



# Quality of Life and Recycling Behaviour in High-Rise Buildings: A Case in Hong Kong

Kin Wai Michael Siu<sup>1,2</sup> · Jia Xin Xiao<sup>1</sup>

Received: 19 March 2015 / Accepted: 25 August 2015

© Springer Science+Business Media Dordrecht and The International Society for Quality-of-Life Studies (ISQOLS) 2015

**Abstract** Many researchers, environmentalists and economists have made tremendous efforts to enable policies and measures for waste recycling, to improve the quality of the public living environment and to achieve a better quality of everyday life. This study examined the quality of life (QOL) in high-rise buildings in relation to sustainability. It investigated household recycling behaviour and explored the QOL factors that affect such behaviour. Two models based on different types of recycling behaviour were estimated: 1) a model for the use of public recycling facilities (UPRF) and 2) a model for the use of private recycling sectors (UPRS). Data were collected through a survey of 505 residents in two old districts of Hong Kong. The assessment of QOL included consideration for the physical settings, the socio-demographic variables and the respondents' attitudes on recycling and living environments. The research methods involved questionnaires and interviews. Correlations and multiple regression analyses were conducted to interpret the data collected through the questionnaires. The findings indicated that UPRF can be significantly predicted by physical settings and by satisfaction with the location of facilities, with the residents' participation and with the quality of the neighbourhood and accommodation. UPRS can be significantly predicted by housing type, income and the availability of private recycling sectors. These findings also indicate some directions for researchers and policymakers to consider. These directions concern how environments and public facilities should be designed to encourage sustainable behaviour and enable a better QOL without compromising environmental sustainability.

---

✉ Kin Wai Michael Siu  
m.siu@polyu.edu.hk

<sup>1</sup> The Hong Kong Polytechnic University, Kowloon, Hong Kong

<sup>2</sup> Massachusetts Institute of Technology, Cambridge, USA

**Keywords** High-rise buildings · Living environments · Public design · Quality of life · Recycling · Sustainability

## Introduction

According to Mercer's quality of livability survey, Hong Kong is one of the top 100 cities on the World's Most Livable City list (Mercer, 2014). The Mercer survey considers living conditions in terms of ten categories, including safety, education, political stability, economic environment, health care, recreation, natural environment and housing. The quality of living in Hong Kong remains at a relatively high level compared to other cities in the Asian region, with only Singapore, Tokyo, Kobe, Yokohama and Osaka receiving higher ratings. Hong Kong offers a good quality of life in terms of reliable transport, public services and consumer goods. However, there are still many challenges to be met for improving the quality of life (QOL) in Hong Kong.

In Hong Kong, with its consumption-led lifestyle and dense population, the generation of waste has increased at an alarming rate. The Environmental Protection Department (EPD) predicts that if the city's waste generation continues to increase, the three existing strategic landfills will be filled to capacity before the end of the decade (EPD, 2010). Over the past 10 years, local authorities, communities and various non-governmental organisations have undertaken numerous campaigns and activities to facilitate public participation in waste recycling. By the end of 2010, the Programme on Source Separation of Domestic Waste had been adopted in 1637 housing estates (including private housing, public housing and government quarters). These estates covered 80 % of Hong Kong's population. Since 1998, recycling facilities have been placed on the ground floors or designated public areas of housing estates to encourage the residents in separating their recyclables from other household wastes. However, these campaigns and the existing public facility designs have had little effect on the prevailing recycling practices (Lo & Siu, 2012). Many people are not willing to participate in recycling, even if they are well aware of the region's environmental problems.

In dealing with such issues, researchers and environmentalists have focused mainly on policy and management initiatives. Various studies of waste management have been conducted in recent decades (Chan & Lee, 2006; Fahy & Davies, 2007; Siu, 2007). Some researchers emphasise that a lack of economic incentives and moral motivation has led many citizens to practise free-riding on the contributions to recycling made by others (Chung & Poon, 1996; Hage et al., 2009; Yau, 2010). A few studies have investigated the complex relationships between people's QOL, their living environments, their attitudes towards physical or social conditions and their sustainable behaviour. Such studies, however, have been especially rare in relation to communities of high-rise and high-density buildings. Martin et al. (2006) suggest that ignoring the social, cultural and structural aspects of people's lifestyles may lead to failure in understanding the issues of public participation in sustainable activities.

In the past, most strategies and management schemes for enhancing sustainability have been formulated by policymakers and experts rather than by local inhabitants. Due to a lack of consideration for QOL from the inhabitants' points of view, many of the existing built environments and designs of public space are unsatisfactory to the residents. What, then, is the nature of QOL in high-rise buildings, and how can it be

integrated with sustainability? What QOL factors affect recycling behaviour? How should environments encompassing public facilities be designed to both encourage sustainable behaviour and enable a better quality of everyday life?

## Quality of Life and Recycling Behaviour

QOL refers to people's degree of satisfaction with ordinary life (Szalai, 1980). In the broadest terms, QOL encompasses the notions of life satisfaction, subjective well being and overall happiness (Campbell et al., 1976; McCrear et al., 2006; Sirgy et al., 2000). Some researchers emphasise that QOL has both exogenous and endogenous dimensions. They suggest that a comprehensive understanding of QOL involves consideration for both objective factors and for subjective perceptions and evaluations (Marans, 2015; Szalai, 1980; van Kamp et al., 2003).

In reviewing the concepts of QOL and sustainability, van Kamp et al. (2003) indicate that there are certain differences between these two concepts, even though they sometimes overlap. The notion of sustainability refers to the future and long-term livability, and QOL is more focused on the 'here and now' (Pacione, 2003; van Kamp et al., 2003). In relation to sustainability, QOL requires that the development of communities should meet the needs and requirements of present generations without compromising the well-being of future generations. Shafer et al. (2000) suggest that sustainability involves finding the means 'to develop and/or maintain a high QOL in the present in a way that provides for the same in the future'.

Although QOL is a multi-faceted concept that is studied by scholars from a wide range of academic disciplines, there is no precise definition or standardised criteria for QOL that incorporates environmental sustainability. Marans (2015) emphasises that it is necessary to integrate sustainability indicators into QOL studies. The natural and built environments along with the individual's perceived QOL and behaviour are suggested as dimensions for QOL studies. However, previous research also shows that it is difficult to balance the concerns for QOL and for sustainable development (Levett, 1998). Many environmentalists and policy makers strive to make communities more sustainable, but residents are commonly slow to adapt sustainable behaviour. Siu (2003) indicates that we cannot impose views and habits on people, as they have their individual and subjective interpretations within the local context. Ways must be found to steer behaviour towards sustainable practices without diminishing people's willingness. In other words, trying to change people's behaviour without considering their needs and their satisfaction may result in annoyance and frustration. The balance between QOL and a sustainable environment must be carefully configured to ensure that recycling behaviour is encouraged, and irritation is avoided.

The quality of living environments can affect people's level of satisfaction and finally influence their behaviour. It is suggested that the places people live in, from their dwellings to their neighbourhoods and surrounding communities, have a strong effect on their QOL and, consequently, on their sustainable behaviour (Marans, 2015; Steg & Vlek, 2009; Timlett & Williams, 2008). In terms of attaining a sustainable environment, numerous environmental attributes, including the physical and social aspects, need to be addressed for the sake of maintaining QOL. According to van Poll (2003), the quality of urban life is determined not only by physical aspects such as the

quality of the built environment and its facilities, but also social aspects such as the human ties in the community. Some researchers indicate that neighbourhoods of high-rise buildings are generally experienced as areas having low social involvement and a weak sense of community (Gifford, 2007; Lee & Yip, 2006). Most of the inhabitants have little sense of belonging or attachment to their surroundings, and consequently they have little interest in participating in recycling activities.

Many studies on sustainable behaviour have been conducted, with numerous proposals discussed. However, most of the existing literature focuses on the issues of waste management, policies and social norms (Chao, 2008). The QOL indicators that affect recycling behaviour are seldom discussed, especially in relation to high-rise, high-density buildings. A limited number of studies, however, indicate that the residents' satisfaction with their facilities, their neighbourhood and the perceived quality of their environment are positively associated with sustainable recycling behaviour (Forrest et al., 2002; Lee et al., 2010; Steg & Vlek, 2009). These studies indicate that QOL plays an important role in motivating sustainable behaviour. To explore how QOL affects recycling behaviour, both objective and subjective indicators of QOL should be taken into consideration. These indicators should encompass the physical settings, socio-demographic variables, the respondents' attitudes towards recycling and various other aspects of their living environment.

## Methods

An empirical study was conducted in Hong Kong during 2014. Questionnaires and interviews were adopted to examine how QOL indicators influence sustainable recycling behaviour. The survey was conducted in two old districts with high population densities, namely Sham Shui Po and Kwun Tong. At the time of the survey, the population densities (number of persons per km<sup>2</sup>) of these districts were 40,690 for Sham Shui Po and 55,204 for Kwun Tong. These densities are far beyond the average level (i.e., 6544) in Hong Kong. Both of these communities include a mixture of public and private housing estates.

In Hong Kong, there are three main types of housing: public rental housing (PRH), home ownership (HOS) and private housing. PRH is provided by local authorities for low-income citizens who cannot afford to rent a private accommodation. HOS housing is sold to low- and middle-income families on the basis of HOS schemes that help them improve their living conditions. To enable residents to maintain their lifestyles in a familiar environment, the HOS housing provided by the local authorities is similar in appearance to the public housing estates. Private housing, unlike the public housing estates built by the Hong Kong Housing Authority or the Hong Kong Housing Society, is built by private developers according to the market-oriented economy. In this study, the authors consider both PRH and HOS housing to be forms of public housing, and they differentiate only between public housing and private housing.

Both of the districts surveyed in this study have a high proportion of low-income households and elderly people. The average household size in Sham Shui Po and Kwun Tong is 2.8. Compared to other districts, the median monthly household income is relatively low: HK\$17,000 in Sham Shui Po and HK\$16,100 in Kwun Tong. The percentage of people aged 65 or above in these two areas is far beyond the average

level in Hong Kong. Regarding educational attainment, 25.5 % of the residents in Sham Shui Po have post-secondary degrees, and approximately 23.5 % (aged 15 and over) have only primary level education or below. In terms of housing, 38.8 % of the residents live in public housing estates and 57.6 % live in private housing. In Kwun Tong, the percentage of residents who have post-secondary degree is even lower (i.e., 20.8 %), and a higher percentage of the residents are poorly educated. The proportion of residents living in public housing estates in Kwun Tong is even higher than in Sham Shui Po. In Kwun Tong, 69.2 % of the people live in public housing estates, and 28.7 % live in private housing. Accordingly, both public recycling facilities and many private recycling sectors such as recycling centres and scavengers co-exist in these two communities. The distinct demographic structures and the spatial characteristics of the various living environments provide a viable laboratory to examine recycling activities.

### Participant Characteristics

Questionnaires were distributed to the residents of these districts through local community centres. Of the 1250 questionnaires distributed, 549 were returned (response rate = 43.92 %), and 505 were utilised in this study. The target sample for this study consisted of all residents who live in these two districts. Of the 505 respondents, a slight majority were female (53.27 %), with 46.73 % being male. In terms of age distribution, 39.41 % of the respondents were 45 to 64 years old, with 34.85 % in the 25 to 44 year-old category. Concerning monthly household income, 30.30 % of the respondents reported receiving between \$10,000 and \$19,999 per month; 24.75 % got between \$20,000 and \$29,999, and 15.84 % had between \$30,000 and \$39,999. In their education levels, 42.97 % of the respondents had a tertiary degree, and 14.46 % had a primary or lower degree. Some 51.88 % of the participants lived in public housing, and 48.12 % lived in private housing (Table 1).

To gain an in-depth understanding of the residents' quality of life and their recycling behaviour, ten respondents were recruited for semi-structural interviews following the survey. This sample of interviewees was by no mean representative, but there was a suitable range of differences among the interviewees in terms of age, gender and other demographic factors. Of the ten respondents, six were female and four were male. Four were 25 to 44 years old, two were 45 to 64, three were above 65 years old, and one was between 15 and 24 years old. Six of the interviewees lived in public housing estates. Two of them mentioned that they used both public and private recycling facilities. Five interviewees mentioned that they used only one of the two kinds of recycling facilities, and three reported that they never recycled. In addition to the ten respondents, two scavengers, two private recyclers and one government officer (District Councillor) were recruited for interviews to gain their insights into recycling activities.

The interviews with the ten residents included questions such as 'Are you satisfied with the existing recycling facilities?'; 'What is your attitude towards the recycling behaviour of people in your residential area?'; 'How do you feel about the private recycling sectors in your area?'; 'Are you satisfied with your neighbours?' and 'Are you satisfied with the neighbourhood and its physical settings?' The interviews with the private recycling workers included questions such as 'When did you start to run your business?'; 'What are you satisfied with in your business?' and 'What are you

**Table 1** Socio-demographic characteristics of the respondents ( $n = 505$ )

Characteristics of respondents	Attribute	Number	%
Gender	Female	269	53.27
	Male	236	46.73
Age distribution	0 ~ 14	20	3.96
	15 ~ 24	45	8.91
	25 ~ 44	176	34.85
	45 ~ 64	199	39.41
	$\geq 65$	65	12.87
Educational attainment	Primary or lower	73	14.46
	Secondary	215	42.57
	Tertiary	217	42.97
Monthly household income (HK\$)	<10,000	28	5.54
	10,000 ~ 19,999	153	30.30
	20,000 ~ 29,999	125	24.75
	30,000 ~ 39,999	80	15.84
	$\geq 40,000$	117	23.17
Housing type	Public housing	262	51.88
	Private housing	243	48.12

dissatisfied with?’ The interview with the officer involved the same questions discussed with the ten residents, along with a few additional questions such as ‘Do you find any difficulties concerning recycling activities?’ and ‘Do you have any suggestions to improve the residents’ sustainable behaviour towards a better QOL?’ The conversations were recorded and transcribed.

## Variables

The questionnaire was divided into three sections to measure various independent variables that could be associated with sustainable recycling behaviour. Section A aimed to discern the respondents’ behaviour related to household recycling. Section B focused on their views and their satisfaction with the recycling services, the neighbourhood and the local facilities. All of the items in this section were measured on a 5-point Likert scale, ranging from ‘very poor’ to ‘very satisfactory’. The final section collected demographical data on the respondents.

In this study, the predictor variables included both objective and subjective indicators of QOL. Previous studies have indicated that people’s satisfaction with physical conditions directly and or indirectly influences their behaviour (Fullerton & Kinnaman, 1996; Hage et al., 2009; Lee et al., 1995; Marans, 2015). The convenience of access to public and private recycling facilities or services is a major determinant of residential satisfaction, which can result in the residents’ willingness to participate in recycling (Vrbka & Combs, 1993). In addition, people’s sense of relatedness to the neighbourhood can affect their level of involvement in community activities (Forrest et al., 2002; Nigbur et al., 2010). Socio-demographic variables were included in the

survey, because it has been well documented that the socio-economic and demographic status of the residents can be an important factor that affects recycling behaviour (Belton et al., 1994; Martin et al., 2006; Siu & Lo, 2011). Based on the approaches used in previous studies, the following selected attributes of QOL for sustainable recycling behaviour were tested: physical settings, social settings, the residents' attitudes towards recycling and their satisfaction with their living environments (Table 2).

Sustainable recycling behaviour was the dependent variable, and the study examined this variable's relationship with the hypothesised indicators listed above. As the authors wished to shed light on the effects that various QOL indicators have on sustainable recycling behaviour, two variables were used to measure household participation in recycling, namely UPRF and UPRS. The questions were designed to elicit the respondents' self-reported recycling behaviour, and the authors took the self-reported information seriously. We used several questions to clarify their recycling activities, because answers to only one question may be incomplete or exaggerated. The survey questions were as follows: (1) Do you participate in recycling? If yes, how often? (2) Do you use the public recycling facilities? If yes, how often? (3) Do you sell recyclables to private recycling sectors? If yes, how often?

## Data Analyses

The data obtained from the survey were analysed using SPSS to find correlations and to conduct multiple regression analyses. Models were estimated to identify the environmental, attitudinal and socio-demographic factors that influence sustainable recycling behaviour. First, the correlations between all pairs of both the dependent and independent variables were measured by Pearson correlation analysis. To avoid having any highly correlated variables in the same model, a precondition of this analysis was that any independent variables that were highly

**Table 2** Hypothesised indicators of QOL for sustainable recycling behaviour

	N	M	SD
Employment	499	2.86	1.292
Educational attainment	505	2.29	0.703
Dwelling density	505	1.73	0.676
Housing type	505	0.48	0.500
Monthly household income	503	3.23	1.245
Availability of recycling facilities nearby	505	0.58	0.494
Availability of private recycling sectors nearby	505	0.46	0.499
Satisfaction with the location of recycling facilities	505	2.92	1.117
Perceptions of the usability of public recycling facilities	505	2.82	0.998
Perceptions of the private recycling sectors	505	2.92	1.218
Satisfaction with residents' participation	504	2.22	1.145
Perceptions of accommodation	505	2.86	0.931
Satisfaction with neighbourhood/community space	502	2.84	0.963

correlated would be excluded from the model. The independent variables that were correlated with any dependent variables were then included in multiple regression analyses to explore the influence of selected QOL indicators on recycling behaviour. Two models based on different types of recycling behaviour were estimated: 1) a model for UPRF and 2) a model for UPRS.

## Results

### Correlations

Table 3 shows that the physical settings and the residents' attitudes were directly correlated with their recycling behaviour. People who were satisfied with the location and design of recycling facilities or with the private recycling sectors reported higher participation in UPRF and UPRS. The respondents' attitudes towards participation and their satisfaction with the neighbourhood significantly correlated with UPRF, but not with UPRS. Monthly household income showed a positive relation to UPRF, but a negative correlation to UPRS. Other socio-economic variables such as educational attainment, dwelling density and housing type did not show any significant correlations with UPRF, but had a negative correlation with UPRS. The availability of nearby recycling facilities and the perceived quality of public facilities did not show any relation to UPRS. Also, no significant correlations appeared between the availability of private recycling sectors and UPRF. The findings showed that the availability of nearby private recycling sectors was significantly correlated with housing types. Private recycling sectors were more accessible in public housing estates than in private housing areas.

**Table 3** Correlations between variables

Variables	UPRF	UPRS
1. Employment	0.092*	-0.036
2. Educational attainment	0.023	-0.088*
3. Dwelling density	0.061	-0.294**
4. Housing type	0.066	-0.451**
5. Monthly household income	0.127**	-0.655*
6. Availability of recycling facilities nearby	0.559**	-0.025
7. Availability of private recycling sectors nearby	0.006	0.570**
8. Satisfaction with the location of recycling facilities	0.599**	-0.037
9. Perceptions of the usability of public recycling facilities	0.339**	0.000
10. Perceptions of the private recycling sectors	0.009	0.540**
11. Satisfaction with residents' participation	0.526**	0.024
12. Perceptions of accommodation	0.351**	-0.109*
13. Satisfaction with neighbourhood	0.537*	-0.507

\* $p < 0.05$ ; \*\* $p < .01$



## Multiple Regression Analyses

Predictor variables that were significantly correlated with the dependent variable were used in the multiple regression analyses. Dwelling density was not entered into the multiple regression analyses, because it was highly correlated with housing type and could cause a problem with multicollinearity. As indicated by Wang and Lin (2013), 81.1 % of PRH units have a relatively small unit size (< 40.0 square metres), but over 80 % of private housing units have 40.0 square metres or more.

The results of the multiple regression analyses of independent variables in relation to UPRF are presented in Table 4. The  $R^2$  indicated that 59.3 % of the total variance in the dependent variable was explained by the independent variables. The residents' satisfaction with their surroundings had a significant influence on recycling behaviour. The findings suggested that the availability of nearby recycling facilities, satisfaction with the location of recycling facilities, satisfaction with other residents' participation, and satisfaction with the neighbourhood and with accommodation were the most significant predictors of UPRF ( $p < 0.05$ ). In this survey, only 48 respondents (9.5 %) mentioned that recycling facilities were installed on each storey of their building. The vast majority (90.5 %) of the respondents said that the common locations were lobbies, entrances of buildings and open spaces outside the buildings. In other words, in many high-rise buildings, hundreds of household units had to share a single recycling facility. As has been shown previously, people's enthusiasm for recycling tends to decrease when they have to bring their recyclables to the ground floor (SITA, 2010). The findings also showed that in the housing estates where recycling facilities were installed on each storey, the rate of use for the public recycling facilities significantly increased. Among these 48 respondents, the mean satisfaction rating with the location of public recycling facilities was 4.58 (1 = very poor, 5 = very satisfactory), and the rate of use for the recycling facilities was 81.25 %.

Although socio-demographic variables such as employment and monthly household income were correlated with recycling behaviour, these variables were not able to predict UPRF significantly. This result is consistent with that of previous research. As discussed earlier, the situation in Hong Kong is quite different from that in many

**Table 4** Multiple regression analysis model 1: UPRF

Variables	Model 1 R = 0.770, R <sup>2</sup> = 0.593, Adjusted R <sup>2</sup> = 0.586, DW = 2.281
Availability of recycling facilities nearby	0.308***
Satisfaction with the location of recycling facilities	0.239***
Satisfaction with residents' participation	0.235***
Satisfaction with neighbourhood/community space	0.168***
Perceptions of accommodation	0.125***
Perceptions of the usability of public recycling facilities	0.044
Employment	0.036
Monthly household income	0.017

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$  Note:  $\beta$  = standardised betas

Western cities, where affluent and well-educated people are the most active recyclers (Chung & Poon, 1994; Martin et al., 2006). In this study, the respondents with higher educational attainment and greater monthly household income did not show higher participation in UPRF. In addition, perceptions of the usability of public facilities were not shown to be significant predictors for UPRF. In other words, people recycled (or not), regardless of the design of the recycling facilities.

Table 5 shows the results of the multiple regression analyses of independent variables for UPRS. The  $R^2$  indicated that 56.7 % of the total variance in the dependent variable was explained by the independent variables. Monthly household income and availability of nearby private recycling sectors were the most significant predictors of UPRF ( $p < 0.05$ ), followed by housing type and perceptions of the private recycling sectors. Perceptions of accommodation and educational attainment did not predict UPRS significantly, although these variables were correlated with UPRS. Monthly household income was a strong predictor of UPRS, as this variable explained 46.6 % of the variance. Respondents who had lower monthly household incomes reported that they participated in UPRS more frequently. Some of the old areas covered by this survey had massive public housing estates in which the government-provided recycling facilities were supplemented by the activities of scavengers, elderly people and private recyclers, who formed active recycling networks. These phenomena, however, were rather rare in richer areas, especially in those neighbourhoods with the latest modern private housing. Consequently, the private recycling sectors were more active in the neighbourhoods of public housing than in areas of private housing. Respondents who lived in public housing were prone to sell their recyclables, not only because of the economic incentive, but also due to the accessibility of private recycling sectors.

### The Quality of Environments and Recycling Behaviour

The quality of local environments was important for encouraging recycling behaviour. The results from the interviews showed that not only the built environments, but also the socio-cultural environment significantly influenced sustainable behaviour, as shown in the following quotations from the participants.

**Table 5** Multiple regression analysis model 2: UPRS

Variables	Model 2 R = 0.753, $R^2 = 0.567$ , Adjusted $R^2 = 0.562$ , DW = 2.120
Monthly household income	-0.466***
Availability of private recycling sectors nearby	0.299***
Housing type	-0.095*
Perceptions of the private recycling sectors	0.105*
Perceptions of accommodation	0.033
Educational attainment	0.052

\* $p < 0.05$ ; \*\* $p < 0.01$ ;

\*\*\* $p < 0.001$  Note:

$\beta$  = standardised betas

a) *Accessibility of recycling networks*

In alignment with the results from the questionnaires, the interviewees raised several points about the issue of accessibility. The accessibility and convenience of recycling networks were of great concern. In general, most of the recycling facilities were installed in the building entrance (Fig. 1).

Respondent: I don't know how many people participate in recycling practices in my neighbourhood. However, I will continue insofar as I can. I feel I'm not alone in that when I notice that there are some recyclables in the bins, even only a few ... I'm still satisfied with the public recycling facilities because they are quite accessible.

Respondent: There are three private recycling sectors on the opposite side of the street. They have been located there for a few years. I always bring some recyclables and sell them to the intermediaries, because it is very convenient ... and I can earn some money. I notice that many residents in my neighbourhood sell their recyclables to private recycling sectors regularly.

Respondent: The recycling facilities are relatively insufficient compared to the rubbish bins. It is very inconvenient for me to bring the recyclables to the ground floor.

To improve the quality of life and establish a sustainable community, an officer began a small-scale recycling programme in his neighbourhood. In addition to the source separation of domestic wastes launched on a territory-wide basis by local authorities in 2005, some other community-level initiatives were conducted in his neighbourhood. The officer explained that increasing the accessibility of recycling facilities could influence pro-environmental behaviour, and that this was thus essential to ensure the efficiency of recycling networks.

Officer: Recycling facilities were the problem. I need enough recycling bins. I cannot ask the people to deposit their recyclables without ensuring



**Fig. 1** Recycling bins located in a building entrance

the provision of public facilities for that. Convenience and accessibility of recycling facilities play an important role in community participation. The number of recycling bins provided by the government is limited, and thus we have to provide more. To collect more types of recyclables, I buy some bins, and even modify the design to meet people's requirements.

b) *Sense of community and satisfaction with neighbours*

Unlike the sense of neighbourhood that was found in resettlement blocks in the past, most residents of the existing public housing estates regard their living environment as a physical space with low social involvement (Forrest et al., 2002; Mitchell, 1971). In the survey, most respondents indicated indifferent or negative attitudes towards their neighbours and their neighbourhoods.

Respondent: It seems I have no neighbours ... even though they live nearby ... You know, most of the neighbours close the iron gate. It is quite different from the past when I lived in resettlement blocks ... we cooked together, ate together, played together and shared what we had.

Respondent: I'm not familiar with the neighbours, and I even have no idea of their behaviour. You know, I work day and night every day, and have no time to recycle ... Maybe other people will recycle ... I don't know ...

Respondent: Actually, I feel alone when I notice that most of my neighbours don't recycle. The low rate of participation decreases my enthusiasm.

However, some respondents reported satisfactory relations with their neighbours. Their descriptions indicated a sense of community and emotional connection. These respondents had lived in their neighbourhoods for a long time and had grown familiar with their neighbours.

Respondent: My neighbours are very nice. They give some waste paper to me because they know I regularly collect some recyclables for private recycling sectors.

When the officer was asked for his suggestions to improve community sustainability, he explained that he had introduced a garden recycling programme to the block of flats where he lived. This food waste recycling project was started in 2013. The open space of the rooftop was used to form a small self-contained recycling system. Residents deposited their food waste in the processor and got some organic soil made from the food waste. Each household had its own pots to grow plants.

Officer: The rooftop is bustling with activity during this period ... adults, kids and the elderly ... More and more residents participate in this sustainable practice.

The rooftop then served as a communal space that enhanced the opportunities for social interaction and encouraged the residents to participate in recycling. In such cases, the built environment can influence people's sense of community and social involvement.

### c) *Socio-economic factors*

Among these districts, scavengers, elderly people and private recyclers formed active recycling networks in addition to the public recycling facilities and networks provided by the government (Fig. 2). Various recycling methods were available for residents to sell their recyclables. For example, some private recyclers had fixed locations in their neighbourhoods for a long time to invite residents to leave their recyclables there. They also collected recyclables on the doorstep if necessary.

Some respondents mentioned that economic incentives had encouraged them to participate in recycling. Five respondents mentioned that they used private recycling networks to benefit financially by selling the recyclables. One respondent indicated that many of her neighbours recycled by using public facilities, because a reward scheme was applied in her neighbourhood.

Respondent: Some of my neighbours use the public facilities frequently. In general, the management staff of our housing estates collect recyclables and then sell them to recycling enterprises. The residents are given some subsidies for community activities such as barbeques and trips as a reward.

In their interviews, the participating private recycling enterprise operators and scavengers said that they were mainly motivated by socio-economic factors. Their attitudes towards quality of life and recycling behaviour were quite simple. The four



**Fig. 2** Scavengers, elderly people and private recyclers formed active recycling networks

intermediaries interviewed all mentioned that they collected recyclables every day because they had to make a living.

Intermediary: We have run this business for more than ten years. Frankly speaking, our business is on a small scale and I have to work hard to feed my family. Many neighbours know us well. They sell some waste paper to me frequently.

Intermediary: I collect waste paper and plastic bottles every day. As it is not allowed to get recyclables from the recycling bins, I have to collect these materials from shops, streets and rubbish bins. Also, some warm-hearted residents frequently give me their waste paper, such as newspaper.

## Discussion

The survey indicated that UPRF can be significantly predicted by physical settings and by satisfaction with the location of facilities, other residents' participation, the neighbourhood and the accommodation. UPRS can be significantly predicted by housing type, income and the availability of nearby private recycling sectors. The results also suggested that socio-demographic variables do not significantly predict UPRF, but these variables do significantly predict UPRS. It is clear from the survey that people's recycling behaviour was highly correlated with their perceived QOL. The quality of their living environment and their level of satisfaction significantly affected the sustainability of their behaviour. It is thus necessary to consider how to improve QOL towards more sustainable behaviour.

### Towards Better Quality of Life and Sustainable Communities

The findings of our study indicate several directions for improving recycling behaviour, achieving a better quality of life and enabling more sustainable communities. These directions are summarised as follows.

1. The availability of recycling networks and satisfaction with public facilities was found to significantly affect sustainable behaviour. the respondents had a relatively high expectation of recycling facilities in terms of accessibility and convenience. however, the locations of most of the recycling facilities did not meet the residents' needs and expectations. the insufficiency or inconvenience of recycling facilities made it difficult for households and communities to participate in recycling practices. however, in the buildings with recycling facilities provided on each storey, the use of the public facilities was relatively high

These results suggest that mature and accessible recycling networks with effective facilities, services and recycling sectors can improve sustainability-related behaviour. Neighbourhoods with convenient and accessible recycling networks can facilitate household and community participation in recycling. Easy, convenient, reliable recycling facilities and infrastructure are therefore essential.

2. Satisfaction with neighbourhood (or community) space was significantly associated with recycling behaviour. as Steg and Vlek (2009) suggest, the physical environment is important for community satisfaction, and a high quality environment results in sustainable behaviour. the results of our study revealed that the percentage of respondents who were very satisfied with their neighbourhood was relatively low. the living environments of existing high-rise buildings were perceived as large physical spaces with low levels of social involvement in community activities. most of the respondents had a weak sense of their surroundings and low satisfaction with their neighbourhood. respondents who felt this way had little interest for participation in recycling.

Marans (2015) indicates that living spaces can be designed to enhance the QOL. To form active sustainable communities, both policy makers and city planners should make the community spaces more satisfactory for the residents. The improvement of built environments is necessary to promote an atmosphere of social interaction and to cultivate sustainable behaviour. To increase residential satisfaction, high-quality recycling facilities are necessary. In addition, some community activities such as garden recycling programmes or environmental competitions can be launched to activate the community space. Cho and Lee (2011) indicate that public participation in community activities can cultivate a sense of community and result in a more sustainable lifestyle.

3. In terms of the socio-economic and demographic status of recyclers, the situation in hong kong is quite different from that of western cities. Belton et al. (1994) and Martin et al. (2006) find that in western cities, people who are affluent, well-educated or retired tend to be active recyclers, and that non-recyclers are more likely to be relatively poorer and younger. in this study, the result was in line with the earlier suggestion from Chung and Poon (1996) that lower socio-economic groups in hong kong are prone to be active recyclers, because they can benefit financially by selling the recyclables. a considerable number of people, especially those who live in public housing, sell recyclables to private recycling enterprises instead of using public facilities.

Economic incentives such as neighbourhood reward schemes can be applied to encourage residents to recycle, especially in public housing estates. Residents tend to show great enthusiasm for participating in recycling if they can gain commodities from their recycling activities. Recycling facilities that can record the amounts of recyclables and schemes that offer rewards in terms of premiums or coupons can be provided in such neighbourhoods.

4. In the decaying neighbourhoods where massive public housing estates are located, private recycling sectors are more accessible than in richer neighbourhoods. given the large number of housing estates, the scavengers, elderly people, private recyclers and recycling enterprises form an active recycling network. for some scavengers and elderly people, the recycling businesses serve to buy the recyclables they collect in the community. these traditional physical settings make it possible and convenient for people to sell recyclables. therefore, it is high time to adopt measures to preserve these sectors. as the public and private recycling networks are not completely independent of each other, a close partnership between the public and private sectors can enable stakeholders to form tangible and effective recycling networks.

## Conclusion

This study measured the QOL in high-rise buildings and explored the QOL factors that affect recycling behaviour. When considering the quality of urban life, it is necessary to integrate a consideration of sustainability into QOL studies. To make communities more sustainable, environmentalists and policy makers tend to impose requirements that people should behave sustainably. Such requirements, however, commonly make people less likely to participate in recycling. In general, most strategies and management schemes to enable sustainability are formulated by experts and policymakers rather than residents. Although recycling behaviour is widely discussed by scholars in various academic disciplines, most of their studies focus on waste management, policies and social norms (Ahmad et al., 2014; Chao, 2008). The QOL indicators that affect recycling behaviour are seldom discussed, especially in relation to people in high-rise buildings and densely populated areas. Due to this lack of consideration of QOL from the inhabitants' points of view, many existing built environments or public designs of recycling systems cannot satisfy the residents' needs and expectations. The findings of this study suggest that not only the physical settings but also the social environments and the residents' satisfaction related to recycling should be taken into consideration in sustainable QOL studies.

This study focused on two old residential areas in Hong Kong, which have various types of recycling activities. Both public recycling facilities and private recycling sectors operate in these areas. The results from the multiple regression analyses showed that the residents' satisfaction with recycling networks and the perceived quality of the environment were positively associated with sustainable recycling behaviour. This study also indicates several approaches for encouraging recycling behaviour towards better QOL and more sustainable communities.

## Limitations and Future Research

Although there was some heterogeneity among the selected study participants in terms of household income and built environments, the sample of respondents did not include a large proportion of the local people. In addition, our research was conducted in two old districts, both with a high proportion of low-income households and elderly people. The findings and proposals from this study may therefore be relatively inapplicable to different situations with other social contexts (e.g., suburban areas, low-rise and low-density buildings). Further studies should expand the sample size and the types of communities examined to accommodate the complexity of local contexts and everyday practices. Long-term empirical studies with particular groups of informants should also be conducted to provide a more in-depth understanding of sustainable QOL.

**Acknowledgments** The authors would like to acknowledge the Hong Kong Research Grants Council for the General Research Fund (RGC Ref.: 547412). The School of Design and the RIUSD of The Hong Kong Polytechnic University provided partial research support for the study. The authors thank the Friends of the Earth (Hong Kong) and Kwun Tong District Councillor for providing a lot of useful information. The authors would like to acknowledge Caritas Community Centre for providing support for the research. The authors also acknowledge Massachusetts Institute of Technology for the Visiting Scholarship to one of the authors, Prof. Siu, during the final analysis and preparation of this paper.



## References

- Ahmad, M. S., Bazmi, A. A., Bhutto, A. W., Shahzadi, K., & Bukhari, N. (2014). Students' responses to improve environmental sustainability through recycling: quantitatively improving qualitative model. *Applied Research in Quality of Life*. doi:10.1007/s11482-014-9366-7.
- Belton, V., Crowe, D. V., Matthews, R., & Scott, S. (1994). A survey of public attitudes to recycling in Glasgow. *Waste Management & Research*, 12(4), 351–367.
- Campbell, A., Converse, P. F., & Rodgers, W. L. (1976). *The quality of American life: perceptions, evaluation, and satisfaction*. New York: Russell Sage Foundation.
- Chan, E. H. W., & Lee, G. K. L. (2006). A review of refuse collection systems in high-rise housings in Hong Kong. *Facilities*, 24(9/10), 376–390.
- Chao, Y. L. (2008). Time series analysis of the effects of refuse collection on recycling: Taiwan's "keep trash off the ground" measure. *Waste Management*, 28(5), 859–869.
- Cho, S. H., & Lee, T. K. (2011). A study on building sustainable communities in high-rise and high-density apartments – focused on living program. *Building and Environment*, 46(7), 1428–1435.
- Chung, S. S., & Poon, C. S. (1994). Recycling behaviour and attitude: the case of the Hong Kong people and commercial and household wastes. *International Journal of Sustainable Development & World Ecology*, 1(2), 130–145.
- Chung, S. S., & Poon, C. S. (1996). The attitudinal differences in source separation and waste reduction between the general public and the housewives in Hong Kong. *Journal of Environmental Management*, 48(3), 215–227.
- EPD, Environmental Protection Department (2010). *Programme on source separation of domestic waste: Annual Update 2010*. Hong Kong: EPD.
- Fahy, F., & Davies, A. (2007). Home improvements: household waste minimization and action research. *Resources, Conservation and Recycling*, 52(1), 13–27.
- Forrest, R., Grange, A. L., & Yip, N. M. (2002). Neighbourhood in a high rise, high density city: some observations on contemporary Hong Kong. *The Sociology Review*, 50(2), 215–240.
- Fullerton, D., & Kinnaman, T. C. (1996). Household response to pricing garbage by the bag. *The American Economic Review*, 86(4), 971–984.
- Gifford, R. (2007). The consequences of living in high-rise buildings. *Architectural Science Review*, 50(1), 2–17.
- Hage, O., Söderholm, P., & Berglund, C. (2009). Norms and economic motivation in household recycling: empirical evidence from Sweden. *Resources, Conservation and Recycling*, 53(3), 155–165.
- Lee, J., & Yip, N. (2006). Public housing and family life in East Asia: housing history and social change in Hong Kong, 1953–1990. *Journal of Family History*, 31(1), 66–82.
- Lee, Y. J., De Young, & Marans, R. W. (1995). Factors influencing individual recycling behaviour in office settings: a study of office workers in Taiwan. *Environment and Behavior*, 27(3), 380–403.
- Lee, Y., Kim, K., & Lee, S. (2010). Study on building plan for enhancing the social health of public apartments. *Building and Environment*, 45(7), 1551–1564.
- Levett, R. (1998). Sustainability indicators – integrating quality of life and environmental protection. *Journal of the Royal Statistical Society*, 161(3), 291–302.
- Lo, C. H., & Siu, K. W. M. (2012). Failure of household recycling participation in a densely populated city: insights for public design. *The International Journal of the Humanities*, 9(6), 23–33.
- Marans, R. W. (2015). Quality of urban life & environmental sustainability studies: future linkage opportunities. *Habitat International*, 45(1), 47–52.
- Martin, M., Williams, I. D., & Clark, M. (2006). Social, cultural and structural influences on household waste recycling: a case study. *Resources, Conservation and Recycling*, 48(4), 357–395.
- McCrea, R., Shyy, T. K., & Stimson, R. (2006). What is the strength of the link between objective and subjective indicator of urban quality of life? *Applied Research in Quality of Life*, 1(1), 79–96.
- Mercer. (2014). *2014 Quality of living worldwide city rankings – Mercer survey*. Retrieved February 14, 2015, from <http://www.mercer.com/content/mercerglobal/all/en/newsroom/2014-quality-of-living-survey.html>
- Mitchell, R. E. (1971). Some social implications of high density housing. *American Sociological Review*, 36(1), 18–29.
- Nigbur, D., Lyons, E., & Uzzell, D. (2010). Attitudes, norms, identity and environmental behaviour: using an expanded theory of planned behaviour to predict participation in a kerbside recycling programme. *Journal of Social Psychology*, 49(2), 259–284.
- Pacione, M. (2003). Urban environmental quality and human wellbeing: a social geographical perspective. *Landscape and Urban Planning*, 65(1), 19–30.

- Shafer, C. S., Koo Lee, B., & Turner, S. (2000). A tale of three greenway trails: user perceptions related to quality of life. *Landscape Urban Planning*, 49(3), 163–178.
- Sirgy, M. J., Rahtz, D., Cicic, M., & Underwood, R. (2000). A method for accessing residents' satisfaction with community-based services: a quality-of-life perspective. *Social Indicators Research*, 49(3), 279–316.
- SITA (2010). *Looking up: International recycling experience for multi-occupancy households*. London: SITA UK.
- Siu, K. W. M. (2003). Users' creative responses and designers' roles. *Design Issues*, 19(2), 64–73.
- Siu, K. W. M. (2007). *Urban renewal and design: city, street, street furniture*. Hong Kong: SD Press.
- Siu, K. W. M., & Lo, C. H. (2011). Environmental sustainability: public housing household participation in waste and implication for public design. *The International Journal of Environmental, Cultural, Economic and Social Sustainability*, 7(3), 365–376.
- Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: an integrative review and research agenda. *Journal of Environmental Psychology*, 29, 309–317.
- Szalai, A. (1980). The meaning of comparative research on the quality of life. In A. Szalai, & F. Andrews (Eds.), *The quality of life* (pp. 7–24). CA: Sage Beverly Hills.
- Timlett, R. E., & Williams, I. D. (2008). Public participation and recycling performance in England: a comparison of tools for behaviour change. *Resource, Conservation and Recycling*, 52(4), 622–634.
- van Kamp, I., Leidelmeijer, K., Marsman, G., & de Hollander, A. (2003). Urban environmental quality and human well-being towards a conceptual framework and demarcation of concepts; a literature study. *Landscape and Urban Planning*, 65(1–2), 5–18.
- van Poll, R. (2003). A multi-attribute evaluation of perceived urban environmental quality. In L. Hendrickx, W. Jager, & L. Steg (Eds.), *Human decision making and environmental perception: understanding and assisting human decision making in real-life settings* (pp. 115–128). Groningen, NL: Regenboog Drukkerij.
- Vrbka, S. J., & Combs, E. R. (1993). Predictors of neighbourhood and community satisfactions in rural communities. *Housing and Society*, 20(1), 41–49.
- Wang, D. G., & Lin, T. (2013). Built environments, social environments, and activity-travel behaviour: a case study of Hong Kong. *Journal of Transport Geography*, 31, 286–295.
- Yau, Y. (2010). Domestic waste recycling, collective action and economic incentive: the case in Hong Kong. *Waste Management*, 30(12), 2440–2447.