpaiboon, 2016; Mukama *et al.*, 2016; Song *et al.*, 2016; Xu *et al.*, 2017; Heidari *et al.*, 2018; Liao *et al.*, 2018; Sekito *et al.*, 2018; Ulhasanah and Goto, 2018; Fan *et al.*, 2019; Gyimah *et al.*, 2019; Issock *et al.*, 2020; Wang *et al.*, 2020b), while only two studies are investigating about waste recycling behaviour (Elayan and Ibrawish, 2017; Wang *et al.*, 2020a). Although the study by Sekito *et al.* (2018) focused on recycling behaviour in Indonesia, they investigated the intention to separate waste, which proved crucial to encourage people to conduct recycling. It is understandable since waste separation is the beginning process before waste is recycled. The

For More Pages, Please Go To
<https://dx.doi.org/10.22034/gjesm.2021.02.10>

compared to habits. However, Stern *et al.* (1999) contended that habits might be disrupted when intervention such as educational activities improve individual dispositions that eventually form new behaviour. In this case, subjective norms can be the best way to develop new habits through social norms along with regulations, as indicated by some studies (Xu *et al.*, 2017; Liao *et al.*, 2018; Salem *et al.*, 2020;). Subjective norms can be moderated by regulation to affect Intention (Xu *et al.*, 2017). Therefore, Xu *et al.* (2017) suggested local governments in China adjust local regulation to the social norms to promote waste management behaviour toward households effectively.

Habits

Habits are defined as a series of learned acts which have been automatic and unconscious, based on specific triggers (Hollingworth and Barker, 2017). The studies about habitual factors of residents in developing countries are only found to be discussed in waste separation behaviour (Odoro-Kwarteng *et al.*, 2016; Ramadan *et al.*, 2016; Xu *et al.*, 2017; Liao *et al.*, 2018; Ulhasanah and Goto, 2018; Fan *et al.*, 2019). In comparison, habitual factors concerning recycling behaviour and reduction behaviour are only found in developed countries such as European Union (Minelgaité and Liobikienė, 2019), Germany, and Israeli (Mintz *et al.*, 2019). Commonly developing countries are still dealing with separation problems in which residents' participation in waste separation is encouraged while recycling activities are mostly handled by the local authorities (Banerjee and Sarkhel, 2019). The study conducted by Fan *et al.* (2019), investigating the waste separation behaviour of households in Shanghai, China, in 2014, found that habits had a significant effect on Chinese residents' behaviour. The habits can be presented by repeating past behaviour, which positively influence willingness and separation behaviour (Liao *et al.*, 2018; Fan *et al.*, 2019). The effect of past behaviour is more significant to the residents in Hangzhou, China, compared to subjective norms and PBC (Xu *et al.*, 2017). The substantial effect of habits toward waste separation behaviour is also proven through the study conducted by Ramadan *et al.* (2016) and Ulhasanah and Goto (2018). They found that residents in Indonesia who were not familiar with waste separation tended to show a low willingness to do the long-term

separation. Also, Odoro-Kwarteng *et al.* (2016) argued that unfamiliarity to waste separation activity, which tends to need full commitment to do, makes this activity often forgettable by Kumasi residents in Ghana, especially if separation activity is not their basic routine activities. Therefore, habits can intervene realization of intention to behaviour resulting Intention-Action Gaps phenomenon (Hollingworth and Barker, 2017). For instance, some people did not practice waste management due to laziness to change or just forgot doing it (Choon *et al.*, 2017; Trihadiningrum *et al.*, 2017). It indicated the role of habits as moderating factors toward intention to action. Xu *et al.* (2017) and Liao *et al.* (2018) suggested publication about separation performance in the public place to make public informed toward the existing behaviour. The information about the existing performance would encourage formation of social norms required to stimulate positive habits development toward waste management. In addition, habits can be enhanced by encouraging residents to practice it daily through habituation as an education method. Such a habituation process will create social norms pro to the new habit formation (Salem *et al.*, 2020). The habituation process has been successful in forming new habits of Chinese residents (Xu *et al.*, 2017; Liao *et al.*, 2018). To reduce the effect of negative habits toward waste management behaviour, Fan *et al.* (2019) encouraged strengthening the intention power to convert it to be behaviour.

Motivation

Motivation is defined as a driver (internal or external) of behaviour related to waste management. Motivation is found to be discussed in term of waste separation behaviour (Tiew *et al.*, 2015a; 2015b; Heidari *et al.*, 2018; Fan *et al.*, 2019; Limon *et al.*, 2020) and waste recycling behaviour (Heidari *et al.*, 2018; Lawrence *et al.*, 2020). Motivation is found to be a substantial determinant of the waste separation and recycling behaviour of residents in Malaysia (Tiew *et al.*, 2015a; 2015b), China (Fan *et al.*, 2019), Trinidad and Tobago (Lawrence *et al.*, 2020), and university students in Iran (Heidari *et al.*, 2018). The motivation can keep the resident behaviour longer-lasting (Tiew *et al.*, 2015a; Lawrence *et al.*, 2020). Intrinsic motivation can be nurtured based on the consideration of environmental conservation (Tiew *et al.*, 2015a; Fan *et al.*, 2019; Lawrence *et al.*, 2020)

plays a vital role in their culture. Eventually, social norms should be included in the educational content to ensure the residents understand it.

Proposed model

Based on a thorough analysis of waste management behaviour conducted previously, the proposed model is built based on two primary areas: extrinsic and intrinsic factors. The extrinsic factors refer to any intervention factors outside the personal domain that could affect personal behaviour. In contrast, intrinsic factors are determinant factors inside the personal domain that involves the behaviour realization process (Stern, 1999). In the area of intrinsic factors, there are three primary domains: knowledge, emotional and behavioural level, which are inspired by the behavioural theory concepts indicating the process of how an individual can finally do a certain behaviour (Lickona, 1991; Stern, 1999; Ajzen, 2005). Some interventions can be involved to improve personal behaviour. Previous studies related to waste management behaviour identified that extrinsic factors were significantly affecting the improvement of waste management behaviour, including education, economic factors, supporting facilities, regulations, and social norms. The education is to share facts, values, and information as the education contents (Stern, 1999). Relevant contents being shared in the educational system are vital to ensure the relevance of knowledge received by the households, which are significantly influential in improving certain intrinsic factors (Janmaimool and Denpaiboon, 2016; Hammami et al., 2017; Xu et al., 2017; Yeung and Chung, 2018). It is identified eight primary contents required to be educated to the households, as shown in Table 6. The contents should address the relevant issues to make them effective (Knickmeyer, 2019). The education will improve technical knowledge (including skills on doing the waste management procedure), knowledge about recent waste management performance in the given area, the perceived environmental and economic benefits from waste management, environmental awareness, knowledge about relevant social norms and regulations, and also understanding toward residents' responsibility to waste management. The direct effect of knowledge acquired by the residents improves key intrinsic factors on the emotional level (Hammami et al., 2017; Xu et al., 2017; Wang et al.,

2020a), such as residents' trust toward authorities, environmental efficacy, motivation, personal moral norms, and subjective norms. The perceived norms from the community have reciprocal effects on personal moral norms. On the other hand, the combination of personal moral norms and motivation will be powerful to improve attitude toward waste management (Mukama et al., 2016). The motivation should be nurtured through the combination of perception of benefits and environmental awareness (Wadehra and Mishra, 2018) while also influenced by environmental efficacy (Ramadan et al., 2016) and personal moral norms, as a result of understanding toward residents' responsibility toward the environment (Abdelradi, 2018; Tiew et al., 2015a). The environmental efficacy itself should be built from the perception of benefits, environmental awareness, understanding of responsibility, and trust to the authorities, which is the effect of knowledge toward recent waste management performance (Wang and Hao, 2020; Xu et al., 2018). The combination of technical knowledge, support of facilities, and environmental efficacy will improve PBC (Yuan et al., 2016; Xu et al., 2018; Liu et al., 2019). When PBC is combined with motivation and personal norms, it will affect the attitude toward waste management (Yuan et al., 2016; Yukalang et al., 2017; Liu et al., 2019). The given attitude will eventually cause the intention to do waste management (Addo et al., 2017; Xu et al., 2017; Almasi et al., 2019). The PBC and personal moral norms separately can also cause intention to do waste management, but the intention will be weak if there is no existing positive attitude (Mukama et al., 2016; Heidari et al., 2018; Liu et al., 2019; Issock et al., 2020; Wang et al., 2020a). When it comes to converting intention to behaviour, economic factors, subjective norms, and the existing habits play as moderating factors that may loosen or strengthen the realization (Kattoua et al., 2019; Issock et al., 2020; Wang et al., 2020b). If the intention is weak due to a lack of support from antecedents and extrinsic factors, the existing habits will determine the behaviour realization (Wang et al., 2020b). Therefore, the key contents in the educational system should meet the requirements, and those key contents should be able to nurture the determinant factors from the intrinsic domain to strengthen the intention. Further, the intention which comes from intrinsic factors will be converted to more sustainable behaviour (Kattoua

For More Pages, Please Go To
<https://dx.doi.org/10.22034/gjesm.2021.02.10>

For More Pages, Please Go To
<https://dx.doi.org/10.22034/gjesm.2021.02.10>

For More Pages, Please Go To
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to boost intrinsic factors on an emotional level by improving residents' knowledge of key contents. The knowledge acquisition influences the intrinsic factors improvement on emotional level, leading the expected behaviour. The changing behaviour becomes the indication that the residents willingly participate in waste management. Improving waste management participation by nurturing key intrinsic factors, supported by external factors and habituation, is essential to keep the participation long-lasting. With full support from the antecedent factors, waste management behaviour can be sustainable, which eventually increases the participation rate significantly. However, the impact degree of antecedent factors, extrinsic and intrinsic, can be contextually different from one city to another. Therefore, educational contents' relevance to the residents' environmental problems is highly encouraged to nurture the critical intrinsic factors. The familiarity of educational materials to the residents' waste problems will make the knowledge more impactful. The educational contents are delivered through resident-based education using various techniques and approaches implemented by adjusting the residents' characteristics. The primary requirements for education are durable learning, allow intensive interaction, and enable learning-by-doing to establish new habits and improve performance. The fundamental goal of the education is to enable the transformation of intrinsic factors on the knowledge level to intrinsic factors on the emotional level. Without the existence of intrinsic factors in the emotional domain, the expected behaviour would not be sustainable. If the emotional domain can reach the maximum level, the behaviour can be sustainable even without being moderated by extrinsic factors. However, achieving such a top level of the emotional domain might be hard to reach. Thus, it is recommended to combine extrinsic and intrinsic factors to ensure sustainable resident participation effectiveness. The relationship between key extrinsic and intrinsic factors is presented in Fig. 3.

AUTHOR CONTRIBUTIONS

Sunarti was responsible for searching the bibliography, selecting the relevant references, coding the references, writing the initial manuscript draft, synthesising the manuscript, revising the final manuscript version. J.H. Tjakraatmadja was

responsible for conceptualizing the draft, analysing the references' coding, and reviewing the whole manuscript. A. Ghazali was responsible for the work plan preparation, defining the bibliographic search, conceptualizing the draft, review the whole manuscript. B. Rahardyan was responsible for the selecting the relevant references, analysing the coding of the references, and reviewing the analysis in the manuscript.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

%	Per cent
3R	Reuse, reduce, recycle
AAA	Ayla aviation academy
e.g.	Exempli gratia/for example
Fig.	Figure
GHG	Greenhouse gas
IGC	International graduate colloquium
MSW	Municipal solid waste
NVIVO R1	A qualitative data analysis software provided by QSR International
LPDP	Lembaga pengelola dana pendidikan

PAYT	Pay as you throw
PBC	Perceived behavioural control
PET	Polyethylene terephthalate
PKM	People and knowledge management
SBM	School of business management
UAE	United Arab Emirates
USD	United States dollar
WM	Waste management

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AUTHOR (S) BIOSKETCHES

Sunarti, Ph.D. Candidate, School of Business and Management, Institut Teknologi Bandung, Indonesia. Email: sunarti@sbm-itb.ac.id

Tjakraatmadja, J.H., Ph.D., Professor, School of Business and Management, Institut Teknologi Bandung, Indonesia.
Email: jannhidajat@sbm-itb.ac.id

Ghazali, A., Ph.D., Assistant Professor, School of Business and Management, Institut Teknologi Bandung, Indonesia.
Email: achmadghazali@sbm-itb.ac.id

Rahardyan, B., Ph.D., Associate Professor, Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia.
Email: benno@ftsl.itb.ac.id

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