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Willingness to pay for higher construction waste landfill charge: A comparative study in Shenzhen and Qingdao, China

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ABSTRACT

High landfill charge presents an effective approach to divert construction waste from landfill. The stakeholders' willingness to pay (WTP) for the disposal of construction waste in landfill provide the useful information to set a reasonable charge level. Considering the diversity in stakeholder groups and regional socioeconomic conditions, contingent valuation method (CVM) was employed in this study to investigate the WTP of two major stakeholder groups in two typical Chinese cities. In addition, the perception of stakeholders towards landfill charge policy was measured and the impact of various factors on WTP was explored. The results indicated that there were statistically significant disparities of WTP between cities and stakeholder groups. Stakeholders from Shenzhen were willing to pay more than their counterparts in Qingdao. Contractors were willing to pay less than owners. Respondents who evaluate the policy as effective in reducing construction waste landfill were willing to pay more. However, firm size, ownership, position of respondent and perceived equity factors did not show statistically significant effect on WTP. These findings highlight the necessity to customize landfill charge policy according to local socioeconomic conditions.

1. Introduction

As a main stream of municipal solid waste, construction waste has drawn a growing level of public concern in both developed and developing countries (Menegaki and Damigos, 2018; Wu et al., 2016; Wu et al., 2014). It has been reported that the construction industry is responsible for 120 million tons of waste which accounted for around a third of total waste in UK (Oyedele et al., 2013). The percentages are 44% and 29% in Australia and US respectively (Ajayi et al., 2016; Poon et al., 2013). With the booming housing requirement and intensive investment on infrastructures, the Chinese construction industry also generated a huge amount of construction waste which was estimated to be around 1.0 billion ton every year (National Development and Reform Commision, 2015). Majority of the construction waste in China is disposed in rural area or landfills irrespective of its high potentials of recycling. Disposal of construction waste in landfill occupies huge amount of land resource and exerts negative pressure on the ecosystem (Ding et al., 2018). In mega cities where the land resource is scarce, disposing of construction waste in landfill is becoming the least preferred option for the local government.

However, a significant challenge exists to divert the construction waste from landfill because of the profit-driven nature of construction industry. It is comparatively cheaper to dispose construction waste in landfill. Reusing and recycling construction waste are commonly perceived by contractors to involve more efforts in sorting waste and therefore leading to higher cost. To address this issue, it is necessary to increase the landfill charge (Jin et al., 2017; Udawatta et al., 2015). Evidences from many economies revealed that the high waste disposal cost contributed to the lower landfill rate and higher recovery rate of construction waste (Andersen, 1998; Lu and Tam, 2013; Oyedele et al., 2013). For example, 64% of Danish construction waste was diverted from landfill while the recycled waste nearly doubled in 1993 after a waste tax was levied on waste delivered to landfill in 1987 (Andersen, 1998).

Higher landfill charge may trigger objection or uncooperative behavior from related stakeholders such as illegal dumping because this policy will affect their economic interest (Challcharoenwattana and Pharino, 2016; Nicolli and Mazzanti, 2013). Nevertheless, too low charge level will not provide sufficient motivation for stakeholders to reduce the construction waste.

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Understanding the stakeholders' willingness to pay (WTP) for higher construction waste landfill charge is a critically initial step for policy-makers so that they can gain fundamental information for setting a reasonable landfill charge level. However, very limited number of studies have attempted to address this issue, especially in China (Begum et al., 2007; Lu et al., 2015).

Different stakeholders may have disparity in their perceptions towards the policy, which will result in the variation of their willingness to pay. Similarly, the regional diversity may influence the stakeholders' willingness to pay for the higher landfill charge which was largely overlooked in previous studies. Therefore, this paper aims to investigate the level of construction waste landfill charge the stakeholders are willing to pay in two typical cities in China. The disparity in WTP between cities and stakeholders groups was analyzed. Meanwhile, the impact of other influential factors such as perceptions on landfill charge policy and enterprise characteristics on WTP was examined. This study will provide useful information to design the landfill charge scheme which suits the local socio-economic conditions.

2. Literature review

2.1. Waste landfill charge policies

The polluter-pays-principle has been commonly used around the world to design environmental policies. The polluter should pay for the damage to natural environment caused by their action. This principle has been strongly recommended by the Organization for Economic Cooperation and Development (OECD). With the aim of reducing waste disposal and increasing waste recycling rate, this principle has also been applied in the waste management in a number of developed and developing economies.

Under the demand of the 1999 Landfill Directive, most member states of the European Union have applied landfill charge either at national level or at regional level (Sasao, 2014). Denmark, for instance, has introduced a landfill tax as early as 1987 and gradually raised the tax from 40 kroner ($5.8) per ton to 335 kroner ($48.6) (Andersen, 1998). Landfill tax had been introduced to encourage waste recycling in UK from 1996 (Oyedele et al., 2013). The tax rate was gradually increased from a low price to about 82.8 lb ($127) per unit ton (Ajayi et al., 2017). In Berlin, disposing unsorted construction waste to landfill will be charged 86 Euro per cubic meter, while sorted waste concrete, brick and tile costs 53 Euro per cubic meter (Sui, 2010). Unlike other countries, landfill tax in Italy is delegated to and defined by regions. The average landfill tax across regions during 1999 to 2008 was 14.9 Euro per ton of waste (Nicolli and Mazzanti, 2013).

In United States, there is no national landfill tax, but many states levied taxes or fees on the collection or disposal of solid waste (Poon et al., 2013). In addition, San Jose adopted the construction waste deposit program in which contractor has to pay a deposit to the city when it gets a new construction permit (Poon et al., 2013). The contractor cannot reclaim this deposit until the generated construction waste was delivered to the recycling facility.

In Asia, Japan has achieved exceptional performance in waste management. It is widely accepted that waste is by-product of industry production and another kind of resource in this country. In order to promote 3Rs principle, industrial waste tax were enforced in 27 out of Japan's 47 prefectures from 2002 (Sasao, 2014). Although there are three types of industry waste taxes employed in different prefectures, their levels are the same at 1000 yen ($10) per ton. Hong Kong is another exemplar in construction waste management. Under the enormous pressure of depletion of landfill, the Hong Kong government has been implementing a landfill charging scheme since 2005 that charges those who dump construction waste into public landfills (Hao et al., 2008). At the moment, the charge is HK$ 71 (about $9.1)/ton for entirely inert construction waste disposed to public fill, HK$ 175 (about $22.4)/ton for mixed construction waste transported to sort facility and HK$ 200 (about $25.6)/ton for mixed construction waste delivered to landfill and outlying island transfer facilities.

Evidences from these countries or regions revealed a strong association of landfill charge with diverting waste from landfill and consequently improving waste recycling rate. An investigation in Denmark demonstrated an expected trend that the disposal of waste declined annually. In particular, the construction waste disposed in landfill dropped by 64% and at the same time recycled waste nearly doubled during 1987 to 1993 (Andersen, 1998). Using panel data analysis, Nicolli and Mazzanti (2013) revealed that the level of landfill tax played a crucial role in promoting landfill diversion in Italy. In Netherlands, land tax was found to contribute to an increase in the service sector's share of recycling (Bartelings et al. 2005, cited in Sasao, 2014). Hong Kong also witnessed a drop of about 60% in the landfill of construction waste and 23% in public fills between 2005 and 2006 (Hao et al., 2008).

However, not all cases are positive. France, for example, only experienced a drop of 4% of waste to landfill after 16 years of the implementing landfill charge (Poon et al., 2013). A study conducted by Sasao (2014) showed that industrial waste taxes in Japan had only moderate effects on the reduction of final disposal amounts. He further argued that one possible reason was that the tax rate was relative low compared to the fee for transporting ashes to landfill. Meanwhile, excessive landfill charge may cause serious illegal waste dumping or waste transfer towards the region with low fee (Nicolli and Mazzanti, 2013). It was found that illegal dumping of construction waste increased by four times from 365 cases in 2005 to 1587 cases in 2006 in Hong Kong since the high waste landfill charge was introduced (Poon et al., 2013).

These suggest that landfill charge for construction waste has to be set at an appropriate level. Too high fees will drive contractors to engage in illegal dumping or oppose the charge scheme, while too low fees will not encourage the industry to change existing practice of waste treament. However, the landfill charge level cannot be set simply referring to others countries or regions due to the great disparity in economic development and social culture. Pricing policy should be suitably customized to their local socio-economic environment and be acceptable to most of payers. Indeed, a valid estimation of willingness to pay (WTP) is essential for developing an optimal pricing strategy (Breidert et al., 2015). The amount that construction stakeholders are willing to pay for disposing waste in landfill will provide a starting point for policy-makers to set a reasonable charge level.

2.2. Willingness to pay (WTP) in construction waste management

Willingness to pay (WTP) refers to the monetary value which people would be willing to pay for receiving a specified supply of public good (Hanemann, 1991). Several approaches are available to value non-market goods and service, such as direct market valuation approaches, revealed preference approaches and stated preferences approaches (Damigos et al., 2016a). The contingent valuation method (CVM) is one of most commonly applied stated preference approach to elicit WTP when estimating the value of a public good that does not yet exist (Ayalon et al., 2006). CVM employs a hypothetical market system to extract WTP to accept for specified goods or service (Afroz and Masud, 2011; Damigos et al., 2016b; Song et al., 2012). In the hypothetical market, customers are asked directly through a survey to state the amount they are willing to pay for a benefit. WTP is the maximum amount they would pay to obtain this good or service.