The interrelationship between sustainable communities and the delivering pro-environmental behaviours actions in China

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Abstract

The majority of the world's environmental challenges are the result of human conduct. Existing pro-environmental behaviour theories that originated mainly in Western nations; due to differences in governance, culture and infrastructure, these theories must be evaluated for their applicability to the development of pro-environmental behaviour in Chinese communities. Therefore, this thesis explores the factors inherently influencing the formation of pro-environmental behaviour in Chinese communities and how this influences pro-environmental behaviour. A case study of the pro-environmental behaviour of inhabitants of two distinct types of residential communities in Beijing, the Hutong residential unit and the Commercial residential unit, is given using a mixedmethods approach. This thesis investigates how residents in both communities exhibit waste separation behaviour before and after mandatory separation regulations, and their perceptions of waste separation behaviour. The study found that the factors influencing the development of pro-environmental behaviour were a combination of legislation, social structure and infrastructure design, and for pro-environmental behaviour, strategies like recycling behaviour need to be developed based on the results of urban design and community demographics. The significance of this study is that by examining the factors that shape pro-environmental behaviour in local communities in China, it provides the basis for a locally relevant theory of pro-environmental behaviour formation and helps us to develop new models of application and evaluation, as well as specific methods to be used for different community types. These models and methodologies may better assist the government in developing policies that are suitable for diverse communities and areas, as well as enhance the creation of pro-environmental behaviour and the sustainable development of communities in China.

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

1. Introduction

1.1 Background

Today, the world is facing various environmental problems, such as global warming, with more than 157 million people affected by heat wave events in recent years compared to 2000 and a projected global increase of 1.5 degrees by 2030 (Xu, Ramanathan and Victor, 2018); air pollution by toxic gases from burning fossil fuels that affect people's health (Turner et al., 2020; Tainio et al., 2021), over 90% population breathes unhealthy air caused by burning fossil fuels (WTO, 2022); and the pollution of water resources leading to death (Hasan, Shahriar and Jim, 2019), etc. These environmental challenges are of international and national relevance, and strategies are being developed to solve them. For instance, the 1992 United Nations Convention on Biological Diversity (Keiper and Atanassova, 2020) aims to regulate and manage the possibility of serious adverse environmental impacts resulting from biotechnology; the Paris Agreement (PA) of 2015, was the first global agreement on climate change, aims to reduce greenhouse gas emissions (Dimitrov et al., 2019). As well as national-level policies such as the National Environmental Policy Act in the United States (Dongoske, Pasqual and King, 2015), which enforces sectoral commitments to safeguard the environment by mandating environmental impact assessment reports for each sector's activity. And the 3Rs legislation was established by the Ontario Ministry of Environment in Canada (Yeheyis et al., 2013), which brings together local government, industry, commerce, and relevant organisations to establish plans to minimise the quantity of waste sent to landfills. All of these government policies have been established to increase awareness of environmental concerns and reduce damage to the environment. However, despite the existence of legislation, the environmental issues we confront are still obvious.

Most scholars believe that these environmental crises are related to human behaviour (Steg and Vlek, 2009; Amoah and Addoah, 2021a; Grilli and Curtis, 2021). This being the case, people need to change their original behavioural habits in a more sustainable way

(Grilli and Curtis, 2021). Changes in behavioural habits can be large structural changes, such as France's transition from the use of fossil fuels to produce electricity to the use of renewable energy sources, such as wind power, which required governmental involvement (Wüstenhagen, Wolsink and Bürer, 2007). There are also changes in individual decisions, such as the mode of transportation used for travel; if the typical US family decreased air travel by 20% per year, that home's total greenhouse gas emissions would decrease by 0.9% (Lacroix, 2018). Although this change may have a minor influence at an individual level, adopting the change on a broad scale will have a significant impact on the environment through its collective impacts. This is why some scholars have begun focusing on making individual behaviours more sustainable and environmentally friendly. For example, in terms of people's travel modes and demands, energy efficiency in the home, and purchasing more energy-efficient appliances or reducing domestic water use (Shove, 2003; Midden, Kaiser and Mccalley, 2007; Shove and Walker, 2010).

Kollmuss and Agyeman (2002) define pro-environmental behaviour as an individual's behaviour effort to minimise negative effects on the environment, such as through lowering resource and energy use. Some nations, such as the United Kingdom, have also been attempting to promote the connection between pro-environmental behaviour and sustainable consumerism, and it has become an essential policy for addressing these challenges (Hargreaves, 2011). This kind of human behaviour that focuses on minimising damage to the environment or improving or protecting it is also referred to as pro-environmental behaviour (Udall *et al.*, 2020; Amoah and Addoah, 2021). Before attempting to alter the behaviour of individuals, researchers and policymakers must comprehend and evaluate the factors and barriers that drive these behaviours in order to build successful interventions and regulations that could promote more sustainable alternatives.

Until now, the field of scholarly research on pro-environmental behaviour has covered a variety of behaviours, including green product purchases (Park and Ha, 2012), ecofriendly tourism (Miller, Merrilees and Coghlan, 2015; Wang *et al.*, 2019), household

energy efficiency, e.g. energy-saving light bulbs, energy-saving cookstoves choices (Jürisoo, Lambe and Osborne, 2018; Wi and Chang, 2018a), water conservation (Corral-Verdugo *et al.*, 2008), environmentally friendly transport (Fallah Zavareh, Mehdizadeh and Nordfjærn, 2020), and one of the main challenges for urban development, the recycling of household waste.

The global municipal solid waste currently exceeds 2 billion tonnes per year and could grow to 3.4 billion tonnes by 2050 (Sorkun, 2018; Wu *et al.*, 2021). China's municipal solid waste is also increasing year over year, and the amount of waste removed in China reached 228.02 million tonnes in 2018 (Lou *et al.*, 2020). The direct combustion of 1 ton of municipal solid waste releases 1,090 kg of carbon dioxide, as well as other harmful gases that pollute the air (Pujara *et al.*, 2019; Silva *et al.*, 2019); and the cost of global solid waste management varies from US\$205.4billion in 2012 to US\$375.5billion in 2025 (Schuler *et al.*, 2012). Municipal solid waste puts significant environmental and economic pressure on sustainable urban growth.

Many countries have taken different actions on different scales on waste recycling. Legislation in countries such as China and Tanzania to reduce packaging at source, banning plastic bags or imposing fees on plastic bags (Miller, 2012); Restrictions on manufacturers, such as the extended producer responsibility strategies implemented in Canada, which places responsibility for the large amount of un-recycled primary plastic generated from municipal solid waste on manufacturers, a program that incentivises production companies will reduce waste by improving recyclable lines in product design and packaging (Diggle and Walker, 2020); There are also individual actions to recycle waste, for example, the government of England regularly updates its waste strategy and kerbside recycling strategy, and the act of recycling has become a norm, relying more on voluntary individual recycling actions (Thomas and Sharp, 2013); South Korea has adopted economic incentives for household waste management, with a volume-based waste charging system in place since 1995 (Lee and Paik, 2011); and Japan passed a container and packaging recycling law in 1997 to encourage Japanese residents to recycle

plastic and paper containers and packaging (Ishimura, 2022).

In China, first-tier cities such as Beijing, Shanghai, Guangzhou and Shenzhen became the first pilot cities to experiment with domestic waste separation. On 1 July 2019, Shanghai became the first city in China to legislate for mandatory domestic waste separation (Wu *et al.*, 2021). Subsequently, on 1 May 2020, Beijing also legislated the separation of domestic waste into compulsory separation. Based on the introduction of this legislation, this thesis compares changes in residents' behaviour before and after the regulations were introduced in Beijing from different perspectives on the pro-environmental behaviour of waste separation.

Some scholars have argued that pro-environmental behaviour is influenced by demographic variables, such as: Gender effects, with Wut and his colleagues (2021) arguing that women are more likely to engage in environmental behaviour than men; Age, with older people more likely to engage in pro-environmental behaviour than younger people (Tonglet, Phillips and Bates, 2004; Sánchez et al., 2015); People with varying levels of formal education also exhibit different pro-environmental behaviours, with people who are more knowledgeable about the environment being more likely to engage in pro-environmental activities (Ajaps and McLellan, 2015; Suárez-Perales et al., 2021); and household income, with people with higher incomes being more concerned and engaged in pro-environmental behaviours (Cordell, Betz and Green, 2010). In addition, scholars have also examined the influence of psychological factors on proenvironmental behaviour, such as value, identity, and attitude. Pro-environmental values can have a positive impact on people's attitudes and behaviours toward the environment (Tamar et al., 2021); multiple identities are important for environmental behaviour, such as having a green and healthy identity (Gatersleben, Murtagh and Abrahamse, 2014). Although scholars have been divided into the factors that influence pro-environmental behaviour, it requires interdisciplinary studies that combine social, contextual, and psychological factors (Clark, Kotchen and Moore, 2003), and it is the analysis from these multiple perspectives that can reveal the significant factors that influence proenvironmental behaviour.

In recent years, there has been an increase in research on how to encourage proenvironmental behaviour, and many pro-environmental behaviour theories have emerged. Several well-known theories include: The Theory of Planned Behaviour (Ajzen and Fishbein, 1980) claims that three elements impact human behaviour: attitude factors, subjective standards, and perceived behavioural control (Oztekin et al., 2017). The Norm Activation Model (Schwartz, 1977), which has three key factors: awareness of consequences, responsibility and personal norms become central (Onwezen, Antonides and Bartels, 2013); Value-Belief-Norm theory (Gardner and Stern, 1996), which is based on self-interest and rational choice (López-Mosquera and Sánchez, 2012). However, these theories do not account for all aspects of pro-environmental behaviour, and often miss some important factors (Klöckner, 2013). However, these theoretical models have helped this thesis to establish a theoretical foundation for the study of pro-environmental behaviour and to understand the factors that may influence the formation of proenvironmental behaviour. In addition to this, they also help this thesis to investigate other factors that are missing from the previous theory, such as governance, social capital, infrastructure design and barriers.

In an attempt to overcome this, The Behaviour Change Wheel (BCW) theory (Susan Michie, Atkins and West, 2014) is a comprehensive approach to behavioural research. It can be used to guide the design of behaviour change interventions. The key components of this theory are the capacity, opportunity, and motivation model (COM-B) and the Theoretical Domains (TDF) model, which aim to link target behaviours to specific interventions and facilitate the development of appropriate policies. The Community-based social marketing (CBSM)-fostering sustainable behaviour model (McKenzie-Mohr and Smith, 1999) is a context-specific model of behaviour (Cole and Fieselman, 2013) that targets the creation of pro-environmental actions. This model promotes the identification of barriers and the selection of relevant interventions to eliminate them. The model focuses on conditions in specific neighbourhoods and is centred on particular communities. This

thesis will combine the BCW theories with the CBSM model to explore and analyse proenvironmental behaviour in contrasting Chinese residential communities. This is the first time the two theories have been combined and applied to studying environmental behaviour.

For this thesis, two residential units with Chinese features were chosen. One is the Hutong residential unit, which has a traditional low-rise architectural style and an open street design, but due to its particular architectural form, the community infrastructure is less well equipped than other emerging communities and lacks green space. Another research site is the Commercial residential unit, which is currently popular in China, and is mainly a high-rise complex with a gated community, but with a well-equipped basic community, public space and underground parking. This thesis will investigate the factors that shape pro-environmental behaviour in these two residential units.

1.2. Aims, themes and research questions

This thesis contributes to improving our knowledge of the relationship between sustainable communities and pro-environment behaviours, specifically the factors delivering sustainable behaviours in China. Using waste sorting and recycling behaviour as a case study, we can better understand intervention methods for pro-environmental behaviour formation, as well as proposed modalities and intervention methods that are practical and widespread to improve the formation and adoption of other pro-environmental behaviours.

The overarching research question is: 'What is the interrelationship between sustainable communities and the delivery of pro-environment behaviours actions in China?'.

This is investigated in relation to 3 key themes:

Governance

- Social structure
- Infrastructure design

These three themes provide the direction for this thesis, which seeks to identify the inherent connections between them, and the emergence of pro-environmental behaviours related to sustainable societies. Based on these themes, the following thesis investigates four sub-questions:

- 1 What roles do legislation and incentives play in delivering sustainable communities and influencing human behaviour?
- 2 Does social capital play a role in fostering pro-environmental behaviours in a community?
- 3 How do the design of individuals living spaces and neighbourhoods design influence pro-environmental behaviours?
- 4 Could removing external barriers help people foster pro-environmental behaviour in a community?

The first sub-question aims to determine the influence of policies and institutions on forming pro-environmental behaviour. This is explored in the context of the known enforcement of waste classification regulations in the cities studied and the corresponding penalties residents face if they do not engage in this behaviour. This provides a suitable research condition for this study to compare the changes in pro-environmental behaviour and changes in attitudes of residents about waste recycling. This is, therefore, the first factor that we have studied to influence the formation of pro-environmental behaviour.

The second sub-question investigates the connection between the social relationships of community members and their pro-environmental behaviour. This element was considered due to the history of community development in China and the unique nature of neighbourhood interactions in Chinese cities. By comparing two different communities with varying levels of social capital, we explore how social capital promotes the

development of pro-environmental behaviour and the factors that shape the development of social capital.

The third sub-question is about the relationship between the architectural form and spatial design of the community's interactions with the formation of pro-environmental behaviour. The architectural form and spatial layout of the majority of Chinese communities are distinct from those of communities in developed countries where theories of pro-environmental behaviour shaping already exist. Therefore, this sub-question aims to find out in the Chinese context whether the pro-environmental behaviour of participants differs under different architectural conditions and whether this factor impacts other factors and the implications of this for future behaviour change programmes.

The fourth sub-question looks at to what extent reducing external barriers can change pro-environmental behaviour. We explore whether there other hidden barriers to pro-environmental behaviour in addition to those previously covered in this thesis.

By addressing these questions, we aim to understand the interrelationship between sustainable communities and people's behaviours, find appropriate interventions for developing pro-environmental behaviour in Chinese communities, and help people develop better daily behaviours to improve community development. As the smallest unit of society, a better understanding of the impacts of community interactions have the potential to improve not only people's pro-environmental behaviour and economic and social improvements in a Chinese neighbourhood. In developed countries such as the United Kingdom and the United States, attention has already begun to focus on the development of sustainable communities and the connections to pro-environmental behaviour. This thesis contributes to this new knowledge in the much fewer studies Chinese context.

1.3. Methodology and research approach

1.3.1. The combination of multiple methods

This thesis employs mixed methods research, a combination of qualitative and quantitative approaches to investigate the research question. And researchers suggest that qualitative and quantitative research are the finest complementing methods and should be used in a range of field studies, since both may offer varying understandings of the same subject from various perspectives (Hari Das, 1983; Amaratunga et al., 2002). Quantitative research methods are mainly used to obtain data through questionnaires, and the questionnaires reside in a predetermined way to measure the attitudes and behaviours of participants towards a topic or phenomenon (Bowling and Ebrahim, 2005; Bilgin, 2017). Qualitative approaches gather data that are often based on participants' own meaning categories and may give comprehension and description of participants' own experiences (Burke Johnson and Onwuegbuzie, 2004). In this thesis, data were collected at two research sites using questionnaires, observational methods, interviews, case studies and social media posts due to the impact of Covid-19 on post-fieldwork, and the data were analysed to understand behavioural changes, attitudes and factors influencing the formation of pro-environmental behaviours among residents. The data will be analysed to understand changes in residents' behaviour, attitudes and factors that affect the formation of pro-environmental behaviour. Chapter 3 presents the subresearch topics corresponding to the particular methodological choices in depth.

1.3.2. Methodological choice

This mixed method data will be analysed from a realist perspective. Realism is a novel method that neither rejects nor endorses positivist and interpretive approaches, and is suitable for evaluating complex interventions (Dalkin *et al.*, 2018; Graham and McAleer, 2018). Realism is the answer to the question of interventions through research 'what works, for whom, under what circumstances and why?' (Rycroft-Malone *et al.*, 2012, p. 3;

Palm and Hochmuth, 2020). This research aims to find and assess the link between governance, social structure, infrastructure design and individuals' behaviour. The interventions evaluated and analysed in the study that are appropriate for proenvironmental development include legislation, social structure and infrastructure aspects. Realism as a method is therefore well suited to this thesis (more details on this methodology are discussed in section 3.2).

1.3.3. Conversion of research methods

This thesis had pre- and post-fieldwork, and the original plan was to carry out the above research methods on-site; however, due to the Covid-19 outbreak during the post-fieldwork, the fieldwork was interrupted, so the post-fieldwork research methods were conducted online. These included questionnaires distributed via mobile phone chat groups, online interviews and the collection of social media messages from people and official accounts for post-fieldwork data collection and comparison of pre-and post-fieldwork data. The research process and methods are discussed in depth in section 3.6.

1.4. The structure of the thesis

Based on the main research question and four sub-questions, this thesis will have five chapters of background, analysis and discussion as follows:

Chapter 2 Literature review

This chapter introduces concepts relevant to this thesis, focusing on the definition of community and the characteristics that influence sustainability and pro-environmental behaviour. We compare the understanding of community in China and the western countries, how the community is managed in a top-down context in China and clarify the concept of community in this thesis. In this thesis, sustainable community development and pro-environmental behaviour formation are considered to be intrinsically linked; therefore, this chapter reviews and compares relevant pro-environmental behaviour

theories, background literature, case studies, and policies from various countries and scholars. The theoretical background of the Behaviour Change Wheel (BCW) and Community-Based Social Marketing-Fostering Sustainable Behaviour (CBSM) model, combined to analyse the effectiveness of the chosen interventions in practice in this thesis, are discussed. This section also identified the gaps in current research on proenvironmental behaviour formation, and the role of this thesis.

Chapter 3 Methodology

This chapter considers the methodology and outlines in depth how case study research was conducted for this thesis. This thesis employs both qualitative and quantitative research techniques. As qualitative and quantitative research approaches are neither contradictory nor divergent, they represent two distinct viewpoints on the same subject (Hari Das, 1983). This chapter describes the methods utilised to meet the research objectives for the three themes and four sub-questions, including qualitative observational methods, interviews, online and social media data collecting and secondary data analysis, and quantitative questionnaire methods. In addition, it details the pre- and post-fieldwork sites as well as the research process. In addition to the methods of data collection, it describes how to carry out different types of analysis of different data and the use of the software.

Chapter 4 Result

This chapter describes the analysis of the data collected and the results obtained, and links them to the four sub-research questions of this thesis. The chapter opens with data on the basic information and background of the questionnaire participants. This is followed by the survey results, which focus on governance, social capital, infrastructure design and removal of external barriers and pro-environmental behaviour. In order to compare behavioural changes before and after the intervention, the data were further separated into pre- and post-fieldwork. In addition to analysing data collected at the sites, this chapter also presents a case study of six other communities in Beijing provided by the Blue Map App. The China Public Environment Research Centre created the Blue

Map App to gather, compile, and analyse publicly accessible environmental data from government agencies and businesses. During the implementation of the waste separation legislation, the app also set up a community-based waste separation campaign - Snapshot. This data from Blue Map App provides a different perspective on the relationship between infrastructure provision and the role of supervisors in the development of pro-environmental behaviours among residents. Furthermore, this chapter analyses the data based on social media statements from regular users and official accounts about trash separation behaviour.

Chapter 5 Discussion

This chapter presents an in-depth discussion of the interventions and factors covered in this thesis, based on the previous data analysis and findings. This chapter continues the discussion of findings according to the sub-questions. Firstly, the effects of governance, social structure, community urban design and removal of external barriers on proenvironmental behaviour are discussed, showing that these factors can influence the development of pro-environmental behaviour. These four research directions also indicate the challenges to the development of pro-environmental behaviour in contemporary Chinese societies, as well as some possible directions for improvement. Then, based on the literature review and the findings in this thesis, a new model is developed that is suitable for studying, evaluating and developing pro-environmental behaviour in Chinese communities, and based on the two different types of residential units in this thesis, two different sets of interventions for the development of proenvironmental behaviour were developed. The chapter finishes with a consideration of Covid-19's implications for this thesis.

Chapter 6 Conclusion

The focus of this chapter is to bring together the content and results of the previous chapters and findings. It returns to the thesis's research questions, summarising and expanding upon the arguments of chapters 4 and 5. This chapter begins with a review and conclusion based on four sub-research questions on the relationship between

legislation and incentive, social capital, the design of living space and removing external barriers to forming pro-environmental behaviour. The thesis also makes recommendations in the context of the current situation in China. The findings of this thesis are then utilised to offer proposals for future study on pro-environmental behaviour in Chinese communities in terms of governance, social capital, and community structure design, as well as to provide comprehensive policy implications. Based on the findings of this thesis, it also outlines limitations and future research areas to discover more effective interventions to encourage the development of pro-environmental behaviour.

2. Literature Review

2.1. Basic concepts of sustainable

2.1.1. Sustainable and sustainable development

Sustainability and sustainable development are terms that have entered common usage as contemporary buzzwords, strongly related to urban, economic, health, environmental, and ecological issues in a variety of nations (Kjærgård, Land and Pedersen, 2014; Azunre *et al.*, 2019; Du *et al.*, 2020; Chien *et al.*, 2021). This section addresses definitions of these key terms, sustainability, sustainable development and sustainable community development.

2.1.1.1. Sustainability

Sustainability was originally coined by a German forester called Hans Carl von Carlowitz in his text *Sylvicultura Oeconomica* in 1712 (Scoones, 2010). As a result of Carlowitz's occupation, he developed sustainability to outline how the forest should be maintained over the long run. Mensah (2019) contends that Sustainability is the capacity of an entity, result, or process to endure across time. Due to the rise of the environmental movement in the 1960s and 1970s, environmentalists associated sustainability with the development of the environment. Subsequently, in the 1970s, the trend of defining sustainability started (Caradonna, 2014), and numerous associations, including the United Nations, the Rocky Mountain Institute, the Worldwatch Institute, and others, began to utilise the term sustainability. However, it was not until the 1980s that sustainability became increasingly prominent in the public eye. A basic concept of sustainability was presented in the 1987 report Our Common Future:

Meets the needs of the present without compromising the ability of future generations to meet their own needs. (WCED, 1987 p.41)

This definition is also called sustainable development. Over time, sustainability has become used obscure and loose which has become a container term (Spindler, 2013), as

it can be associated with any aspect.

Scholars and researchers at the time classified sustainability into multiple categories, including wide and narrow, strong and weak, big S and small S, and so on (Scoones, 2010). Big s (Spearman and Eckhoff, 2012; Brem and Puente-Díaz, 2020) is concerned with the complex interactions between people, society, and nature at the macro level and focus on the role of each factor, such as individuals, groups, and institutions, and generate large decision scenarios; the small sustainability is centred on the everyday actions of people that maintain economic, environmental, and social linkages in microsystems, where anybody may contribute, and there is a greater degree of creativity. Daly and Cobb 1989 (Palmer, Cooper and Van der Vorst, 1997) establish a distinction between strong and weak sustainability via the lens of social considerations. They argue that strong sustainability means that society is sustainable when the quality of life is distributed equally among all people, and the biosphere is not overexploited as a resource by humans; weak sustainability is more oriented toward the individual and allows the biosphere to be used for social benefit (Palmer, Cooper and Van der Vorst, 1997). Thus, a broader discussion exists between strong and weak sustainability, with some people suggesting that technology and approaches may give answers (Giurco, Stewart and Petrie, 2006). These include technologies related to climate change mitigation, carbon capture and storage, and water quantity and quality (Bugden, 2022), however Bugden (2022) argues that these technologies can mitigate the environmental impact of activities with little effect. Thus, others argue that natural resources are irreplaceable (Pearce and Atkinson, 1993; Palmer, Cooper and Van der Vorst, 1997; Scoones, 2010). However, some scholars, such as Holland and Cox (1996, P. 7), argue that there is no distinction between strong and weak sustainability since weak sustainability advocates for the premise of infinite capital substitution without a decline in human well-being. In contrast, strong sustainability is also basic on this assumption. As sustainability has evolved from a forest management approach to response to industrialisation and ecological overload, the focus of sustainability has gradually moved towards energy, economic systems, population growth and agriculture, thus characterising sustainable development.

2.1.1.2. Sustainable development

Since 1987, when the World Commission on Environment and Development (WCED) under the auspices of the United Nations (UN) established its concept of sustainable development, sustainability and sustainable development have been widely recognised. By 1992, the United Nations Conference on Environment and Development established a plan called Agenda 21 (Klarin, 2018), which is a framework that countries and governments can strictly adhere to in order to protect the environment. Switzerland was the first to place sustainable development in its constitution (since 1 January 2000) (Spindler, 2013), specifically listed in Art. 73 (The Federal Council, 1999) mentions that the Confederation and the cantons should balance the population and nature and the capacity for self-renewal. From 1987 to 2015, the definition of sustainable development changed slightly in different countries and organisations (Table 2.1). The European Union (Cavagnaro and Curiel, 2012), for example, sees sustainable development as a vision of shared progress that combines immediate and long-term goals, local and global action, and provides a good quality of life for everyone, now and in the future, and that is not only sustainable through policy, but also for society as a whole. In 1997 (Cavagnaro and Curiel, 2012), Canada's idea of sustainable development was that the economy, environment and society interact. These are the areas that need to be considered when a government makes a decision that will affect development planning at all levels of society.

Table 2.1 The meaning of sustainable development in the period 1987-2015 (Klarin, 2018)

Authors/publication and year	Meaning and understanding of sustainable development		
WCED, 1987	Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.		
Pearce et al., 1989	Sustainable development implies a conceptual socio-economic system which ensures the sustainability of goals in the form of real income achievement and improvement of educational standards, health care and the overall quality of life.		
Harwood, 1990	Sustainable development is unlimited developing system, where development is focused on achieving greater benefits for humans and more efficient resource use in balance with the environment required for all humans and all other species.		
IUCN, UNDP & WWF, 1991	Sustainable development is a process of improving the quality of human life within the framework of carrying capacity of the sustainable ecosystems.		
Lele, 1991	Sustainable development is a process of targeted changes that can be repeated forever.		
Meadows, 1998	Sustainable development is a social construction derived from the long-term evolution of a highly complex system – human population and economic development integrated into ecosystems and biochemical processes of the Earth.		
PAP/RAC, 1999	Sustainable development is development given by the carrying capacity of an ecosystem.		
Vander-Merwe & Van-der-Merwe,	Sustainable development is a programme that changes the economic development process to ensure the basic quality of life, protecting valuable ecosystems and other		
1999	communities at the same time.		
Beck & Wilms, 2004	Sustainable development is a powerful global contradiction to the contemporary western culture and lifestyle.		
Vare & Scott, 2007	Sustainable development is a process of changes, where resources are raised, the direction of investments is determined, the development of technology is focused and the work of different institutions is harmonized, thus the potential for achieving human needs and desires is increased as well.		
Sterling, 2010	Sustainable development is a reconciliation of the economy and the environment on a new path of development that will enable the long-term sustainable development of humankind.		
Marin et al., 2012	Sustainable development gives a possibility of time unlimited interaction between society, ecosystems and other living systems without impoverishing the key resources.		
Duran et al., 2015	Sustainable development is a development that protects the environment, because a sustainable environment enables sustainable development.		

Today, many people consider sustainability and sustainable development to be interchangeable terms and even describe the concept in articles by directly interpreting sustainability as sustainable development (Scoones, 2010). Some scholars, however, see these as two different concepts (Axelsson and Johansson, 2011), arguing that sustainability is an ancient source of mastery of human societies and is related to using natural resources but not running out. Axelsson and Johansson (2011) argue that sustainable development is a more complex issue requiring multiple levels of decision-making and participants with different abilities and stakeholders to consider social, economic, and ecological social processes. China, at both the national and government level, views sustainable development issues as a long-term action that requires consideration of a variety of influencing factors, such as regional impacts, geographical

conditions, climate, infrastructure, investment in science and technology, and financial support (Xu *et al.*, 2020; B. Liu *et al.*, 2021).

2.1.1.3. Three pillars of sutainable development

The United Nations has adopted sustainable development as a basic premise in assessing the world's progress, taking economic, environmental, and social factors into account (UN, 1987). With the basic situation and development status varying from country to country, some scholars have also described economic, environmental and social factors as the 3Es, which are economy, ecology and equity (Caradonna, 2014; Kent E, 2015; Boyer et al., 2016), or the 3Ps, planet, people, and profits (Schoolman et al., 2012). Scholars have referred to these three dimensions by various names throughout the years. The three pillars of sustainable development are environmental, social, and economic sustainability, as well as the necessity of coordinating these structures in order to achieve overall sustainable development (Olawumi and Chan, 2018). Boyer et al. (2016) also refer to these three facets as pillars in their article to emphasise their significance. In addition, some scholars have also used the three-legged stool (Vos, 2007) to describe these three factors. These words are synonymous and so interchangeable. Harald (2012) says, however, that a better approach to sustainable development is based on a resource analysis, such as the economic element, which may be seen as the link between various types of capital such as financial, human, and natural capital and there is no need for three pillars to achieve sustainability. Nonetheless, in the process of long-term sustainable development, these three components are mutually reinforcing and complementing; one cannot exist without the other. The economic, environmental, and social dimensions of sustainable development will next be discussed in this section.

The sustainable economic development

Economic growth is considered the only tool to achieve sustainable development (Tiba and Omri, 2017). In *A Survey of Sustainable Development: Social and Economic Dimensions* (Harris *et al.*, 2013), it is mentioned that Economic sustainability requires the

ability to create commodities and services continuously, keep governance and external debt manageable, and prevent excessive sectoral imbalances that harm agricultural or industrial output.

One of the factors in economic policy that distinguishes it apart from traditional approaches is the concept of resource conservation for future generations (Al-Qudah, Al-Okaily and Alqudah, 2021). Economic development sustainability occurs due to the coordination between co-giving and demand for solving human problems (Espinosa, Neira and de Soto, 2021). According to some researchers, such as Goodland (1995), the economic component is concerned with capital preservation. The economic dimension is based on renewable and non-renewable input resources as raw materials for the manufacturing process and includes cost, profit, and new business formation (Ukko et al., 2019). Central to the consideration of business sustainability is the achievement of sufficient profits to maintain viability as well as cost savings (Svensson and Wagner, 2015). On the other hand, some scholars (Foy, 1990) are critical of the value placed on environmental interests above all else, and also reject the interchangeability between natural and manufactured capital and the use of efficiency as the only factor in the allocation of environmental assets. They claim (Rogers, Jalal and Boyd, 2008; Harris et al., 2013; Kurniawan and Managi, 2018) that a sustainable economy must consider natural, social, and human capital. As a result, some experts (Seghezzo, 2009) believe that including the economic factor into sustainability is unreasonable and that environmental goods and amenities will never satisfy the unlimited needs of individuals. Limited natural resources will eventually constrain economic development. Thus, in order to achieve sustainable economic development, one must take into account both environmental pollution and deterioration and energy usage (Brock and Taylor, 2005; Tiba and Omri, 2017; Asongu et al., 2020).

The sustainable social development

A socially sustainable system must prioritise equality in distribution and opportunity, proper provision of social services such as health and education, gender equity, and

political responsibility and participation (Harris, 2003). Social sustainability, according to Tomislav (2018) and Ukko et al. (2019), is defined as the preservation of social and cultural identity, respect for cultural diversity, ethnicity, and religion, the preservation of social rules and norms, the protection of human rights and equality, and consideration of human capital development.

According to Chiu (2001, P. 221), social sustainability may be summed up in three ways. The first is that social progress is sustainable and involves the dismantling of social limitations, for example, ensuring specific social relations, customs, structures and values. The second, which Chiu relates with ecology, is ecologically oriented, and she contends that social sustainability is a necessary social condition for ecological sustainability since the social environment's laws and values dictate how people are distributed now and in the future. In order to achieve social sustainability, which is also ecologically sustainable, social structures, social values and norms need to be changed so that they are conducive to sustainability. Boyer et al. (2016) also argue that social sustainability can be understood as a stimulus for economic and environmental change rather than just a prerequisite and that environmental problems are ultimately social problems. The third is people-centred, which is our most often used and popular definition. It emphasises the importance of social cohesion and integrity, social stability and increases in quality of life, as well as the decrease of social inequities. According to Cronjé and Chenga (2009), development should not just focus on individuals' material requirements; it should also ensure individual fulfilment and achievement, as well as an equitable development environment. In contrast, the first interpretation is not comprehensive enough, as it only focuses on changing the sustainability of society in terms of human values and attitudes. The other two interpretations are more inclusive, taking into account the physical environment and resources as well as egalitarian lifestyles, and as a result, more similar concepts such as sustainable human development (Biggeri and Mauro, 2018) and socio-ecological transitions to sustainability have emerged in recent years (Eisenmenger et al., 2020). Thus, Dubois (2005) summarises three conditions for assuring social sustainability. The first of which is making a distinction between various sorts of social challenges, such as

sustainable social development and socially sustainable development. The second condition relates to the relationship between sustainable development and the many elements of policy, economic, and environmental decision-making. The third condition is equity, or the equality of development within a generation, encompassing resource allocation and continued well-being improvement.

Sustainable social development has been proposed to address contemporary economic, social and environmental issues and increase linkages. Its concept suggests that sustainable societies think about the interplay between economy, ecology and society (Luna-Nemecio, Tobón and Juárez-Hernández, 2020). A society needs a sense of community and commitment (Bijl, 2010), and citizens need to be involved in the society where they live and experience the same events as their fellow citizens. Thus, the existence of social capital is critical to a community's viability. Social capital is a tie that binds people together and enables them to depend on and trust one another; it is an unseen social network through which individuals build knowledge, skills, connections, and trust (Putnam, 2000; Field, 2005; Bijl, 2010). Participation in communal life entails opportunity equality, which translates into equal rights for everyone. Section 2.1.4 will provide a more extensive introduction to social capital.

The sustainable environmental development

Ecologically sustainable systems must have a stable resource base, avoiding excessive use of renewable resource systems or ecological sink activities and depleting non-renewable resources only to the degree that acceptable replacements are invested in. This includes biodiversity protection, maintaining atmospheric stability, and a variety of other ecosystem services that are not normally classed as economic resources (Harris, 2003)., According to Olawumi and Chan (2018), environmental sustainability entails constraining human activities to the carrying capacity of locally prevalent ecosystems, such as energy, land, and water resources, and emphasising human life quality. Additionally, some experts contend that environmental sustainability is inextricably linked to economic support (Wilkinson, Hill and Gollan, 2001; Baleta *et al.*, 2019; Purvis, Mao and Robinson, 2019).

In the United Nations' Sustainable Goals (SDGs) released in 2015, six of the 17 goals concentrate on the environment, climate change, and natural resources (Figure 2.1). These objectives focus on environmental sustainability; for instance, goal 13 discusses climate change and its repercussions. Protecting natural resources is also a component of environmental sustainability; goal 14 focuses on seas, and marine resources, as well as another focus of environmental sustainability, is the sustainable use of terrestrial ecosystems and forests, as in goal 15. When seen from an environmental perspective, all of the SDGs have a strong connection to the environment (Leal Filho *et al.*, 2018), which connects sustainable development as a whole in a weakly linked way.

Sustainable development has been proposed with the ultimate aim of alleviating various environmental problems and is also known as the general equivalent (Luna-Nemecio, Tobón and Juárez-Hernández, 2020) used by various social actors to express certain concerns about the environment. The environmental problems we face today, such as climate change, drought, deforestation, loss of biodiversity, pollution, etc., are the direct or indirect result of unsustainable human behaviour. It is, therefore, difficult to separate environmental from social factors. According to data published by the United Nations in 2016 (da Silva *et al.*, 2019), if the global population reaches 9.6 billion by 2050, at least three planets will be needed to meet the natural resources needed if people continue to use their current lifestyles.

Several important companies around the world (da Silva *et al.*, 2019; Ling, Anping and Di, 2022; Sheng *et al.*, 2022) have started to prioritise environmental transformation and pollution reduction in the assumption that improvements in businesses and industries would promote environmental sustainability. Some scholars (Oyekale, 2018; Liu *et al.*, 2021) have raised the importance of waste separation and recycling in their environmental sustainability studies. In a study between 28 countries (Cerqueira, Soukiazis and Proença, 2021), over a period of 16 years from 2000 to 2016, it was shown that recycling waste could contribute to sustainable development. Sanneh and her

colleagues (2011) suggest in their research of the Gambia's larger Banjul region that the collection and utilisation of materials and garbage may help decrease not just the environmental load but also the expense of waste disposal. Additionally, they think that recycling systems should be connected with the local community in order to foster recycling activities, preferably with resource recovery, mandated trash separation, and an effective waste management system. Thus, from an environmental point of view, it is possible to promote sustainable development by changing people's behaviour.



Figure 2.1 Sustainable development Goals (United Nations, 2015)

2.1.1.4. Sustainability and sustainable development in China

In terms of sustainable development, the Chinese government has had 14 five-year plans since its reform and opening up in 1978, and these plans have included economic, social and environmental sustainable development plans. In 1978, China opened the prelude to reform and set off a wave of large-scale economic construction. Although the goal of the market economy has not been clearly stated at the beginning of the reform and opening up, it has always been the direction of China's reform centred on economic construction. From 1978 to 1992, economic growth accelerated, environmental problems began to appear, and environmental protection obeyed and served economic development (Wu et al., 2018). During this period, with economic construction as the centre, environmental

protection gave way to economic development. Economic development in local and departmental areas did not pay attention to environmental protection and occurred even at the expense of the environment in exchange for economic development at that time. According to the 1989 State of the Environment Bulletin (National Environmental Protection Administration, 1989), in the case of atmospheric pollution, most cities had serious sulphur dioxide pollution in winter, and the average daily average value of northern cities is 43%, and that of southern cities is 29%.

From the initial focus on economic development, the seventh and eight five-year plan gradually adjusted to focus on environmental planning and ecological sustainability (Wang *et al.*, 2018). From 1992 to 2012, rapid economic development brought tremendous pressure on the ecological environment, but environmental protection has been emphasised and strengthened. The rapid development of the economy provides abundant financial support for environmental protection. After the United Nations Conference on Environmental Development in 1992, the Chinese government issued the 'China Agenda 21 - China White Paper on Population, Environment and Development in the 21st Century in March 1994 (Yao, 2019). In 1996, it promoted sustainable development as a national strategy and comprehensively implemented it. In the new century, China further deepened its understanding of the connotations of sustainable development.

In 2001, when China joined the WTO and became the 143rd full member state, the tenth five-year plan formulated by the Chinese government made environmental protection and sustainable development strategies the focus of national development (Wang *et al.*, 2018). In 2003, Chinese government put forward a people-oriented, comprehensive and sustainable scientific development concept (Permanent Mission of the People's Republic of China to the UN, 2012). By 2003, China had issued seven laws on environmental protection, with more than 120 regulations to ensure ecological protection. For example, the People's Republic of China's Environmental Impact Assessment Law was introduced in 2003, and all construction projects must undertake an environmental impact

assessment, and the state has established an evaluation team to evaluate the environment fully, and all of them are composed of professionals (The Central People's Government of the People's Republic of China, 2006). However, some targets of the plan were not completed, and the total indicators of sulphur dioxide emissions and industrial sulphur dioxide emissions not only failed to decline but rebounded. In 2005, national sulphur dioxide emissions increased by 27% compared with 2000, and chemical oxygen demand (COD) emissions were reduced by 2% from 2000 and failed to complete the 10% reduction target (Wu *et al.*, 2018).

However, since China joined the WTO, Chinese policy measures in terms of economic and environmental policy have gradually shifted to consumption-centred development, from the Chinese government's resource-saving and environment-friendly core economic development model from 2002 to the development of a circular economy, green lifestyles and other concepts in 2011(Browne *et al.*, 2016). Until now, developing a low-carbon society, green consumption and reducing environmental pollution have become the main policy directions for sustainable social development. These policies have had a profound impact on people's daily activities, for example, the Chinese government started to clamp down on food waste and wasteful behaviour in 2012, as well as the ban on eating and drinking at public expense(Sui *et al.*, 2013).

After 2012, economic development entered a new stage, environmental protection received unprecedented attention, and it has gradually entered into economic development and has power. At this stage, attention has also been paid to the wideranging environmental problems such as atmosphere, water and soil pollution. In particular, the country's large-scale heavy pollution weather process in 2013 directly promoted the ecological and environmental protection work to be mentioned on a more important agenda. Ecological environment protection has received much attention in economic and social development, and it has gradually gained more and more dominant power. The Atmospheric Environmental Action Plan, Water Pollution Prevention Action Plan and Soil Pollution Prevention Action Plan have been promulgated and implemented

(Wu *et al.*, 2018). Since the launch of the pilot inspection in Henan Province in December 2015, the central environmental supervision has achieved full coverage of the supervision of 31 provinces (cities, districts) in the country within two years. During the inspection period, a total of 18,000 provincial and municipal leaders participated. It accepted 135,000 environmental reports from the citizens and directly promoted more than 80,000 environmental problems around the citizens (Wu *et al.*, 2018). From 2012 to 2016, the completion of fixed assets investment in environmental protection, public social services and other special equipment manufacturing increased sharply 2003 to 2012. In 2018, air quality continued to improve. In the first half of the year, 338 towns and cities in the country were fine particles (The concentration of PM2.5) decreased by 8.3%, the concentration of inhalable particulate matter (PM10) decreased by 3.7%, and the quality of the water environment was stable and developed in a good direction. The proportion of water quality in the country (I-III) increased by 2.7% year on year. The satin ratio is 6.9%, decreased by 2.2% year-on-year (Tong, 2018).

2.1.1.5. Conclusion

The three components of sustainable development are mutually exclusive, and without any one of them, sustainable development would remain unstable throughout time (Dale and Newman, 2010). Of course, some researchers prioritise one of these three components above the others, with Dawe and Ryan (2003, P. 1458) saying that the environment should take precedence and Lehtonen (2004) believing that the social aspect is the weakest and should be emphasised. However, given the passage of time, all three must be evaluated concurrently. The United Nations' seventeen sustainable development goals encompass environmental, economic, and social objectives. In addition, it advocates bringing these three components closer by 2030 (Dalampira and Nastis, 2020)., which is the ultimate objective of sustainable development goals. However, sustainable development is a challenging task in general. Until now, the concept of sustainability has developed according to the perspectives of researchers and the fields of study concerned, at times emphasising the economy, at other times emphasising the

environment and society or combining these three parts. Sustainability is investigated in this thesis in connection to communities and human behaviour, indicating that this study is mainly concerned with social and environmental interaction. As such, the next part will define community in China and present the concepts of pro-environmental behaviour and social capital and relevant concepts.

2.1.2. Sustainable community and sustainable community development

This section introduces the concept of community, both in the traditional, familiar sense and in the sense of what is referred to as community in China. It will also describe how the architectural forms of modern communities in China have evolved, as well as the concepts of sustainable communities and sustainable community development.

2.1.2.1. Sustainable community

Since the 1950s, the term "community" has been construed in a variety of ways. The idea of the community might be understood spatially or non-spatially. In spatial terms (Muthuri, Moon and Idemudia, 2012), it refers to a group of individuals who share an area or region but do not necessarily have shared links or social interactions. Alternatively, it refers to a group or unit that has a shared interest, such as a green community (Shaffer, Deller and Marcouiller, 2006). Additionally, a community may be a location that connects the living and working spaces (Wei *et al.*, 2016). However, other academics contend (Mason, 2000; Richards and Hall, 2000) that community cannot be defined literally geographically; instead, it is characterised by shared interests, solidarity, equality, and other kinds of association. Thus, from a non-spatial perspective, a community is a collection of people who share shared qualities, share a common perspective, and do joint action on the ground or in the environment (MacQueen *et al.*, 2001), which may be applicable to social, cultural, or ethnic groupings (Richards and Hall, 2000).

A sustainable community can be a type of community, town, city or region, and the activities that such a community can afford and the activities that citizens want and can afford vary from community to community (Roseland, 2000). Scholars also often cite the Minnesota Citizen's explanation of sustainable communities, and this definition provides a good overview of what sustainable communities mean (Minnesota SEDEPTF, 1995): "a community that uses its resources to meet current needs while ensuring that adequate resources are available for future generations. A sustainable community seeks a better quality of life for all its residents while maintaining nature's ability to function over time by minimising waste, preventing pollution, promoting efficiency and developing local resources to revitalise the local economy. Decision-making in a sustainable community stem from a rich civic life and shared information among community members. A sustainable community resembles a living system in which human, natural and economic elements are interdependent and draw strength from each other."

Xia and her colleagues (2015) also argue that sustainable communities should meet the diverse needs of current and future residents and that they should be safe, inclusive, planned, and built with equality for all. In addition to balancing the elements of a prosperous economy, a healthy environment, and social-well-being (Power and Porritt, 2004), sustainable communities should also pay attention to housing, education, health, accessibility, and the arts (Xia *et al.*, 2015).

A number of researchers have developed a set of criteria for measuring sustainable communities (Power and Porritt, 2004; Hsueh and Yan, 2011; Xia *et al.*, 2015), which, when combined, highlight four themes.

- a. Planning, design, density and layout
- b. Minimising energy use and environmental impact
- c. A viable local economy and services
- d. Community organisation and neighbourhood management

The most researched studies on sustainable communities have been on energy use and

consumption and low carbon energy (Schweizer-Ries, 2008; Hsueh and Yan, 2011; Omer, 2017), as well as on government policies to promote sustainable community formation (Mazmanian 2009), and public participation (Agyeman and Angus, 2003). However, little literature links sustainable communities to pro-environmental behaviour change, where individual behaviour change is the potential to improve environmental conditions (Hua, Dong and Goodman, 2021). Pro-environmental behaviour is behaviour that minimises damage to or benefits the environment (Udall *et al.*, 2020). In section 2.1.3, pro-environmental behaviour would be outlined in depth. Waste separation is a daily basic, simple, sustainable behaviour that can be applied to communities to achieve sustainable community development. This thesis focuses on identifying the elements that influence people's pro-environmental behaviour in order to achieve sustainable communities.

2.1.2.2. The evolution of residential building forms in China

The definition of community in China is different as China has a different historical background to the Western countries, the reality of its environment and the impact of socialism on urban residential communities (Zhang, 1996). In China, the development and construction of communities must be moulded by the growth of residential architecture from ancient to contemporary times. Since 770 B.C.E., which is Spring and Autumn period, China's living space has evolved through four distinct phases: the ancient Lifang, the street, the current unit system, and the commercial housing community (Xu, 2012):

1 Spring and Autumn Period to Tang and Song Dynasties: Lifang

The establishment of the Lifang system and the Spring and Autumn Period (since 770 B.C.E.) was the most prosperous in the Tang Dynasty (from 618 to 907 AD). The most typical city is Chang'an (Figure 2.2). The city was divided into several closed Li and Shi by the wall of the square. Li is the basic living unit. The Shi is a commercial and handicraft activity place. A high wall encloses the neighbourhood (Xu, 2012). This kind of space is closed, and the space division is obvious. The living pattern is suitable for security management. It is conducive to maintaining social stability, but it has caused many

negative impacts on people's lives and contacts because of limiting movement (Xu, 2012). The buildings of this period are the precursors of the Hutong residential units. The area was divided into a grid pattern, with residential areas separated from commercial areas, and the status of the area was divided according to the location and size of the houses. This form of architecture and planning made it easier for the government of the time to administer the area, but it was an obstacle to the harmonious development of the area.



Figure 2.2 Chang'an Plan (Xu, 2012)

2 Northern Song Dynasty to the time of liberation (960-the 1950s): street and alley In order to comply with the actual needs of commodity economy development, the cities of the Song Dynasty had repeatedly disguised the wall, and there were streets and prosperous stalls along the streets. Yuan Dadu (Figure 2.3) was completely created in accordance with the street and alley system. The city comprises blocks, and commercials were set along the streets. The block is divided into several residential areas by Hutong alleys. The residential area is composed of a courtyard, and the courtyard constitutes the

basic cell of living space. This living pattern continued until the Ming and Qing Dynasties and still lived in the current Beijing city centre which is called Hutong in Beijing. The street and alley system has two characteristics. One is that the street space is open, and there is no constraint on the square door and the square wall. The other is the mixture of functions, the street mainly undertakes commercial functions, and the street is the intermediate level of transition to the living space (Xu, 2012). This kind of living space provides residents with a certain space for communication and activities. Residents living in the Hutong residential unit maintain harmonious neighbourhood relations. As the streets are around four metres wide and the buildings on either side are around four metres high as well, the small size of the space is inclusive, comfortable and territorial, and creates an atmosphere of interaction (Chen, 2003). This type of living space provides a certain amount of space for residents to interact and move around. During this period, neighbourhoods also reached an unprecedented level of intimacy, and people had a recognised neighbourhood (Zhang, 1996). This building form has a lot of public space and provides a very convenient space for communication and daily life in the neighbourhood. It is also conducive to the sustainable development of the neighbourhood. In the current Beijing Hutong residential units still maintain good neighbourhood relations.

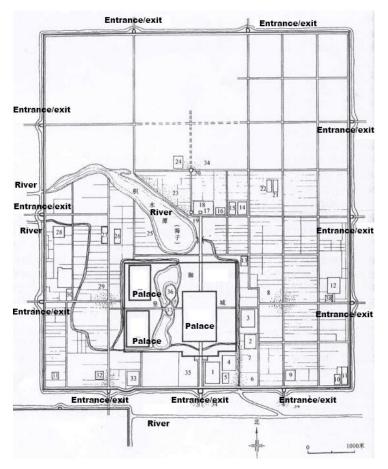


Figure 2.3 Yuan Dadu Plan (Xu, 2012)

3 From the founding of the country (1949) to the 1990s: the Danwei system community After the liberation to the early 1990s was China's planned economy period, housing was uniformly distributed by the government and units (Danwei) (Xu, 2012). After the reforming and opening up, in order to improve the living conditions of employees, units with certain economic foundations began to build a residential area for workers, and under the principle of combining production and living, most of the residential areas are close to factories or workplaces, forming unitary communities where production and living functions are organically combined.

The Danwei system community has a full suite of infrastructure, and the residents of the community are all employees or their families who belong to the same place, so the residents of the community know each other well and the neighbourhood is more harmonious, which is conducive to the establishment of a community atmosphere and

social network. This was the predecessor of the current commercial residential units.

4 Commercial residential community

With the gradual advancement of the economic and political system reform, the land use system and the Commercial residential systems were finally established, which promoted the nationwide residential development boom. The modern residential space pattern based on the Commercial residential community gradually formed, and the new city began to appear with large numbers of residents; large cities have even emerged as new cities based on residential functions (Xu, 2012).

The new residential community is no longer based on the traditional residential distribution model in the housing market environment. People of varying occupations and social standing are relatively free to pick their residences within the constraints of their financial means, and there is a hierarchy of living spaces. Due to the lack of neighbourhood communication, acquaintance and effective the traditional neighbourhood relationship gradually diminishes. The living space form, such as an alley or Hutong road, not only plays a role in the inheritance and transition but is also an important space for neighbourhood communication. Such a space is highly defined, and easy to create a sense of belonging and identity. The enclosed courtyard and patio are the basic unit of residence and the most important public activity venue for residents and create a sense of intimacy and security that is embraced and protected.

For the traditional community, the pedestrian-scale street and the chessboard-style space provide sufficient space for neighbourhood communication. The unit system community is close to the factory, and the residents are familiar with each other and get along with each other, and it is easy to cultivate neighbour relationships. In contrast to the daily travel of contemporary inhabitants between various urban functional zones, residential communities are the final place individuals relax each day, and time and energy constraints restrict the chances for community connection. Modern residential high-rise housing affects the opportunities and frequency of neighbourhood interaction.

Large-scale environmental spaces cannot easily foster a sense of belonging and are not conducive to neighbourhood interaction (Xu, 2012; Nguyen *et al.*, 2020a).

As China's economic and social growth entered a medium-to-high-speed development phase in 2010, urban development shifted from a new district construction model to the renewal and renovation of old cities (Shen, 2019). Some historic neighbourhoods with poor internal infrastructure, but where residents have a strong sense of belonging to the place where they live, are particularly important for preserving the history of the old city as well as the lifestyle and social capital of the original inhabitants (Zhai and Ng, 2013). Nineteen Hutong residential areas in Beijing have been designated as protected areas of Chinese historical and cultural heritage, so their renovation has become a focus of attention (Su, Wall and Ma, 2017). For example, Nanluoguxiang, one of the oldest hutong streets in Beijing, has a history of over 700 years. The spatial and infrastructural renovation of the Hutong, while ensuring that the houses, streets, and livelihoods of residents are not affected, has resulted in the removal of some illegal structures and the addition of commercial services. The regeneration of the Old Town has enabled the sustainable development of the community, the promotion of tourism and the history and culture of the area, without wasting too many land resources and while ensuring the needs of the residents.

2.1.2.3. Chinese community (unit)

During the Lifang system and the Spring and Autumn Period (since 770 B.C.E.), each lifang and alley were generally considered community, and the living space divided by the street, which we also refer to as a Siheyuan (Figure 2.4), was designated a family living unit (Zhang, 1996), although the residents were unaware that this form was a community. However, the word "community" swiftly entered the Chinese population's awareness in the 1980s, but it has a totally different connotation in the Western liberal environment, where the community is closely connected with the execution of government objectives (Wan, 2013). Scholars brought the word community to China during the Republican era

(1912–1949) when it was popularised as a sociological concept and translated as She Qu (Wan, 2013). Initially, a community was defined as a collection of individuals who are geographically related to each other (Fei and Malinowski, 2013), and community studies were mostly researched in rural settlements during this period. However, communities were momentarily withdrawn from public view due to political concerns until the 1980s, when the word was reintroduced and defined as a geographical region with distinct borders and a street-level administration responsible for the area's public affairs (Wang, 2009). In 2000, the Chinese Ministry of Civil Affairs defined a community as a group of individuals who live in close proximity to one another within a designated geographical region (Ministry of Civil Affairs of Beijing, 2000). This replaced the Danwei system, and communities, unlike the Danwei system, have a variety of spatial configurations and offer public services, with street offices-resident committees serving as the new administration structure (Wan, 2015). Due to the fact that the term "community" is defined differently in China, we also refer to it as a "residential community" or "residential unit".

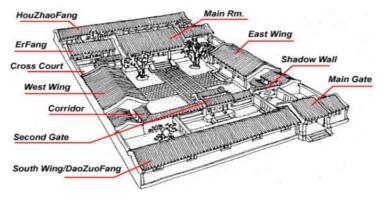


Figure 2.4 A sketch map of traditional Siheyuan (Huang, Chiou and Li, 2019)

2.1.2.4. The community administration system in China

In order to provide the latest guidelines for sustainable community development, the leaders from different countries in 2016 adopted new global commitments and sustainability standards, including the 2030 Agenda and the New Urban Agenda, and sustainable cities and communities are also known as focal points (Satterthwaite, 2017). When communities and the built environment in cities achieve the requirements for

sustainable development, only then will cities and the nation as a whole become sustainable. As China's environmental preservation and ecological conservation have shifted from supporting the economy to concentrating on the ecological environment, China's commitment to sustainable development has become more evident. In order to achieve sustainable community development, different sectors of the Chinese government have proposed various concepts of urban development, such as 'green city' 'garden city, 'eco-city' ', 'low-carbon city', 'ecological low-carbon city', etc. (Zhao, 2012; Joss and Molella, 2013; Shen *et al.*, 2018; Pan, Wang and Yang, 2020). While these urban development concepts are consistent with sustainable urban development, as they were developed by various Chinese ministries, such as the Ministry of Housing and Construction's Garden City and the Ministry of Environmental Protection's Eco-City (Liu *et al.*, 2014), the guidelines developed by these ministries overlap and do not strictly regulate these urban concepts at the political level.

In addition to the various urban sustainable development concepts mentioned above, China has developed national model sustainable development communities and has gone through a start-up phase (1986-1993), a steady phase (1994-2002) and a rapid development phase (2003-2015). Until December 2014 China had 186 national model sustainable development villages (Lu *et al.*, 2017). However, during the selection process, local officials may select the data most favourable to their own selection materials, thus increasing their own performance(Lu *et al.*, 2017). China has been engaged in promoting sustainable urban planning policies. However, local level, sustainable development and planning initiatives have not been addressed (Zhang et al., 2018). Therefore, community building and planning should be the key to achieving sustainable development.

In Chinese cities, communities (neighbourhoods) are the fundamental unit of social, political, and administrative organisation (Feng and Chen, 2019). Communities are progressively adopting certain political and social duties (Derleth and Koldyk, 2007), and they serve as an essential link between municipal administrations and local citizens (Tynen, 2019). The national government conveys rules and directives to local governments, which

then disseminate them to communities and other government agencies (Figure 2.5). In theory, other agencies do not offer direct commands to communities but merely direction and counsel; nonetheless, in fact, communities continue to listen to some of the demands of street offices and above (Feng and Chen, 2019). In other words, the development of Chinese communities has been characterised by top-down leadership from the very beginning. For the sake of administrative efficiency, the government usually promotes community building from the top down and influences community development through policies and funding, yet there is little involvement of residents in the decision-making process with regard to public participation in community decision-making (X. Li *et al.*, 2020).

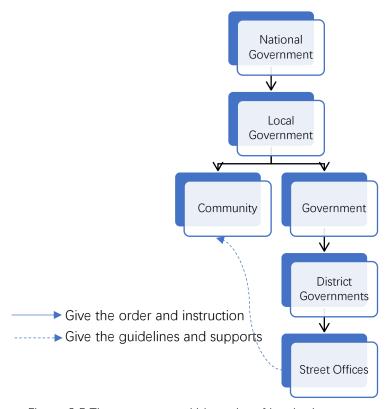


Figure 2.5 The structure and hierarchy of local urban governance (Zhang et al., 2018)

This community management system is China's top-down management system. Bottom-up approaches are more likely to result in increased understanding and views of sustainability, whereas top-down approaches are less effective at promoting sustainable development behaviours (Mazon *et al.*, 2020). Environmental issues handled top-down need expensive monitoring, are discouraging, ineffective, and may result in false

environmental reporting. Additionally, this top-down strategy prevents local stakeholders from participating and may even result in locals' hostility and resentment (Ouyang *et al.*, 2020). The best known and classic theory for bottom-up public participation is Arnstein's Ladder of citizen participation (1969), which provides planners with a public participation goal of redistributing power from those in power to the poor (Arnstein, 1969, P. 217). The social interaction of participants is essential in community decision making and building to build social capital and trust (Slotterback and Lauria, 2019).

Thus, scholars have highlighted three obstacles to China's community planning growth under top-down management (Zhang *et al.*, 2018; Feng and Chen, 2019): 1 Insufficient policy formulation and legal backing; 2 Unsuitable local governance and planning environments; 3 Weak community awareness and little resident participation desire. The key to the growth of Chinese communities is a rise in resident engagement, which may be supported via a variety of activities.

2.1.3. Pro-environment behaviour

2.1.3.1. Definitions

The majority of today's environmental concerns, such as climate change and waste pollution, are caused by human misbehaviour. As a result, the study of human behaviour and the environment has long been a popular subject (Markle, 2013; Yusliza *et al.*, 2020; Minelgaitė and Liobikienė, 2021). Most environmental behaviours may be classed as either environmentally friendly or unfriendly based on their influence on the environment, and Krajhanzl (2010) suggests that environmental behaviours should be classified according to the social context in which they are considered. Pro-environmental behaviour (PEB) is environmentally friendly behaviour, which refers to behavioural approaches that protect the environment (Krajhanzl, 2010). PEB may also be referred to as environmental protection behaviour, environmental conservation behaviour, environmentally responsible behaviour, ecological behaviour, or sustainability behaviour.

Cottrell (2003) argues that environmentally responsible behaviour is the deliberate act of minimising the negative effects of one's actions on the natural environment and built environment (Kollmuss and Agyeman, 2002) and that protecting the environment or reducing environmental damage in the specific outdoor environment in which one lives constitutes environmentally responsible behaviour. In general, pro-environmental behaviour refers to minimising adverse effects on the environment while engaging in personal activities. These concepts are almost from an environmental perspective, with some scholars arguing that pro-environmental behaviour should also consider economically sustainable consumption by consumers, as excessive spending can have social and environmental costs that affect the well-being of future generations (Hüttel et al., 2018); others argue that it is equally important to consider pro-environmental behaviour under conditions of social sustainability, such as local attachment and proenvironmental behaviour relationship (Daryanto and Song, 2021), and the gender gap and the development of pro-environmental behaviour (Kennedy and Kmec, 2018). Therefore, it is necessary to conduct research on pro-environmental behaviour across the three pillars of economic, social, and environmental (Table 2.2).

Table 2.2 Pro-environmental behaviour and three pillars

	Economic	Social	Environmental
Pro-environmental	Economically	Local attachment	Reduce hazards to
behaviour (for	sustainable	(Daryanto and	the natural and
example)	consumption by	Song, 2021)	outdoor
	consumers,	Gender gap	environment in
	reducing social and	(Kennedy and	personal activities
	environmental	Kmec, 2018).	(Kollmuss and
	pressures (Hüttel <i>et</i>	Culture (X. Wang <i>et</i>	Agyeman, 2002)
	<i>al.</i> , 2018)	al., 2021)	

2.1.3.2. The factors influencing human behaviour

Scholars in various fields have been studying the relationship between human behaviour and the environment and have argued that changing people's behaviour will change the state of the environment. People choose environmentally preferable products by comparing them to each other; for example, Gardner and Stern (1996) suggest that changing people's purchasing behaviour is often more beneficial to the environment than reusing products. In Malaysia (Abd Rauf et al., 2021), a study found that changes in people's behaviour were positively associated with household waste recycling. People's behaviour towards the environment is often influenced by a wide range of factors (Krajhanzl, 2010). Some scholars (Maio et al., 2007; Krajhanzl, 2010) believe that the influences on human behaviour towards the environment can be divided into two factors: external factors, which refer to the individual's environment, and internal factors, which refer to the physical and mental aspects of the individual. Krajhanzl further divided the internal factors into those of the individual's personality and those of the individual's relationship with nature, as shown in Figure 2.6 Internal factors of changing people's environmental behaviour. The chart based on the factors influencing people's behaviour towards the environment proposed by (Krajhanzl, 2010)

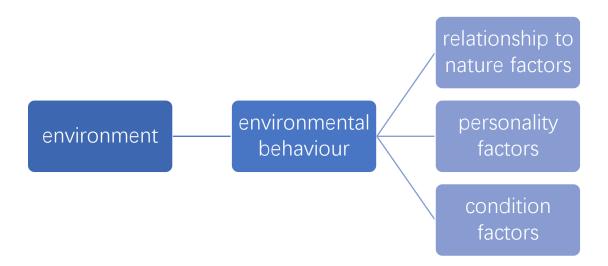


Figure 2.6 Internal factors of changing people's environmental behaviour. The chart based on the factors influencing people's behaviour towards the environment proposed by (Krajhanzl, 2010)

External factors on the environmental behaviour

External factors on environmental behaviour (Krajhanzl, 2010) are also known as conditioning factors. This refers to the factors, such as social, cultural, environmental, legal, and economic elements, that impact changes in people's behaviour toward the environment. For example, in the UK, the first UK Sustainable Development Strategy (Lucas *et al.*, 2008) means that the UK has adopted policies and laws to regulate additional negative impacts of people's behaviour on the environment. Ölander and ThØgersen (1995) also suggest in their study that many environmental factors such as infrastructure and product utility may influence or promote people's environmental behaviour. Hong Kong's local government has also enhanced garbage separation and recycling awareness by placing an extra 16,000 waste separation containers to encourage waste recycling among households (Wan, Shen and Yu, 2014). In trial research conducted in Spain in 2019 (Gibovic and Bikfalvi, 2021), residents were incentivised to recycle their garbage using virtual coin rewards, and waste sorting significantly improved. Such externalities are well understood, and when externalities are environmentally friendly then people's behaviour will become more sustainable based on these factors.

Personality factors on the environmental behaviour

Individual personality factors that impact environmental behaviour, according to Krajhanzl (2010), include 'the effect of personal qualities, motivational features (attitudes and values), talents, and psychological emotions on environmental behaviour'. In other words, how environmental behaviour is influenced by the individual's life values, lifestyle and personal qualities. When people have environmental values, they tend to behave in an environmentally friendly way, for example, people with a green identity are more likely to participate in environmental initiatives (Whitmarsh and O'Neill, 2010), and people with an energy-saving identity are positively associated with energy-saving awareness and behaviour (Van Der Linden, 2015). In Gatersleben and his colleagues'(2014) study, it was also shown that people's values were strongly related to pro-environmental behaviour. Wi and Chang (2018) also indicated an association between the two in their study of values as one of the variables of people's behaviour towards environmental protection in a Singapore residence. Thus, human personality frequently subtly influences people's behaviour; as attitudes and values change in

response to new knowledge and the surrounding environment, so does people's behaviour toward the environment.

Relationship to nature factor on the environment behaviour

A person's attitude toward environmental protection can be a good predictor of behaviour (Gatersleben, Murtagh and Abrahamse, 2014). However, Krajhanzl (2010) argues that the relationship with nature cannot only focus on attitudes towards nature but that environmental behaviour is also influenced by its psychological events, phenomena, persona and conditions and is directly confronted with nature and the environment in addition to the human world, such a relationship is called the relationship with nature (Figure 2.7). Of course, when studying the relationship between people's behaviour and the environment, it is important to consider all three elements together, including the external environment, personality and the relationship with nature. For example, in the case of waste separation and recycling, the following factors influence people's behaviour: the presence of waste separation bins (external environment), whether the person is aware of this (personality), and how the attitude towards waste separation is perceived (relationship with nature).

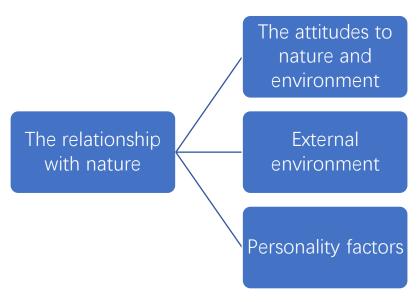


Figure 2.7 The relationship with nature (Krajhanzl, 2010)

2.1.3.3. The models of pro-environmental behaviour

Early pro-environmental models

Scholars have been studying pro-environmental behaviour since the 1960s (Kollmuss and Agyeman, 2002), and the earliest models (Figure 2.8) to describe pro-environmental behaviour were based on a linear development. It began with knowledge of environmental issues and awareness of the environmental problems and eventually led to pro-environmental behaviour (Kollmuss and Agyeman, 2002). However, this model was subsequently proven wrong, as in most cases, increased knowledge and awareness did not lead to pro-environmental behaviour; for example, Foxall (1983) and Tarrant and Cordell (2016) have shown in their studies that analysing behaviour in terms of attitudes alone is not an accurate predictor of actual behaviour. This early pro-environmental model did not combine external and internal factors. In contrast, in this thesis, multifactorial consideration of the effects on pro-environmental formation is required.



Figure 2.8 Early stage Theory of planned behaviour (Kollmuss and Agyeman, 2002a)

Theory of planned behaviour

As research was conducted, Ajzen and Fishbein (1977; 1980) developed their theory: The Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) (Figure 2.9), which are influential attitude-behaviour models in social psychology. In TPB, the determinants of behaviour are the intention to engage in the behaviour and perceived behavioural control (PBC). Intention represents a person's motivation, and intention is measured by three variables, attitude, supervisory norms and the degree to which an

individual's behaviour is controlled by others and labelled as PBC (Conner, 2001). Perceived behavioural control is a person's expectation that behavioural performance is within that person's control. TPB has been used in various areas of behavioural research, including health and concern exercises, travel, and in relation to recycling, environmental behaviour (Jackson, 2005; Macovei and Octav-Ionuţ, 2015) and more recently, there has been a growing body of scholarship linking TPB to pro-environmental behaviour (Setiawan, Afiff and Heruwasto, 2020; Yuriev *et al.*, 2020). Although some scholars (Kollmuss and Agyeman, 2002) have suggested its limitations, it is still used today due to its clarity and simplicity. This thesis does not deny its strengths, however, the TPB model is primarily concerned with personal factors but not analyse the influence on pro-environmental behaviour in terms of external factors but only in terms of the human self and intents; consequently, it is inapplicable to this thesis's investigation.

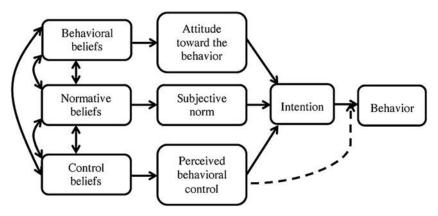


Figure 2.9 Theory of Planned Behaviour

Source: Ajzen's official website: http://people.umass.edu/aizen/tpb.diag.html (accessed on the 30th of October 2019).

Model of responsible environmental behaviour

Hines et al. established a model of responsible environmental behaviour in 1986 (Figure 2.10), building on the theory of planned behaviour and delving further into the components involved (Hines, Hungerford and Tomera, 2010). They propose that while examining responsible behaviour, the following factors should also be considered: (1) Knowledge of the problem (2) Knowledge of action strategies (3) The need for control (4)

Attitudes toward the pro-environment (5) verbal commitment (6) personal responsibility. Therefore these factors are described by Hines (Mueller *et al.*, 2020) as situational factors such as economic pressures, social pressures and opportunities. Although this model is more complex than the TPB and takes into account external contextual factors such as social relationships, environmental knowledge, and skills, these factors do not capture all the factors that influence pro-environmental behaviour, and the consideration of ability and opportunity alone does not account for pro-environmental influences in terms of motivation. Therefore, this thesis does not use this theory as a theoretical framework.

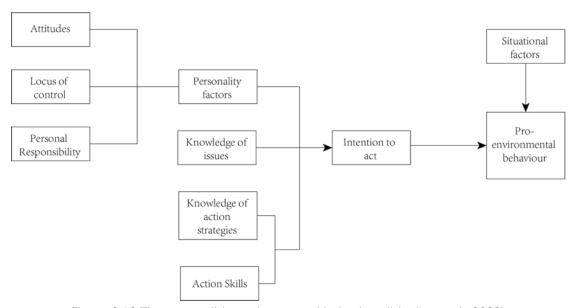


Figure 2.10 The responsible environmental behaviour (Mueller et al., 2020)

The Model of Norm Activation and the Value-Belief-Norm Theory

The norm activation model (Schwartz, 1977) is a model of altruism, empathy, and prosocial behaviour that was first developed to study pro-environmental behaviour in a pro-environmental setting. The norm activation paradigm is based on three concepts: prosocial intents and behaviours, consequences awareness, accountability, and personal standards. Gardner and Stern (1996) then developed the Value-belief-norm theory (Figure 2.11), which was based on Schwartz's concept of norm activation and connected to value theory. Thus, the VBN model is an expanded form of the norm activation model that better explains and connects pro-environmental behaviour to environmental goals by including a biosphere orientation and egoism in addition to altruism, or concern for

the interests of others (Gardner and Stern, 1996) (Figure 2.12). The biosphere is connected to nature; it is the prevention of devastation and suffering in addition to the human world; and egoism is geared toward maximising individual gains (Klöckner, 2013). Different researchers have defended the VBN theory in terms of pro-environmental behaviour. For example, Steg et al. (2005) used the VBN model to examine the feasibility of an energy policy aimed at reducing household CO2 emissions in a residential community in the Netherlands. They discovered that, in addition to energy considerations, there was a relationship between mode choice and a sense of responsibility and morality. Minelgaitè and Liobikienè (2021) also conducted research through VBN theory to assess the influences on environmental behaviour in Lithuania. However, the VBN theory does not take into account cognitive factors such as environmental knowledge and relevant skills. Therefore, this theory is not used as the basis of this study.

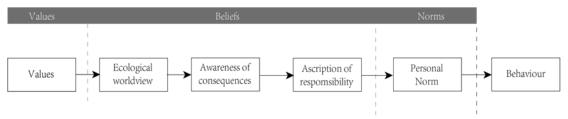


Figure 2.11 The VBN model (Klöckner, 2013)

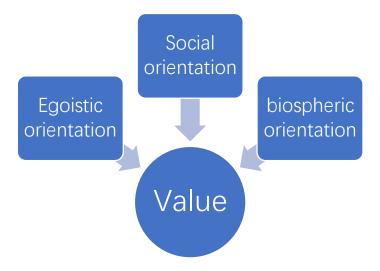


Figure 2.12 The relationship between value, egoistic, social and biosphere (Gardner and Stern, 1996)

Barriers between environmental concern and environmental behaviour

Blake (1999) summarises three major impediments to promoting pro-environmental behaviour, individuality, responsibility and practicality (Figure 2.13). His opinion is somewhat consistent with the notion discussed above, in which Black says that individuality is something that every person deserves and is tied to attitudes and temperament. The second barrier is responsibility, which encompasses not only personal responsibility for the environment but also a lack of confidence in organisations, which can prevent people from engaging in environmentally friendly behaviour due to their scepticism about their place and country, and thus their unwillingness to act. It has organised pro-environmental behaviour around internal and external elements, but not around social ones like familial and societal constraints or cultural standards (Kollmuss and Agyeman, 2002). Therefore, this theory is also not suitable as a theoretical basis for this thesis.

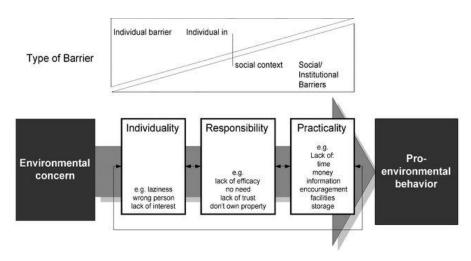


Figure 2.13 Barriers between environmental concern and environmental behaviour (Kollmuss and Agyeman, 2002b)

2.1.3.4. Conclusion

We can see from the components and models of pro-environmental behaviour above that there are several elements that impact and interact with pro-environmental behaviour, just as many academics have stated above that no single cause can alter people's behaviour. Most of the research on interventions for pro-environmental

behaviour has been conducted in Europe and the United States, and most of the available research is on the influence of internal factors on pro-environmental behaviour (Wu, Font and Liu, 2021). In China, more research has focused on the predictors of environmental attitudes and less on the predictors of pro-environmental behaviour (Chen *et al.*, 2011). Some Chinese scholars have studied the factors influencing pro-environmental behaviour, mostly considering unidirectional factors, such as the influence of psychosocial factors on waste sorting (H. Wang *et al.*, 2021), the influence of moral norms on green consumption through the TPB model (Liu, Liu and Mo, 2020), and the influence of ssocial norms-Chinese tradition, on environmental behaviour (Wang and Zhang, 2020). In this thesis, we have taken into account TPB, VBN theory, internal factors including personal identity and values, and external factors such as legislations, regulations and infrastructure, architectural factors, social relationships and peer pressure.

2.1.4. Social capital and social network

2.1.4.1. Definitions

In recent decades, social capital has risen in popularity as a concept in the social sciences, with interest growing fast in fields such as sociology, economics, education, and public health (Pretty and Ward, 2001; Ferlander, 2007; Batt, 2008). Social capital may be roughly described as a group's relationships. Social capital is a wide term that refers to the links and membership in a group (Ihlen, 2005) and has been defined variously by researchers at various points in time. Granovetter and Swedberg (2018) argue that social capital is the sum of actual or potential resources that are connected through a grid of mutually recognised and enduring relationships. In contrast, Putnam (2000) argues that the concept of social capital is based on the idea that social networks have value and that social ties influence individual and group productivity. In other words, social capital is composed of two components: the worth of the person in the network and the value of the network members. Members assist one another, build bridges via words and time while also receiving care, respect, and friendship (Giacovelli, 2022).

2.1.4.2. Forms of social capital

As social capital has evolved, scholars have classified it into different forms, authenticity, strength and diversity levels (Ferlander, 2007). Granovetter (1973) suggests that the most familiar classification is that of strong and weak social capital. Strong ties are intimate relationships, such as those between direct family members and close friends, and this is multilinear and can be maintained on a regular basis. Weak ties are non-intimate relationships, such as those with acquaintances, which tend to be single-lined and are not maintained regularly. The classification of diverse social capital is made up of bonding and bridging social capital (Putnam, 2000; Ferlander, 2007). Bonding social capital is based on people being similar in basic factors such as age, race and education; however, bridging social capital is based on consistency and outward-looking ties that link people across different social groups. Woolcock (1998) adds a new dimension to bonding and bridging social capital; linking social capital has also been called crossing-cut social capital.

Mitchell and Lagory (2002) found that bridging social capital had a positive effect on people's mental health. Weitzman and Kawachi (2000) suggest that the social capital gained through membership in student unions may be important in preventing binge drinking in American universities. From these studies we can see that there is a wide cross-section of social capital that can change people's behaviour and improve their mental health. And cross-cutting, bridging and linking social capital have the right opportunities to connect for various purposes, thus gaining new knowledge and resources and improving their problem-solving skills (Ferlander, 2007). It also has a positive impact on health through social capital, changing the norms of healthy behaviour and spreading and adopting them in society, with a cross-cutting effect on deviant behaviour (Kawachi, Kennedy and Glass, 1999). Therefore, linking social capital to healthy, appropriate behavioural practices is a step toward a positive start.

However, in the last few years, the outbreak of the Covid-19 epidemic in the world has restricted all types of social capital, countries have introduced segregation at home policies (Alfano, 2022), thus reducing the meeting of family and friends. School students have been receiving online classes and have less contact with their peers which affects the social capital of individuals and communities (Luo *et al.*, 2022; M. Fulkerson *et al.*, 2022).

2.1.4.3. Factors for development of social capital

The two most important factors of social capital are trust and cooperation (Bridger and Luloff, 2001). Jules and Hugh (2001) also consider trust relationships to be one of the most important factors, in addition to reciprocity and exchange; common rules, norms and sanctions; and connectivity, networks and groups as core aspects of social capital.

Relations of trust

Relations of trust may engender a sense of social duty (Pretty and Ward, 2001). When you choose to join in a community activity, you are expressing your willingness to trust other members and, conversely, others are expressing their willingness to trust you. Without this trust, no cooperative relationship can be formed. This is, of course, the critical component of developing a networking system. Gambetta (Akbar Valadbigi and Bagrat Harutyunyan, 2012) contends, however, that trust takes longer to develop but is readily shattered.

Reciprocity and communication

This factor also strengthens the connection of trust, and in the process of reciprocity, people are also rewarded or balanced through the passage of time. Helping relationships develop between people through such relationships will be a critical component of promoting positive environmental development (Platteau, 1997).

Common rules, norms and sanctions

This is a regulation that has been collectively agreed upon, or that prioritises the collective above the individual (Pretty and Ward, 2001). With such a precedent in place, individuals would follow suit because they are certain that others will do the same. Individuals that violate the regulations are subsequently penalised. For example, laws and regulations are stricter than official norms.

Connectedness, networks, and groups

Groups of people may be connected to each other in a variety of ways, for example, through information sharing, mutual aid, and cooperative involvement in activities. They might be one-way or two-way, long-standing, and require periodic renewal. Pretty and Ward (2001) claim that the more connections there are, the better for the growth of social capital.

2.1.4.4. Social capital in Five capitals model of sustainable community development In order to make the development of the community sustainable, some researchers use a model as a guideline to help build a sustainable community. That is the five capitals model. This model was developed by an organisation called Forum for the Future. The five capitals model was used to study how social, environmental, and economic factors promote and cooperate in sustainable development at first, and any organisation can demonstrate its content through these five capitals (Forum for the Future, 2011). Now, researchers are more willing to use this structure to plan the development of small-scale environments, such as organisations and communities. The five capitals are human capital, social capital, manufactured capital, natural capital and financial capital (Gazzola and Querci, 2017, p. 369).

Social capital has a close relationship with human capital. 'Social capital is any value added to the activities and economic outputs of an organisation by human relationships, partnerships, businesses and co-operation' (Forum for the Future, 2011), like networks, communication, and communities. Communities or organisations need to develop

through social relationships. Through communicating and sharing, people have a common goal and thus become more united, and the community or organisation will become more effective. Selman (2001) also thinks social capital is the glue which holds communities together. Social capital is not born by nature itself but is based on social relations, the relationship between people and people, and people's communications, rather than relying on one person. Therefore, people's communication and cooperation play a vital role in the community's sustainable development.

2.1.4.5. Architecture and social capital in the community

Communities are not simply the places where people reside but also where the majority of their everyday activities occur. According to scholars (Blom, 2013; Shemesh *et al.*, 2016; Jennings and Bamkole, 2019), people's behaviour is inextricably tied to the constructed and social environment. Hadfield-Hill (2013) considers that sustainable communities and the design of the built environment have an influence on the conduct of children and young people. Some researchers (Yau, 2010; Xiao and Siu, 2018; Xiao, Luo and Li, 2021) contend that the built environment may impact inhabitants' pro-environmental behaviour. To increase social capital, people connect, travel around public areas in communities, and form relationships of trust and respect with one another (Christensen, Malberg Dyg and Allenberg, 2018). Moreover, high social capital has a favourable effect on the environmentally conscious behaviour of community members (Hua, Dong and Goodman, 2021).

Black communities in deprived areas of London have become urban spaces (Reynolds, 2013) in which a range of social capital resources are generated, including trust, solidarity, and participation in activities among community residents. Moreover, neighbourhoods are becoming a resource of social capital in communities (Refaeli and Achdut, 2022). However, many people now feel that the neighbourhood relationship in today's society is becoming more and more indifferent in China. The China Youth Daily Social Investigation Centre did a survey of 4,509 people through the China Internet and Sohu News Centre in 2011 (Han, 2011). According to a survey of 4,509 people, 40.6% of them

are unfamiliar with their neighbours, and 12.7% of them "do not know" their neighbours at all (Han, 2011). Compared with the neighbourhood and community relations in Western countries, there is a big gap. In Western countries, there are collective activities and good relations between neighbours. The big lunch is the biggest annual activity for neighbours (Austwick, 2019) in UK; the idea of this activity is to encourage people in the community to get together, chat, eat, and get acquainted with each other (Figure 2.14). In 2018, more than 6 million people participated in the event and formed 4.5 million friendships. Since the beginning of this activity, a total of 38 million new relationships between people and their neighbours have been added (Austwick, 2019). In China's residential communities nowadays, the level of neighbourhood intimacy is low, with the exception of a few historic neighbourhoods where they have stronger social relationships and are more engaged (Forrest and Yip, 2007a).



Figure 2.14 Big lunch in the community source: (Austwick, 2019)

Scholars have debated the architecture of residential communities in China, which can be classified into two architectural styles: gated and non-gated. While some researchers suggest that gated communities decrease crime and provide inhabitants with a feeling of security (Abdullah, Salleh and Sakip, 2012; Bint-e-Waheed and Nadeem, 2019), while

some other researchers (Forrest and Yip, 2007b; Sakip, Johari and Salleh, 2012; Wilson-Doenges, 2016) contend that gated communities do not necessarily reduce crime but do diminish neighbourhoods. Wilson-Doenges (2016) has studied the relationship between a community being gated and a sense of community. In high-income residential communities, participants in gated communities have a lower sense of community than residents of non-gated communities. He also suggests that a walled community does not increase the sense of community but may decrease it.

Forrest and Yip (2007) conducted a study in Guangzhou, China, in which they selected a community in the old part of the city and a new commercial and residential area in the city, which had a similar architectural form and internal street plan as the Hutong community in Beijing, and which were both historic buildings. In this study, they compared the perceptions and relationships between residents of the two communities in terms of their neighbourhoods and their sense of belonging to the community. As the majority of inhabitants in traditional neighbourhoods are elderly, they have lived there for a long time, and also, they are better acquainted with their neighbours. They like to make friends in the neighbourhood, and members of traditional neighbourhoods express a preference for neighbourly assistance. However, residents in the Commercial residential neighbourhoods had slightly lower attitudes to these issues and said that they did not interact much with their neighbours. Regarding the sense of belonging to the community, respondents were asked if they felt they belonged to the community, and over 44% of residents in the older neighbourhoods said they did, whereas in the Commercial residential unit, only 18% of respondents said they felt they belonged. In traditional communities such as Beijing Siheyuan, property rights are private in perpetuity, whereas modern Commercial residential communities have 70 years of private property rights (Property Rights Law of the People's Republic of China, 2007), meaning that residents in traditional communities have the opportunity to live there for longer.

2.1.4.6. Case study of social capital in the community

There are two social service agencies in America, Neighbourhood Settlement House and Latinos United; they both started as community centres. Settlement House is one of the most prominent institutions in the history of American welfare (Hansan, 2011), contributing significantly to the development of neighbourhoods, women's suffrage, house construction, etc. Latinos United is a non-profit organisation whose mission is to assist community members with the job, education, and health issues, among others (Latinos United, 2013). Participants in these communities include elites and local community residents who work together and discuss community deficiencies. Although there are older people, young people, and adults in these communities, the educational backgrounds are different, but they have similar goals and work for them. They only eliminate the boundaries between them and establish network relationships, learn from each other, and build the development of a community together; they think this face-to-face communication like this is always more rewarding than working alone (Schneider, 2006).

Dale and Newman believe that sustainable community development is the integration of ecological, social and economic decision-making (2008). In addition, they also believe that the community should be understood as the people who live in it forming a network of systems that they use to communicate with each other. Sustainability has been a popular subject of discourse in communities, but implementation has always been sluggish (Dale and Newman, 2008), and Dale and Hill (2001) indicate that the lack of social networks between communities, cities, and governments may be a contributing factor. Thus, Dale and Newman claim that social capital is a necessary factor for sustainable community development because it not only maintains ties inside the community but also provides access to resources outside the community (Dale and Newman, 2008). The following example of United We Can is a good illustration of the effect of social capital on the behaviour of people in the community.

United we can, led by Ken Lyotier, is often considered a junk diver, a person who often walks around the blue bins which are behind a hidden alley in downtown Vancouver. They get cash by recycling items from the public bins, selling them to the store, and training street people in this way. The most effective place is the Victoria Park depot. People who used to work alone in the alleys began to walk to the streets to connect and communicate. The government has also learned this phenomenon, so the government organises community activities for them to communicate and provides them with consultants. Through discussion and communication, they realised that they could create their own deposit system and manage related interests. In the first year, they achieved fantastic recycling results and also received corresponding rents and salaries from the government (Dale and Newman, 2008).

The two most important factors of social capital are trust and cooperation (Bridger and Luloff, 2001). When you decide to participate in a community event, you decide to trust other members, and at the same time, others will choose to trust you. Without such trust, any cooperation is not established. Of course, this is also the key to building a network system. After the network is completed, it will also benefit the development of the community.

2.1.4.7. Conclusion

Social capital, in whatever form it exists or is distributed among communities according to variables, is about connecting people and attaining common goals via common activities. However, during the covid-19 pandemic, it had a severe influence on social capital since individuals were forced to curtail their regular activities and, in many locations, people spent the majority of their time at home, with no access to friends other than close relatives. This is where social media was relied upon to enhance the social network of the community, but it also depended on how the community organised events and got residents involved in online activities.

2.2. Environment sustainable Regulation and legislation in the world

In order to achieve sustainable development and safeguard the environment on a global scale, communities, governments, regions, and continents must change their policies and regulations (Rogers, Jalal and Boyd, 2008). Regulation of behaviour in connection to the environment is a legal tool that has been proven to have beneficial benefits (Hoek and Jones, 2011; Martin, 2019). This section will discuss environmental legislation on a global scale and in specific nations.

2.2.1. International's environmental and sustainable regulations

In section 2.1 the UN definition of sustainable development is mentioned as well as some regulations. In addition to these, some environmental sustainability regulations have been proposed at the UN. The United Nations Framework Convention on Climate Change is the most significant multilateral environmental agreement in support of sustainable development, having been signed by over 175 countries; the treaty expressly recognises and promotes the right of signatory countries to sustainable development and environmental cooperation (United Nations, 1992). Along with these international norms, there are also joint national regulations that oblige signatory nations to apply them jointly. For instance, the 21 May 1960 Mexico-United States pact on irrigation in the Juarez Valley and the 1916 United States-Canada Convention on the Protection of Migratory Birds (Rogers, Jalal and Boyd, 2008).

2.2.2. European Union environmental sustainable legislations

It is clearly stated in Article 37 (European Union, 2000) that environmental protection is a norm that countries must abide by, and Article 37 requires EU countries to comply with a high level of environmental protection and the improvement of the quality of the

environment in accordance with the principle of sustainable development. Article 191 of the EU policy specifies that policies in the environmental field contribute to the following objectives: preservation, protection and improvement of the quality of the environment, protection of human health and prudent and rational exploitation of natural resources (Kenig-Witkowska, 2017).

2.2.3. Environmental legislations in United States

Environmental protection laws in the United States date all the way back to the Yellowstone National Park Act (US, 1872), which was signed into law by the United States Congress on 1 March 1872 and established the country's first federally protected national park to safeguard wildlife, forests, water resources, and other natural resources within the park. As the United States entered the 1970s, a number of significant environmental laws were enacted, the most famous of which was the National Environmental Policy Act (Dongoske, Pasqual and King, 2015), which was signed into law by President Nixon on 1 January 1970 and required all departments of the US government to submit environmental impact statements. This legislation mandated each department of the US government to produce an evaluation of their actions' environmental effects, enforcing each agency's commitment to safeguarding the environment. The Environment Protection Agency was then founded in the United States to develop and enforce environmental laws according to congressionally enacted environmental legislation. Subsequently, each state and town got worried about environmental preservation and implemented rules in the United States. For example, a law requiring water meters on residential properties can curtail wasteful water usage by holding property owners accountable for associated costs (City of Calgary, 2010). In Westchester country, New York State (NYS, 2010) bans the disposal of all cell phones and their batteries in regular trash; all handsets and batteries must be collected at country-certified facilities. Michigan has adopted a mandatory e-waste recycling program, a law that requires manufacturers of electronics to establish free recycling programs for households and small businesses (Arain et al., 2020).

2.2.4. Environmental and Sustainable legislations in Japan

Japan is a country with a strong focus on waste recycling, and policies enacted in Japan are focused on promoting the efficient use of resources and minimising the environmental impact of production and consumption (Yabar, Uwasu and Hara, 2013). Japan is one of the world's leading countries in terms of domestic waste management legislation (Kaplan Mintz et al., 2019). In the Handbook on resource recycling legislation and 3R rends in 2003 (METI. Ministry of Economy, 2004), various regulations and implementation dates are clearly marked for various types of waste and resource recycling, including containers and packaging, plastics, glass, paper, electrical appliances, vehicle construction materials and foodstuffs. The regulations include the Waste Manage Law, Containers and Packing Recycling Law, Food Recycling Law, Green Purchasing Law, etc. For example, in May 2019, the Resource Circulation Strategy for Plastic (Kawai et al., 2022) was published, which sets out a number of targets for plastic recycling over the next few years, such as the reuse and recycling rate of plastic packaging and containers by 2030, and containers by 2030, and to achieve a 100% recycling rate for all plastics by 2035. In June 2021, the Law for Promotion of Resource Circulation of Plastics was enacted to help achieve the objectives of the strategy.

2.2.5. Other countries' environmental and sustainable regulations

Canada

Recognising that construction and demolition waste produced by the construction industry accounts for 27% of the total municipal solid waste disposed of in landfills, the Canadian government has established a ban on landfilling specific C&D materials in several municipalities (Yeheyis *et al.*, 2013). The Ontario Ministry of the Environment (MOE) adopted the 3Rs regulations in 1994 to ensure that local government, industry, commerce and related institutional sectors work together to develop strategies to reduce the amount of material going to landfills (Yeheyis *et al.*, 2013). The Federal Government published Canadian Guidelines for Domestic reuse Water for Use in Toilet and Urinal

Flushing in 2010 (Van Rossum, 2020).

Korea

In Korea, in order to effectively manage and control municipal solid waste, it was deemed necessary to reduce this solid waste at its source, which was also known as household waste. In 1995 Korea introduced a quantity-based waste charging system (Lee and Paik, 2011), a regulation that requires each household to purchase government-established plastic bags for waste disposal and separate recyclable waste for free disposal, with each community having a different charging system.

Australia

Australia's federal government passed the Australian Natural Heritage Trust Act in 1997 and the National Environment Protection Act, while the Environment Protection and Biodiversity Conservation Act was enacted in 1999 (Tam, 2009). In Australia, laws on waste disposal and recycling are usually administered by state or territory environmental agencies. Therefore the Victorian Environmental Protection Act was amended in 2002 to promote environmentally sustainable use of resources and best practice in waste management (Gumley, 2014). In 2013 the Victorian government enacted a new policy, Getting Full Value: The Victorian Waste and Resource Recovery Policy (Gumley, 2014), with the aim of providing greater clarity on the management and use of waste and resources.

Turkey

Consumers in Turkey will be taxed 0.25 toul lira for plastic bags starting in January 2019 (Yakut, 2021). Yemez (Senturk and Dumludag, 2021) did a face-to-face study of 183 inhabitants in the Sivas area in 2019 and indicated that more than half of the respondents opposed the legislation. However, the regulation is obligatory, and individuals must comply. Senturk and Dumludag (2021) did another face-to-face survey of 789 consumers in Istanbul and discovered that while plastic bags were free, the frequency of customers bringing their own bags climbed from 33.4 % to 65.8 %. When plastic bags were charged

a payment, the frequency of consumers bringing their own bags increased from 33.4 % to 65.8 %. And whereas customer demand for plastic bags was 85 % while they were free, it plummeted to 51.4 % when a cost was imposed. 8 % of respondents reported reducing their usage of plastic bags. We can observe from this instance that the policy aimed at changing people's sustainable buying habits has resulted in a shift in people's proenvironmental behaviour. Of course, this example is an examination of the consumer's attitude, compelling them to spend more money and therefore altering their behaviour.

2.2.6. Environmental and sustainable policy in China

In 2.1.1.4. the Chinese government's policy on environmental sustainability at the national level is presented. In this section, few examples of environmental policies at the city level in China would be presented.

2.2.6.1. Shanghai environmental regulation

In Shanghai, China, the government uses financial ways to manage people's behaviour. Shanghai legislated the waste separation system on 31 January 2019 and made it mandatory from 1 July 2019 (Lv *et al.*, 2020); individuals, families, and companies must classify and recycle garbage. Those who do not comply with the regulations will not only face massive fines, from 200 yuan to 50,000 yuan but will also reduce their most crucial social credit rating, which may affect their access to some economic or social privileges. Shanghai is one of the world's largest populous city, with 24 million inhabitants, and only 10% of the waste is recycled (Allen, 2019). The Chinese government hopes to pass Strict regulations for waste management are implemented, and it is hoped that by 2020, more than 35% of the waste will be recycled. According to the Shanghai Urban Authority, within just four weeks of the introduction of the new policy, the average daily recyclable waste increased by 10%, food waste increased by 15%, and dry waste decreased by 11.7%, based on the 26,000 tons of waste generated in Shanghai per day (Xiao *et al.*, 2020). Point redemption has also become the mainstream way to guide garbage classification.

Whether this incentive measure can help people form sustainable behaviour still needs to be observed.

2.2.6.2. Beijing environmental regulation

Although the Beijing government has been advising citizens to separate and recycle their waste since 2000, the practice has not been enforced. The Beijing government has taken a number of approaches, many of which were piloted in designated residential areas where different types of bins were installed (Landsberger, 2019) (Figure 2.15). However, some of these trials were successful, and some failed, and no one outside of these experimental areas engaged in waste separation. It was not until the Shanghai government made waste separation a mandatory law that there was a noticeable increase in recycling and environmental behaviour. Therefore, the Beijing government made the separation of household waste compulsory and started implementing it in May 2020.



Figure 2.15 Community garbage bins on the grounds of a residential community. The sign indicates which garbage needs to go into which bin. Image from (Landsberger, 2019), taken by the author in May 2017

2.2.7. Environmental incentive policy and regulation

Financial incentives are the main policy tool in international to promote proenvironmental behaviour (Maki *et al.*, 2016; De Martino, 2017; Ghesla *et al.*, 2020; Ling and Xu, 2021). Incentives are a typical source of motivation that can initiate new behaviours, and incentives can increase the attractiveness of the motivated behaviour, leading to behavioural frequency (Maki *et al.*, 2016). Maki and his colleague (2016) study shows that in all published articles from 1977 to 2012 on pro-environmental behaviours related to incentives, environmentally friendly behaviours include recycling, conservation, bus transport, organic food, public household buckets, consumption and rewards, including coupons, tickets, wages and lotteries. Of these studies, they selected 49 articles for analysis, 22 provided detailed data and contained 30 case studies, 25 of which showed an increase in pro-environmental behaviour as a result of incentives.

2.2.7.1. Incentive regulations in Canada and UK

Incentives are a powerful way to foster human behaviour towards more commercially efficient and environmentally sustainable patterns (Yamabe *et al.*, 2010). McKenzie-Mohr and Smith (1999, P. 111) also agreed that changing people's behaviour through money is more effective sometimes. In 2003, the Canadian federal government introduced a rebate to encourage residents to use energy-efficient homes (Gamtessa and Guliani, 2019). Successful applicants received \$1,240 and a tax break on renovations, and over the subsequent five years, 890,724 homes were retrofitted, resulting in 3.04 tonnes less CO2 emissions per home annually. A Green Deal programme in the UK improves the energy efficiency of UK homes by encouraging homes to install energy efficiency measures products and can minimise upfront installation costs with loans, and 14 million homes have already been retrofitted in 2020 (Howarth and Roberts, 2018).

2.2.7.2. Incentive regulations in China

In the past decade, the number of private cars in Beijing, China, has increased to 5.5 million, accounting for 70% of the total consumption in the transport sector (Wen and Bai, 2017). This has had a negative impact on air quality and is detrimental to the city's sustainable development, so the Beijing Municipal Government has taken a number of

measures. Vehicle restrictions are the most effective way to minimise automobile carbon emissions and reduce traffic congestion. The Beijing Municipal Government has stated that beginning on August 20, 2015 (Yang, Liu, 2015), it would begin restricting the last number on a driver's licence on various weekdays, with different numbers limiting travel on different weekdays. If the public does not comply, they will be subject to a minimum RMB100 fine and ordered to return along the same path. And as a result of this measure, the air pollution index decreased by 24.9% between 2007 and 2008 (Xie, Tou and Zhang, 2017).

The case study of using incentive on recycling separation behaviour in Shanghai In recent years, Shanghai has been one of the more successful cities in China in enforcing waste separation regulations, with the Shanghai Municipal Regulations on Household Waste Management coming into force on 1 July 2019 (Zhang, 2019). A Shanghai-based environmental company conducted a 14-month study of waste recycling in eight Shanghai residential communities (Yang et al., 2022), which covered the period before and after the implementation of Shanghai's waste separation regulations. The company used an incentive-based recycling system, whereby different items were collected at different prices, and the recycling company offered residents a cash incentive based on the type and price of recycling. There were 26 weeks between the start of the study and the implementation of Shanghai's waste separation regulations, with an average weekly increase of 190.9% in total recycling from week 7 to week 26. From the 27th week (the first week after the implementation of the waste separation regulations) to the 52nd week, the average weekly increase in recycling was 19.6% compared to the previous week. Although the recycling rate has increased since the implementation of the sorting legislation, Yang and her colleagues (2022) attribute this to the implementation of the sorting legislation, the government's promotional efforts, the operation and management of the recycling companies and the gradual adoption of the sorting habit by residents. In this case, the use of incentives led to a significant increase in the waste sorting behaviour of the participants during the observation period. Thus, there could be a positive impact on the residents' recycling behaviour to some extent by using incentives. However, the experiment still demonstrates that incentive and pro-environmental behaviour have a positive effect.

The case study of using incentive on recycling seperation behaviour in Anji County From the previous legislation section, we know that waste separation and recycling are implemented as mandatory regulations in Beijing and Shanghai, China, however, there are many areas in China where the practice of recycling is not implemented, and incentives have been used elsewhere. This is why some scholars (Ling and Xu, 2021) conducted a study on incentivising recycling in Anji County, China. In the study, they selected a community containing 827 residents to participate in the study. They created an incentive for residents to separate recyclables from their daily waste and bring it to a community collection point for 0.8 green points per kilogram of recyclables (1 green point = 1 RMB). Residents can use their green points to buy household items at nearby shops. After eight months, the authors conducted the first study, and 280 people did not participate in the campaign; after a year and a half, a second study was conducted, and only 22 people were found not to have participated. The recycling behaviour of these participants had also increased. In the case of Anji, the use of rewards as a form of incentive increased the participants' waste recycling behaviour. For pro-environmental behaviour change, consider using incentive method.

Similar cases study by using incentive way to encourage people recycling behaviour. For example, on Chongwai Street in Beijing, Residents receive points for recycling separated waste and can redeem the points for everyday items. A roll of paper costs 70 points, a garbage bag costs 100 points, salt costs 120 points, a ceramic knife costs 150 points, and five catties of rice cost 1,000 points (Yukun Li, 2019);. Residents may also select from a variety of other everyday essentials. Also, Jianguomen Street, a street with a long history in the centre of Beijing, connected to the hutong residential area and with some government offices and historical buildings on both sides of the street, has six smart bins that can be detected by face and fingerprints and used to earn points with a membership card have been installed.

2.2.8. Conclusion

In the Chinese context, behavioural change needs to take place under national policies. Policies at the national level are guiding directions. To make behaviour relevant to sustainable, city-level, or even for individuals' regulations and legislations are needed. Incentive can be beneficial for the implementation of environmental policies, both in the European and American context and in the Chinese context. For example, travel restrictions on car registration numbers in Beijing; in the case of the points rewards used in Shanghai and Beijing for waste separation, this monetary incentive is targeted at the individual and household level. This type of targeted management for individuals or households is more appropriate for the development of sustainable behaviour in China.

2.3. Theoretical foundation of the thesis

2.3.1. Behaviour change wheel-Susan Michie, Lou Atkins and Robert West

Michie and her colleagues (2014) believe that 'improving the implementation of evidence-based behaviour and public health depends on behavioural change'. Therefore, interventions in behavioural change become a key factor. A behaviour change intervention can be understood as a coordinated activity set that changes a particular behaviour pattern (Susan Michie, Atkins and West, 2014). Michie and her colleagues (2011) believe that in the previous study, there was no clear, systematic, comprehensive and coherent intervention framework, such as an influential report from the UK Government Institute' MINDSPACE' (Dolan *et al.*, 2010), which is the most critical impacts of behaviour list for policymakers. However, this framework does not contain all the essential types of intervention and lacks coherence. Michie and her colleagues believe that a framework for characterising interventions should be comprehensive, consistent, and linked to the overall behavioural model (Susan Michie, Atkins and West, 2014), which is also the framework for establishing behavioural intervention frameworks. Full coverage means

that the framework applies to already or each intervention that may be formed; coherence, such as the category, is all samples of the same type and characteristics of the entity and is connected to an overall behavioural model (Susan Michie, Atkins and West, 2014). Under such background and standards, they created a new, comprehensive, coherent intervention framework, the Behaviour Change Wheel (BCW) (Figure 2.16).

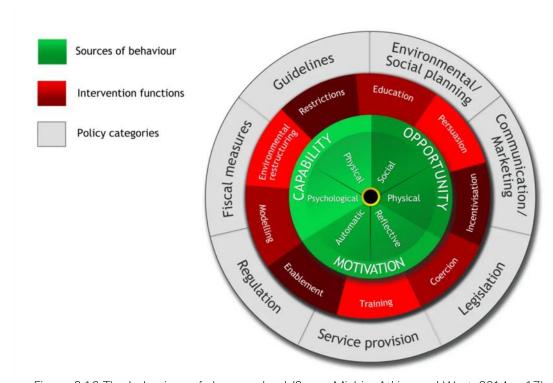


Figure 2.16 The behaviour of change wheel (Susan Michie, Atkins and West, 2014, p.17)

2.3.1.1. Capacity, opportunity, and motivation model

BCW is a theory used to guide the design and intervention of behaviour change. It is comprised of 19 frameworks of behaviour change identified in a systematic literature review (Susan Michie, Atkins and West, 2014, P. 16), including nine intervention functions, seven policy categories, and three others in which capacity, opportunity, and motivation interact to produce behaviour. These three components comprise the COM-B core model of BCW (Susan Michie, Atkins and West, 2014, P.51)(Figure 2.17). The COM-B presupposes that in order for a behaviour to occur, the ability, opportunity, and desire to do the behaviour must be met.

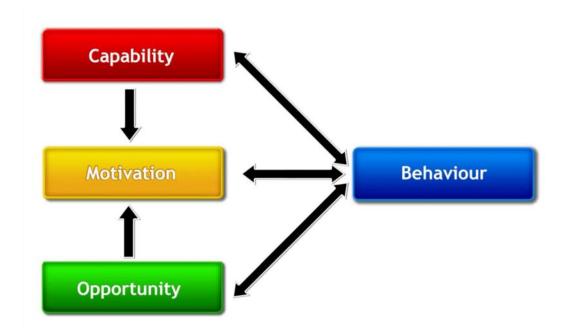


Figure 2.17 COM-B model (Susan Michie, Atkins and West, 2014, p.51)

Capability is described as a person's mental (e.g., knowledge) and physical ability (e.g., skills) to participate in the mission at hand. Motivation is defined as all brain processes that motivate and direct behaviour, including automatic (e.g., habitual activities) or reflective processes (e.g., beliefs, intentions, emotional responses and analytical decisions). Opportunity encompasses the social (e.g., social standards) and the material (e.g., natural resources).

2.3.1.2. Theoretical Domains Framework

Continuing the COM-B in-depth and differentiation will result in an improved model framework, the Theoretical Domains Framework (TDF), consisting of 14 theoretical domains that may address individuals' personal, sociocultural, and environmental elements. These fourteen domains are:

Social influence, Environmental Context and Resources, Social/Professional Role and Identity, Beliefs about Capabilities, Optimism, Intentions, Goals, Beliefs about consequences, Reinforcement, Emotion, Knowledge, Cognitive and Interpersonal Skills, Memory, Attention and Decision Processes, Behavioural Regulation, Physical Skills.

These 14 categories are fully mappable to the COM-B (McDonagh *et al.*, 2018b). Figure 2.18 depicts the link between the TDF and the COM-B. The TDF's objective is to assist in assessing the obstacles and facilitators to the examined behaviour and to guide the development of suitable and focused treatments (Buchanan *et al.*, 2021). The use of the TDF in combination with the COM-B can greatly improve the efficiency of investigating barriers and facilitators to various behaviours. Since its development, the TDF and COM-B have been utilised by researchers to explore medical topics such as maternity (De Leo *et al.*, 2021), cancer treatment (Fahim *et al.*, 2020), and chlamydia testing (McDonagh *et al.*, 2018b).

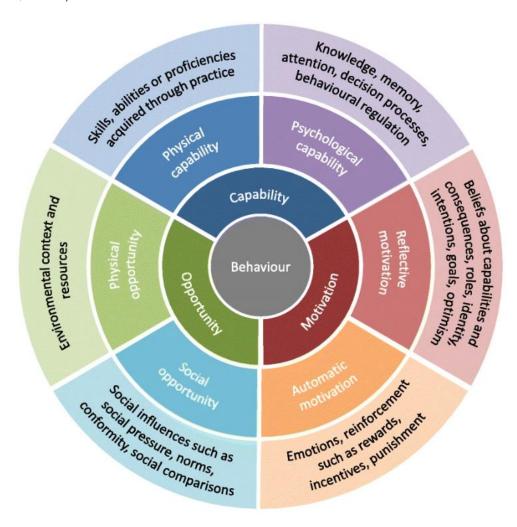


Figure 2.18 The relation between TDF and the COM-B model Image from (McDonagh $\it et al.$, 2018a)

2.3.1.3. Seven policy strategies

After analysing the pre-COM-B model and TDF, policymakers must establish prudent laws and actions. The seven policy models are the sorts of choices that support and assist political decision-makers in formulating effective policies and interventions (Susan Michie, Atkins and West, 2014, P. 119).

BCW's seven policy strategies are:

1 Communication/marketing

This may be accomplished by the use of media such as print, electronic telephones, and radio, i.e., mass media campaigns.

2 Guidelines

Create suggested documentation or approved procedures that include all modifications to service delivery, such as the production and distribution of treatment protocols.

3 Fiscal measures.

Reducing or raising economic costs via the use of tax systems, for instance, by increasing tariffs or anti-smuggling efforts.

4 Regulation

Providing standards or codes of behaviour, for instance, creating voluntary advertising agreements

5 Legislation

Creating or modifying legislation, such as forbidding the sale or use

the sixth environmental/social planning

6 Environmental/social planning

Planning or regulating the psychological or social environment, such as via the use of urban planning.

7 Service provision

Providing a service, such as providing workplace and community support services, etc.

Each legal strategy will support the appropriate corresponding intervention component

so that the whole wheel is interlinked and mutually supportive. As long as the prospective intervention functions and policy categories are specified, the BCW framework may assist researchers and intervention designers in avoiding the need to neglect crucial elements (Susan Michie, Atkins and West, 2014). Nonetheless, there is a paucity of research that applies BCW to environmental protection, particularly in terms of recycling behaviour. The first case study on the application of BCW and TDF to produce intervention suggestions for recycling behaviour was published in 2016 (Gainforth *et al.*, 2016). The case study was undertaken at a London university in order to determine the attitudes and issues of students and faculty around garbage recycling lines and to generate appropriate treatments. Several researchers at University College London (Allison *et al.*, 2022a) used TDF and COM-B to investigate the link between UK residents and home food waste recycling in an effort to increase the rate of household food waste recycling in the UK. Even if relevant research is sparse, it is obvious that BCW theory may be used in the study of pro-environmental behaviour, notably garbage recycling behaviour.

2.3.2. Fostering sustainable behaviour-Doug McKenzie-Mohr and William Smith

Community-based social marketing (CBSM) was devised by Canadian environmental psychologist Doug McKenzie-Mohr in early 1996 as a reference tool primarily to promote and shape sustained behaviour (Lynes, Whitney and Murray, 2014), followed in 1999 by McKenzie-Mohr and Smith (1999) published fostering sustainable behaviour: an introduction to community-based social marketing book for context-specific behavioural models (Cole and Fieselman, 2013). The CBSM model is a strategy to influence change at the community level through influencing individual and group behaviour and is linked to action through knowledge. Until now, the model has been used by many businesses, government and non-profit organisations, and individuals to promote sustainable behaviour, for example, to encourage green shopping, transport, agriculture, new energy use, food, and pro-environmental behaviour (McKenzie-Mohr, 2022). Some universities are also privately using CBSM behaviour change techniques to encourage students and staff to save energy and change green office behaviour (Cole and Fieselman, 2013;

2.3.2.1. The Five-step approach: Community-Based Social Marketing

CBSM is designed with five stage steps (McKenzie-Mohr and Schultz, 2014), which are selecting behaviours, identifying barriers and benefits, developing strategies, and conducting pilots and large-scale trials. The steps will be described in more detail below.

Step 1 - Behavioural selection: Whether your ultimate goal in using CBSM is waste reduction, environmental protection, transport mode change, or other behavioural change, the first step in implementing CBSM is to find the right target behaviour, as it is then possible to develop a plan that is appropriate to the target behaviour. Tabanico and Schultz (2008) stated that finding the target behaviour is the most important step.

Step 2 - Identifying barriers and benefits: McKenzie-Mohr and Schultz (2014) argue that before a sound strategy can be developed, it is important to have a clear idea of what barriers there may be to adopting certain behaviours and what will motivate people to behave. Identifying barriers can be done through a review of literature, articles and reports on behaviour and then through field research (Lightman, 2011), which can be done through observation, focus groups and questionnaire research. Identifying the barriers and benefits of people's particular behaviour is another component of CBSM (Lynes, Whitney and Murray, 2014), and it is important to identify the barriers and benefits of the target behaviour in relation to their competing behaviours. Barriers are divided into internal and external barriers, internal, for example, lack of knowledge, lack of motivation, and external such as economic and infrastructure.

Step 3 - Develop a strategy. After identifying the barriers, McKenzie-Mohr and Smith (1999, P. 21) suggest that researchers use statistical analysis of research data to prioritise the barriers and then develop corresponding strategies to remove as many of these barriers as possible. Different tools will correspond to different barriers. These tools are described in detail in the next section, and after the barriers have been

removed, one or more studies are conducted to get advice and feedback.

Step 4 - Pilot: McKenzie-Mohr and Smith (1999, P. 137) argue that before a CBSM strategy can be implemented on a large scale, it needs to be tested with a small group of people in the community to determine if it is effective.

Step 5 - Widespread implementation and evaluation: Once the effectiveness of the strategy has been demonstrated through test sites and the strategy can be implemented widely. Evaluation of the strategy is not only measured based on individual self-attitudes and changes in awareness but also through direct measurement of resource use or changes in resource quality (McKenzie-Mohr and Schultz, 2014).

2.3.2.2. The strategies of Community-based social marketing

In the third step above, the employment of suitable instruments to overcome the various obstacles was stated. According to McKenzie-Mohr and Smith (1999), the following strategies are suggested: commitment, prompting, norms, communication, reward, elimination of obstacles, and social dissemination.

Commitment

The community-based social market approach, commitment, is likely to be the most effective, with written down commitments being more effective than post-commitments (McKenzie-Mohr and Schultz, 2014). The reason why commitment works are explained by Daryl Bem (1972) as a process of self-awareness, with self-awareness being an important factor in commitment working. It is also a prerequisite in order to ensure that thoughts and actions remain consistent. This approach was used by Shippee and Gregory (1982), who asked a number of small commercial companies to sign a random 'mild commitment', 'strong commitment', or In the case of the Mild commitment, the names of these companies were published every other month with proactive energy and environmental information. In the case of the strong commitment, not only the name of the company published but also the energy-saving actions they have taken and those

they have not taken are published. Burn and Oskamp (1986) also conducted a study on the relationship between commitment and waste collection behaviour in the community, in which two control groups were given a pledge to sign prior to the experiment that the first group would adhere to waste collection. The other group was not informed of any information or commitment. After six weeks, 42% of the people in the first group who signed the pledge had carried out the act of recycling; however, in the control group, only 11% of the residents in the group that had not been informed or promised had carried out the act of recycling.

Prompts: remembering to act sustainably (ads, flyers)

Reminders are an excellent method of reminding individuals to participate in sustainable behaviour (McKenzie-Mohr and Schultz, 2014). People sometimes forget, which is a trait of humans. Sometimes individuals do not want to participate but forget, such as failing to bring cotton bags to the grocery. Scott and his colleagues launched an experiment to urge consumers to purchase reusable soft drink bottles (Scott Geller, Wylie and Farris, 1971). They handed out a number of flyers advising customers to buy recyclable drink bottles at convenience stores, an action that increased the purchase of recyclable bottles by 32%. A year-long Green Office campaign at Oregon Pacific University (Cole and Fieselman, 2013) aimed to reduce the use of paper, recycle and purchase environmentally friendly office materials, in which they used the CBSM framework and tools to intervene, including reminders in the form of signs, flyers, notes, posters and stickers. As environmental conservation becomes more vital in all nations, it is becoming more usual to see environmental slogans and trash separation signs asking everyone to take action. In places such as Shanghai and Beijing, where garbage separation and recycling rules have been enacted, slogans and information boards on how to separate rubbish can be seen everywhere (Figure 2.19).



Figure 2.19 A wall promoting waste separation knowledge in a commercial and residential community in Shanghai Photo by Fang Zhe (Zheng and Du, 2019)

Norms: building community supports

Some literature has shown that social norms influence individuals engaging in sustainable behaviour (Thomas and Sharp, 2013; Czajkowski, Hanley and Nyborg, 2017; Sorkun, 2018). For example, at the University of California Santa Cruz, a slogan was designed in the men's bathroom to encourage people to turn off the shower when they were using soap (Aronson and O'Leary, 1982); the slogan was 'Conserve water: 1 Wet down. 2 Water off. 3 Soap. 4 Rinse. In fact, the impact of this slogan was not very effective, with an average of only 6% of users completing it in this way. Elliot Aronson and Michael O'Leary (1982) analysed this phenomenon and found that more students completed the steps because one of the students who gave them the peer presure. Social psychology argues that the social pressure exerted by other people's recycled behaviours is stronger than the expectations of others that we should engage in recycled behaviours; in other words, descriptive norms are stronger than prohibitive line norms (Thomas and Sharp, 2013). Peer pressure puts more pressure on behavioural change, and when recycling behaviour becomes a visible activity, this has a positive effect on people carrying out waste recycling. This is linked to the social capital mentioned in section 2.1.4 above, where the community is a place with a strong network of connections, and when a small number of people

engage in sorting behaviour, in addition to peer pressure and learning from each other, more people will implement recycling sorting behaviour.

Communication: creating an effective message

"All persuasion starts with grabbing attention" (McKenzie-Mohr and Smith, 1999, P. 93), and of course, the message to individuals must be vivid and from a trustworthy source. In a unique experiment conducted in California (Gonzales, Aronson and Costanzo, 1988) on vividly describing energy use, Gonzales and her colleagues trained nine pacific gas and household electricity assessors to teach them the criteria for articulating messages, which had previously consisted of simply informing household users about energy use. In the past, these assessors just informed home users about energy use, but in this research, they brought the information to life. Shawn Burn (1991), from California's polytechnic state university, portrays the garbage as 'enough to fill a two-lane motorway ten feet thick from Oregon to the Mexican border,' which is far more colourful than just stating that California generates 1,300 pounds of rubbish annually. Due to the message's vividness, individuals are more likely to retain and reflect on its substance, therefore recognising the message we want them to care about.

Incentives

The incentive is another one of the more effective ways to change people's behaviour by providing motivation; providing rewards for behaviour can increase its frequency (McKenzie-Mohr and Schultz, 2014). If the barrier preventing people from the targeted behaviour is a matter of cost, then providing incentives can make it less difficult to implement the behaviour. Although incentives can make a huge difference to behaviour, some scholars argue that once the incentive is removed, behaviour also returns to previous, or even lower, levels (Bolderdijk and Steg, 2015; Maki *et al.*, 2016). McKenzie-Mohr himself, therefore, emphasises the need for caution in using an incentive to change people's pro-environmental behaviour and the need to identify the cost as a barrier to action where it works best (McKenzie-Mohr and Schultz, 2014). The incentive is also described in the section 2.2.7, along with some case studies.

Removing barriers--convenient

At the heart of CBSM is the removal of barriers, and although they come in many forms, they often make it more difficult to move around (Lightman, 2011). McKenzie-Mohr and Smith (1999, p. 21) emphasise the necessity of removing external barriers. People may encounter external barriers such as inconvenient infrastructure, a lack of clear categorisation signs, a lack of education, etc. When barriers are extremely high, individuals lack the adequate drive to overcome them, and however, when they are low, it is simpler for people to overcome them, even if their motivation is low (McKenzie-Mohr and Schultz, 2014) (Figure 2.20). If there are clear external barriers to altering people's behaviour, then methods to modify behaviour will not be effective. Therefore, we must eliminate external barriers and expand possibilities to influence people's behaviour. For instance, in Kitchener-Waterloo, Canada, an experiment to decrease obstacles and enhance participation was conducted (McKenzie-Mohr et al., 1995). First, the surveyed communities supplied homeowners with bins or carts to lessen the expense and hassle of garbage disposal. Second, these towns supplied organic waste receptacles for kitchens, so boosting convenience, and as a result of these new behaviours, the percentage of homes engaging in recycling increased from zero to 99 %. Frank and her colleagues (Bezzina and Dimech, 2011) conducted an online questionnaire survey of local residents' attitudes and satisfaction with recycling behaviour in Malta. Perceptions of recycling behaviour were heavily weighted towards inconvenience and normative skills hindering people's behaviour, and the availability of infrastructure is a prerequisite for waste management.

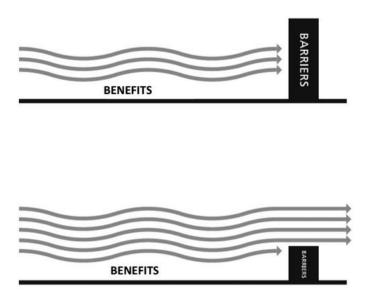


Figure 2.20 Diagram of the relationship between motivation and barriers, image source (McKenzie-Mohr and Schultz, 2014)

Social diffusion

This might be seen when your neighbour, acquaintance, or co-worker begins to adopt the behaviour and informs others about it on a social network (McKenzie-Mohr and Schultz, 2014). This is comparable to the transmission of social norms and is also connected to social capital. Social transmission is essential for the conduct to be apparent in society; for example, curbside recycling is a visible behaviour, while water and energy saving behaviours, which households generally do at home.

2.3.3. Find the Gap

In European countries and the United States, the theory of the Behaviour change wheel has been applied almost exclusively to medical treatments such as patients and health rehabilitation workers (French *et al.*, 2012; Barker, Atkins and de Lusignan, 2016; Smith *et al.*, 2020), but also to harmful behaviour change such as drug use and smoking (Fulton *et al.*, 2016; Vasiliou *et al.*, 2021). Michel and her colleagues (Susan Michie, Atkins and West, 2014) use hospital cases as examples throughout their book. McKenzie-Mohr and Smith (1999) employ the notion of community-based social marketing to examine the establishment of sustainable behaviour, and it has been shown to be beneficial for

recycling behaviour. Similar to the idea of planned behaviour, CBSM theory focuses on psychological elements such as attitudes and beliefs to assist behaviour change. Additionally, CBSM focuses on interacting with individuals and integrating a larger range of stakeholders in order to modify and adapt behaviour for a collective and collaborative impact (Domegan, 2021). The general population's behaviour is actively encouraged to change through the high level of public participation. Furthermore, CBSM integrates top-down and bottom-up stakeholders in a complex system (Flaherty *et al.*, 2020, P.162). From the preceding section 2.1.2.4, we may deduce that the type of community administration in China is top-down and that this rigid top-down method has a negative impact on the participation motivation of individuals. Few research has examined the use of CBSM in the Chinese contextual policy.

2.3.4. Conclusion

In this research, BCW and CBSM are integrated better to match the Chinese regulatory structure in its present state. This is due to the fact that garbage separation for recycling is a legal requirement in Beijing, China. Consequently, the behaviour change elements and methodologies analysed in this research are based on both BCW and CBSM theories, which comprise governance, social structure, and infrastructure design (Table 2.3).

Table 2.3 Research questions and TDF, COM-B and CBSM

Themes	Key words	TDF	COM-B	CBSM
	of sub-			
	research			
	questions			
Governance	Legislation	Reinforcement	Motivation ,	
			Opportunity	
	Incentive	Environmental	Opportunity	Incentive
		context and		
		resources		
Social structure	Social	Social influence	Opportunity	Social diffusion
	capital			
Infrastructure	Removing	Environmental	Opportunity	Removing
	barriers	context and	Capability	barriers —

Design of	resources	Capability	convenience
living	and		
space	Knowledge		

2.4. How it will fill the gap

Through this review, we discovered that the BCW framework and CBSM theory are directly related to behaviour change. There is a dearth of research on the application of BCW to pro-environmental behaviour, as well as little practical experience with the two theories in China. Furthermore, there is a gap in research on the application of the two theories together to pro-environmental behaviour, particularly recycling behaviour in Chinese residential communities. In the previously mentioned theories of behaviour change, such as the Theory of Planned Behaviour, Value-Belief-Norm Theory, and the CBSM and BCW frameworks, attitudes are the starting point and the corresponding regulation, legislation, etc. determined by changing people's attitudes and perspectives on the desired behaviour. This research, however, is an examination of the application of laws, regulations, infrastructure design and social capital. This research uses the concept that laws, regulations, infrastructure design and social capital are passed and changes in people's attitudes toward behaviour as a tool for evaluating the practical applicability of the theory and the interventions.

Filling Gaps:

First, to analyse the causes and obstacles that impact pro-environmental behaviour in a Chinese community under a top-down management system based on BCW and CBSM theory.

Second, BCW and CBSM are designed to drive the creation of policies and interventions. However, this thesis is founded on the concept that interventions for pro-environmental behaviour are known, and the literature review reveals the main components that may impact behaviour. And research and data analysis are used to validate the policies' applicability. This thesis is a practical application of theory to the theory that tests whether

these two theories and government interventions are relevant in the Chinese context and proposes strategies and models for promoting pro-environmental behaviour in different types of Chinese residential communities.

3. Methodology

3.1. Introduction

This chapter aims to familiarise readers with the research methods and related data collection methods adopted by the researcher. This chapter will also explain the research philosophy, processes, and strategies of the study, as well as the justifications for the methods adopted by the researcher. At the same time, data collection and analysis will also be discussed.

The research purpose of this thesis is to understand the interrelationship between sustainable communities and delivering pro-environment behaviours actions in China. The table below (Table 3.1) illustrates the research methods involved in the research questions of this thesis. To understand the status in China, obtaining valid data and information is the key to accurately investigating this research issue. Moreover, the methodology determines the results of any research. Therefore, choosing an appropriate research method and approach to conducting research effectively is the key to answering these questions and achieving the research goals.

Table 3.1 Themes, sub-questions and research methods

Themes	Research Question	Methods
	(sub-question)	
Governance	1 What roles do	
	legislation and	
	incentives play in	face to face
	delivering	survey questionnaire
	sustainable	online
	communities and	
	influencing human	
	behaviour?	

Social structure	2 Does social capital play a role in fostering sustainable behaviours in a community?	Social structure Questionnaire Face to face Online Face to face Online
Infrastructure	3 How does the design of living space/ neighbourhood influence sustainable behaviours of human?	Observation
	4 Could removing external barriers help people foster sustainable behaviours in a community?	Questionnaire

3.2. Overall statement of the research process-original plan and actual methods

The research topic and questions were clarified by studying and researching previous scholars' theories and perspectives on sustainable communities and changing people's pro-environmental behaviour. During the first phase of the research, a policy change happened to arise in Beijing, China, which is a good opportunity to research how to delivery pro-environmental behaviour. Thus, Beijing is selected as a case study place.

In accordance with the Beijing Municipal Government's 2019 legislative work plan, the Task Force for Revision of Regulations produced *the Amendment to the Beijing Municipal Regulations on Domestic Waste Management (Draft for Examination)* and made it

available for public comment (Zhou, 2019), and the decision to adopt the Beijing Domestic Waste Management Regulation at the 16th meeting of the Standing Committee of the 15th Beijing Municipal People's Congress on 25 November 2020, and to officially implement the new version of the regulation on 1 May 2020 (Wang, 2020), residents who fail to comply with the content of the regulations will face a fine of 50-200 RMB. Therefore, the researcher selected two representative study sites in Beijing, China, one in a Beijing Hutong community and the other in an ordinary Commercial residential community. As it was necessary to compare the changes in behaviour and attitudes of residents in the two communities before and after the implementation of the regulations, there were two pre- and post-site studies. Pre-fieldwork is before the implementation of the regulations and the other after 1 May 2020. The pre-study took place between 3 December 2019 and 15 December 2019, and this research was conducted through site observations, questionnaire distribution and interviews to collect data from both sites, and the study was actually carried out as planned. The Post-fieldwork is after the implementation of the separation regulation.

Then when the researcher returned to the UK, in January 2020, a virus called Covid-19 spread widely in China and on 23 January 2020, medical staff from all over China supported Wuhan as the city was sealed off to help treat Wuhan patients and contain the outbreak. Chinese cities were put on lockdown to protect the Chinese and other nationalities and on 26 March 2020, the Ministry of Foreign Affairs of the People's Republic of China also announced a moratorium on the entry of other foreign nationals (2020). During this period, Chinese residents had to stay at home to protect themselves, and only one person per household was allowed to go out each week to buy food and necessities. With the concerted efforts of everyone, China was unblocked in March 2020, except for Wuhan, which was also unblocked on 8 April of the same year. After lifting the seal, Chinese residents were required to wear masks at all times and to show a health code, which means they had not carried or been in contact with an infected person, to enter or leave all places. As the epidemic became globalised, the UK officially went into lockdown on 26 March 2020. Until then, the UK had been advised to wash their hands

regularly to ensure hygiene until the outbreak occurred in the UK, after which the government asked the nation to stay at home, reduce unnecessary outings and wear masks indoors. The first national closure then ended on 23 June 2020 but was followed by a second and third national closure. Until 1 May 2020, the UK was still under closure (The Institute for Government, 2021). Even though the closure was lifted at a later stage, there were still many procedures to travel between China and the UK, a 14-day quarantine and risk of Covid-19 infection, and until 2021 there were still a small number of tickets back to China and a mandatory quarantine of at least 28 days after entering Beijing.

Therefore, on 1 May 2020, when the researcher found out that it was impossible to return to Beijing to continue the fieldwork research, the researcher changed the research method from the original field research to online research, by sending links to questionnaires and online interviews via mobile phones to complete the mobile phone data process. Of course, there is Plan B as well. If the online mobile phone data was not enough, we would wait until the epidemic was over before returning to the site to collect data.

The figures below (Figure 3.1 and Figure 3.2) show the whole process of the study, including the preparation and timing of the pre-study, the timing of the study, the timing of the post-study change of plans, and the regulations and events in China and the UK at different stages during the outbreak.

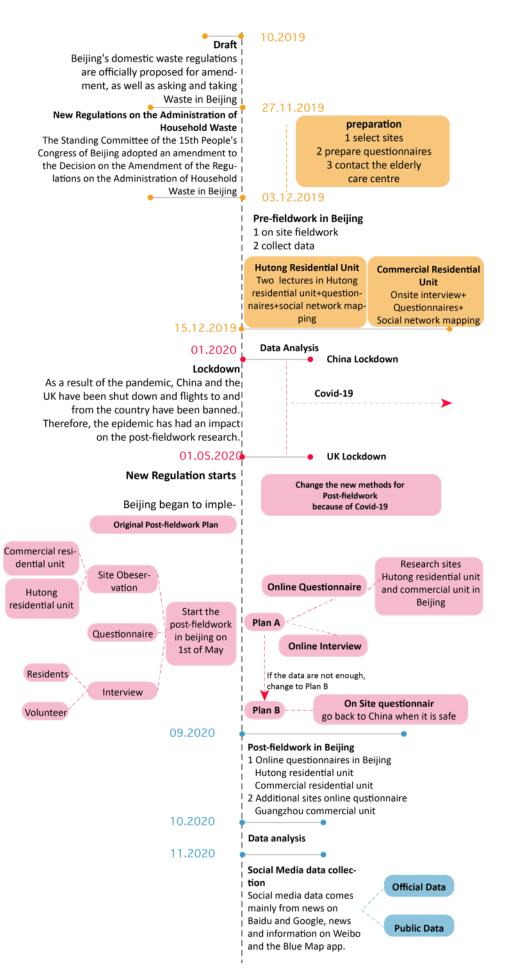


Figure 3.1 The whole project timeline 1

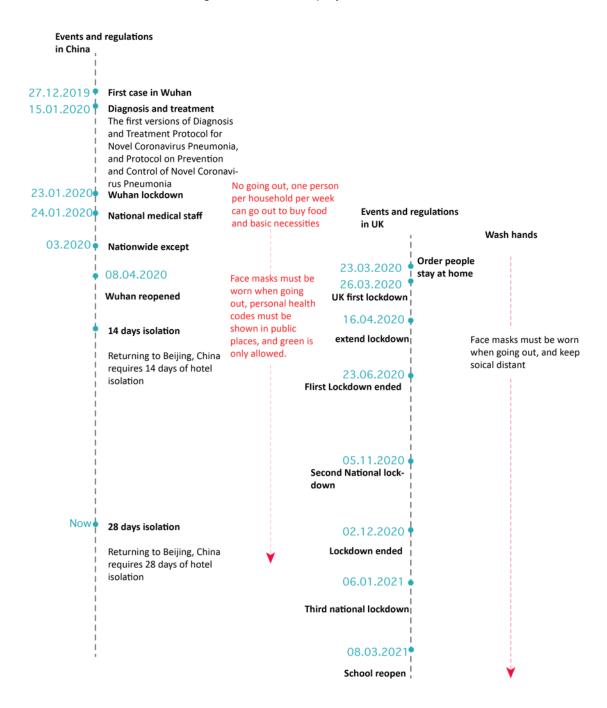


Figure 3.2 The whole project timeline 2

Once the case study has been defined, the study will be carried out according to the research question and sub - question. The case study will focus on three thematic areas, governance, social structure and infrastructure, and the appropriate data collection methods and data analysis methods will be chosen for each research question (Table 1 and Table 2). In the following sections, the choice of method and the contribution of each

of the different data to the study will be analysed in detail.

3.3. The research Process

The methodology for this study was based on the following steps (Figure 3.3), including a mixed approach to data collection.

Literature review and identify research gap

- Review of previous relevant work and areas and research to establish the framework and purpose of this research
- Find the gap of this research in China by studying the literature review and find the research direction

Site Selecion and Case study

- Select two distinctive units in Beijing as research sites for fieldwork, including pre- and post-research, site architectural forms, resident behaviour, infrastructure
- In addition to this, a case study of six units was added to the study in order to gain a deeper understanding of the effects of the implementation of waste separation regulations in Beijing and the changes in people's behaviour.

Original behaviour

- Collect original attitudes, behaviours, values and knowledge about pro-environmental behaviour and waste separation through observation, questionnaires and interviews.
- The data collected is analysed through excel and spss to establish the proportions of people's behaviour in the early stages and to facilitate comparison of the data in the later stages.

Behaviour after intervention and social media data collection and secondary analysis

- Collecting questionnaires and interviews on the behavioural changes of the residents after the publication of the legislation and their attitudes towards waste separation, in addition to understanding the state of social capital in the two units
- Social media data was collected to understand the real attitudes of people and the current status of waste segregation.
- Secondary data analysis using data from the Blue map App, and a case study of waste segregation in 6 communities

Figure 3.3 Research Process

3.3.1. The literature review identifies a research gap

The first part is based on a study and research of the relevant fields. After confirming the research question, a review of existing work and related research on pro-environmental behaviour, legislation, social capital, infrastructure, and the relationship between them was conducted. The theoretical foundation for this thesis is established by analysing and debating these studies and theories. In addition, the development of sustainable communities and the extent and current state of research are summarised and discussed, and the gap in research is identified, especially for the development of China. As sustainable development and pro-environmental behaviour have been studied in developed countries in Europe and the USA, the focus of this study is on whether the methods and approaches are equally applicable to China. Filling this gap will also contribute to broadening the field and the topic. This section is mainly described in detail in the previous literature review.

3.3.2. Case study and site selection

As this study focuses on China, two units representing different typical architectural forms currently existing in Beijing were chosen as the research site to ensure the rationality of the study. In each neighbourhood, observations, questionnaires and interviews were used to understand the built environment, interpersonal relationships, neighbourhood facilities, and pro-environmental behaviour of the residents of the two units. As the aim was to discover what could change people's pro-environmental behaviour, the research was divided into two parts, pre- and post-fieldwork (Figure 3.4), in order to draw changes in people's behaviour, attitudes, social capital and communities' infrastructure. To increase the real behaviour and perceptions of people after the adoption of the regulations, six case studies of Commercial residential units in Beijing were added in the post-fieldwork of the research.

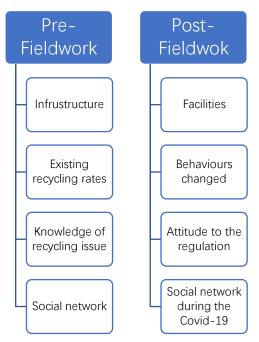


Figure 3.4 Pre-and Post-fieldwork aims

3.3.3. Behaviour after intervention and social media data collection and secondary data analysis

The original plan for the entire research process is discussed in section 3.2, as well as the process of altering the post-fieldwork data collection techniques due to the covid pandemic. This section would describe the post-fieldwork design process.

Following the introduction of mandatory waste segregation regulations in Beijing, post-survey research began. The questionnaire was improved for the post-implementation period by retaining some of the same questions to compare pre-and post-implementation data, as well as adding questions on perceptions of the new regulations and on neighbourhood and community activities during the Covid-19 outbreak. The questionnaires were also used to collect data in the latter stages of the research. However, due to the epidemic, it was impossible to return to the research site to distribute the questionnaires in person. Therefore, it was possible to switch to an online questionnaire. Interviews were also conducted online. The latter interviews focused on the changing attitudes of the respondents towards waste segregation, the segregation they saw in their

neighbourhoods and the neighbourhood situation during the epidemic.

As the main method of the post fieldwork is through information on the internet, news and data were obtained by browsing the web and searching for relevant information and communicating with interviewees. Over the last few decades, people have witnessed the growth of online information, and online communication, and as of 2019, the number of internet users worldwide has exceeded 4.3 billion, a figure that is 1114% higher than in 2000 (Sujata *et al.*, 2019). Therefore, in the post-fieldwork of the research, social media data collection is added to the research methodology. The researcher searched for official news sources versus private postings by browsing the web as well as Weibo (the Chinese version of Twitter), to compare the data collected and understand the difference between official information and personal attitudes and ideas on the internet. When we opened the Weibo page (Figure 3.5) and entered the keyword 'Beijing waste separation' in mandarin into the search field, we got netizens' opinions on the topic and uploaded photos of the actual situation. We collected data from April 2020 to May 2021, a year-long period of posts from Beijing residents.



Figure 3.5 Weibo Page Topic Setting

Secondary analysis is the best-known method of statistical analysis through data that already exists (Heaton, 2004). Secondary analysis can be conducted on quantitative data and qualitative data. The pre-existing data used for quantitative secondary analysis comes from a variety of activities, including research projects carried out by academics, government agencies and business groups, as well as the administrative work of public authorities and other organisations that often keep records for management purposes (Heaton, 2004). In qualitative studies, secondary analyses include the use of data from pre-existing data and through different methods were used to analyse 'unnatural' data solicited by the researchers, as well as 'natural' data 'discovered' or collected by the researchers and structured to a minimum (Heaton, 2004). In qualitative analysis, the data comes from previous research, for example, collected through field notes, observation notes, interviews, focus group recordings, and transcripts. Mass observation (Sheridan, 2000), for example, is a typical example in which researchers have used a variety of naturalistic data, such as interview and observation reports, timelines and diaries, and primary documents, and these data are used as evidence for historical research in a variety of disciplines, including sociology, anthropology, and psychology. Secondary analysis was used as one of the main methods of analysis because, at a post-stage of the research, due to the pandemic, the current situation of waste separation in six Beijing Commercial units collected by other research institutions and interviews were used as a source of data for secondary analysis. The secondary data used in this thesis includes basic information about the six units, including location, building form, information and photographs of the infrastructure in the community, and interviews with community volunteers and supervisors. Conclusions and suggestions may be derived by compiling this data and concentrating on comparing the attitudes and behaviours of the supervisors of the six units and linking them to the behaviour of the community inhabitants. This is something that was not analysed and covered by the original data.

3.4. Choice of methods and philosophy

This study was conducted using a mixed method, which is a combination of qualitative and quantitative research (Keith F., 2014, P. 312). The reason for choosing a mixed method is that this research is a long-term observational process and combines theory and practice. Therefore, the data is a combination of qualitative and quantitative data supporting each other, and it is necessary to find methods that suit both types of data. Das (1983, P. 309), points out that qualitative and quantitative methodologies are not opposing or divergent, rather they focus on different latitudes of the same problem. Johndon and Onwuegbuzie (2004, P. 20) also suggest that synthesising the two methods can achieve both complementary strengths and be non-overlapping. Although some scholars (Eisenhardt, 1989, P. 546; Miles and Huberman, 1994, P. 5; Yin, 1994, P. 363) advocate the use of a single methodology, there are certain limitations, such as time constraints and the need to limit the scope of the study. Qualitative methods collect data such as observations and perceptions that can help the researcher to develop a comprehensive picture of the investigation, including the architectural forms, and neighbourhoods in both communities. Data collected by quantitative methods can complement the qualitative data and be analysed by statistically analysing data to obtain the proportion of residents in the two neighbourhoods who treat different situations as choices. Therefore, in this study, we use a mixed methods approach, where both methods complement each other's weaknesses.

Quantitative research methods are mainly used to obtain data through questionnaires, and the questionnaires reside in a predetermined way to measure the attitudes and behaviours of participants towards a topic or phenomenon (Bowling and Ebrahim, 2005; Bilgin, 2017). Qualitative methods often collect data based on participants' own categories of meaning and can provide an understanding and description of participants' own experiences(Burke Johnson and Onwuegbuzie, 2004). However, this research is to understand the internal factors that affect sustainable development in the community through changes in people's behaviour and changes in people's attitudes. The research

questions and sub-questions raised in the introduction approach different aspects of this research. Sub-questions address research questions on three themes of governance, social structure and infrastructure design. Sub-question one (Table 3.1) asks, 'What role do legislation and incentives play in delivering sustainable communities and influencing human behaviour' and is addressed through quantitative methods, using pre- and post-questionnaires. Sub-question two, 'Does social capital foster sustainable behaviours in a community?' is addressed by a mixed method which is interview and questionnaire, and sub-question three, 'How do the design of living space and neighbourhood influence sustainable behaviours?' is addressed through observation. Sub-question four, 'Could the removal of external barriers help people foster sustainable behaviours in a community?' is addressed through observation and questionnaire. Although some open questions will be interviewed among the participants during the survey, the interviewer will be given predefined options to answer. The relationship between research methods and sub-research questions is shown in Table 3.1.

This research is mainly based on the changes in residents' behaviours in two different community structure forms in response to changes in waste disposal regulations and systems, to use data to understand the internal factors and residents' behaviour that affect the sustainability of communities and to evaluate the efficacy of the interventions used. Therefore, this research will follow the research philosophy of realism. This is because realism is a strategy that synthesises evidence, is a theory-driven approach (Dalkin *et al.*, 2018; Palm and Hochmuth, 2020) and focuses on explaining why interventions work or do not work, under what conditions, and for whom (Rycroft-Malone *et al.*, 2012; Graham and McAleer, 2018). The realist approach is also known as realist synthesis (Mehdipanah *et al.*, 2018) and the main strength of this approach is explaining how and why context affects results (Price *et al.*, 2021).

Realism exists for a balance between positivism and interpretivism. Even though positivism and interpretivism are the prevalent approach to academic research, their antagonistic character, lack of causal explanation, and conceptual impoverishment have

led to the development of realist methodology that neither rejects nor accepts positivism and interpretivism (Dalkin *et al.*, 2018). This thesis examines the consequences of interventions in two communities, where the same interventions in different contexts may have varying outcomes. Therefore, assessing whether interventions are effective or not in using traditional methodology usually leads to limited answers (Rycroft-Malone *et al.*, 2012). Currently, realist methodology is used in medicine (Palm and Hochmuth, 2020; Price *et al.*, 2021), environmental and health research (Jones, Cunsolo and Harper, 2018), and urban renewal (Mehdipanah *et al.*, 2018). Nevertheless, other academics claim that realism lacks empirical moments, interpretative moments, and language-shaped moments (Price and Martin, 2018). However, it appears that only the realism method is relevant for evaluating intervention methods. It is the context, mechanisms and outcomes of research in the real world, through the sensory, brain and cultural processing (Graham and McAleer, 2018).

This study aims to identify and evaluate the relationship between government, social structure and infrastructure design and people's behaviour. Moreover, this study concludes that to understand people's experience of different situations, such as regulations, infrastructure, and the researchers should avoid interference that might affect the activities and behaviours of participants. And this thesis combines the experiences and perceptions of people in different communities with quantitative data analysis to evaluate the effectiveness of the intervention. Hence, the realism methodology is suitable for this study.

3.4.1. Observation

Observation is a very straightforward and convenient method for the community infrastructure and availability and usage of facilities. For many years, observing the behaviour of participants has always been an essential method of sociological research. Marshall and Rossm (2016) consider observations as the systematic description of events, behaviours, and artefacts in the social setting chosen for the study. De Munck and Sobo

(1998, P. 43) argue that observation is the primary method used by people for field research. It is a process by which researchers can observe the daily behaviour of the observed person in the natural environment. Other researchers (Schensul, Schensul and LeCompte, 1999) define observation as the process of learning through exposure to or involvement in the day-to-day or routine activities of participants in the researcher setting, and the aim of observation as a method for research design is at a comprehensive understanding of the phenomena in the study, taking into account the limitations of the method (DeWalt and DeWalt, 2002, P. 1). In order to be as objective and accurate as possible, they suggest enhancing validity through observation, so that the study results can assist the researcher in gaining a better understanding of the context and phenomena under investigation. The method of observation covers both participatory and nonparticipatory methods (Busetto, Wick and Gumbinger, 2020). Participant observation is a kind of long-term observation in which the observer is a part of the observed and participates in the practical activity. The purpose of participant observation is to discover and experience the social life and social process in a given setting (Emerson, Fretz and Shaw, 2012). During non-participant observation, the observer is present in the situation but does not affect the observed's behaviour in any way. Although both approaches have the potential for people's behaviour to alter when they realise they are being observed (Hammersley, 2015), this phenomenon is possible with any method. Due to the fact that this research project is based on a study of behavioural and attitude changes toward waste segregation in a residential community in China, the elements impacting behavioural change investigated in this thesis include legislation, social capital, and infrastructure design. Consequently, the thesis blends participant and nonparticipant observation methodologies, which is a realistic approach to comprehending people's lives without influencing their behaviour. And it is a more practical method to obtain primary data.

Observation is a very time-consuming method that requires prior preparation and requires the researcher to visit the site where the event is taking place (Queirós, Faria and Almeida, 2017); in addition, the use of observation is also limited temporally, as certain

events have a time limit after which they will not happen again, the pre-fieldwork for this research involved the researcher visiting the study site in advance and observing for a period of one week, observing people's daily behaviour and the characteristics of the built form of the site and record it by photographs and notes.

Fieldwork data——observation method

The observation method was used in both the pre- and post-fieldwork. In the pre-fieldwork, at the very beginning of the study before the waste separation regulation started, and in the post-fieldwork, the observation method was used to observe the infrastructure of the site, the behaviour of people after the implementation of the waste separation regulations and the neighbourhood relationship in the research sites. During the research process, observations are collected by taking photographs, videos and written notes. The data collected provides a dynamic reflection on the legislation, neighbourhoods relationship and the architectural fabric of the two communities.

The selection of suitable sites for fieldwork is necessary to investigate whether regulations, social networks, building design forms and urban design promote and change people's pro-environmental behaviour sustainably. The fieldwork was carried out by observing the architectural form, infrastructure, and communication between the residents of the two sites. The preliminary site research is done by the researcher, and the post site research is helped by other volunteers who took photographs of the sites and secondary data to build up the data and provide data for analysis. When using the observation method, the observer tried to observe people's behaviour from a distance in case they change their behaviour as a result, in addition to observing people's behaviour and the built environment without affecting or harming people or the environment.

3.4.2. Questionnaires

Questionnaires are a way to obtain information on a specific range of issues from people (Gillham, 2000, P. 21). Questionnaires are used as data collection tools for many types of

survey objectives, including identifying opinions and attitudes, identifying interests and experiences, and conducting needs assessments (Thomas, 2004, P. 108). Collecting data using questionnaires can investigate the ideas and thoughts of a wide range of participants and collect various perspectives to ensure that many people are heard. Besides, using a questionnaire can understand the support level for a project or action (Thomas, 2004). Therefore, this study will use survey questionnaires to collect data on existing recycling rates and residents' knowledge of recycling issues and support for recycling as a sustainable behaviour.

The approach to sampling

In the preliminary research, information about the waste sorting lecture was posted in the Hutong residential community to a WeChat group containing 222 residents of the community. 95 of them signed up for the seminar and questionnaires were distributed to each person and collected after the lecture. Questionnaires with more than 40% of the content missing were considered invalid and deleted, resulting in 71 valid questionnaires. In the commercial residential unit, the questionnaires were filled in randomly in the community and were collected directly after being filled in on the spot or being interviewed. The number of valid questionnaires obtained in this way was 21. In addition, the questionnaires were distributed to people who work at Tsinghua Tongheng Planning and live in Qinghe New Town. A total of 41 valid questionnaires were collected, making a total of 62 valid questionnaires for the commercial residential unit.

In the post-fieldwork, the questionnaire was changed to an online questionnaire due to Covid. The questionnaires were distributed to the WeChat group of the Hutong residential unit and 222 local residents in the group randomly filled in the questionnaires. 82 valid questionnaires were returned. In the commercial residential unit, the questionnaire was snowballed to friends living in the unit and distributed to neighbours or colleagues living in the neighbourhood. A total of 19 valid questionnaires were collected.

Survey data——face to face questionnaire method in the pre fieldwork

The Face-to-face questionnaire was used in the pre- fieldwork and took place after the two waste sorting lectures held in December 2019. The Online questionnaire was the research method used in the post- fieldwork and took place in September 2020. The questionnaire was designed based on the three themes of this study, Governance, Social structure, and infrastructure. The aim was to discover what factors are inherent in changing people's pro-environmental behaviour. The households in the research sites that will be doing the questionnaires.

In the preliminary questionnaire, questions were added in to understand people's knowledge of waste separation. In addition, to find the social network of the participants in the two units, the researcher prepared layout maps of the two units to facilitate the participants to map out the location of the neighbourhoods where they have good relationships.

Online questionnaire method in the post-fieldwork

In the later stages of the questionnaire, to find changes in the behaviour of the participants, we kept some of the original questions, but also added questions about infrastructure provision and volunteers, as well as the participant's participation in waste separation. In addition, due to the Covid-19 outbreak, we also added questions on neighbourhood relations and community care during the pandemic to reflect whether the social network had changed in such a difficult situation.

In the later stage of the study, the time of the pandemic was at its peak. Therefore, the questionnaire was changed from a paper-based questionnaire to an online questionnaire. The impact of covid on data collection methods has led to a shift from face-to-face to online questionnaires. There is a corresponding impact on the amount of data available, as people's focus at this time is on disease prevention and may not actively participate in online questionnaires. Therefore, the way in which the online questionnaires are distributed will differ between the two residential community sites.

The questionnaire was uploaded via the web questionnaire star, and the link to the web page where the questionnaire was generated was saved. There was a WeChat group in the Hutong residential unit, and the link to the questionnaire was distributed with the permission of the WeChat group administrator. However, there is no similar WeChat group in the Commercial residential area. Thus, the questionnaire was distributed by finding other volunteers to have their neighbours and colleagues living in the area fill in the questionnaire.

Before using this method, the researcher took into account the different age distributions of the two units; therefore, in the Hutong residential unit, the activity was announced through the elderly care station manager, as the researcher considered the personal safety and financial security of the elderly. Thus, the activity was carried out in a more familiar environment and with a group of residents. In the Commercial residential unit, the questionnaire was chosen to be conducted in the public open space of the district as people are young and middle-aged and have their own judgement of information. In the later stages of the research, as the research method was changed to an online questionnaire, the Hutong residential unit continued to choose to post the questionnaire through the station manager of the elderly station. Before sending the questionnaire link, we asked the station manager to review the questionnaire's content for any sensitive topics related to the elderly or links suspected of being financial scams. The online questionnaire in the Commercial unit was distributed to colleagues and neighbours living in the same unit through the people who live in the same area. The ethical implications would be discussed in Section 3.8.

3.4.3. Interview

Interviews are an established method for generating the rich, in-depth data this research sought to produce (Mason, 2002; Kvale, 2016). Interview is a conversation with a purpose (Burgess, 2003, P. 164) or a professional conversation (Kvale and Brinkmann, 2009)

between a researcher and a participant. Data generated can be regarded as either excavated – that is, 'pre-existing' data that can be uncovered from an external reality – or constructed, produced in the shared interactions of the participant and researcher, just one of many potential realities (Mason, 2002; Kvale and Brinkmann, 2009). Interview participants were understood as agents with the capability for reflexivity regarding their personal experiences and interpretations of these, and they could present themselves in their own manner and at their own speed (Jamshed, 2014), which may, in turn, be influenced by external, structural factors beyond their awareness or control. Therefore, they had the potential to consciously examine pre-existing experiences and ideas that they brought to the interview situation and alter these in response to it. Creswell (1994) believes that interviews can provide a comprehensive and in-depth understanding of people's perspectives, and interviewers will discuss other personal ideas and perspectives based on the problem. Thus, for social capital, in addition to the statistical data of the questionnaire, it is also necessary to understand the neighbourhood relationship of people in the residential area through a face-to-face interview.

Interview data from the fieldwork

The face-to-face interview was mainly used in the pre-fieldwork, which took place after the two lectures in December 2019. Online interview was used in the post-fieldwork, which took place at different stages after the implementation of the waste separation regulations in Beijing. These include June 2020, one month after the implementation of the waste regulations, November 2020, six months after the implementation of the waste regulations and May 2021, one year after the implementation of the waste regulations.

The approach to sampling

The interviews were used to gain a more in-depth understanding of residents' views on waste separation regulations, changes in residents' behaviour, and their feelings about the community environment. After the use of the questionnaire method mentioned in 3.4.2, four respondents were randomly selected in each of the two sites. Their contact details were kept as well as adding them to WeChat and interviewing them about the

content. Table 3.2 shows the interviewers basic information, the more interview results would be presented and discussed in results section. The ethical implications would be discussed in Section 3.8.

Table 3.2 Interviewers information

Research site		Gender	Age group	Basic information
Hutong	Interviewee	male	35-44	The station manager of the Hutong
residential unit	NO. 1			elderly Station lives in Beijing all
				year round and is very familiar with
				the neighbourhoods in the Hutong
				community. Beijing citizen.
	Interviewee	female	>55	A resident of the Hutong, who has
	NO. 2			lived here for decades. She is a
				Beijing citizen.
	Interviewee	male	>55	A local resident in this community.
	NO. 3			He is retired.
	Interviewee	female	>55	A local resident in this community.
	NO. 4			She is retired.
Commercial	Interviewee	Male	25-34	He has been working in Beijing for
residential unit	NO. 1			three years and currently lives in a
				Commercial, residential area close
				to his workplace. He is not a local
				Beijing citizen, a tenant in this
				Commercial residential unit,
				sharing a flat with several other
				people who are also non-Beijing
				citizens
	Interviewee	female	25-34	Having just moved from another
	NO. 2			residential neighbourhood
				because it is closer to her
				workplace and near the metro
				station. She is not a Beijing citizen.
	Interviewee	female	25-34	She has been working in Beijing for
	NO. 3			four years and lives in a
				Commercial residential unit, three
				metro stops from her workplace
	Interviewee	female	25-34	She has been working in Beijing for
	NO. 4			four years and currently lives in a
				Commercial residential unit

3.4.3.1. Face-to-face interview

The Interview is a follow-up format and is also divided into two parts based on the pre and post-research. The purpose of the interview is to enrich the data collected by the questionnaire and the observation method and to help the researcher to give a complete picture of the changes in the situation before and after a period. The duration of the interviews varied from one interview to the next because of the different formats.

The pre-interviews mainly involved four interviewees, two of whom were residents from the Hutong residential unit, and the other two interviewees were residents from the Commercial residential unit. The pre-interviews are conducted face-to-face, and after the volunteers have filled in the questionnaires, they are interviewed for 10 minutes or less, focusing on the current views on waste separation and environmental protection, as well as on facilities and neighbourhood relations.

3.4.3.2. Online interview

Due to the impact of the epidemic, the researcher was unable to obtain detailed information about the actual situation of the residents and their thoughts. Therefore, in the post fieldwork of the research, an online interview was added to the research methodology, with four interviewees who are tenants and residents living in Commercial residential areas in Beijing. The interviews were happened after the regulation started one month (06/2020), half year (11/2020) and one year (06/2021). All four Commercial residential unit interviewees are aged between 25-30 years old and have been working in Beijing for 3-4 years, and none of the four interviewees is a local citizen in Beijing. The online interview is a question-and-answer format via the WeChat app. The main content of the interview was as follows: (1) Whether your Commercial residential unit currently separates waste. (2) Whether the sorting infrastructure in your commercial residential unit is equipped. (3) How do other residents in your Commercial residential unit separate waste? (4) Whether there are supervisors or volunteers in your Commercial residential unit. (5) How do you feel about the act of separating waste?

When using the interview method, the researcher explained the purpose of the study and how the data would be used in advance and ensured that no personal information about the interviewees would be disclosed and that they would not be subjected to any physical or psychological harm. Therefore, the names of the interviewees are not mentioned in the results section. Different codes would refer to the interviewees, for example, Hutong interviewee No. 1 and Commercial interviewee No. 1. The ethical implications would be discussed in Section 3.8.

3.4.4. Social media data collection in the post-fieldwork

The collection of social media data takes place in post-fieldwork and six months after the implementation of the waste separation regulations, which is in November 2020.

Social media data comes mainly from news on Baidu and Google, news and information on Weibo and the Blue Map 6.5.11 app for iPhone (Figure 3.6). The Blue Map app was designed by the Institute of Public and Environmental Affairs (IPE), a public interest environmental research institute registered in Beijing. The app is a database that collects information about the environment. People take photos of environmental issues in their daily lives and upload them to the relevant topic in Blue Map, where the uploader can locate the images to create a map. As a result of the mandatory waste separation legislation, Blue Maps launched a photo campaign where people could take photos of the waste separation in their neighbourhoods and rate and grade the current situation.

The approach to sampling

The data collected from social media is divided into two parts, one is official news and messages posted by official accounts and the another is personal messages posted by private accounts. Recorded official news and messages from before the implementation of mandatory waste sorting in Beijing, from November 2019 to November 2020, and personal account messages recorded from April 2020 to November 2020. The search

terms for social media were Beijing waste classification, and relevant content was collected for this period, in which advertising content was removed. A total of 62 valid data were collected.

When processing comments on social media, the content collected is stored in NVivo and scaled for analysis, and some of the comments are translated into English, but the user ID is not included in the analysis. The ethical implications would be discussed in Section 3.8.

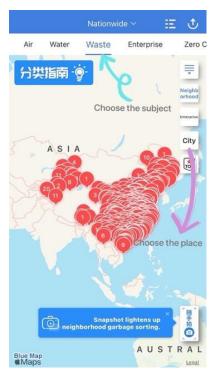


Figure 3.6 Blue Map App Setting

Blue Map App Data

By locating the Blue map in Beijing, China, and selecting the theme of waste, we will find photos of different locations of rubbish collection through the App by citizens. "To participate in the project, simply scan the Alipay QR code" Blue Calendar" app or download the Blue Map App (Figure 3.7) and follow the three steps below to take part in the community waste sorting survey.

- 1. Open the app or download the map and find "Waste Separation".
- 2. Find your community's rubbish bin

3. Fill in the questionnaire and take a photo to upload your sorting status



Figure 3.7 Blue map app QR code

The first part of the questionnaire (Figure 3.8) is a required question: Is food waste in our community basically disposed of in food waste bins?

The rest of the questions are optional: whether there are plastic bags in the food waste bins, the hygiene situation around the containers, whether there is a waste segregation supervisor in the neighbourhood, whether there is a knowledge board on the distribution of the various types of waste, whether there is a collection point for harmful waste, how recyclables are collected, and how the public bins are arranged in the neighbourhood.

In addition, the separation of food waste is the most direct indicator of the effectiveness of the sorting process, as it may pave the way for composting and return to the land, whereas the absence of separation may have an impact on other disposal methods; observers can enhance the resident's understanding of the sorting process, and a map of the location of the bins reveals the community's infrastructure. These are also the concerns of this thesis regarding the formation of pro-environmental behaviour.

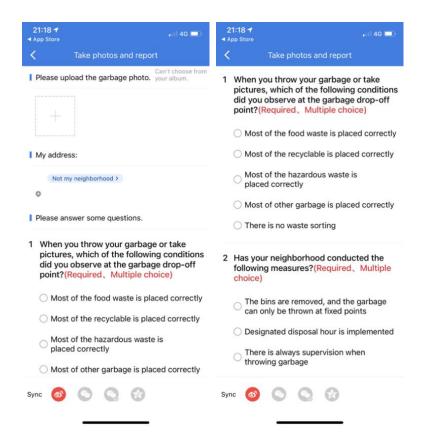


Figure 3.8 Submit a report through the Bule map app

After taking a photo and uploading it, this bin sorting observation is displayed on the Blue Map App. Based on the judgement of most users over the course of 6 months, the following are marked in green, red and yellow (Figure 3.9 and Figure 3.10).

- Food waste is put out separately from other types of waste, marked in green.
- Food waste not separated from other types of waste, marked red.
- Food waste not broken into bags, or relying mainly on secondary sorting, marked in yellow.

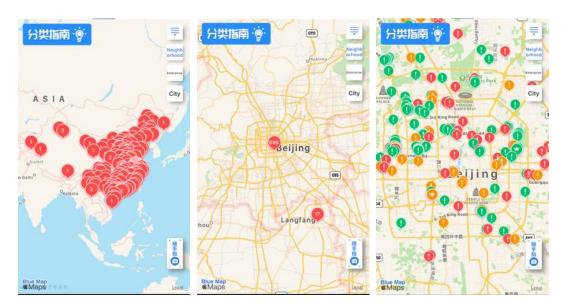


Figure 3.9 Locate the specified city on the Blue Map



Figure 3.10 Images uploaded to the Blue map by netizens

Since the researcher is a native Mandarin speaker, the data collected from the fieldwork and within the research process were translated by author.

3.4.5. Case study

Most academic scholars engaged in qualitative research employ the case study approach

as a strategy (Rashid *et al.*, 2019, P.1). Compared to other qualitative research methods, a case study is a thorough analysis and description of a single system or unit that is limited in both time and place (Hancock, Algozzine and Lim, 2021, P. 9). In this study, a case study approach was used to examine the uniqueness of different building forms in China during different periods of time, to clearly demonstrate the different forms of Chinese settlements and the impact on social capital. In addition, because of Covid, action was restricted. Thus, six other communities Beijing from Blue Map App were selected in post-fieldwork to study the impact of changes in pro-environmental behaviour, infrastructure and volunteerism on the behaviour of residents after the implementation of waste separation regulations. In the Blue map app, these six communities are only described in terms of basic information and some superficial aspects of residents' attitudes towards waste separation, but they are not linked to infrastructure, attitudes of residents, or attitudes of volunteers. These six communities were therefore selected for case studies and secondary data analysis. The selection detail of the six additional communities and secondary data analytical method for the case study will be presented in section 3.7.4.

3.5. Research site

This section describes the study sites' selection and the detailed architectural styles and locations of the two areas. The sites were chosen as this study was conducted in China (Figure 3.11), and as Beijing will have mandatory waste separation regulations by 1 May 2020, the sites were located in Beijing. There are two types of representative residential areas in Beijing, one is the historic Hutong residential unit, and the other is the Commercial residential unit. Therefore, these two types of neighbourhoods were chosen for this study (Figure 3.12).

Beijing was chosen as the city of study for two reasons, firstly, as mentioned above, the mandatory implementation of waste separation legislation was implemented in Beijing, so that changes in people's behaviour before and after the legislation could be compared;

secondly, as the capital of China and a first-tier city in China, Beijing can ensure that infrastructure is equipped, personnel management and publicity related knowledge is widespread, so that other cities in China can easily learn from it. As an ancient city with a long history in China, the city's residential areas contain a combination of ancient and modern, Hutong residential unit form and Commercial residential unit form, which are also found in other Chinese cities.



Figure 3.11 Map of China and the research city (Cartography: author)

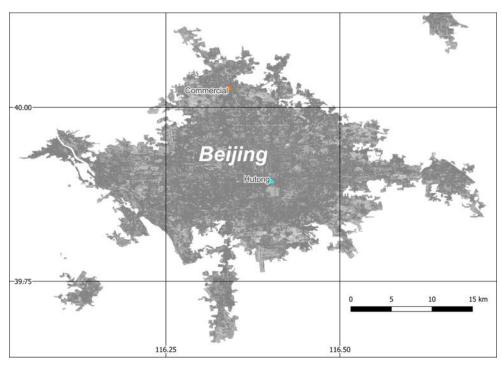


Figure 3.12 Two research sites in Beijing (Cartography: author)

3.5.1. Hutong residential unit introduction

The Caochang Hutong unit (Figure 3.13), the site selected for this study, is located in the northwestern part of Beijing's Dongcheng District, in the Chongwen District, close to Beijing's Qianmen. It extends from West Xinglong Street in the north to East Zhushikou North Road in the south and from North Luchaoyuan Hutong in the west to Xuejiawan Hutong in the east. Although Caochang Hutong is close to the other two Hutong residential units, and all are located in the city centre, Caochang Hutong is one of the Hutong units that the Beijing government has focused on renovating. There are ten alleys in Caochang, and as they are relatively large, the Hutong alleys between Caochang Santiao Alley (3rd Alley) and Caochang Shitiao Alley (10th Alley) were chosen for the study, which have over 900 households (Ying Li, 2019).



Figure 3.13 Map of the Caochang Hutong residential unit (Map resource: Google Map data ©2023, Cartography: author)

Hutong units are the best-preserved group of historical buildings in Beijing and have survived the storms of the city, and they are a symbol of the life of the old Beijingers and a reflection of the city's ancient culture. This is not present in any other city or country. In 2009, Caochang Santiao Alley to Shitiao Alley, as a dense north-south Hutong alley in the old part of Beijing, was listed as one of the 25 historical and cultural reserves in the old city of Beijing. There are 17 alleys covering an approximate area of 16 hectares and a total length of about 3,500 metres (Tian, 2018).

Starting from March 2017, the environment of these 17 alleyways in the Caochang area of Beijing has been upgraded by the construction team of Beijing City Construction Group. After the renovation, Caochang Hutong has truly returned to the hutong style of the late Qing Dynasty and Republican period, allowing people to experience the cultural atmosphere of Beijing. After having been consulted by the residents, Caochang Sitiao Alley (4th Alley), Wutiao Alley (5th Alley) and Liutiao Alley (6th Alley) are covered with granite, while Qitiao (7th Alley), Batiao Alley (8th Alley) and Jiutiao Alley (9th Alley) are paved with modern new stone tiles, which are perfect for the elderly to walk on. The environmental

improvement and landscape enhancement of the entire neighbourhood can be seen as a direct result of the changes. In addition to these changes, in recent years, the Caochang unit has also seen many more activities for the elderly, which continue to improve the well-being of the residents of Caochang, who are educated while participating in the activities, enhancing the sense of belonging and cohesion in the community (Tian, 2018).

3.5.2. Commercial residential unit introduction

Qinghe New Town (Figure 3.14) is the second research site, a Commercial residential unit with a combination of tower and slab building types. Qinghe New Town is developed and marketed by Beijing Qiyou Real Estate Development Company. It is located at the intersection of the Badaling Expressway and the North 5th Ring Road Qinghe, at the northwest corner of the Shangqing Bridge, bordered by the west side of the Badaling Expressway side road to the east, the north bank of the Qinghe River to the south, the Social Welfare Institute to the west and the Qinghe North Road to the north. There is a metro station and 47 bus stops within 2km of this unit, which makes it very convenient for transportation. In addition to transport, there are 60 kindergartens and 21 primary schools within 3km, and the world-famous universities Tsinghua University which is 5 km away and Peking University which is 8 km away to the Qinghe New Town. There are also hospitals and leisure and shopping venues in the vicinity of Qinghe New Town.

In addition to the rich infrastructure in the surrounding area, Qinghe New Town is also adjacent to Tsinghua Tongheng Planning and Design Institute Co, which is only 2 minutes' walk away from the Qinghe New Town. Tsinghua Tongheng Planning and Design Institute is a wholly owned state-owned enterprise under Tsinghua University, which is mainly engaged in urban research, urban and rural planning and design consultation, and research and development of engineering technologies for the human living environment. Tsinghua Tongheng is one of the most famous design companies in China and, therefore, one of the places that many students studying urban planning, urban design and architectural design will choose to work. Due to the excellent location of Qinghe New

Town, many people who work or intern at Tsinghua Tongheng choose to rent this commercial unit.

Qinghe New Town was established in 2007 and is a relatively new residential area. There are 21 buildings in this unit, and it covers 23 hectares of land, in order to be close to the area of the Hutong residential unit study, therefore Qinghe New Town buildings from number 5 to number 21 were used as the study area for the Commercial residential unit which has estimate 1956 households. There are around 115 apartments in each building, and each building contains three types of flats: one, two and three bedrooms, ranging in size from 26 square metres to 140 square metres, depending on the type of flat.



Figure 3.14 Map of the Qinghe New Town Commercial residential unit (Map resource: Google Map data ©2023, Cartography: author)

3.6. Fieldwork data collecting Process

This section would provide the process of the pre-and post-fieldwork process in detail,

as well as the methods used in the processes. The Table 3.3 summarises the study sites, the research methods used, the time of data collection and the sample size.

Table 3.3 The summary of the research data information

	Location	Sample	Work status	number	Methods	participants	Time
		size					
	Hutong	71	Retired and	69	Observation	Two sites	Before the
	(Caochang		unemployed				mandatory
Pre-	Hutong		Employed	1			separation
fieldwork	unit)		Didn't	1			regelation
			answer				(12/2019)
	Commercial		Retired and	12	Face to face	71	
	(Qinghe	62	unemployed		questionnaire		
	New Town)		Employed	50	Face to face	4 Hutong	
					interview	residents	
			Didn't	0		4	
			answer			Commercial	
						residents	
	Hutong	82	Retired and	56	Observation	Two sites	After the
	(Caochang		unemployed				mandatory
	Hutong		Employed	21			separation
Post-	unit)		Didn't	5			regelation
fieldwork			answer				(05/2020-
(Online)		19	Employed		Online	82	06/2021)
	Commercial		19		questionnaire		
	(Qinghe				Online	4 Hutong	
	New Town)				interview	residents	
					(WeChat)	4	
						Commercial	

			residents	
		Social media	62	
		data		
		Case study	6	

3.6.1. Pre-fieldwork data collecting process

The previous survey took place in December 2019, a three-week survey, which is, before May 1, 2020, the release of Beijing's mandatory waste classification regulations. The main purpose of this observation is to compare whether there were changes in the recycling facilities, such as sorting bins, between the two communities before and after the regulations were issued. Besides, observe people's garbage classification behaviour before and after.

The primary purpose of the questionnaire was to understand the current situation of garbage recycling in the two communities and the extent to which people understand the problem of garbage recycling. Therefore, there were three parts to this questionnaire: the first part was information about individuals, the second part was the level of knowledge and participation in garbage collection, and the third part was a community plan (which is for social capital and interview). In the Hutong residential unit, self-completed questionnaires were used as the primary method to collect data. However, the premise is that the investigator contacted the community's elderly care centre in advance, organised two lectures on waste separation and recycling, and released the lecture information to the community WeChat group.

The Caochang residential community Elderly Care Centre operated in 2018, with services radiating to nearly 2,000 elderly people in the surrounding area. The station is not only a place for the elderly to move around and provide services such as cleaning, bathing, and meal assistance to the elderly in the community, but also conducts rounds and visits (Wang, 2020). During the covid epidemic, the staffs at the station made daily enquiries

on Wechat group and provided assistance with medicines and food orders.

By using the lectures way, the participant's personal information and the participants were obtained. In total, 71 people registered to participate in the event and divided participants into two morning and afternoon events (Figure 3.15 and Figure 3.16). Each lecture was about 50 minutes, and most participants filled out a questionnaire after the lecture. The situation in the Commercial residential unit is different because there is no WeChat group in the community, and information cannot be released uniformly. Therefore, the researchers surveyed by asking questions to the participants in the community, (The questions are all on the questionnaire, and the researcher filled the information on the questionnaire with the answers given by the investigator) and sent the questionnaires to the company near the community and selects staffs living in this community to conduct the questionnaire survey. In total, 62 people who live in the Commercial residential unit participated in the questionnaire survey. The time to undertake the questionnaire was 3-4 minutes. During the completion, the interviewer would also be asked additional questions about neighbourhood relations. The pre-fieldwork questionnaire is in (Appendix 1-A).

Pre-fieldwork interviews were after the participants completed the questionnaire and asked briefly about the neighbourhood relationship in order to obtain the social capital of the two communities. The questions are divided into three parts and four questions. The basic information and contact details of the participants, as well as their WeChat, will be kept for the follow up interviews at post-fieldwork of the research. See Appendix 3 for site plan maps and questions.

section 1

Please use

on the map to mark your location

Section 2

Please use mark neighbours that you can call by name

Please use X on the map that you can say hello to your neighbours

section 3

How much do you trust your neighbours?

In this part of the interview, some people did not participate. Thus 41 people answered in the Hutong community, and 55 people answered in the commercial-residential unit. In the Hutong residential unit, the participants who did not answer indicated that they could not mark them all because they knew too many people.



Figure 3.15 Participations in the Hutong residential community's elderly care station (Photo by author, 11/12/2019)



Figure 3.16 Lectures about waste separation and recycling in Hutong residential unit (photo by author, 11/12/2019)

Taking into account the different age distribution of the population in the two units, the fact that the majority of residents in the Hutong unit are elderly. The elderly people have always been a major group of financial fraud victims in China (Li *et al.*, 2016, p1525; Xing *et al.*, 2020, p46), so they have a certain amount of defensiveness. Thus, the researcher contacted the elderly station in this unit. In order to get the unit involved in the campaign, we contacted the elderly care station in the Hutong residential unit and announced the campaign through the station manager. The majority of the people living in the Commercial residential unit are young and middle-aged. Thus, the research was conducted during off-hours and midday. Before doing the activities and interviews, participants were informed of the purpose of the study and the use of the data, and the confidentiality of participant information was fully guaranteed.

3.6.2. Post-fieldwork data collecting process

The post-fieldwork was originally planned to take place around June 2020, and it was a field investigation. However, due to Covid-19, the researcher was unable to return to the

investigation site in Beijing. Therefore, the investigation method was changed to an online questionnaire method. People's behaviour and psychological conditions due to the pandemic have changed, which will have a certain impact on the research results. The post-fieldwork research took place in September 2020. The survey method is the anonymous questionnaire survey by sending a mobile phone link.

The aim of the post-study was to compare the changes in people's behaviour and attitudes after a period of time when waste separation and recycling regulations were mandatory. The questionnaire was also used to understand the impact of the epidemic on people's neighbourhoods during the epidemic, which is a reflection of the social network and connectedness of people in different communities. The questionnaire was divided into four sections:

- The first section was about personal information.
- The second section was about the infrastructure and volunteer guidance after the implementation of the legislation.
- The third section also focused on people's knowledge of waste separation and their perceptions of the legislation.
- The fourth section was a new section, as the sudden emergence of the epidemic had some impact on the research, which made the research more difficult but also revealed the social connection of the different communities. Thus, this part focused on the daily activities of the community and the perceptions of the neighbourhood during the epidemic.

The rapid spread of the Coronavirus in China in late January 2020 led to an almost three-month lockdown of the country, which brought the situation under control and people's lives gradually returned to normal. However, at a time when other parts of the world are experiencing epidemics and have adopted lockdown policies, this prevented a return trip to the Beijing site for research. During this period, the researcher continued to follow the news online, and social media and the communication software group (WeChat) as well, and the different communities showed different states of social interaction. Thus, the

research was changed to an online questionnaire, which was sent to the community chat group. However, the Commercial residential unit in the original two research objectives did not have a chat group for residents. As a result, the research method for this community was changed to send the online questionnaire link via a snowballing method. The link was sent first to the friends and residents familiar with living in this community and with the help of assistants who live in this community in Beijing and gradually passed it on, but the number of research questionnaires sent through this method was predictably small.

3.7. Analytical techniques

This section would describe the process of storing research data and the options for data analysis procedures.

3.7.1. Data analysis process

The data collected from the research process is organised in different ways to support the next stage of analysis. The questionnaires were recorded in Microsoft Excel 16.62 and SPSS Statistics V27.0.1.0 for MAC and analysed by descriptive statistics, chi-square test and Wilcoxon test to categorise the data by themes. The interviews were coded and recorded in Nvivo 20.3.2 to facilitate comparison with later data and prepare for the next stage of the study.

Fieldwork observation data

Fieldwork data is recorded through photographs and notes. This data is stored in Nvivo 20.3.2 and coded as pre-survey data to describe the data and compare it with the post-survey data in the analysis results section.

Survey data

The data from the pre-survey was entered into Excel for descriptive analysis. Each question in the questionnaire was coded with a different number for each option, and the Excel file was then entered into SPSS Statistics V27.0.1.0 for chi-square and t-test analysis. The post-online questionnaire was collected via the Questionnaire Star website. Hence the data was downloaded into different formats and imported into SPSS, where the pre- and post-data were combined and analysed for different topics.

Interview data

In the pre-fieldwork interview, the data was recorded by taking notes and then collated and entered into a word document. The data from the post-interviews is recorded via WeChat and is collated and stored in a word document. The interview data is presented separately according to the analysis of the different topics in the Result chapter.

Social media data

The data collected from social media includes images posted by users, text screenshots of comments, and video screenshots. The data collected is entered into Nvivo 20.3.2 and coded into groups according to different themes and attitudes. The data will be used for the analysis in the Result section.

3.7.2. Primary data analysis methods

Primary analysis is the most common and original method of analysing data in research, and it is the most typically imagined statistical method of data analysis (Hox and Boeije, 2004). This section will discuss the data that will be collected, including research questionnaires, interview transcripts, social media data, and the analysis techniques and software used.

Excel

Excel is a powerful spreadsheet application (Kaula and Kaula, 2018). And it is often seen as a number calculation tool and, as such, is associated with quantitative data analysis. It

can process enormous volumes of data, provides multiple attributes and allows for a variety of presentation methods (Meyer and Avery, 2009). The majority of the quantitative data obtained is descriptive, and these descriptive data will be presented graphically in tabular and graphical formats. Additionally, it is possible to control for various factors and evaluate distinct outcomes (Nick, 2007). Excel is thus the tool of choice for displaying quantitative data. In the chapter Result, differences in age groups, rental status, and participation between the Hutong residential unit and the Commercial residential uint will be analysed and compared using Microsoft Excel.

SPSS

The Statistical Package for Social Sciences is a statistical package developed by IBM. Thanks to its powerful analytical capabilities and the ability to present different outputs through different algorithms, it is widely used in various fields of research, including business education researchers and academics (Burns and Burns, 2008; Ting *et al.*, 2012; Valposcholar and Arkkelin, 2014). Different versions of SPSS software have also been designed due to different updates and improvements to the software. SPSS for MAC (SPSS Statistics V27.0.1.0) was used in this study. There are two main analysis methods used in SPSS, Wilcoxon test and chi-square test of independence.

The Wilcoxon test is a statistical test to compare the relationship between two samples for qualitative variables (Ahumada and Sanchez, 2019). Wilcoxon test was first proposed by Deuchler and found independently by Wilcoxon, Mann, and Whitney (Kitani and Murakami, 2020). The Wilcoxon test is more powerful than the t-test in non-normal populations, when the data, although continuous, do not show a normal distribution (Garren and Davenport, 2022, p. 47). Therefore, in this thesis, the Wilcoxon test was used to analyse data from both communities.

The Chi-square test of independence, referred to as Chi-square, is one of the most valuable statistics for testing variables as nominal variables, and chi-square not only provides information on the significance of any observed differences but also provides

detailed information on exactly which categories are responsible for any differences found (McHugh, 2013). In this thesis, chi-square was used to analyse changes in waste sorting behaviour in Hutong residential unit and Commercial residential unit during the before and after fieldwork.

The sample size in this study may be relatively small in comparison to other social science studies, especially the data from the commercial residential units in the latter part of the study. However, in the context of the newly implemented waste segregation legislation and the Covid epidemic, a small sample size is the most logical choice given the relative time and money available and does not waste the limited resources available. Under existing conditions, the size of the sample is not the key to the study, but rather the control of all factors. With all the measures and methods in place, such as regulations, volunteers, knowledge dissemination and infrastructure in this paper, a small sample is more advantageous and therefore the sample in this study is one that can provide credible results and a direction for future research.

NVivo

The use of computer-assisted qualitative data analysis software as an aid to data analysis is now commonplace in academic research (Bassett, 2004). Nvivo is a form of CAQDAS and is considered by Lyn Richards (Riadi *et al.*, 2021) to be comprehensive software that supports code-based querying, searching and theoretical analysis, as well as annotating and editing documents. Furthermore, NvIvo is simple to operate and does not impact the design of the study (Zamawe, 2015). Therefore, in this thesis, most social media data like the website news data, Weibo netizens' thoughts, comments of the recycling behaviours, as well as conversations and images from the interviews, were recorded into Nvivo, which was used as an aid for qualitative analysis. The data collected was also categorised and coded by the type of data, different attitudes and behaviours towards waste sorting, and different deficiencies and strengths found in the communities. The version of Nvivo 12 for MAC was used in this study.

The analysis process and results of the above analysis methods are presented in the 4. Results section.

The formation of pro-environmental behaviour is examined in this thesis from three themes: governance, social structure, and infrastructure. The analysis strategy is guided by the BCW and CBSM theories at various points in the research process (Table 3.4). For instance, a comparison of the pre and post fieldwork of two locations is analysed through three themes using Excel and SPSS. Codes and nodes are also set in the Nvivo based on the content of the two theories combined with the content of the social media collection, for example, the path taken by moving exterior barriers.

Table 3.4 The relationship between the themes, methods and theories

Themes	Key words	TDF	COM-B	CBSM	Analyse
	of sub-				Methods
	research				
	questions				
Governance	Legislation	Reinforcement	Motivation,		Excel
			Opportunity		
	Incentive	Environmental	Opportunity	Incentive	
		context and			
		resources			
Social	Social	Social	Opportunity	Social	Excel,
structure	capital	influence		diffusion	SPSS
					NVIVO
Infrastructure	Removing	Environmental	Opportunity	Removing	Excel
	barriers	context and	Capability	barriers —	SPSS
	Design of	resources	Capability	convenience	NVIVO
	living	and			
	space	Knowledge			

3.7.3. Content analysis

Content analysis was developed in the late 1940s, initially by transcribing interviews and then analysing them, and nowadays by analysing material in the media through communication and content in the media (Mayring, 2019). It is an easily accessible,

reliable method of qualitative data analysis and content analysis is particularly useful in light of the presence of large amounts of textual data for analysis (Kleinheksel *et al.*, 2020). In this thesis, content analysis of official and personal data collected by social media on residents' views on waste sorting behaviour have been discussed in detail in section 3.4.4.

3.7.4. Secondary data analysis method-The six units Case study

As mentioned earlier in this chapter, due to the impact of the pandemic, six additional Commercial residential units in Beijing have been added as case studies to present a more realistic picture of the current situation in Beijing after the implementation of the regulations. The data for these six Commercial residential units were obtained from the Blue Map app data report and used as secondary data analysis material. The six residential units are located in Xicheng District, Tongzhou District, Shijingshan District and Haidian District. The six residential unit locations are in Figure 3.17. The data from the six residential units were stored in NVivo, and the characteristics of the six units were tabulated for comparison. The data collected included pictures, interviews, and observations by Blue map App staffs from the Blue Map app survey (IPE and Vanke Foundation, 2021). The data from these six units will be summarised and secondary analysis of the data will be carried out in section 4.3.2.1, including the perceptions of building form on waste segregation behaviour and the influence of supervisors' attitudes on residents' waste segregation behaviour.

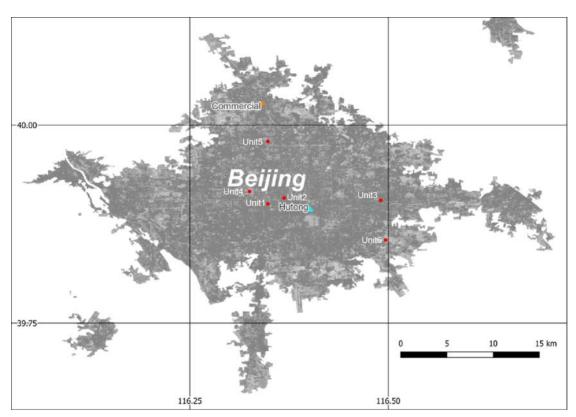


Figure 3.17 The map of six residential units' location (Cartography: author)

3.8. Ethics

The study was not designed to have any legal implications. However, the study will inevitably have ethical implications as the topic under study relates to people's behaviour and views. This study was therefore accredited by the Department of Environment and Geography at the University of York before the implementation of fieldwork.

According to Bryman and Bell (2007), ethical considerations require attention to the following: ensuring that the research is conducted with the participant's full consent, that the participant is treated with respect and safety, and that the participant's privacy and the confidentiality of the research data are maintained; besides, the purpose of the study is communicated truthfully, and that all communication is open and transparent. Participants will not be misled into making any wrong or biased decisions. It will not distort the results of the participant's data.

Therefore, the ethical validity of this thesis was assured by the following three aspects of

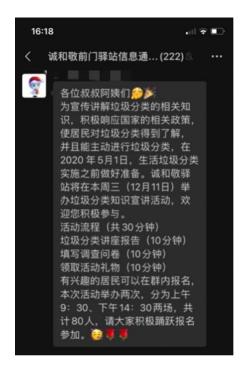
this thesis' fieldwork. First, participants' informed consent was obtained. In the two communities, individuals were informed using different methods. In the Hutong residential unit, the manager of the elderly care station posted information on the topic of these to the participants and asked them to join in voluntarily. In contrast, in the Commercial residential unit, participants were informed individually and asked about the topic and purpose of the study as well as whether they would like to participate. Each participant was allowed to decline participation and had the option of completing the questionnaire and interview or withdrawing. There were a few refusals to complete the survey and dropouts throughout the fieldwork. However, in the spirit of respect for the participants, no actions were forced on them during the research process.

The second factor is privacy. There may be questions on surveys or in interviews that participants do not want to answer or are uncomfortable responding to, but there are also participants whose opinions are more open, and thus total anonymity and privacy of all participants, including the acquired data, are protected. The diverse viewpoints of the participants are a significant addition to the study, and their anonymity is a safeguard for these vital accounts. In this research, as the topic of the study, 'waste separation' is a mandatory regulation in Beijing after May 1st, 2020. When filling out the questionnaires and interviews, participants will not be able to express their personal behaviour and opinions truthfully due to they are afraid of being found out by other people or relevant institutions. Some participants may change their thoughts and behaviours to ensure their safety or not want others to know, and the management finds out about their unsorted waste behaviours. The topic of sustainable environmental management is by nature a sensitive one and respondents to the survey are unlikely to predict themselves as environmentally unsustainable (Roxas and Lindsay, 2012). Furthermore, the Chinese people have a great deal of trust in the Chinese government, but this may contain reasons for fear (NICHOLSON and HUANG, 2022). Thus, there is a social expectation bias for sensitive topics. Therefore, before interviewing and distributing the questionnaires, the researcher made it clear to the participants that no personal information would be released to the public, no unreasonable behaviour would be reported, and all data

collected would be used for academic analysis only. This was to ensure the participants' personal safety and the data's reliability.

The last element is to ensure that the study's discussion and analysis remain objective. This is a requirement that any research must guarantee. To reach the intended conclusion, it is the researcher's responsibility to offer an accurate depiction of the participants and not alter their perspectives or conduct inaccurate analyses. Although there are interactions between participants and the researcher in this thesis study, these interactions do not change the behaviour or attitudes of the participants and do not affect the objectivity of the researcher's analysis of the data. All interviews and data analysis are provided in the Results chapter.

As mentioned in section 3.4.2 above, the questionnaires in the Hutong residential unit were distributed through the station manager of the elderly station, both in the early stages of the waste sorting workshops and in the later stages of the online questionnaire. The reason for choosing the station manager as the intermediary is that in China, it is not only necessary to prepare full research paperwork and a letter of recommendation from the university but also to find someone who is trusted by the research population, especially the elderly. The manager of the station has been working in the Hutong residential unit for many years and regularly helps the elderly in the community with any health problems and educates them about safety and health to ensure their essential well-being. All the residents know how good the station manager is and trust him in all his statements, and the conversations below (Figure 3.18) in the WeChat group show that the residents are very supportive of the station manager's actions. Therefore, the residents are willing to trust and actively participate in the activities and events organised by the station manager. This will also ensure the physical and psychological health and safety of the residents and the safety of the ethical nature of this research.



In order to promote the knowledge of waste separation, and in response to the national policy, residents can learn about waste separation and take the initiative to separate their waste before the implementation of waste separation on May 1, 2020. This Wednesday (11 December), you are invited to attend a talk on waste separation at the Elderly Station.

Programme flow (30 minutes in total)

Lecture presentation on waste separation (10 minutes)

Fill in the questionnaire (10 minutes)

Receive a gift for the event (10 minutes)

Interested residents can sign up in the group. This event will be held twice, at 9:30am and 14:30pm, for a total of 80 people, so please sign up actively!



Resident 1
I am signing up for it

Resident 2
Where is the event location?

Resident 3
Elderly station

Resident 4
Thank you

Resident 5
I would like to join it

Resident 6
Are bot morning event and afternoon event at the same place?



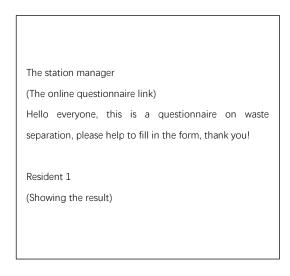


Figure 3.18 The screenshots of Hutong residential unit WeChat group conversations (Translate by author)

4. Results

This section explores the changes in participants' and interviewees' behavioural attitudes and thoughts on the mandatory implementation of waste separation regulations in Beijing from the data collected in the pre-and post-fieldwork. The data will be divided into five sections according to the four sub-research questions and the corresponding COM-B and CBSM theories (Table 2.3), comparing the pre-and post-research data with basic information about the participants, government data, infrastructure data, social data, and barriers data, as well as comparing data from the Hutong residential unit with the Commercial residential unit. This provides insight into whether the above methods can help people develop pro-environmental behaviour in Beijing.

4.1. Basic data- Description of the sample of participants

This section presents basic information about the participants who completed the questionnaires in the two pre- and post-survey, as well as a comparison of the data. As this study is a pre-post comparison of pro-environmental behaviour in the Hutong residential unit and the Commercial residential unit in Beijing, China, under the mandatory implementation of waste separation regulations, therefore, the study was divided into two parts: a pre and a post-study. Basic information about the participants in the two communities was collected and collated, allowing for a comparison of the different groups of people living in the different built living environments, including age groups, occupational status, and ownership. Table 3.2 and Table 3.3 show the number of participants in each pre- and post-fieldwork area and the interviwers information.

4.1.1. Pre-fieldwork questionnaires data

In total, 71 people who live in the Hutong residential unit registered to participate in the recycling knowledge lectures. 62 people who lived in the Commercial unit participated in the survey. participants spent around 3-4 minutes to finish the qustionnair.

Since the data did not obey normal distribution, Wilcoxon test was used. The results showed that Z=-8.316, p<0.01<0.05. This indicates that there was a significant difference between the age group of the Hutong residential unit and the age group of the Commercial residentialunit in the pre-fieldwork, and that the age group of the Hutong participants was older (Appendix 4-A). The bar chart below shows that the majority of people interviewed in the Hutong community were over 55 years old, which is approximately six times the proportion of the same age group in the Commercial residential unit. However, the age group of respondents in the Commercial residential unit was mainly young people aged 25-34, which is 19 times the proportion of the Hutong in this age group (Figure 4.1). Of course, this is also in line with the situation in the two communities, because in Beijing, Hutong residential units are the choice for older people, and Commercial residential units, especially those near many companies, are the leading choices for young people.

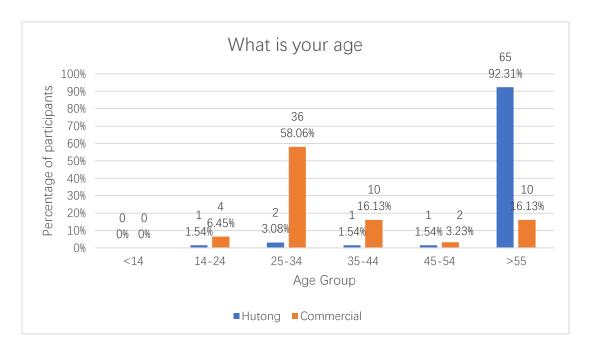


Figure 4.1 Hutong and Commercial residential units pre-fieldwork age group comparison

In the Commercial residential unit, 64.52% of participants were renters, while the majority of participants in the Hutong residential unit were owners (Figure 4.2). A chi-square test

for association was conducted between location and home ownership levels (Appendix 4-B). All expected cell frequencies were greater than five. There was a statistically significant association between location and home ownership, $\chi 2(1) = 22.194$, p =0.000002. There was a significant association between location and home ownership, $\phi = 0.418$, p = 0.000002. The result shows that most of the residents in Hutong own the property, and most residents of the Commercial community rent the flats in this community.

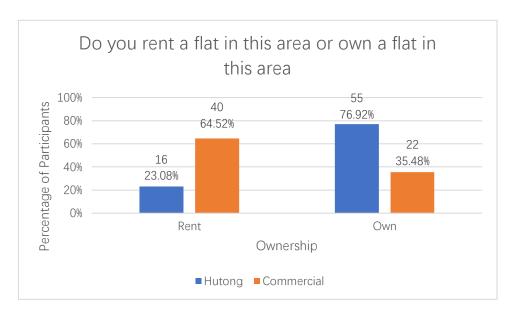


Figure 4.2 Hutong and Commercial residential units pre-fieldwork ownership comparison

In the Commercial residential unit, however, the majority of the residents were young people who had to go to work during the day. Therefore, the questionnaires were completed during their lunch break or after work in the evening. This can be seen from Table 3.3, in the Hutong area, most of the participants were retired people, whereas, in the Commercial residential area, the residents have different occupations, as there are many companies around this residential area. The word clouds below (Figure 4.3 & Figure 4.4) show the occupation statuts. The word clouds of the work status of the participants in both communities show that in the Hutong community the residents as a whole are relatively unoccupied and mostly unemployed. In contrast the participants in the commercial neighbourhood were mostly in a working state. This may also contribute to

the fact that there is little time for interaction with the neighbourhood. The difference in occupations causes a difference in the free time of the residents, as older people have more time to participate in community activities, interact with their neighbours and form a social network. In contrast, the young people in the Commercial unit prefer to relax on their own or go out with their friends during their rare free time, and therefore know less about their neighbours and do not have the opportunity to meet them.



Figure 4.3 Hutong residents' occupation in the pre-fieldwork

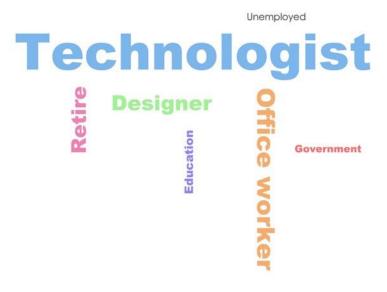


Figure 4.4 Commercial residents' occupation in the pre-fieldwork

4.1.2. Post-fieldwork online questionnaire data

In the Hutong community chat group, 82 participants completed the research questionnaire. However, in the post-field work research in the Commercial community, only 19 people completed the questionnaire; during the research period, the investigator was unable to conduct the research face to face during the Covid-19 due to the fear of the spread of the pandemic. The post-field work online questionnaire is in (Appendix 2-A).

As the following bar chart shows (Figure 4.5), there was a slight change in the age distribution between the two communities in the post-fieldwork online questionnaires. However, the age gap between the two communities remained large. The majority of participants in the Hutong residential unit were over 55 years old, while in the Commercial residential unit, young people were more dominant.

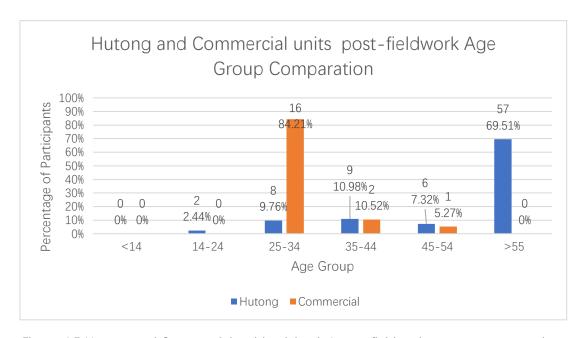


Figure 4.5 Hutong and Commercial residential units' post-fieldwork age group comparison

In the post-online research questionnaire, respondents were also asked about their housing situation, and as can be seen from the bars below, the overall situation is similar to that of the earlier research (Figure 4.6), with the majority of residents in Hutong owning

properties, accounting for 85.37% of the total, creating a clear gap with Commercial residential unit, where only 10.53% of interviewees in the Commercial residential unit owned flats. A chi-square test for association was conducted between location and home ownership levels (Appendix 4-C). However, the data analysis resulted in $\chi^2(1) = 0.218$, p = 0.641. φ = 0.046, p = 0.641. The analysis of the results at a post-stage of the research did not reveal a clear association between location and housing ownership. However, the results (figure 4.6) of the post-fieldwork questionnaire show that more than 85% of the residents in the Hutong are owner-occupiers, while close to 90% of the residents in the Commercial residential units are renters. This situation is similar to that of the same question in the previous questionnaire (figure 4.2), people in the Hutong residential unit are more likely to own, whereas, in the Commercial residential unit, the majority are renters, but the Chi-square test gives different results in reality. The reason for the different results of the chi-square test in the post stages of the analysis is that there is a large difference in the amount of data between the two sites due to the fact that the questionnaire was changed from a face-to-face questionnaire to an online questionnaire, and that there is a chat group in the Hutong residential unit but not in the Commercial residential unit. The results of the chi-square test are the same as the bar chart for the questions on location and home ownership, as the number of respondents was similar in both research sites in the pre-fieldwork research.

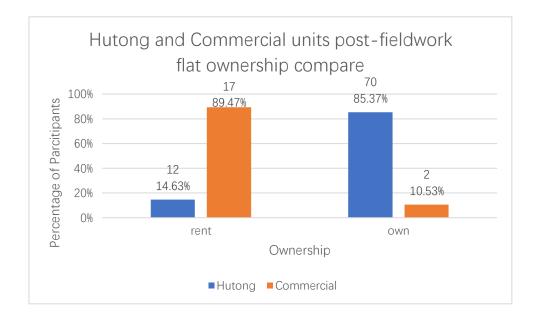


Figure 4.6 Hutong and Commercial residential units' post-fieldwork flats ownership comparison

4.1.3. Pre-and Post-fieldwork questionnaires data comparison

In the Hutong residential unit, a comparison of the pre-and post-fieldwork shows a slight change in the age group of participants. Since the data did not obey normal distribution, Wilcoxon test was used. The results showed that Z=-3.295, p<0.01<0.05. This indicates that there was a significant difference between pre-fieldwork and post fieldwork age group in Hutong residential unit (Appendix 4-D).

The age of participants in the Hutong residential unit has remained relatively stable (Figure 4.7), with little fluctuation in the age group between the two studies, with the majority of participants remaining over 55 years of age. However, there has been an increase in the number of participants in the other middle-aged and youth groups. Part of the reason for the increase in the proportion of young and middle-aged people is the impact of the epidemic, which has necessitated people to be at home and have a limited number of trips.

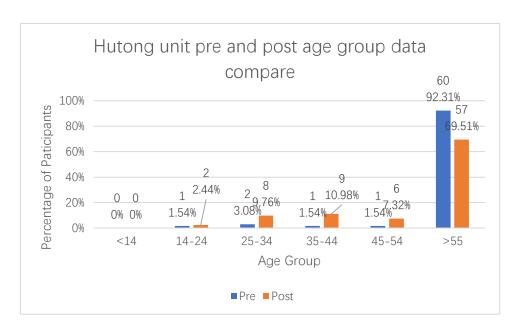


Figure 4.7 Hutong residential unit pre-and post-fieldwork age group data comparison

The distribution of age groups in the pre-and post-questionnaire survey of the Commercial residential community changed slightly (Figure 4.8), but the surveyed population remained distributed among young and middle-aged people. The proportion of people aged 25-34 grew from 58.06% in the pre-fieldwork to 84.21% in the post-fieldwork, and the proportion of respondents aged 35-44 went from 16.13% to 10.52%. No residents over the age of 55 took part in the post-questionnaire study.

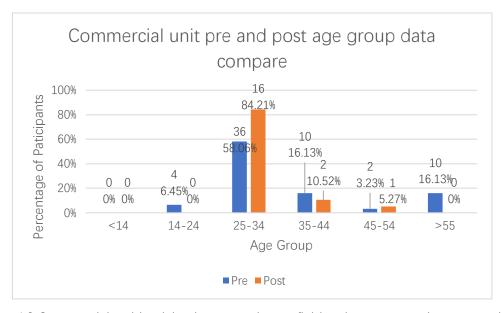


Figure 4.8 Commercial residential unit pre- and post-fieldwork age group data comparison

In the pre-fieldwork, the number of female participants in the research was higher than the number of male participants in both the Hutong residential unit and the Commercial residential unit. In the Hutong residential unit, the female participation rate was 64.62%, which is about 1.8 times higher than the male participation rate. In the Commercial residential unit, the female participation rate was slightly higher than the male participation rate, at 58.06% and 41.94% respectively. However, the difference was not significant.

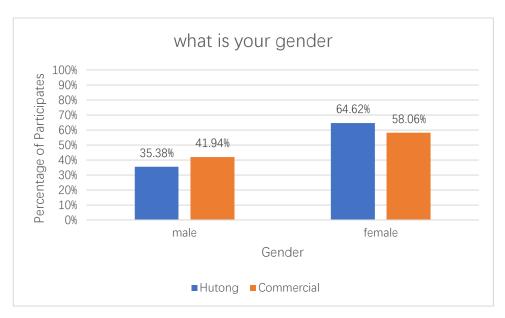


Figure 4.9 Hutong and Commercial residential units gender comparison in the pre-fieldwork

In the post-fieldwork online survey, there were still more female than male participants in the Hutong residential unit, with 70.73% and 29.27% respectively. In the Commercial residential unit, there were no WeChat group like the one in the Hutong residential unit, and during the epidemic, the post-fieldwork questionnaires could not be asked face-to-face as easily as the pre-survey. Therefore, with fewer data, there were relatively few respondents in the Commercial residential areas in the later period, with female and male participation rates of 42.11% and 57.89% respectively, though the male to female ratio in the later period was similar to the earlier data, with little difference in the male to female ratio. In the Seventh Census of China, the male-to-female ratio in Beijing was 51.1% and 48.9% (Xinhua Net, 2021). This ratio is similar to the gender ratio of participants in the Commercial residential unit.

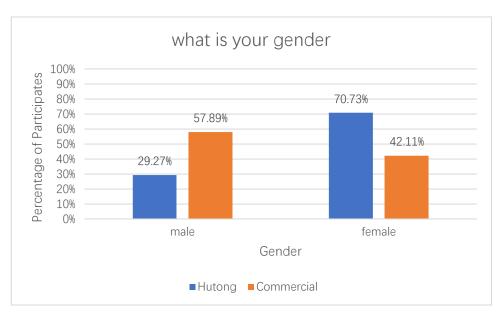


Figure 4.10 Hutong and Commercial residential units gender comparison in the postfieldwork

4.2. Providing opportunities and capability-Infrastructure data

Data collection on infrastructure was mainly through the observational research method. The first stage of research was before the epidemic. Therefore, data could be obtained through field observations and photographs, while the second stage of research on infrastructure changes was obtained through online enquiries due to the occurrence and persistence of the epidemic.

4.2.1. Pre-fieldwork infrastructure observation

4.2.1.1. Hutong residential unit

The research site Hutong commercial unit has undergone several years of upgrading since 2016 (He, 2022), and the Hutong residential unit has maintained the original charm of the traditional Hutong architecture and feelings, while the residents have lived a modern life and added a lot of greenery as the accent which adds to the view of the Hutong. Before the mandatory implementation of Beijing's waste sorting regulations, it was difficult to put down too many facilities on the paths in the Hutong residential unit as they were only around 4 meters. Thus, there were no rubbish bins in the Hutong alleys; residents would put their daily rubbish into a bag and leave it outside their doors (Figure 4.11), and at certain times of the day, a cleaner would drive a small electric cart to collect rubbish from each house to keep the cleanliness of Hutong alleys (Figure 4.12).



Figure 4.11 Residents would leave the daily rubbish outside of their houses. Photo was taken by author, 03/12/2019 Beijing Hutong residential unit



Figure 4.12 Cleaner drives the electric car to collect rubbish.

Photo was taken by author, 03/12/2019 Beijing Hutong residential unit

As the Hutong building has over two hundred years of history, the sewerage facilities were not installed at the beginning. Thus, public toilets were provided in the Hutong for the convenience of the residents. After the renovation, the public toilets are very different from the dirty and smelly public toilets we remember in the Hutong, not only are they neat, clean and odourless due to the installation of a fresh air system, but they are also accessible toilets, so that both residents and visitors can use them with confidence (Figure

4.13). It is also worth mentioning that a rest room has been thoughtfully installed next to the public toilets for the cleaning staff.



Figure 4.13 Public toilets in Hutong residential unit

Photo was taken by author, 03/12/2019 Beijing Hutong residential unit

As elderly people mainly inhabit the Hutong residential community, there is an elderly care station in this Hutong residential unit (Figure 4.14), which is responsible for the daily services for the elderly in the community, such as cultural and recreational activities, food ordering service, life care, health guidance, psychological comfort and knowledge popularisation. During the epidemic, the elderly residents could not come to the activity room for leisure, nor could they hold group activities, workshops, etc. Therefore, the elderly care station's director, lectures on knowledge and science were transferred to a live webcast, where the staff introduced the latest elderly policy through a live webcast (Figure 4.15), and the station opened a university for the elderly residents, which is for elderly people educational training, like teaching cultural courses, elderly-related policies, knowledge on fraud prevention, etc. in the nearby community.



Figure 4.14 Elderly care station in Hutong residential unit

Photo was taken by author, 03/12/2019 Beijing Hutong residential unit



Figure 4.15 Elderly care station staff are explaining the elderly policy online to residents of the Hutong community China Youth Reporter Wang Jiaxing/photo by Wang Jiaxing

Hutong residential unit layout and street Layout

The Caochang Hutong residential unit has a clear hierarchy of streets and public spaces (Figure 4.16 and Figure 4.17). The Santiao Alley (3rd Alley) and Shitiao Alley (10th Alley), which serve as the east-west boundary of the Hutong residential area, are wider and are

used as the main urban road. The Hutong residential unit is bordered to the north by West Xinglong Street, which makes the boundary of the entire Hutong residential unit and is also a commercial street with mainly service-oriented shops. Caochang Hutong is bordered to the south by North Luchaoyuan Hutong, which is the dividing line with the other Hutong residential units to the south. The rest of the longitudinal Hutong alleys of the neighbourhood are narrower, mainly for walking and bicycle access, and private cars are not allowed in Caochang Hutong residential unit, but in the other Hutong neighbourhoods, one-sided access or parking is possible in the wider Hutong lanes. Some service shops are also located in the Hutong lanes. For example, the retirement station is at the end of Qitiao (7th Alley), the hairdresser is in the middle of Batiao alley (8th Alley), and the corner shop is in the Santiao Alley (3th Alley). Residents generally walk to each of the target locations.

Each Hutong alley links individual houses, and each house will have a private outdoor courtyard. Each courtyard is shared by many families, making it a semi-private place for those within the courtyard and a private space for peopel outside (Figure 4.16). The residents frequently leave the courtyard gates open or unlocked throughout the day, a phenomenon also seen in other Hutong neighbourhoods. During the early site investigation, Hutong residential unit occupants often chat or walk with their neighbours.

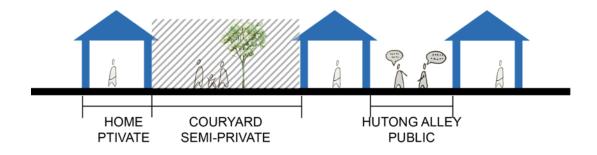


Figure 4.16 Hutong private and public spaces (Made by author)

Hutong Interviewee No. 3

"...when the weather is nice, we sit outside, talk and sunbathe..." 'I love our place, it's old-fashioned, and after the renovation, it's a much better environment and a lot more convenient ..."

Hutong Interviewee No. 4

'...it's quite suitable for us old people, we don't have to go upstairs and downstairs, we have our own yard... all our acquaintances are here.'

The structure of the Hutong residential unit roadways is grid-like and reasonably regular, separating the Hutong community into smaller blocks, therefore establishing several nodes and making it easy for inhabitants to get to different locations (Figure 4.17). It also adds to the community's appeal. The residential buildings in the Hutong residential unit have been refurbished to a consistent building height of around 4 metres, and the width of the Hutong alleys is also around 4 metres. The three major roadways around the perimeter of the Hutong residential unit are about 6.7 meters wide and are suitable for vehicular usage (Figure 4.18). The Hutong residential unit does not have a clear entrance and exit. Instead, every intersection of the alley can be used as an entrance or exit to the community.



Figure 4.17 Hutong residential unit road map (Map resource: Google Map data ©2023,

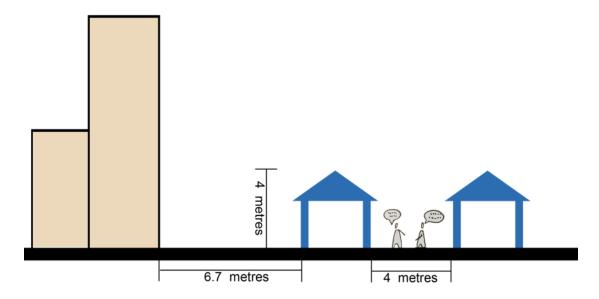


Figure 4.18 The widths and heights in Hutong residential unit (Made by author)

4.2.1.2. Commercial residential unit

The research site, a Commercial residential area, is located outside the fifth ring road in Beijing and is a modern neighbourhood. There are many companies and offices in the surrounding area. Therefore, many young people have just graduated in this neighbourhood who rent flats in this neighbourhood. Before the pandemic, there were rubbish bins in the community. However, they were not marked with sorting standards (Figure 4.19). Thus, the residents did not sort their rubbish. However, there were some elderly people who used to guard the rubbish bins, and when they saw someone throwing paper rubbish, such as courier boxes, they would collect them and sell them for money at the scrap collection point. There is no WeChat group in this residential area like the Hutong community, nor is there a chat group to organise events and seminars for community members.



Figure 4.19 The bins in the Commercial residential unit before the regulation (photo by Commercial interviewee 1, 06/12/2019)

The Commercial residential unit is managed by another management company, which only does the daily cleaning of the area and the management of the underground garage, and there are almost no humanistic care and community activities compared to the Hutong community. However, the neighbourhood has a very big public space with some benches inside the gate and a small square with some public fitness facilities not far away (Figure 4.20).



Figure 4.20 The public area in the Commercial residential unit (photo by Commercial

Commercial residential unit layout and street layout

The residential unit has two entrances, one for cars, which connects directly to the underground garage, and one for pedestrians, which requires an access key. The residential unit is made up of seven 30-storey high-rise slab buildings, which are enclosed by the entire residential area, with pavements and green areas along the inner circle of the high-rise buildings. The width of the pavement is approximately 3 metres. The footpaths connect the green areas with the public squares and children's playgrounds (Figure 4.22). Most of the public green space is surrounded by shrubs, so that residents do not have access to most of the green space. As can be seen from Figure 4.21, the entire residential unit has a cul-de-sac and curved layout, with the main road linking the high-rise buildings and then a number of paths linking the various public spaces. The north-to-south width of the public area enclosed by the high-rise structures is roughly 90 metres.



Figure 4.21 The Commercial residential unit road map (Map resource: Google Map data ©2023, Cartography: author)

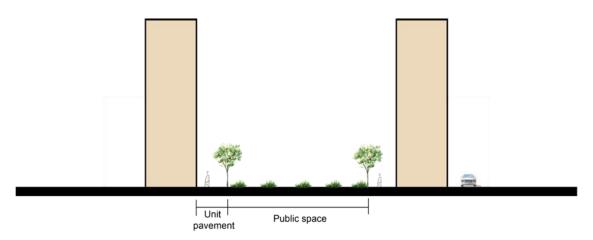


Figure 4.22 The Commercial residential unit spatial map (Made by author)

Commercial residential units are characterised by a mix of commercial and residential uses. In this Commercial residential unit, the first to third floors are used for commercial purposes, such as restaurants, small convenience stores, fruit shops, print shops, courier stations, animal clinics, hair salons, and some other functions stores. The square between the city's main thoroughfare and the residential sector serves as an outdoor parking lot. Although the residential unit has an underground car park, not all residents have purchased a parking spot due to the high cost; instead, some residents who prefer to park their cars outside use the outdoor car park, which is less expensive; this car park also provides parking convenience for the customers of the shops in the outer circle of the Commercial residential unit. It can be said that these shops provide for all the basic needs of the community's residents, but it has been observed that they do not fare well, as residents tend to spend money in these locations to meet urgent needs, as there is a larger shopping mall and restaurants in this area, and there are lines for all the shops within.

The inside of the complex is notably quieter than the outside, and while the residential unit is supplied with green spaces and public services, there are few pedestrians and only inhabitants in a rush to leave or return home. Some older individuals or parents with young children use the children's play area when the weather is nice, but there is little

interaction between the parents, and the children play alone.

Commercial Interviewee No. 1

'...I rented this place because it's close to my workplace, it's very convenient, I don't have much interaction with my neighbours, and I don't know my flatmates very well, the neighbourhood is average, but I don't care, it's just a place to sleep anyway...'

Commercial interviwee 1's first priority in choosing a neighbourhood is the convenience of getting to work, not so much the neighbourhood or the public space. This is also the priority of many commuters for flats.

Commercial Interviewee No. 4

'...I don't hang out in the common areas downstairs, but sometimes I see a few older people gathered together, standing by the side of the building, sunbathing... Parents with children take them to the children's play area...'

Interviewee 4 is not very interested in the public spaces in the community and uses them less, but the older people in the community seems use the public spaces a little more. This may be due to the fact that they have more time due to retirement.

4.4.2. Post-fieldwork infrastructure observation

4.4.2.1. Hutong residential unit provision of separate waste bins

In the Hutong residential area, there are nine garbage bin stations (Figure 4.23) positioned on the community's larger outside roadways. Two stations are located on the northbound main road, six on the main eastbound road, and one on the southern ploughed road. In addition to these nine freshly built bin stations, there is a household trash segregation station positioned south of the main road. These stations are open from 7:00 a.m. to 8:00 p.m. and are essentially open the whole day. The numerous bins are handled by the appropriate firms and individuals in responsibility, and when the food waste bins and

general bins are full, they are replaced with new bins. Residents may choose to have recyclable garbage collected by one of the Hutong area's recycling firms, or they can bring their recyclable rubbish to the household trash segregation station on the south side of the community in exchange for cash. Residents must drop off their hazardous garbage at the Household Waste Separation Station, and then the community's hazardous material delivery workers will take the waste to the enclosed cleaning station.



Figure 4.23 Layout of segregated waste bins in Hutong residential unit (Map resource: Google Map data ©2023, Cartography: author)

4.4.2.2. Commercial residential unit provision of separate waste bins

Commercial residential unit have had two waste separation stations at this research site since the implementation of the waste separation legislation (Figure 4.24). As seen from the photograph (Figure 4.58) provided by Commercial interviewee No. 1, the community has re-labelled the bins, which already existed as general bins, into different types of bins for recyclables, general waste and food waste. In addition, a central sorting station with

eight bins is set in the community, which has seven general bins, and one recyclable bin. Each station is open 24 hours a day, and there is an extra collection of food trash from 7:00 am to 9:00 am daily.



Figure 4.24 Layout of segregated waste bins in Commercial residential unit (Map resource: Google Map data ©2023, Cartography: author)

4.4.2.3. Waste collection method in the Hutong residential unit

Due to the structural peculiarities of Hutong residential units, the roadways inside the community are too small to allow the installation of trash cans. Consequently, the collection of residents' garbage is still performed by mobile rubbish collection trucks, but people are now compelled to separate their waste, unlike before the adoption of the waste separation law. As we know from section 4.4.2.1 how Hutong residents handle recyclable and hazardous waste, the mobile collection vehicles within Hutong alleys are for food waste and general waste. Even though the nine new extra bin stations are available 24 hours a day, locals are more used to waiting for mobile garbage collection

cars to collect their trash. The mobile garbage collection car will collect the rubbish from the Hutong residential unit twice a day, from 7.00-9.00 am and from 6.00-8.00 pm. At each Hutong alley, the mobile trash collection vehicle pauses to clear the area and shouts "waste collection" (Figure 4.25). The residents then place their segregated food waste and general waste in the mobile garbage car. When the mobile garbage car is filled, the cleaner transports the waste to a nearby waste station.



Figure 4.25 Residents take their sorted waste and put it in the mobile waste truck (Photo by Ke Lu, 20/02/2022, Hutong residential unit)

4.4.2.4. Waste collection method in the Commercial residential unit

In the case of Commercial residential unit, residents are required to put their own waste into the appropriate bins. As with the Hutong residential unit, there is a company and a person in charge of the transport and management of the different types of waste. When the waste separation regulation was first implemented, there were supervisors and instructors near the bin stations (Figure 4.26), but they were all from the community's property management company. When residents want to put out hazardous waste, they

need to give it to the cleaners. From the interviews performed in section 4.4.3, it is evident that after a year, the residents' waste separation practices had reverted to how they were before the adoption of the sorting restrictions, with the majority of individuals no longer sorting their garbage.

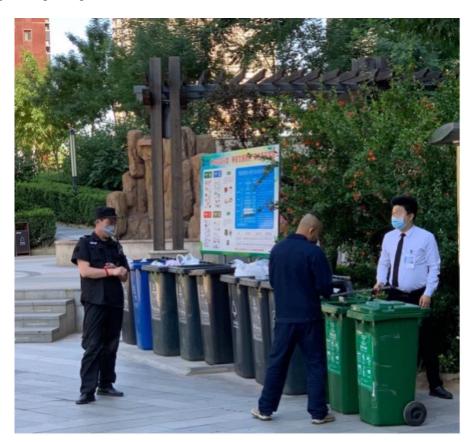


Figure 4.26 Supervisors and instructors near the bin station (Photo by Commercial interviewee 1, 30/02/2020, Commercial residential unit)

4.3. Providing motivations-Governance data

4.3.1. Pre-fieldwork online questionnaire data

4.3.1.1. Willingness to separate waste for recycling

From one of the questions in the pre-questionnaire,' Do you currently participate in the garbage classification at your unit?' It can be seen that before the mandatory implementation of waste separation regulations in Beijing, more respondents chose the

option of not participating in waste separation than participating in waste separation in both the Hutong residential unit and the Commercial residential unit. However, 43.08% of respondents in Hutong chose to participate. In the Commercial residential unit, the contrast between those who participated in sorting and those who did not, and their appearance was 3.2% and 96.8% of the total respectively (Figure 4.27).

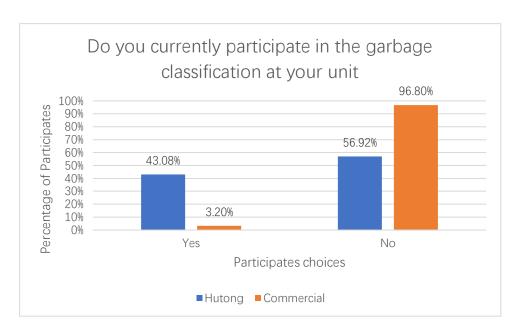


Figure 4.27 Hutong and Commercial residential units' participation in the Pre-fieldwork

4.3.1.2. Find the barriers

When respondents were further asked the reason, 'Why don't you participate in waste separation and recycling in your residential Unit'. This question is also in line with an essential step in Community-Based Social Marketing theory, finding barriers to the formation of pro-environmental behaviour. As can be seen from the bar chart below (Figure 4.28), people in the Commercial residential unit chose 'I have not received any news that I need to do waste separation and recycling', accounting for 88.33% of the total and 20.93% of people in the Hutong residential unit chose this option, taking the second highest number of all reasons.

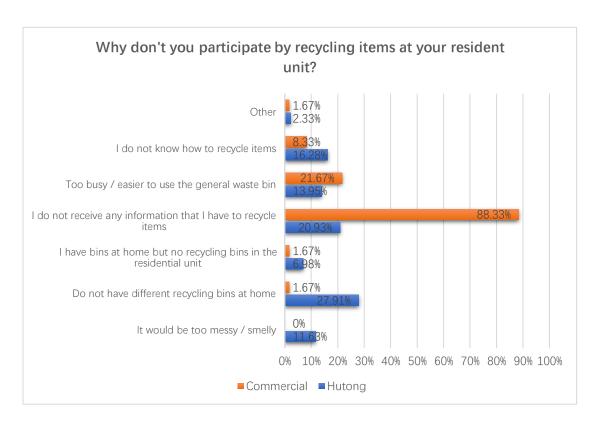


Figure 4.28 The reason of don't participate by recycling items in Hutong and Commercial units in the Pre-fieldwork

4.3.2. Post-fieldwork online questionnaire data

4.3.2.1. Participation in waste separation

Following Beijing's mandatory waste separation regulations, there has also been a significant change in the level of participation in the separation of waste. According to the question, 'Do you currently participate in the garbage classification at your unit?' In the preliminary questionnaire (Figure 4.29), in the Hutong community, 43.08% of the residents said that they do separate their waste, but in the later survey, more than twice as many residents chose to separate their waste, accounting for 89.02% of the total. Only 10.98% of residents chose not to have participated in waste separation. This dramatic change occurred during the pandemic, but with such a large proportion of people participating in waste separation, it is conceivable that without the epidemic, the proportion of people participating in waste separation would have been even higher.

Since the data did not obey normal distribution, Wilcoxon test was used. The results showed that Z=-5.947, p<0.01<0.05. This indicates that there was a significant difference between the pre-fieldwork participant level and post-fieldwork participant level (Appendix 4-E). Post-fieldworkparticipants in the Hutong residential unit are more willing to join the recycling separation.

The pre and post-data in the Commercial residential unit are even more pronounced (Figure 4.30), with only 3.2% of residents in the pre-study indicating that they were actively involved in recycling activities in the community, and then 100% in the post-study indicating that they were involved (Figure 4.31). This implies that it is a communal activity for most of the interviewees in the Hutong residential unit, rather than that they are sorting their own household waste using recycling facilities in the community. Since the data did not obey normal distribution, Wilcoxon test was used. The results showed that Z=-8.369, p<0.01<0.05. This indicates that there was a significant difference between the pre-fieldwork participant level and post-fieldwork participant level (Appendix 4-F). Post-fieldwork participants in the Commercial residential unit are more willing to join the recycling separation.

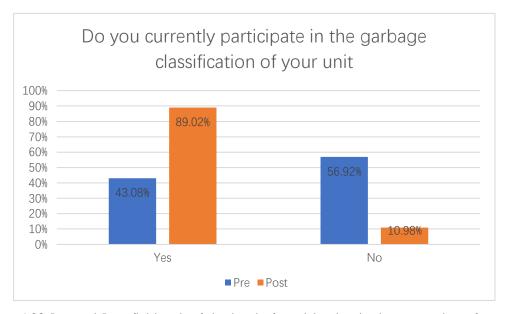


Figure 4.29 Pre and Post fieldwork of the level of participation in the separation of waste in Hutong residential unit comparison

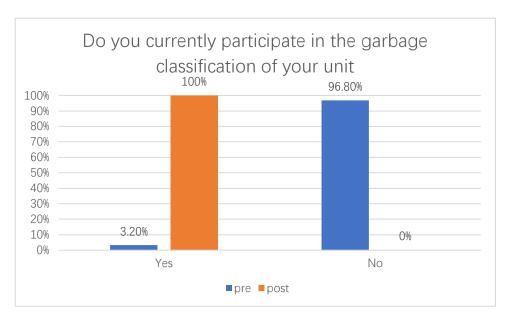


Figure 4.30 Pre and Post fieldwork of the level of participation in the separation of waste in the Commercial residential unit comparison

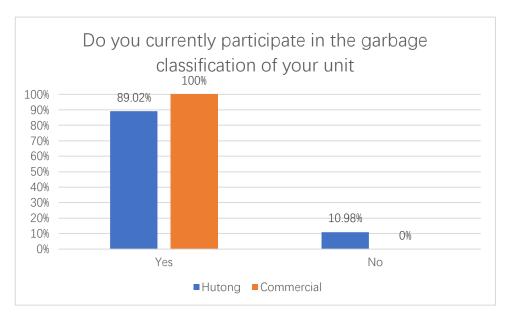


Figure 4.31 Hutong and Commercial residential units post fieldwork level of participation in the separation of waste comparison

The majority of the participants in both research sites agreed with the waste separation legislation, including 96.34% of Hutong residents and 84.76% of Commercial residential unit residents (Figure 4.32). Another 2.44% of Hutong residents and 5.26% of Commercial residential unit participants were neutral, while the rest of the participants disagreed with

the legislation.

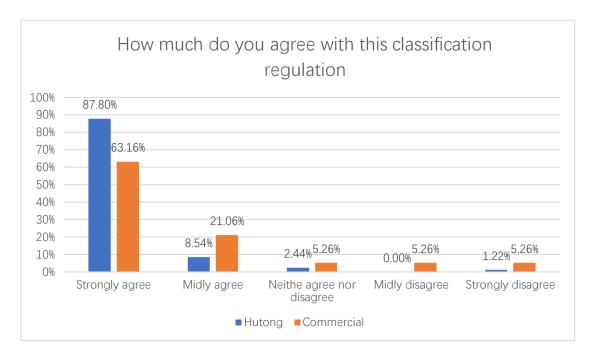


Figure 4.32 The extent to which the Hutong and Commercial residential units agree with this legislation

The reason that the number of people who agree with the classification regulations is very high, that social desirability bias might have an impact on this phenomenon. In section 3.8 it is mentioned that the Chinese public hides some of their innermost thoughts on sensitive topics such as environmental management.

4.3.2.2. The motivations for waste separation

The question in the post-fieldwork online questionnaire followed the last participation question asking why they would participate in waste separation. This was a multiple-choice question, with everyone in both the Hutong residential unit and the Commercial residential unit choosing to participate voluntarily in waste separation and protecting the environment. In the Hutong residential unit, 4.11% of residents said it was because they were afraid of fines and 1.37% of Hutong participants also chose involuntary, mandatory behaviour because this is a legal requirement and people have to do this recycling action

(Figure 4.33). However, 42.11% of the residents in the Commercial residential unit said that it was involuntary and that it was compulsory to separate waste. This is an interesting result, with the ambivalence of people choosing to participate voluntarily because the law protects the environment, while on the other hand, there is the choice that it is a compulsory act and must be participated in.

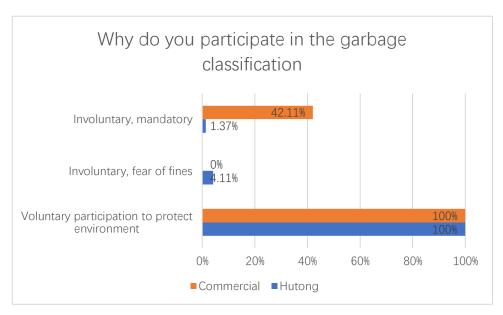


Figure 4.33 The willingness to participate in Hutong and Commercial residential units in the post-fieldwork

The data for the post-questionnaire was collected five months after the mandatory implementation of waste segregation and the interviews in the two years following the implementation of waste segregation regulations; we followed up and updated information on waste segregation for two respondents in both communities.

Commercial Interviewee No. 1

'No one continues to separate waste at all now, they just mix it up and throw it away, then there are cleaners downstairs who do the simple sorting' and 'No one has been sorting for a long time.'

Hutong Interviewee No. 2

Most people continue to sort their rubbish now, but there are only a few households that

don't sort their waste and leave it at the door, but the cleaners still help sort it and put it in the sorting bins'.

From the descriptions of the two interviewees, the current level of waste separation behaviour in both communities is maintained, with the Hutong community adhering a little better than the Commercial residential community, and with more people continuing to separate their waste than the Commercial residential community.

4.4. Providing social opportunities-Social capital and social media data

4.4.1. The social network in Hutong and Commercial residential units

Responses to the survey question 'When your household is unsure an item is recyclable, what do you do?' and this is a multiple-choice question. In the Commercial unit, 70.97% of people chose to search online (Figure 4.34), which is also a reflection of the willingness of young people to understand information through the Internet. Only 19.35% of people chose to seek the help of their neighbours. Although the choices are relatively scattered in the Hutong unit, the number of people who chose to seek help from neighbours is the largest, accounting for 35.38% of the total. A chi-square test for association was conducted between location and the choice of 'ask for help from a neighbour (Appendix 4-G). All expected cell frequencies were greater than five. There was a statistically significant association between location and the choice of 'ask for help from a neighbour', $\chi 2(1) = 4.084$, p = 0.043. Hutong participants were more willing to ask for help from neighbours than Commercia participants.

Besides, the question 'If you start to recycle, will you suggest your neighbours, do it?' (Figure 4.35). Although both communities chose 'yes' more than 'no' the number of people in the Hutong who would suggest this behaviour change to their neighbour was

still 35% more than that for the Commercial community. A chi-square test for association was conducted between location and the willingness to recommend to their neighbours (Appendix 4-H). All expected cell frequencies were greater than five. There was a statistically significant association between location and the choice of 'the willingness to recommend to their neighbours', $\chi 2(1) = 11$, p =0.001. Hutong participants have more willing to recommend their neighbour to do the recycling.

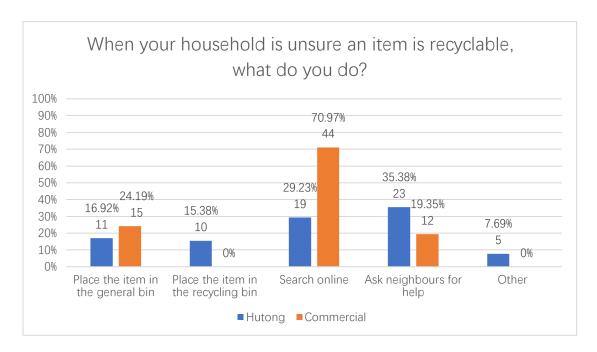


Figure 4.34 Hutong and Commercial residential units' pre-fieldwork data comparison of the choice for an unsure item recyclable

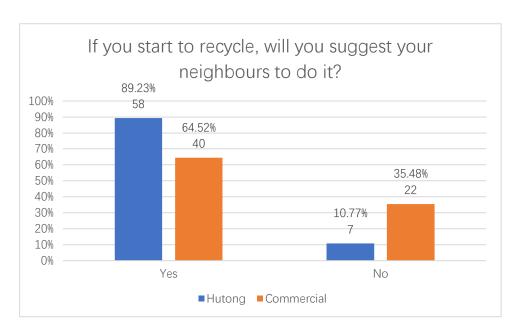


Figure 4.35 Hutong and Commercial residential units' pre-fieldwork data comparison of the willingness of suggest neighbours recycle

In the second part of the pre-fieldwork questionnaire, participants were asked to mark on a map the location of neighbours they could name and the location of neighbours they greeted regularly. However, for the qualitative data obtained from the interviews, in the Hutong residential unit, many people were unwilling to mark everyone they knew. Because a large proportion of people living in Hutong are elderly (over 55-year-old), they said they have lived here for a very long time and know so many people that it is impossible to mark them all, and the elderly said it is difficult to use the map as well. Thus, the participants counted the neighbours who could be named and the neighbours to whom they could say hello regularly. In the Commercial residential unit, 27% of people do not know anyone, and 51% said they could name 1-5 people (Figure 4.36). The situation of greetings is similar to these data. In the Hutong community, 42% of people can name 11-15 names, 17% of the participants can name 16-20 people, and even 24% of participants said that they know 20-50 people's names. In the Hutong residential unit, participants greet more people daily, reaching up to 100 people (Figure 4.37).

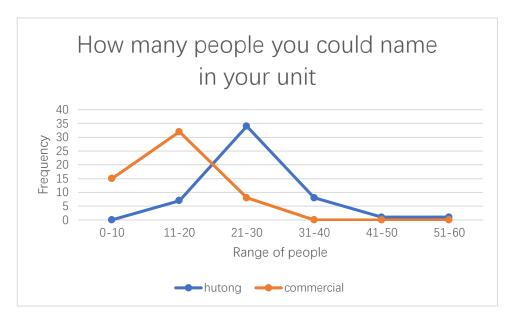


Figure 4.36 The number of people could name in Hutong and Commercial residential units

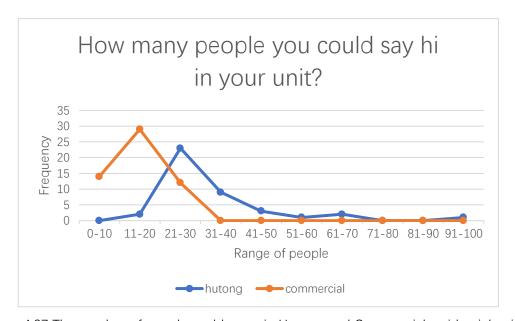


Figure 4.37 The number of people could greet in Hutong and Commercial residential units

In addition to the data on the questionnaire, four interviewers in the post fieldwork made statements on the issue of neighbourhood relations.

Hutong Interviewee NO.1

The station manager of the Hutong elderly Station lives in Beijing all year round and is very familiar with the neighbourhoods in the Hutong community. He stated that 'we often have activities and talks in our community for these elderly people, and every time we

post a message directly in our WeChat group, everyone actively participates, they all know each other and will help to sign up their neighbours for the activities... There is also an activity room in our elderly station, and these neighbours often meet to play cards together and practice Calligraphy...' '··· we always say hi to each other when we meet in the alley…'

Hutong interviewee NO.1, as the station manager for the Elderly Care Centre, regularly organises activities for the elderly in the community, increasing contact between the residents and providing a good basis for increasing social capital.

Hutong Interviewee NO.2

A resident of the Hutong, who has lived here for decades, said 'We have known each other for decades, and we all say hello when we meet... We usually participate in these activities...' '···· I'm quite happy to live here; I could see my friends every day and chart with them···.'

From Hutong interviewee NO.2's elaboration, it is clear that most of the older people living in the Hutong have lived there for a long time and are relatively well known to everyone. The length of time living in the community increases the opportunities for interaction and social network to a certain extent.

In addition, the Hutong residential unit has a council chamber, which is a platform for collecting residents' opinions and discussing daily decisions in the hutong (Luo, 2023). At the beginning it was just a place for residents to chat, but later it evolved into a place for residents to discuss matters such as the placement of community infrastructure, the choice of the main dance for the public green space and the choice of floor coverings. Each resident has the right to decide and the responsibility to build the hutong, which enhances the sense of belonging of the inhabitants.

Commercial residential unit Interviewee NO.1

He is not a local Beijing citizen, a tenant in this Commercial residential unit, sharing a flat

with several other people who are also non-Beijing citizens, and said he chose to live here because of its location close to his workplace. When talking about the neighbourhood, he stated, 'I don't know anyone here. To be honest, I don't even know my roommates very well, and when I come back here after working late every day, I don't have the opportunity to meet other neighbours, and then I just go to bed.' '…maybe I will change to another place to live next year…'.

For commercial interviewee NO.1, who is not from Beijing, the flat for him is just a scripted need to provide accommodation, with no social network opportunities for the community residents or even neighbours.

Commercial residential unit Interviewee NO.2

Having just moved from another residential neighbourhood because it is closer to her workplace and near the metro station, she said about her neighbours that she doesn't know these people around her at all and that when she has free time, she only goes out with her close friends or meets out at restaurants.

Similar to the commercial interviewee NO.1, part of the reason for choosing this residential area is the ease of access to work, and once you change jobs, she may also change her accommodation and have less likelihood of creating a social network with your neighbours.

Due to the small sample size of this study, the results can only be considered indicative. Hutong residential unit is likely to have better neighbourhood relations overall than Commercial residential unit neighbourhood. Combined with the dynamic insights provided by the four interviews above that Hutong residents are more social with their neighbours.

4.4.2. Social media data

4.4.2.1. Blue Map app data (secondary data analysis)

In section 3.4.4 mentioned how to set up the Bule map App which could help people and city government find out which community has recycling situations need to be solved. In the period between 8 June 2020 and 31 July 2020, there were 115 photos uploaded through the Snapshot activity in Beijing. Forty-nine snapshots were marked as "classified" (green colour), which indicates that these communities are effectively sorting garbage. Sixty-one snapshots were labelled as "unclassified" (red colour), which means the waste separation is inadequate in these areas, and five snapshots were marked as "partially classified" (yellow colour), which means the overall situation of waste separation in these communities is acceptable, but there are some shortcomings that need to be improved.

On a weekly basis (Figure 4.38), over the period from 8 June 2020 to 31 July 2020, we can see that in June, about half of the snapshots descriptions show that residents believed that food waste is discarded separately from other waste in their neighbourhoods, however, as we entered July, the percentage of 'sorting' started to drop, and by the week of 6 July to 12 July, the rate of 'sorting' even reaches 20%. By the week of July 6 to July 12, the percentage of 'sorted' had even reached 20%. Over the next three weeks, the number of snapshots marked as classified gradually increased from 29% on 13 July to 55% on 31 July. From the beginning of July, the 'partially categorised' category appeared, and the percentage of 'partially categorised' fluctuated from 7% at the beginning of July to 19%, and by the end of July, the percentage of 'partially categorised' dropped to 9%.

One of the reasons for the fluctuations in the "sorted" and "partially sorted" figures may be related to the outbreak of a pandemic in some parts of Beijing in July. As the epidemic situation was more serious then, communities needed more staff to manage the pandemic, and the supervision of waste sorting was therefore affected.

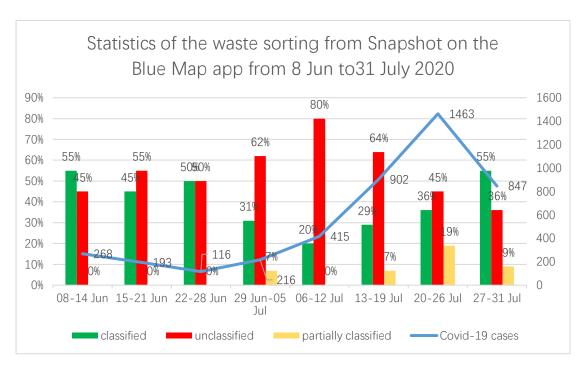


Figure 4.38 Snap shoot in the Blue map app and Covid-19 cases from 8 Jun to 31 July

The author has recreated the data from the blue map app survey (IPE and Vanke

Foundation, 2021) and added the Chinese covid case for the corresponding time (WTO,

2022)

According to the "Blue Map" app, the percentage of correct food waste disposal increased from 47.4% to a maximum of 80.0% in 673 photos from 11 June 2020 to 10 January 2021 (Figure 4.39), but fluctuated considerably, from 14 December 2020 to 10 January 2021. The average for the six weeks from 30 November 2020 to 10 January 2021 was 58.9%.

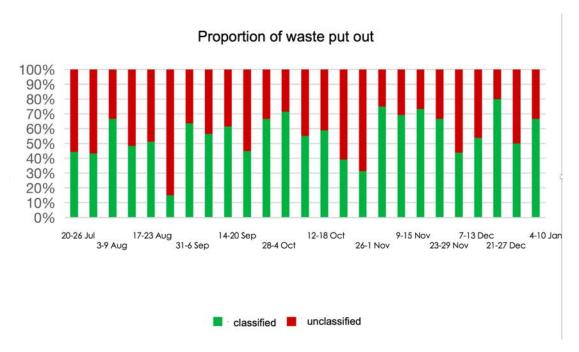


Figure 4.39 Proportion of waste from 20 July to 10 January

6 Commercial residential units case study

From the above data (Figure 4.38), it can be seen that there is a wide variation in the effectiveness of waste separation between different neighbourhoods in Beijing. A few neighbourhoods can sort their own waste and put it in the correct bin. However, a large proportion of neighbourhoods still require secondary sorting to achieve effective waste recycling and disposal. When we open the Blue Map App, we can see that throughout Beijing, there are crown symbols (Figure 4.40), which means that there are some units where sorting rubbish can be achieved. In order to find out why the Crown neighbourhoods are separating waste successfully, the Snapshot Observation team selected six representative neighbourhoods (Table 4.2) from the map in late October 2020 and investigated the situation of waste segregation by taking photos and talking to volunteers and cleaners (IPE and Vanke Foundation, 2021). The basic information of these six units was obtained from the Blue Map app survey (IPE and Vanke Foundation, 2021), including the form of the buildings, the infrastructure, the opening hours of the waste separation bins, the interviews with the volunteers and the photos. In this section, the data from these six units will be summarised and secondary analysis of the data will be carried out, including the perceptions of building form on waste segregation behaviour

and the influence of supervisors' attitudes on residents' waste segregation behaviour.



Figure 4.40 Different issue levels of waste separation in Blue Map

Table 4.1 Waste separation management in 6 residential Unites (from Blue Map survey translate by author)

Unit	1	2	3	4	5	6
Building Type	Large high- rise slab-type	Large high- rise	High-rise tower building	High-rise slab-type	Low-rise Building	Low-rise building
Remove Old bins	√	Х	√	Х	√	√
and build a bin						

st	ation						
Time slots for Waste		√	Х	√	Х	Х	Х
coll	ection						
Dedicate	ed guidance	√	Х	√	Χ	√	X
Four	Kitchen	√	√	√	√	\checkmark	√
types	Waste+						
of	Other						
sorting bins	Recyclable	Some rubbish collection Station	Some rubbish drop-off points	All-day drop-off points only	Some rubbish drop-off points	One rubbish collection station	At the scheduled drop- off points only
	Harmful waste	One rubbish collection station	Few rubbish drop- offs points	All-day drop-off points only	One or two rubbish drop-off points	One rubbish collection station	At the scheduled drop-off points only
ties	Bin lid with pull handle/fo ot pedal	X	√	X	√	X	X
Ancillary Facilities	Hand washing facilities	X	Х	X	X	√	Х
	Bag- breaking tools	X	Х	Х	√	Х	Х

Effectiveness of	Sorted	Not	Sorted)e	ved	96	ved)e	ved
waste Separation		Sorted		To b	impro	To b	impro	To b	impro

Unit 1 is a block marked as a Green-Crown residential unit. It comprises large multi-unit slab buildings with approximately 200 households in each building. During the regular opening hours of the bins, observers from the Blue map app observed that the rubbish drop-off points in this block were clean and well lit, and that residents came to the drop-off point with their separated rubbish. Most of the residents were able to give their recyclable items such as plastic, paper and medicine boxes directly to the sorting instructors for packing or separate collection. However, it is important to mention a recycling situation that has always existed in China - the recycling of waste paper, a general term for a series of activities that transform waste paper into a public resource by storing, placing and handling it in accordance with regulations or standards (Ge, 2019). Wastepaper such as books, newspapers, cartons, etc. can be sold by weight to designated collection points. From 1 May 2020, the waste separation stations will only be open from 7.00 to 9.00 am and from 6.00 to 8.00 pm daily, with the abandoned and practical bins locked and the waste separation instructors present during the opening hours.

The staff of the neighbourhood committee said:

When rubbish sorting started in May, each household was issued a small bin with a leaflet inside to let everyone know the specific time to put out the rubbish, kitchen rubbish, other rubbish, and hazardous rubbish all had to be separated, and there was a form inside so everyone would know when they read it.

A number of waste sorting supervisors said that they were tired at first and had to explain how to sort every time they saw a resident, but after persevering, changes usually occurred within a month. Ms Z, a waste segregation instructor who is a property cleaner, mentioned the history of waste segregation in Unit 1, saying that at first, many residents did not understand and did not cooperate, but after a month, the situation changed. A

number of Unit 1 waste sorting instructors said that 90% of the residents have now sorted their own waste (Figure 4.41). When asked about the inconvenience of putting out waste at regular intervals, the residents said they could accept it.



Figure 4.41 Unit 1 rubbish collection station. Photographer Ma Jun 21.10.2020

Unit 2

Located in Beijing's Xicheng District, Unit 2 consists of a number of large towers, the largest of which has over 300 households, with a set of waste drop-off points under each building (Figure 4.42). Different from Unit 1, each building is more closely to each other in Unit 2 and the drop-off points are relatively close to each other and open all day. Volunteers are on duty in front of the buckets from 7 am to 9 am and 6 pm to 8 pm, with property cleaners less involved in supervision and guidance.

Volunteers in the district said that about 30% of residents are currently able to take the initiative to separate their rubbish. The volunteers believed that although the effectiveness of rubbish sorting in the district has improved after many rounds of mobilisation and publicity, there was still a gap compared to the most successful districts. It was impossible to monitor waste separation quality at each drop-off point.





Figure 4.42 Unit 2 selected from Snapshot. Photographer: Zhang Lianna 26th Oct 2020

Unit 3 is located in the Tongzhou district of Beijing and has 24 high-rise towers with three regular drop-off points, which are locked during non-drop-off times, and one all-day drop-off point (Figure 4.43). At the all-day drop-off point, a cleaner is stationed for a long

period of time to check on the waste being put out. The observer saw a high level of cooperation from residents at the all-day drop-off point (Figure 4.44), with young, middle-aged and elderly residents bringing in correctly sorted rubbish, some of whom volunteered to open bags for inspection by the cleaners before dumping. The cleaners said that they had also gone through a difficult check-persuasion period in Unit 3 and were now more than satisfied with the behaviour of the residents.



Figure 4.43 Unit 3 all-day drop-off point for waste separation





Figure 4.44 Distribution of waste separation points and Food waste bins at all-day drop-off points in Unit 3 Photographer Shen Sunan 22nd Oct. 2020

Unit 4 is located in Shijingshan District, Beijing, and is a multi-rise slab building with waste drop-off points under each building, which were open throughout the day (Figure 4.45), with basically no on-site guidance on waste sorting and only volunteers on duty for a short period in August. The street community where this block is located employed a third-party company to carry out secondary sorting in all blocks within its jurisdiction, more frequently during the weekdays.

In early November, the community started installing bucket lid pullers (Figure 4.46), a device connecting the bin lid to the pull handle with a wire. This device can reduce the chances of residents touching the bin lid. It was later discovered that at some drop-off points, as it was easier to pull the lid off the food waste bin, some non-food waste was also thrown in, which added to the problem of mixed waste.



Figure 4.45 Unit 4 drop-off point Photographer Ma Jun 22nd Jun. 2020



Figure 4.46 Separation bins with bucket lid pullers in Unit 4 Photographer Ma Jun 7th Nov. 2020

Unit 5 is located in Haidian District, Beijing and consists of four relatively separate areas. In each area, there are a number of low-rise buildings, and after 1 May, the bins under each building were removed and brought together in one drop-off point. The containers at the drop-off point are open all day.

From mid-May to the end of June, volunteers in the A area were present at the bin stations during the morning and evening rush hours every day to urge residents to separate their food waste and to provide guidance if they had any problems. During offpeak hours, cleaners are on hand to patrol the area. In some areas, the cleaners and volunteers regularly took photos of residents throwing out the wrong rubbish and posted them on WeChat groups to remind neighbours of the problem. The cleaners had also taken the initiative to try to install additional hand washing facilities to address residents' concerns (Figure 4.47). The volunteers have now withdrawn, and the cleaners are not at the drop-off point all day, but residents in three areas of Unit 5 have been able to sort their own waste.

A residential building in the B area was managed separately by the property, and the bins were set up separately. Because of the Covid-19 pandemic and the lack of supervision, the residents of this building were not strictly required to sort their own waste at the beginning of the implementation of compulsory sorting, but rather the cleaning staff sorted it twice, with the result that the current level of waste sorting in this area lags significantly behind other areas.



Figure 4.47 Unit 5 one rubbish drop-off point photographer Shen Sunan 21st Oct. 2020

Unit 6 is located in Tongzhou District, Beijing, and is a multi-block low-rise building. After 1 May, the food waste and other rubbish bins under each building were withdrawn, and a group of regular drop-off points were set up, which were locked at all other times beyond the designated time, and a group of open drop-off points throughout the day (Figure 4.48). The cleaning staff helped sort the waste in front of the bins during the morning and evening rush hours and checked them at irregular intervals during the rest of the day.

Observers found that residents in the area were not adequately monitored and disciplined when throwing away their rubbish. When residents did not sort their waste properly, the cleaners repeatedly did not point out their mistakes on the spot and asked them to correct them, instead saying "just put it there", with the result that currently, only 50% to 60% of the residents can sort their rubbish (the approximate proportion according

to the cleaners), and the unsorted waste is only sorted by the cleaners twice.



Figure 4.48 Unit 6 two drop-off points Photographer Shen Sunan 22nd Oct. 2020

Based on the above data of unit 1 to unit 6 from Blue map app, it has been collated into the table below. The attitudes shown by the supervisors next to the bin stations were different in these six units (Table 4.3). The job of unit 1 and 3 supervisors has been one of persuasion and oversight, and while the process has been laborious, with residents needing constant reminders, the outcomes have been positive. The supervisors of the remaining four units performed almost no supervisory role. They deliberately persuaded the residents that they did not need to sort since a secondary sort would be conducted. After a month of persuasion and correct guidance from the supervisors, the residents of Unit 1 and Unit 3 were able to sort the rubbish by themselves, even without the presence of supervisors. For the other four units, the supervisors' lack of firmness and failure to appropriately instruct and point out the residents' misclassification resulted in a subsequent deterioration of the sorting situation. Therefore, the supervisors' attitude might be a factor influencing the residents' garbage sorting situation. Comparatively, unit 4 and unit 5 supplied more disinfection tools and bin pullers but did not enhance the waste sorting issue for residents.

The poorly sorted communities in these six units (units 2, 4 and 5) are similar in building form to the Commercial residential units in this study, being either high rise buildings or large high-rise buildings. These communities have fewer waste separation points and are not sufficiently regulated, and the role of supervisors is only as secondary sorting, as is

the case in the Commercial residential unit.

Table 4.2 Attitudes of the supervisors in 6 units

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5		Unit 6
					А	В	
Second time sorting	Not exist	Maybe exist	Not exist	Hire cleaners exclusively to do this	Not exist	Cleaners will do the sorting job	Cleaners has offered to do the sorting job
Superior attitude	Firm attitude, won't help with secondary sorting; only persuasion and guidance	Very little supervision and guidance	Only supervision, guidance and persuasion	No guidance and persuasion	There is supervision and guidance	No strict requirement for residents to do sorting	Very little supervision and persuasion

Resident recycling behaviour
At first, they were uncooperative and sorted the wrong waste; later they took the initiative to sort the waste and 90% of the residents can sort it correctly
At first only 30% of residents were proactive in sorting; the situation gradually deteriorated
Initially residents were uncooperative; then gradually improved and residents were highly cooperative and could sort correctly
Due to the lack of guidance on sorting, residents have been in a situation where they are sorting the wrong waste or not sorting it
Initially incorrect; later residents can sort their own waste and get it right
There has been no strict enforcement of sorting requirements and residents are much less sorted than in the A area
Initially there were cases of misclassification; later there were cases of non-classification

4.4.2.2. Weibo Data and Official Account Data

The corresponding results will be generated by entering the keyword 'Beijing rubbish sorting' into the search field of Weibo. As the purpose of this social media data search is to compare the actual perception of the public and the government on the waste sorting regulations and whether people's behaviour has changed, the period for the Weibo data search is six months of data collection starting in late April 2020 to mid-November 2020. This period covers the six months before and after the implementation of the waste separation regulations, allowing for a good comparison between the majority of netizens involved in recycling actions on Weibo and the official news on social media.

Among the Weibo accounts, there are also personal accounts and some official accounts of local government companies. In personal accounts, people expressed excitement and anticipation ahead of the implementation of the regulations, as well as actively learning about it and preparing the appropriate separation bins at home.

'Once back in the office, everyone's small bins have been taken away and replaced with mini sorting bins, the sorting bins in the building bathrooms have been replaced for a few days, the home block has been prepared, and the home bins have had to be replaced, and the food waste disposals have had to be arranged. '

-----Excerpt from private Weibo account 27th April 2020

It is clear that the government and the community have prepared for the sorting regulations and that infrastructure such as waste separation bins have been provided. This has created a certain level of readiness for residents to engage in this behaviour.

After four months, some netizens began to complain and report the behaviour of some units, mainly including the fact that waste separation required volunteers or community cleaners to carry out secondary sorting, that all kinds of rubbish were piled up near the rubbish bins and stank (Figure 4.49), and that some units were not even equipped with waste separation bins. Some netizens said that there were few waste drop-off points, and their locations were unreasonable. For example,

'After the classification of rubbish in the district, the rubbish points are reduced from 7 to 3, and for which the non-allocation is extremely unreasonable, and the rubbish truck can only collect part of the rubbish in the morning.'

-----Excerpt from private Weibo account 15th November 2020

'.....Plastic bags in the food waste bin and food waste in the recyclable bin, most general bins are also inaccurately sorted, and waste removal is not timely... Property owners don't care'

-----Excerpt from private Weibo account 6th September 2020



Figure 4.49 Images uploaded to Weibo by netizens

Although these complaints show that some communities are not managing waste segregation properly and that this is causing dissatisfaction among residents. However, it also shows that residents are positive about waste segregation and are giving positive feedback to the public about this unreasonable phenomenon.

The public official accounts on Weibo, both before and after the implementation of the waste separation regulations, are full of positive publicity and the remarkable results of the communities and the positive cooperation of people. For example, before 1 May 2020, the official Haidian News Weibo account, Civilised Chaoyang and the official Beijing Daily Weibo account shared how to separate waste and that Beijing had provided the appropriate facilities and was ready for waste separation. After 1 May, the official accounts continue to post positive and negative messages, such as

.... The community launched a waste separation campaign with more than 20 community staff, waste separation instructors and community residents····· (Figure 4.50)

-----Shanshui Huairou 5 May 2020



Figure 4.50 Residents are learning about waste separation. Image source from Weibo official account Shanshuihuairou.

In addition to posting about it on Weibo, Baidu and other websites will provide a search of the news about the progress of waste separation in Beijing

.....The sorting bins were placed in an orderly manner, and community residents were mainly able to accurately put their waste into the appropriate bins under the guidance of the waste sorting instructors.....

-----10 June 2020 Xinhua Title: 'Residents increasingly receptive to waste separation' (Guan, 2020).

·····Firstly, the quantity of food waste separated from households has increased significantly. Secondly, the quality of food waste separation is gradually improving. Thirdly, the rate of setting up bucket stations to meet the standard has further increased. Fourth, the rate of instructors on duty has increased significantly. Fifth, the rate of publicity and mobilisation coverage has increased significantly. Sixth, enforcement and inspection efforts continued to improve. Seventhly, the volume of other waste removal decreased significantly. Eight is the rate of problems declined to varying degrees. The problem rates of both enforcement inspections and municipal spot checks are on a downward trend ······

----- Beijing Municipal Commission of Urban Management 3 August 2020 (Beijing Municipal Commission of Urban Management, 2020)

As can be seen from the official accounts above, as well as the official webpage, most of the official news is reported as positive news, with the masses working together with remarkable results, a phenomenon described somewhat differently from the reactions of many netizens on Weibo. This, of course, has to be taken into account, as the official accounts see the data as an overall effect, while the personal views are only for the situation in the neighbourhoods where people live.

Despite the differences in the content presented on social media between personal and official accounts, the concern for waste separation is always in the forefront of people's minds. The majority of residents are able to do so and are opposed to any practices that do not meet the requirements. It seems that the government's and the community's advocacy efforts and the enactment of legislation have had a positive impact on waste separation behaviour. From the 6 units data analysis in section 4.3.2.1. and the opinions of social media users, it seems that if there is a strong effort to increase regulation and to deal with residents' feedback on sorting, the number of non-compliance will be reduced and the state of affairs as expressed in the official account will be achieved.

4.4.2.3. Social media thematic analysis

The data collected from social media include Weibo data, and Official account Data in the form of images, videos, messages and screenshots of relevant information, totalling 62 messages.

The keywords of the data were extracted to form the word cloud of Figure 4.51. It can be seen that the social media statements are both positive and negative and reflect different directions. Therefore, the data was categorised by attitude and topic of interest and coded in Nvivo. The data were summarised in table 4.4. These data were coded as positive, neutral, negative and mixed attitudes. Individual social media users tended to point out

the shortcomings of the facilities, such as the low opening hours of the bins, their unreasonable location and the low number of bins. Other positive messages were more about policy support and volunteer help. The numbers in the table represent total responses. The data in the table is shown below as bar charts illustrating the proportional relationship between them.



Figure 4.51 Social media data key words word cloud

Table 4.3 Attitudes of netizens, themes of feedback and the number of the messages

Attitude	Mixed		Negative		Neutral		Positive	
	(Total	5	(Total cases)	31	(Total	1	(Total	25
Themes	cases)				cases)		cases)	
Facility	Well	1	Bins have	2		0	Well-	4
	equipped,		limited				equipped	
	but limited		opening time				facilities	
	opening		Few bin points	6				
	time		and locations					
			are unidealized					
			Lots of rubbish	10				

			around bins Mixing and transporting waste away No sorted bins, people don't need to sort rubbish	2				
Support	Good regulation but needs second sorting	1	Formality	2		0	Good propaganda	3
	Things are improving but needs incentives and penalties	1	People are not conscious	3			Government Policy support	13
			Second time sorting	1			Voluntee r	5
People's behaviour	Want to get involved but too lazy to classification	2	Few people do the classification	4	People are conscious of sorting, but some of them don't do it right	1		0

However, in the process of collecting data, the researcher found discrepancies between online news reports of the recycling process, the remarkable results, the significant increase in public participation, and the experience of some of the interviewees. As can be seen from the bar chart below (Figure 4.52), negative attitudes accounted for the most data in the "Attitude" code, at 50% of the total. Positive attitudes accounted for 40.33%

of the total, mixed attitudes for 8.06% and those with a mixed attitude also brought up some inadequate remarks in the community. The remaining 1.61% of the data was neutral. Negative attitudes far outnumbered positive attitudes, so it is clear that the first six months of the waste separation process were characterised by complaints and negative attitudes, not by the government and some news reports. Of the negative attitudes data, 67.75% were reflected about the facility, 19.35% on support and the remaining 12.9% on residential behaviour (Figure 4.53).

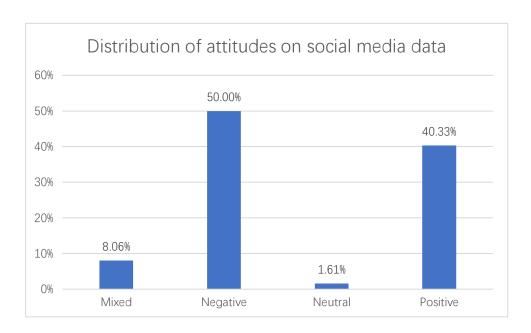


Figure 4.52 Attitude distribution of social media data

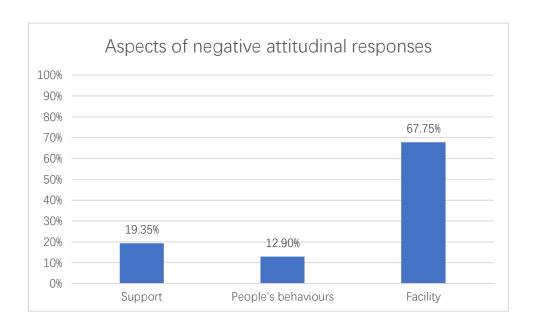


Figure 4.53 Aspects of negative attitudinal responses

Of the most common complaint about the facilities option (Figure 4.54), with 9.52% of residents saying that there were no waste separation bins in their neighbourhoods or that people did not separate their waste, 47.62% said that there was a lot of rubbish around the bins and 28.58% said that there were very few waste separation points in their neighbourhoods and that the locations were not easy to find or ideally. 9.52% of residents said that they sometimes go downstairs and find that the bins are locked at the same time and are not allowed to be used. Another 4.76% of the residents said that after the volunteers had sorted the waste a second time, the bins were still mixed with all kinds of waste. The data collected also showed a positive attitude towards the rubbish facilities.

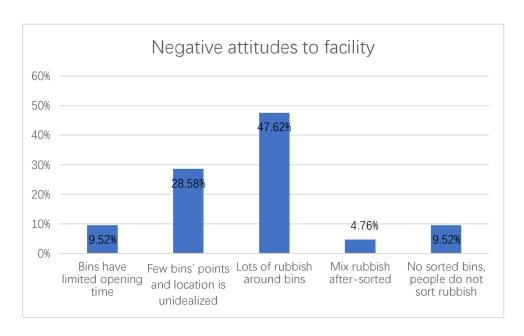


Figure 4.54 Aspects of negative attitudinal responses to facility

More than half of the positive attitudes are supported by government legislation, followed by volunteer assistance and excellent community facilities for waste segregation. At the same time, the remaining twelve percent are extensively propagandised. The positive attitudes are not as specific as the negative ones and are only appreciated extensively (Figure 4.55).

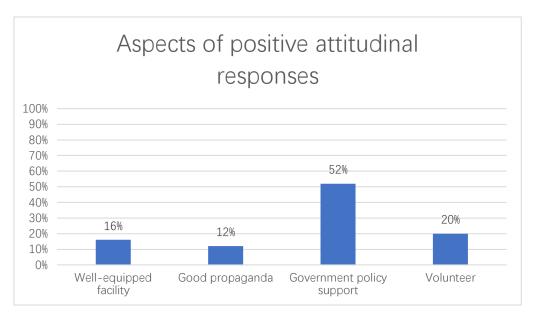


Figure 4.55 Aspects of positive attitudinal responses

When we compare the attitudes of official and public personal data combined, the negative attitudes are mostly feedback from personal accounts (Figure 4.56), but the positive attitudes are mostly from official news and messages published by accounts (Figure 4.57).

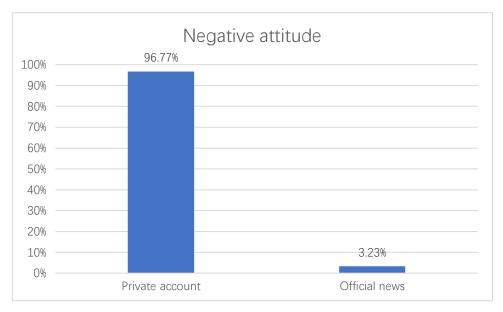


Figure 4.56 Negative attitudes toward social media data

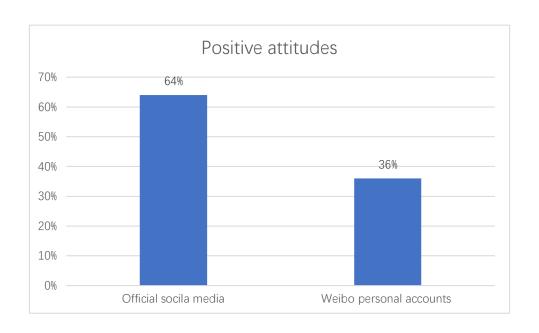


Figure 4.57 Positive attitudes toward social media data

4.4.3. Post-fieldwork Online interview

There were three interviewees who are tenants and residents living in the Commercial residential areas in Beijing. All three interviewees are aged between 25-30 years old and have been working in Beijing for 3-4 years, and none of the three interviewees is a local citizen in Beijing.

Commercial Interviewee No. 1

Interviewee 1, male, age 29, has been working in Beijing for three years and currently lives in a Commercial, residential area close to his workplace, one of the target neighbourhoods for this field survey. Before 1 May 2020, he had stated that the residents in this neighbourhood were still littering, and that the infrastructure was not equipped. Until 1 May 2020, he said that the bins were marked as to what kind of litter and that there was someone at the bins to give instructions and was there every day (Figure 4.58), and that he said that sorting was easy and that he would know how to do it when he got to the bins.



Figure 4.58 the segregated waste bins in the unit where interviewee 1 lives Photo by interviewee 1, 01/05/2020, Commercial residential unit

The photograph shows the bins being labelled with printed labels, from left to right: the recyclables bin, the general bin, and the food waste bin.

One month later, on 30 May, interviewee 1 said: "When there are a lot of people throwing rubbish in the neighbourhood, the supervisors are next to the rubbish bins to guide them, and during the day when there are fewer people throwing rubbish, they go there occasionally and take a clip to do a secondary sorting". Six months later, on 17 November 2020, interviewee 1 said reluctantly that "there are no volunteers or supervisors around the bins anymore, people just throw their rubbish away". One year after the implementation of the waste separation regulation, after another online interview with Interviewee 1 and asking him about the relevant issues of waste separation in his

neighbourhood, he said that currently, there is no one separating waste in the neighbourhood anymore, according to his observation. Although there is a supervisor sitting next to the bins, it doesn't make any difference; sometimes, the supervisor just tells him to throw the waste into the rubbish truck.

The commercial residential unit was well equipped with waste separation bins and supervisors to guide the sorting process when the waste separation regulations were first implemented. However, as the attitude of the volunteers changed and they offered to help with the secondary sorting, the residents' attitude towards sorting changed. In the later stages, very few people would sort their waste without a supervisor. This phenomenon seems to be related to the presence of the supervisor and the fact that the attitude of the supervisor also influences the sorting behaviour of the residents.

Commercial Interviewee No. 3

Interviewee 3, female, 30 years old, has been working in Beijing for four years and lives in a Commercial residential unit, three metro stops from her workplace. Before the waste separation regulations were implemented, residents living in the district did not practice waste separation. One week after the implementation of the regulation, on 7 May 2020, she said that the bins downstairs were the same as before. Nothing had changed, except that there were people sorting the rubbish next to the bins. She thought that "the district was not sorting the rubbish because the regulation had just started and it would take some time for some places to start implementing it, and it was also during the epidemic prevention period ". After six months, on 26 November 2020, interviewee 3 said the situation of waste sorting had not changed much; the act of sorting depends on people's consciousness, there is no help to correct the wrong sorting, and there are no fines, but there are always two sanitation workers doing secondary sorting", "At first there was someone to manage it and guide people to sort it, but now residents don't care at all". She says she doesn't sort her own rubbish either, as she finds it too much trouble, especially when ordering a takeaway. A year after the rubbish sorting regulations were implemented in Beijing, Interviewee 3 was contacted again, and she said that "no one was sorting rubbish early on, and people were only sorting waste for a few days", "but there were always two people at the bins, sorting, and it felt like they would stay at the bins for a day "She thought that the reason for no one sorting was probably due to the epidemic, which was not supervised very closely from the beginning, resulting in people not forming habits and eventually not caring about the matter.

Interviewee 3's community is in a special situation, because from the beginning it was not mandatory for residents to sort their waste and the community took the initiative to provide staff to help with secondary sorting. This side leads to the imagination that no one is sorting their waste and can lead to the perception that this knowledge of the legislation is false and not effective. Interviewee 3 also suggests that this could be due to Covid's reason that the community is mainly concerned with epidemic prevention and control. But in contrast to its community, this community has problems with its management.

Commercial Interviewee No.4

Interviewer 4, female, 31 years old, has been working in Beijing for four years and currently lives in a Commercial residential unit. However, this unit is predominantly local and has fewer tenants than others. When waste separation was first implemented, she showed the waste separation bins in the neighbourhood and mentioned that the facilities were complete (Figure 4.59). However, she did not see any instructors, although there were secondary sorters. She thought it might have been during the epidemic, and there were no instructors. Six months later, she said, "there was no supervisor next to the bins, but there was monitoring, and each house was given a small green bin for food waste, and then they took the bin and threw it into the big food waste bin downstairs and scrubbed their own small bin because the plastic bags could not be mixed into the food waste bin". "There were no supervisors, to begin with, and it was probably unsafe to have supervisors standing next to the bins during the epidemic". After a year, interviewee 4 said that "people now throw away their rubbish consciously and the bins are open all day" and that "most people sort their rubbish, but they don't sort it carefully enough, or

they don't sort it precisely as required.

The neighbourhood of Interviewee 4 is better equipped than other communities in terms of infrastructure for waste sorting, as they provide each household with a household waste separation bin to facilitate sorting. In the absence of a supervisor, residents were able to maintain good sorting behaviour in the early stages, probably partly due to the presence of mandatory regulations. However, in the later stages, there were some changes in residents' behaviour, and there was a lack of careful and incorrect sorting. Therefore, having a supervisor and increasing supervision can help residents to form good sorting habits



Figure 4.59 the segregated waste bins in the unit where interviewee 4 lives. Photo by interviewee 4, 01/05/2020, Commercial residential unit

The picture shows the waste separation information and slogans.

4.5. Providing capabilities-Removing external barriers data

4.5.1. Exited external barriers in the Pre-fieldwork

In section 4.3, mentioned the question 'Why don't you participate in waste separation

and recycling in your neighbourhood?' was mentioned. In addition to demonstrating the importance of the policy, it also reveals the additional barriers that exist in both units. As can be seen in Figure 4.28, 8.33% of residents in the Commercial residential unit and 16.28% of residents in Hutong residential unit chose 'I don't know how to separate recyclables. 1.67% of residents in the Commercial community and 6.98% of residents in the Hutong community chose 'There are no separation bins in the neighbourhoods where they live'. In addition, 27.91% of Hutong residents said that there are no waste separation bins at home either, the highest percentage of all options in the Hutong community. This question reflects the lack of complete infrastructure and knowledge of waste separation in both neighbourhoods before the regulation.

The lack of knowledge about waste separation is also evident in the question, 'What do you do when your household does not know how to separate an item? Figure 4.35 mentioned in section 4.4.1, shows that 15.38% of Hutong residents put unidentified items in the recyclable bin in the previous questionnaire, which is clearly a mistake and a lack of knowledge about waste separation.

In the pre-questionnaire, respondents were also asked about their knowledge of waste separation. The question was, 'which of the following items do you think can be recycled?' (Figure 4.60). This was a multiple-choice question where respondents chose could be recycled based on their own experience. As can be seen from the bar chart below (Figure 4.61), apart from the common items such as cans, books, paper shells and plastic bottles, which were chosen more often by the residents of both units. Other options such as batteries were chosen by 16.92% of the residents of the Hutong and 29% of the residents of the Commercial living community as being recyclable, and glass was chosen by 44.62% of the residents of the Hutong and 50% of the residents of the Commercial residential unit as being recyclable. However, both batteries and glass can be recycled. In addition, option H is classified as food waste. However, 7.69% of Hutong residents and 4.8% of Commercial residential neighbourhood residents chose H as recyclable waste.

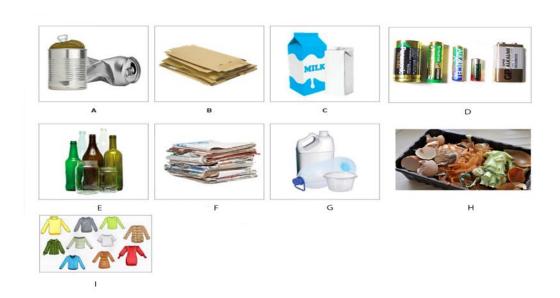


Figure 4.60 The question in the pre-fieldwork questionnaire

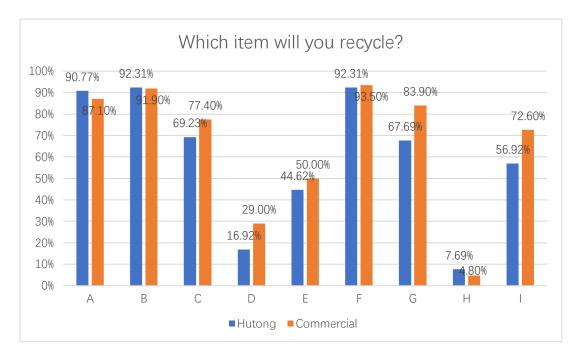


Figure 4.61 The recycling knowledge comparison between Hutong and Commercial residential units in pre-fieldwork

From the pre-questionnaire questions above, prior to the mandatory implementation of regulation, residents of the two research sites, Hutong and Commercial residential units lacked waste recycling facilities, such as segregated waste bins, or segregated refuse collection points. In addition, people in these two neighbourhoods lacked knowledge of waste separation. Figure 2.17's COM-B theoretical diagram demonstrates that these two

aspects are of equal importance in boosting people's capability and opportunity to adopt pro-environmental behaviours. Therefore, among the interventions, education and the provision of environmental infrastructure in the community are the main focus of waste segregation legislation. When people are provided with the opportunity (education) and the ability (facilities), coupled with the motivation to enforce regulations, this has a positive impact on residents' behaviour towards waste segregation. The implementation of the Beijing Waste Separation regulation also focuses on these two aspects, with community knowledge boards, online knowledge of waste separation, talks in schools, community events and the addition of waste separation bins throughout the city.

4.5.2. Removing external barriers in the post-fieldwork

The results of questions in the post-fieldwork questionnaire 'At present, is the unit equipped with sorted trash bins?' and question 'Is there an information board for popularising waste sorting in the unit?' show that the knowledge of waste separation and the availability of waste separation bins is very high (Figure 4.62). 87.80% of residents in the Hutong residential unit reported that they have waste sorting bins in their Hutong and all of the residents in the Commercial area reported that they have waste sorting bins. In addition, 91.46% of Hutong residents reported having a waste separation board in their unit, while 8.54% said they did not know if they had one (Figure 4.63). In the Commercial and residential units, all respondents indicated that there were boards for waste separation. In addition to the infrastructure, the distribution of volunteers can be seen in questions 'Is there anyone in the unit to help classify' and 'Do you think these people (volunteers) have improved your knowledge about recycling?'In the Hutong residential unit (Figure 4.64), 64.63% of respondents said that there were always volunteers around the bins to help with sorting. In contrast, in the Commercial residential unit, people said that volunteers were not always there, with 84.21% of residents saying that at first there were volunteers to help with sorting, then none at a later stage. However, a tiny percentage of inhabitants in both communities were unaware of the existence of

volunteers, indicating that they do not take waste separation seriously. In the Hutong residential unit (Figure 4.65), 80.49% of those interviewed said these volunteers helped to improve their knowledge, then in the Commercial residential unit, 26.31% of residents said the volunteers helped with their knowledge of waste recycling. Only 2.44% of residents in the Hutong residential unit and 10.53% in the Commercial residential unit said they did not improve their knowledge of sorting. Another interesting point is that 63.16% of respondents in the Commercial residential unit said that they did not ask for volunteer help, and only 17.07% of residents in the Hutong survey said that they did not ask for volunteer help. It seems that volunteers have a greater role in the Hutong residential unit, as there are more residents seeking help.

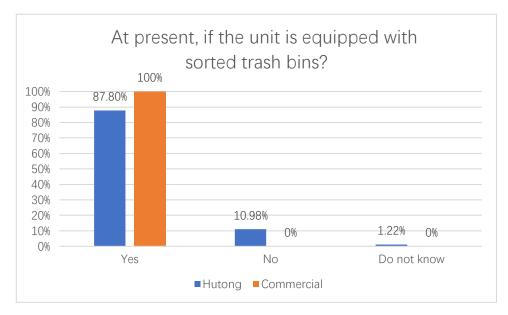


Figure 4.62 The comparison of the equipment in Hutong and Commercial residential units in the post- fieldwork

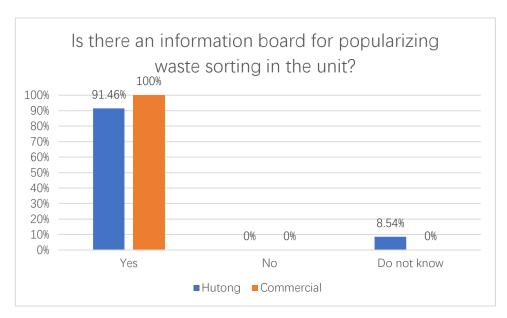


Figure 4.63 The comparison of the information board in Hutong and Commercial residential units in the post- fieldwork

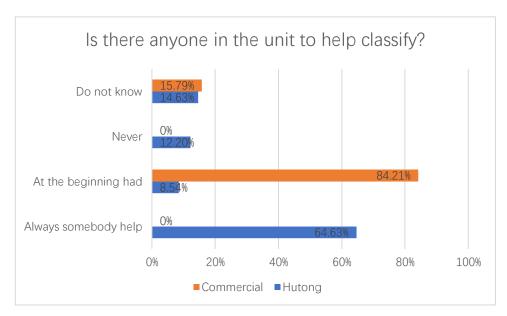


Figure 4.64 The comparison of the volunteers in Hutong and Commercial residential units in the post- fieldwork

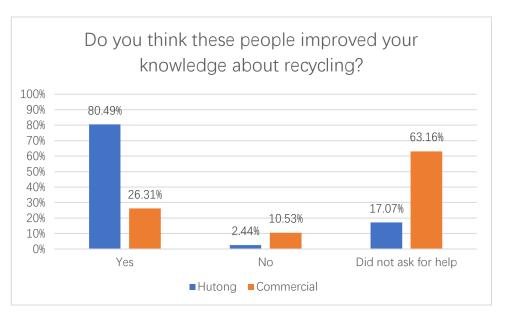


Figure 4.65 Do volunteers make a difference in Hutong and Commercial residential units in the post-fieldwork

In both the pre-and post-fieldwork questionnaires, the same question was asked, 'When your household is unsure an item is recyclable, what do you do?'. As a result of the implementation of the waste separation legislation, the Beijing government has requested that there should be instructors or volunteers in each community to help guide the sorting process and spread knowledge about waste separation, as well as monitor the process. Therefore, the option to ask about volunteers was added to the questionnaire at the post-fieldwork questionnaire, which revealed some changes in the views of residents in the Hutong residential unit on this issue. In the Hutong residential unit (Figure 4.66), the percentage of those who placed items in other bins remained almost stable, changing from 16.92% in the earlier period to 17.07% in the later period. The number of people who chose to search online also decreased, from 29.23% to 23.17%. In the post-survey questionnaire, 46.34% of residents chose to seek help from volunteers. A very interesting change is that 15.38% of residents chose to put their items in the recycling bin in the pre-fieldwork questionnaire. However, no one chose this option in the postfieldwork questionnaire. This shows that the popularity of waste separation and people's awareness of separation has improved. Of course, this does not exclude the explanation that the additional supervisors near the bins have led to a change in people's behaviour as they do not want to put their rubbish in the wrong bin. In addition to this, another noticeable change is the option of seeking help from neighbours, 35.38% of residents at the beginning preferred to ask their neighbours for help, yet only 1.22% chose to seek help from their neighbours in the later stages of the online questionnaire. This is understandable, as people had to keep a social distance and the number of times they went out due to the pandemic, and also in China, where the management of the pandemic was much stricter, only one person per household, at a time, can go out for daily necessities such as food. Thus, in the Hutong residential unit, there had been a big change in asking neighbours for help.

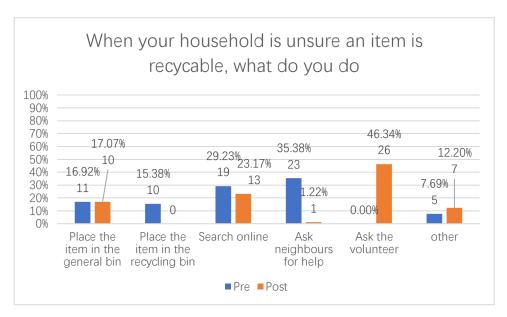


Figure 4.66 Hutong residential Unit Pre and Post comparison

In the post-questionnaire survey of the Commercial residential unit, the attitude of the majority of the residents towards the question 'When your household is unsure if an item is recyclable, what do you do?' also changed (Figure 4.67). The largest proportion of the options in the pre-questionnaire was searching online, with 70.97% of the total number of people, while in the post-questionnaire survey, only 21.05% of the residents chose to search online. The number of people who placed items in the general bin increased from 24.19% in the pre-period to 42.10% in the post-survey. In addition, 36.85% of residents chose the newly added option of asking a volunteer for help. But the option that

accounted for the smallest number of people in the earlier questionnaire, asking for help from neighbours, dropped from 19.35% to 0%. This is similar to the results of the late Hutong survey, both of which have dropped, and the cause of this cannot be ruled out as an effect of the Covid-19 pandemic.

Covid has had a significant impact on community sustainability, such as the proenvironmental behaviour of waste segregation studied in this thesis, not only by affecting
interactions between residents and reducing the social network of the community, such
as Hutong residential unit with strong social capital in the pre-fieldwork, but also by
reducing the focus of government and community attention on sustainability, such as
waste segregation, and shifting it to disease prevention and control. This means that there
is less regulation of sustainability and people are less pro-environmental. While this is
unexpected and uncontrollable, it is important to consider the impact of this unexpected
situation on the future sustainability of the community and to provide appropriate
solutions. In the Hutong community, for example, the staff of the elderly care station have
been providing knowledge to the community, providing daily services to the community
in a wechat group, and helping to maintain the community social network, so the
development of community social media is a solution to this situation.

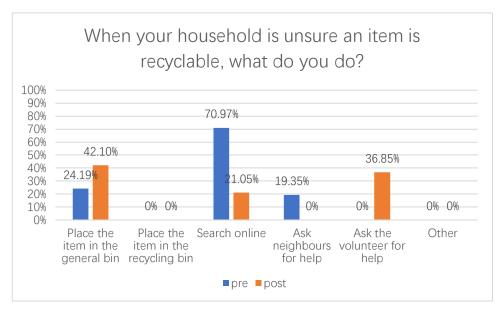


Figure 4.67 Commercial residential Unit Pre and Post comparison

To further compare the behavioural changes between the Hutong residential unit and the Commercial residential unit in the pre-and post-research on this question, and the differences between these four data. The four sets of data were put into SPSS for a Chisquare test, and the results are as follows:

1 Hutong Pre and Post fieldwork Choices comparison:

A chi-square test for association was conducted between pre-fieldwork and post-fieldwork in Hutong residential unit (Appendix 4-I). Most expected cell frequencies were greater than five. There was a statistically significant association between Pre-fieldwork and post-fieldwork', $\chi 2(1) = 69.492$, p =0.000. P<0.05. There was a significant relationship between the implementation of the waste separation legislation and the behaviour of Hutong residents towards waste separation, as shown by figure 4.65, which shows a change in behaviour for the better. At post-fieldwork questionnaire no participants chose to put items such as recyclables in the bins.

2 Commercial Pre and Post fieldwork choices comparison:

A chi-square test for association was conducted between pre- and post-fieldwork in the Commercial residential unit (Appendix 4-J). There was a statistically significant association between Pre-fieldwork and post-fieldwork', $\chi 2(1) = 36.656$, p =0.000. P<0.05. In the case of the Commercial residential unit, as in the case of the Hutong residential unit, there was a clear relationship with the waste segregation behaviour of Commercial residents before and after the implementation of the waste segregation legislation. There was also an improvement in behaviour, with no participants choosing to put unsure items in the recycling bins.

3 Pre-fieldwork data between Hutong and Commercial residential units:

A chi-square test for association was conducted between Hutong residential unit and Commercial residential unit in Pre-fieldwork (Appendix 4-K). There was a statistically significant association between Hutong residential unit and Commercial residential unit,

 $\chi 2(1) = 28.942$, p =0.000. P<0.05. The results of the data prove that the difference between the two sites in the pre-fieldwork has an impact on the residents' waste sorting behaviour. Residents of the two communities differed significantly in their preference for asking neighbours and searching online, with more Hutong residents choosing to ask their neighbours compared to over 70% of residents in the commercial residential unit who chose to search online. This may also be due to the different age distribution and social capital level of the two communities.

4 Post-fieldwork data between Hutong and Commercial residential units

A chi-square test for association was conducted between Hutong residential unit and Commercial residential unit in Post-fieldwork (Appendix 4-L). There was not a statistically significant association between Hutong residential unit and Commercial residential unit, $\chi 2(1) = 7.329$, p = 0.119. P>0.05. This data suggests that site differences did not have an impact on people's choice of waste sorting at the later stage of the study. There are several reasons for this result. Firstly, in the later data collection, there is no WeChat group in the Commercial residential unit like the one in the Hutong residential unit, and the neighbours are not connected to each other closely enough to send each other mobile phone questionnaires. As a result, there was a large gap in the amount of data between the Hutong and the Commercial residential units. In addition, after a few months of enforcing waste separation regulations in Beijing, people's behaviour towards waste separation has changed, and the proportion of waste separated has increased in all communities, and the pandemic also had an impact on people's behaviour. The combination of these causes the results of the post questionnaire weights to be irrelevant for the area.

In the post questionnaire survey, in response to the question: What do you do when your household is unsure if an item is recyclable? The highest percentage of respondents chose to ask a volunteer in both the Hutong unit and the Commercial residential unit (Figure 4.68), 46.34% and 36.85% respectively. In addition, the options to put the item in the general bin both increased, and the percentage of options to put the item in the

recycling bin was 0% in both the post-survey. In the post-survey, the proportion of residents in the two communities who chose to search online was more or less the same, 23.17% in the Hutong and 21.05% in the Commercial residential unit respectively.

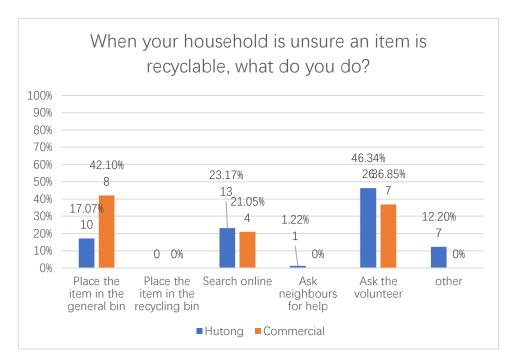


Figure 4.68 Hutong and Commercial residential units post-fieldwork data comparison

After the mandatory implementation of the waste separation regulations in Beijing, the research units have removed additional obstacles, including the infrastructure of waste bins, the popular version of waste separation, and the availability of volunteers and instructors. The behaviour of respondents in Hutong residential unit and Commercial residential unit settlements has changed to a varying extent; firstly, they have the help and supervision of volunteers to sort their waste correctly; in addition to this, knowledge of waste sorting has increased, in the pre-questionnaire, some Hutong respondents placed unidentified items in the recyclable waste bins, however in the post questionnaire, no one placed unidentified items in the recyclable bins. With the above data, it is clear that removing the barriers that exist can, to a certain extent, help people to develop pro-environmental behaviour and that over time this behaviour becomes a habit, even without supervisors.

5. Discussion

Based on the data and results, this section will analyse and discuss each of the factors found in this thesis that influence the formation of pro-environmental behaviour in the context of the research question.

From the research data in section 4.3.1, we can see that in the pre-fieldwork, when trash separation rules were not obligatory, the majority of inhabitants in both research communities claimed that they did not participate in separating their garbage. And from the pre-questionnaire, the question "Why don't you engage in trash segregation and recycling in your community? "is designed in accordance with one of the steps in the Community-based social marketing (CBSM)——Fostering sustainable behaviour theory, to identify barriers. We may characterise the participants' choices as barriers to the formation of waste segregation behaviours among residents. In other words, what factors prevent residents from participating in waste separation:

1 The impact of information and awareness of regulations, and effective communication with residents on pro-environmental behaviour

'I don't receive any information that I have to recycle items' in other words, I am not compelled to perform this behaviour. This option can be divided into the residents' knowledge of information on regulations, as well as their awareness of waste separation and effective communication between the government and the residents.

2 The impact of external barriers on pro-environmental behaviour such as availability and usability of facilities

'Don't have different recycling bins at home', 'Don't have recycling bins in the units' and 'Easier to use general bin' are examples of inconvenience and poor infrastructure, which can be categorised as external barriers to pro-environmental behaviour.

'I don't know how to recycle items' is a lack of knowledge about waste separation, which can be classified as an external barrier.

In addition to the two factors mentioned above, which influence residents' waste sorting behaviour, which corresponds to the thematic factors of this thesis, Governance and Infrastructure. There are some findings indicate that the social structure of the two communities, as well as the building structure and urban planning, impact the waste segregation behaviour of the inhabitants in both research sites.

In this chapter, the impact of legislation, incentives, social structure, community living space design, and the removal of external barriers on the development of waste separation behaviour is examined in detail.

5.1. Can Legislation promote pro-environmental behaviour?

After the mandatory implementation of the waste sorting regulation, the data in section 4.3.2 indicates that 87.8 percent of Hutong residential units and 63.16 percent of Commercial residential units highly agreed with the policy when asked how much they agreed with the garbage sorting regulation. In both research sites, engagement in garbage sorting has grown dramatically. The perspective that necessary rules may affect people's attitudes and behaviours is compatible with that of Li et al., (2020) and Wan, Shen and Yu (2014). They believe that mandatory waste separation policies have a positive impact on people's behaviour towards waste separation and their willingness to separate waste.

5.1.1. Are mandatory laws deterring or voluntary?

In the pre-fieldwork questionnaire, when participants were asked why they did not engage in waste segregation practices, 88.33 % of Commercial residential unit residents selected that they had not been informed that they were required to segregate their waste. This option was chosen by 20.9 % of Hutong residents, making it the second most prevalent reason Hutong people did not participate in trash separation behaviour. It is evident that initially, residents did not have this sense of ownership to implement waste

segregation, but after the implementation of the mandatory legislation, people's behaviour changed either through a genuine subjective change in attitude or a change in behaviour due to the deterrence of the law. This may also explain the locals' ambivalence when asked, "why do you engage in the waste classification?" According to the statistics, every participant selected to join willingly in environmental protection. However, 42.11 % of occupants of Commercial residential units said their participation was involuntary due to the mandated character of the legislation. This involuntary attitude may have also contributed to the occurrence of random tossing of waste seen by the post-fieldwork interviewers. Some researches (Hao, Zhang and Morse, 2020) argue that mandatory regulations may have a negative effect on waste separation and that teaching, and guidance should be the main focus. Other researchers (Jiang, Wang and Lan, 2021) believe that voluntary environmental behaviour should be recommended in conjunction with mandatory regulations.

5.1.2. Penalty system

Beijing has made the act of waste segregation a legal action that everyone needs to comply with through the Beijing Municipal Regulations on the Management of Domestic Waste, with residents who fail to comply punished by the act of fines. However, just 4.11 % of Hutong inhabitants said that they would do so because of the penalties. We do not know whether this is the genuine attitude of the people, or if they are only attempting to seem to be good citizens by willingly participating in trash separation operations, regardless of penalties and the law. In reality, this regulation fine is meaningless for people, and the government does not in reality enforce the fines on individuals. There are only four reports on penalties issued by Chinese news websites, including 739 individual fines and 4,940 written warnings in the first half of 2021 (Zhan, 2021). From June 2021 until mid-2022, there is no information on specific fines. There are no records of persons receiving fines in the research sites and six case studies on the Blue map. Although Beijing has a clear penalty system, it is not really implemented, and as a result, residents believe that they do not receive punishment for their violations, making the existence of such a penalty system a mere decoration, which does not serve as a real

restraint. Nearly two and half years after the enactment of the law, it was discovered that Commercial residential units did not have a high rate of trash separation and were not mainly motivated to recycle. This phenomenon was also evident in the responses of social media users (Weibo), the majority of whom felt that when the regulation was initially established, individuals only complied for the sake of appearance, and no one afterwards insisted on doing so (Figure 5.1). The change in residents' sorting and recycling behaviour started from a fear of legal deterrence and ended in a lack of strictly enforced penalties. Since the regulations clearly want to restrain behaviour through a system of fines, the government should step up its monitoring efforts with relevant regulators to inspect and enforcement should be stepped up as well. However, Doris Knickmeyer contends (2020) that penalties may also encourage citizens to adopt a rebellious attitude and discourage recycling habits. Some experts (Meng et al., 2019; Zhang et al., 2022) recommend using both incentives and penalties to promote residential recycling behaviour. In section 5.2, the function of incentives will be examined in depth.



···I know that many neighborhoods in Beijing simply don't care, and people still litter casually··· After that, I also mixed up the littering as well



···Beijing's rubbish sorting seems to be dead···the reason is that there is no supervision and no fines and the sorting methods is too complicated···

Figure 5.1 Screenshots from Weibo of users' thoughts (Image source Screenshot from

5.1.3. Combining top-down and bottom-up approaches to managing proenvironmental behaviour

China's legislative procedure for the separation of domestic solid waste has been led by the central government (Wang and Jiang, 2020). Before the official implementation of waste separation laws, Beijing had an open citizen hotline and website to solicit ideas from the public. However, there is no change between the draught version of the regulations and the final regulations. This could be classed as simply symbolic engagement by the public or could indicate either that the engagement was not taken up or no useable ideas were provided. Real public engagement seems to occur during the phase of implementation, in which the duty of people is to comply with national policy and the public must sort garbage in an orderly way to avoid fines. The Chinese tradition, and compliance with the regulatory attitude, have led China to adopt a non-public participation approach in the environmental field (Wang and Jiang, 2020). Some scholars suggest that a bottom-up approach to environmental policy would be more conducive to the formation of pro-environmental behaviour (Wang and Jiang, 2020; Jans, 2021; Martire et al., 2022). When used with the public, the bottom-up strategy will raise the people's awareness of environmental initiatives, as well as the environment's perceived value and pro-environmental identity. Individuals see their function within the group and continue to strive for it as a result of this form of public involvement. Moreover, through reciprocal psychological contacts, a small group progressively impacts the whole community and civilisation (Jans, 2021). For example, in the council chamber of the Hutong residential unit, mentioned in section 4.4.1. Residents are able to discuss and make decisions together on matters large and small. This provides an opportunity for public participation in the community, which is a bottom-up opportunity compared to commercial residential units. In addition, the daily activities of the elderly care centre also provide a good opportunity for local residents to interact with each other and increase

the social capital of the community.

Both top-down and bottom-up management systems are available to promote the development of pro-environmental behaviour. Top-down is a coercive type of management, and bottom-up is a voluntary type of management. In China, however, it is not appropriate to rely exclusively on bottom-up policies, as relying entirely on the public to negotiate their own management system may result in uncontrollable events occurring. Therefore, a combination of top-down and bottom-up management systems complements each other and is appropriate for China's development (Figure 5.2). The government is leading the overall direction and allows the public to actively participate in environmental decisions, which can place social unrest and also promote solidarity (Jans, 2021). Citizens can also provide suggestions to allow policy makers to take the situation into account, depending on their own communities.

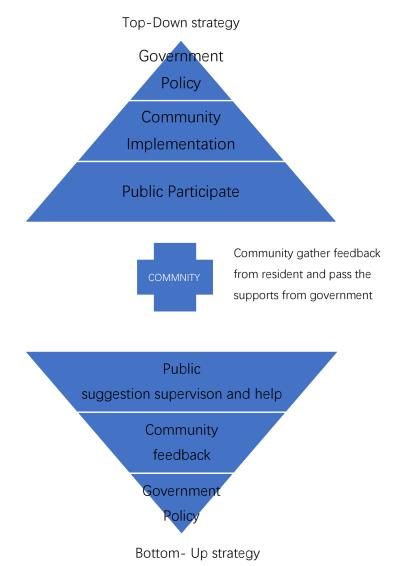


Figure 5.2 Top-Down and Bottom- Up strategy (Cartography: author)

5.1.4. The role of social media in determining what people believe in and want

Following the implementation of waste separation regulations in Beijing, the internet and television news have reported some positive results. For instance, the data collected from the official social media account in section 4.4.2.2 (Beijing Municipal Commission of Urban Management, 2020) demonstrates the active participation of citizens, a 93.2 % installation rate of sorting containers, a public awareness rate of over 80 %, and a 97 % campaign participation rate in residential areas. In addition, the statistics published on the official website of the People's Government (The State Council, The people's republic of China,

2021) shows that residents have a waste separation awareness rate of 98 %, a participation rate of 90 %, and an accuracy rate of 85 %. However, according to the Nvivo data in section 4.4.2.3 50 % of public social media accounts had unfavourable sentiments regarding the status of trash separation in their neighbourhoods. This is complemented by images depicting comparable circumstances, including the fact that people continue to place mixed rubbish at the bin points, the distance and opening rate of the sorting bins, and secondary sorting. This may be because residents are more inclined to post when they see a problem, but seldom report when they observe compliance with waste separation requirements. However, this honest reaction obviously makes us doubt the data and information sent out by the official accounts. Because the official version does not disclose how the data is collected and how the indicators are calculated. The attitude of netizens towards waste separation and recycling has shifted from one of positivity prior to the implementation of regulations to one of dissatisfaction with the facilities in the early days after implementation, and by 2022, checking social media once more, the attitude of some netizens towards waste separation and recycling has deteriorated to apathy and laziness regarding sorting. As citizens' excitement for garbage separation wanes, their behaviour progressively reverts to what it was before the implementation of the law. This issue also happens at the study site's Commercial residential unit, where occupants are now less inclined to sort their garbage proactively. Part of the reasons for this phenomenon is the lack of government and community support in the later stage after the implementation of regulations, which includes waste segregation guidance, reminders and infrastructure. This view is in line with Jürisoo, Lambe and Osborne (2018). who contend that social support is the intervention component that has the most influence on the behaviour modification process. In sections 5.5.2 and 5.5.3, infrastructure and the role of volunteers and supervisors will be examined.

Residents expressed their opinions on social media and mentioned the official accounts of the government and administration in an effort to address the phenomena stated. By participating in such public involvement and conversation, it is evident that the majority of people engaging with recycling provision on social media desire to be actively

engaged in garbage separation and recycling from the onset, but the material supplied by residents challenges the favourable status presented by the government and official social media. It would have been preferable if the government had aggressively addressed the concerns voiced by the residents at this time, so that the people might have felt that the government was making an effort and that they were participating in the management. This might be an effective method of public participation in the present Covid-19 situation.

5.2. What role do Incentives play in influencing proenvironmental behaviour?

Incentives data discussion

As can be seen from the post-study questionnaire in section 4.3.2, 100% of respondents in both communities chose to voluntarily participate in waste segregation following the mandatory implementation of waste segregation regulations. However, it is interesting to note that while choosing to participate in waste segregation voluntarily, only 4.11% of Hutong residents also chose to through fear of being fined. It is clear that fines do have an impact on the behaviour of a small proportion of respondents, albeit against their 'voluntary participation' option. Nevertheless, from the literature review in section 2.2.7, we know that incentives are not only about fines, but also about rewards. There is no direct data on financial incentives in this thesis research, for two reasons. Firstly, in the Beijing Municipal Regulations on the Management of Domestic Waste, there is no provision for rewards, but rather a very detailed description of fines for failure to separate. In addition to this, although the measures for fines are clearly marked in the regulations, there are no residents who have been fined in the two residential units so far. This can be concluded from the interviews in section 4.3.2, as the residents in the Commercial residential unit started littering casually at an early age and did not comply with the regulations, and the residents in the Hutong community have similar littering, but also have cleaners to help sort and clean up. Therefore, it is not possible to directly prove in

this study whether fines can directly change people's pro-environmental behaviour. However, from the data analysis, it can be found that fines can change some people's attitudes towards waste separation due to the fear of being fined. This view is in line with Amini, Ahmad and Ambali (2014), who found in their study that penalties have a substantial impact on behaviour related to perceived waste recycling by residents, and therefore suggested the design of penalty-based regulations and intervention policies increase people's intention to recycle.

In previous scholarly research on pro- environmental behaviour interventions, the rewards in incentive are often referred to rather than penalties, as in the example mentioned in section 2.2.7. Thus, the policies studied in this thesis have been framed as being more concerned with the punitive component of incentive. Even though in figure 4.17 only 4.11% of Hutong residents chose to carry out the act of separating rubbish for fear of fines, this is partly a social desirability issue, as discussed in section 3.8, because in the Chinese context people will not discuss sensitive topics too much. However, penalties like fines seem to have an impact on people's behaviour. In Figure 4.38, the Blue map app data shows that around one month after the implementation of the waste sorting regulations, when the Covid situation is getting better in China, 55% of the community is classified. In addition, Commercial interviewee 1 and interviewee 4's interviews in section 4.4.3 also indicated that in the first month, residents could engage in proper waste separation behaviour. Such penalties are a motivation for people to change their behaviour, and in China they are used to change people's behaviour through monetary fines and even prison sentences, for example, drinking and driving penalties include suspension of driving licence, fines and up to 6 months detention (Liu, Chui and Deng, 2021), supermarket shopping bags are changed from free to paid (Wang and Li, 2021). Thus, the appropriate use of penalties in incentive is feasible for changing proenvironmental behaviour. But only if there is greater government and community oversight to ensure that unsustainable practices are informed, or penalties are raised in a timely manner.

Dynamic impact on waste separation regulation

However, a number of scholars (Dahlén et al., 2007; Shaw and Maynard, 2008; Zhou et al., 2021) have suggested that economic rewards incentives are an important factor in influencing waste separation behaviour and have conducted experiments and implemented policies in many countries such as Sweden (Dahlén et al., 2007), Bangladesh (Matter et al., 2015) Singapore (Fan, Yang and Shen, 2019), etc. We can therefore believe that incentive is a positive factor influencing recycling behaviour, however, there are some scholars who have raised questions (Van Der Linden, 2015; Ghesla et al., 2020; Li et al., 2021; Y. Li et al., 2021) as to whether people will continue to recycle once the financial incentive has been removed. These scholars believe that once this 'incentive' is removed. people's behaviour reverts to what it was before the intervention policy was implemented, or even worse. In a study by Li et al., (2021) in a Hangzhou community, it was found that when waste separation and recycling behaviour had formed pro-environmental behavioural habits in the presence of incentive, 80% of residents continued to carry out waste separation and recycling behaviour even when these incentives were gradually reduced after 12 months. This is a good thing for policymakers, as the government cannot keep relying on financial incentives as the basis for universal waste separation behaviour, which would be too much of a financial strain on the government and could ultimately lead to failure. Therefore, the use of incentive can be a combination of penalties and rewards.

Suggestions for incentives method

In terms of what unit is used as an incentive, it is currently evident from previous scholarly research that it can be categorised as a community-based incentive, a household-based incentive, or an individual-based incentive (Shaw and Maynard, 2008).

Community-based incentives, for example, in the England Recycling Incentive Pilot Scheme (Shaw and Maynard, 2008), many communities received cash incentives and the funds were used for construction and infrastructure improvements, some of which were used to build schools, and some of which chose the beneficiaries to be charitable

organisations or charitable activities. This approach can only be implemented when there is a strong sense of community belonging and a strong social network between residents, after all, it is through the joint participation and efforts of all that the funds are received. In China, the definition of community differs from that of the West, since the community is predominantly in the form of residential units, where the schools around the community are funded by the government, and the residents are not willing to contribute to the community for reasons that are not in their interest. Each residential unit has its own property management company, and residents simply pay property management fees; they are not required to pay extra for facility upgrades. Residents living in the higher-end residential units will pay more for the management fees and will also enjoy higher amenities and facilities. Residents living in the more upmarket residential units will not have to make as much effort for the communal resources themselves, as they do pay a management fee, and there is no guarantee that all residents will make a concerted effort to upgrade the community's infrastructure. As a consequence, people do not upgrade the community's infrastructure since they assume it is covered by their property management fees. Therefore, it seems that this form of incentive is not applicable in Chinese communities.

Incentives on a household basis are an approach being used in the United States and European countries. Pay-as-you-throw (PAYT) schemes offer financial penalties and incentives based on the amount of residual waste collected by each household (Shaw and Maynard, 2008). In Oostzaan, the Netherlands (Linderhof et al., 2001), for example, after three years of using the PAYT scheme, the total amount of waste collected per year fell by 42%, and non-recyclable waste was reduced by 56%. A prerequisite for the implementation of this incentive is that the form of housing needs to be a house rather than a flat, as PAYT is based on the weight of waste in the curbside bin outside the home, which may be easier to implement in western countries as residents tend to choose the house option. However, in China, unless a very wealthy family decides to live in a house, most city dwellers live in high-rise flats, and it is not possible to have a segregated waste bin in front of every household. In addition, many of the tenants in Commercial residential

units like the one in this thesis are shared tenants, and it is difficult to ask them to do waste separation together with a low-intensity social network.

Receiving incentives as an individual is one of the most common ways in which scholars have conducted research on incentive and pro-environmental behaviour in Chinese communities. This is also the incentive method chosen by Beijing's waste separation legislation, which is to fine individuals. The direct stimulation of individual environmental behaviour through rewards can have a considerable positive impact (Lu and Wang, 2022). In Guangzhou, China, a residential community has adopted a new type of electronic waste bin (Li, 2020), where residents first register for an account online, and then each time they put out their waste, they can use a QR code scan, or face recognition to log in, at which point the side of the bin will open, and after putting it out, the bin will automatically be weighed and displayed on an electronic screen, where different types of waste can be redeemed for different points, and the points are displayed on the resident's mobile phone account. With face recognition and mobile phone payment applications now common in China, it is possible to link waste collection points to mobile phone payments such as WeChat pay or Alipay (similar to Apple pay). However, before this intervention can be implemented, the government will need to consider the price of the different types of waste and the overall cost, and it will also be expensive for the government to put in place such a high-end waste collection system.

5.3. Can Social structure influence pro-environmental behaviour?

Social structure data discussion

The social network in both communities in section 4.4.1 and the number of respondents participating in waste segregation in the post-fieldwork questionnaire in section 4.3.2, do not provide direct evidence that social capital is a significant factor in changing waste segregation behaviour. The data from the post-fieldwork questionnaire shows that 100%

of the Commercial residential unit respondents were involved in the act of sorting waste for recycling. However, in the Hutong community, there were still 10.98% of Hutong participants who chose not to participate in the act of sorting. For this, we cannot exclude the relatively large difference in the amount of data collected in the two communities. The number of people who participated in the questionnaire in the Hutong residential unit during the post-fieldwork was 82, while 19 individuals participated in the questionnaire in the Commercial residential unit and compounded by the influence of Covid on the results of the study.

Based on the post-questionnaire data from section 4.3.2 and interviews with two residents living in different neighbourhoods, we can see that the current level of waste segregation behaviour in both neighbourhoods, with the Hutong community adhering a little better than the residents in the Commercial residential unit, and that more people continue to segregate their waste than in the Commercial residential unit. Although the Commercial residential unit had a higher level of participation when waste separation was first made mandatory, it is important to consider the current behaviour of the population over time.

Dynamic impact on waste speration strategy

In this thesis, two residential units with different levels of social capital were chosen based on the hypothesis of the factors that influence pro-environmental behaviour in order to observe the changes in the residents' pro-environmental behaviour of the two residential units. From collected data, we can determine that the social network of the Hutong residential unit is more robust than that of the Commercial residential unit, and we can draw conclusions based on the data of greeting and calling out the names of neighbours in section 4.4.1 as well as Hutong interviewee 1 and 2 and Commercial residential unit interviewee 1, and 2. In addition, Hutong respondents were more likely than the Commercial residential unit interviewees to recommend garbage separation to their neighbours.

From the above data, we hypothesise that social capital may encourage proenvironmental behaviour, which is partly supported by the fact that social capital has a favourable effect on pro-environmental behaviour, and the stronger the social network, the bigger the effect. This view is in line with Macias and Williams (2014), Rugel et al. (2019) and Hua, Dong and Goodman (2021). High levels of social capital can effectively promote pro-environmental behaviour represented by waste recycling behaviour with a direct, positive impact (Li et al., 2019; Hua, Dong and Goodman, 2021). In addition, the building form of the Hutong residential unit is a one-storey cluster of single-family houses, while that of the Commercial residential unit is a high-rise multi-building cluster. In the contract that the building form is a factor in the formation of pro-environmental behaviour and social capital of the residents, which is in line with Gifford (2011), Kearns et al. (2011), and Nguyen et al. (2020). They suggest that in addition to the impact of living in a high-rise residential area on residents' waste separation and recycling behaviour, there are negative consequences on residents' psychological health, community satisfaction, neighbourhood interactions among community inhabitants, and social networks. More information on the effects of building form on pro-environmental behaviour and social capital will be discussed in section 5.4.

Suggestions for forming strong social capital

How to form a strong social capital? First, there needs to be community trust. A high level of trust promotes collective action to protect the environment (Cho and Kang, 2016). However, a dense social network is one in which members are more trusting and more willing to help each other. A dense social network is a social network that is formed within a community through acquaintance and communication. The more people each resident knows in the community, the denser and more intertwined the social network of the community becomes. The data from section 4.4.1 reveals that residents of the Hutong community, with a denser social network within the community, know far more people than residents of the Commercial residential unit. And from interviews with residents of both communities, we found that residents in the Commercial residential areas trust their neighbours less than those in the Hutong community.

We also found an interesting situation in the research. The majority of people living in the Hutong community are middle-aged and elderly, almost retired from their occupations and have a lot of free time to go out and hang out and participate in activities. In contrast, the majority of residents in the Commercial residential areas are middle-aged and young-aged, working most of the day and even working late at night, and do not have time to socialise with their neighbours, which has a negative impact on social capital relationships. Thus, the amount of free time residents have is a possible factor in the production of social capital; when they have sufficient free time, they will concentrate on more community activities, community socialisation, getting to know their neighbours, and creating trust. Although there are direct and indirect factors that influence the strength of social trust, social trust is a core element of social capital (Jones, Halvadakis and Sophoulis, 2011), and social trust has a positive effect on communities practising pro-environmental behaviour.

The second is a sense of belonging, which develops when there is social trust. Residents who have a strong sense of belonging to their community are more likely to engage in private environmental action and public environmental action (Takahashi and Selfa, 2014; Cho and Kang, 2016). Takahashi and Selfa (2014) used being in a place to determine community attachment by the time spent living there in their study. From the prequestionnaire and interviews, we can know that most of the Hutong residents are local residents, have fewer tenants and have typically lived in the area for a long time. In contrast, the residents of the Commercial residential area, most of whom are tenants and have a one-year lease contract with the option to renew or move elsewhere after the expiry of the contract. In China's first and second-tier cities, with their developed economies and high population mobility, and where there are many opportunities for development, people from cities all over the world will come to work for their future lives. However, because first and second-tier cities' housing prices are so high, there are many long-term rental flats that exist, typically on one-year leases (Zhao, Liu and Cheng, 2018). Therefore, renters in the Commercial residential communities will now remain for a

shorter amount of time than owners, and it is possible that tenants will move to a new residential unit after one year due to job transfer or salary adjustments. The evidence in this thesis indicated that residents of the Hutong residential unit have a stronger sense of community belonging than those in the Commercial residential unit. According to the statistics in section 4.4.1, Hutong dwellers are more likely to encourage their neighbours to participate in garbage separation and recycling. Therefore, the sense of community belonging can influence the pro-environmental behaviour of the community, and there is a positive relationship.

Finally, there is public participation. Community development is the process of making full use of the creativity of the community and promoting its progress through the active participation of the residents (Paul, 1987; Zhang et al., 2020). Therefore, the participation of the residents is an important factor for the protection and management of the community, because the residents, as the beneficiaries in the community, need to be involved in co-management or participate in the discussion. For the act of separating waste for recycling in the community, it is a low-cost pro-environmental act that is more acceptable to residents than pro-environmental acts that require special equipment (Hua, Dong and Goodman, 2021). In China, low cost is also a very essential aspect of promoting pro-environmental behaviour, where people do not have to spend too much to assist improve environmental conditions; this concept is proposed in section 6.5 for the development of communities in China. Residents in the Hutong residential unit are far more engaged in the activity than those in the Commercial residential areas, and in the Hutong residential unit, community events are often organised, and community representatives are invited to discuss and study the corresponding regulations for issues in their community. During the pre-fieldwork research, we announced a workshop on waste sorting in the Hutong community via a WeChat group, and residents signed up to attend. In contrast, in the Commercial residential communities, there are no media to post the news, let alone get residents to attend and participate in the discussion. Certainly, we cannot rule out the possibility that this is due to the fact that the residents of the Hutong residential unit are older, almost retired, at home, and have a great deal of time to participate in activities. However, in Hua, Dong and Goodman's (2021) study, their data showed that community residents aged 60 years and above are less involved in community activities, which they analysed because of mobility, i.e., physical ability, even though they have established a strong social network and social trust, however, their study is a combination of a China-wide web-based questionnaire and on-site research in high-traffic places, with just 1.2% of participants aged 50 or older, which may result in findings that vary slightly from those presented in this thesis. In this thesis, over 92% of the residents in the Hutong community were over 55 years old and were very involved in community activities and building, and when they participated in activities or signed up, they brought their neighbours and friends with them. It is this mutual exchange and learning that strengthens the social network of the community, meaning that social trust, social belonging and social participation are interlinked and mutually reinforcing, and that quality social capital relationships and social trust are more likely to promote residents' interest in the community. When all three become better, residents are likely to participate actively in community building. Consistent with Ma, Gong and Li (2019), Cho and Kang (2016), and Hua, Dong and Goodman's (2021), when a strong social capital is established, it will more effectively promote integration across communities and increase inhabitants' desire to participate in pro-environmental behaviours. The participation of Hutong residents in activities, such as the elderly station activity room designed specifically for Hutong residents, provides the foundation for fostering social capital among residents. The unique form of the public space in the Hutong residential unit also contributes to the social capital of the Hutong residents. The influence of architecture and spatial form on social capital will be discussed in more detail in section 5.4.

However, in the process of forming social capital, when uncontrollable factors such as the Covid epidemic occur, social capital is bound to be affected. In the course of this study, which was happened before and after the Covid epidemic. In the pre-fieldwork, Hutong residential unit had strong social capital, and the community residents used to move around together and communicate in the eldely care centre. Then in the post-fieldwork, when investigating about social capital, even in the Hutong residential unit with strong

social capital, residents rarely chose to ask their neighbours about waste separation. The need for residents to be isolated in their homes during this period due to epidemic prevention regulations also reduced their daily interaction and activities. This also potentially affects the formation of social capital, even in a neighbourhood with a strong social capital ethos. However, unlike the commercial residential unit, the Hutong residential units continued to socialise with older residents during the Covid epidemic through wechat groups or live streaming, spreading awareness of epidemic prevention and other health issues. To a certain extent, the social connections of the community were maintained. However, in the Commercial residential unit research, no activities were found to maintain social capital, which is also the state of Chinese communities in the face of covid disease. Therefore, in the future, when similar illnesses occur again, social capital levels could be enhanced or maintained by establishing a social media presence in the community to connect with residents.

In most Chinese communities today, the social network among residents is significantly weaker than the relationship between neighbours in the previous Danwei period (Zhao, 2014), particularly in the new residential communities in cities, where the trust of community residents is low, and their participation in community activities is also poor, both of which are highly influential in building a strong social network and promoting pro-environmental behaviour. Modern Commercial residential communities, despite their modernised setting, have a substantially lower feeling of community belonging than inhabitants of older traditional communities, according to the Guangzhou case study in section 2.1.4.5. The progressive deterioration of neighbourhood social conditions, behaviours and relationships is one of the most significant issues facing Chinese residential communities today. It is crucial to investigate how to strengthen the social trust, social belonging, and social involvement of residents of contemporary residential communities, if pro-environmental behaviour is to be fostered within the community by strengthening social capital.

5.4. How does Community urban plan influence proenvironmental behaviour?

The two study locations of this thesis reflect two typical architectural forms of Chinese residential communities: the Hutong residential unit is a traditional Chinese historical building type characterised by low-rise structures, courtyards, and roadways linking the dwellings. The Commercial residential unit is the architectural form that has been used in China since the 1990s, gradually transitioning from a system community to the current Commercial residential unit, except that the height of the building has gradually become higher over time and with the development of the economy. And the number of facilities within the residential unit has increased, but the fundamental reason for this is that the "Urban Residential Planning Standards" (2018) issued by the Chinese Ministry of Housing and Urban-Rural Development mandates that the height of buildings and the number of facilities within the residential unit must increase.

It is evident from the post-fieldwork two interviews in section 4.3.2.2 that those residents of the Commercial residential unit in high-rise buildings are less likely to practise waste separation than residents of Hutong residential units in traditional neighbourhoods. In China, it is more challenging to continue recycling behaviour in a high-rise or superhigh-rise residential neighbourhoods. This finding is consistent with the Guangzhou, China, investigation conducted by Jia and Luo (2021). In addition, the statistics on greeting neighbours and naming out their names in section 4.4.1, as well as the Hutong interviewer No. 1, No. 2 and Commercial residential unit interviewer No. 1, No. 2, indicate that the social network of the Hutong residential unit is stronger than that of the Commercial residential unit. In accordance with Forrest's (2007) perspective, traditional neighbourhoods have a better environment and are more interconnected than contemporary residential communities. As cities expand and we shift from historic to Commercial neighbourhoods, social networks, connections, and trust tend to decrease (Forrest and Yip, 2007b). Moreover, according to the discussion in Section 5.3, the social

network is positively associated with pro-environment behaviour. Designing the physical and spatial aspects of a community to strengthen neighbourhoods and social networks is an important part of achieving sustainable community development (Karuppannan and Sivam, 2011). Therefore, a critical challenge for planners and architects is how to strengthen the social network of community members in terms of the architectural form of the residential area, to help build social capital, and so help promote proenvironmental behaviour, such as residents' waste separation behaviour. This topic will be explored in more detail below.

5.4.1. Road layout of the residential unit

Road layout data disscussion

As shown in the Hutong residential unit layout in section 4.1.1, the roadways in this neighbourhood are arranged in a grid pattern and connect the various households, with the narrower alleyways being passable only by pedestrians or bicycles, and the wider alleyways being passable on one side. Interestingly, there is no parking space inside the Hutong residential unit in this thesis, since the majority of the lanes are just around 4 metres wide, and residents of the Hutong choose to ride electric bicycles or tiny mobility scooters and park their automobiles in the yard. As a consequence, the majority of Hutong's people would like to travel the neighbourhood on foot. The grid-like roadways of the Hutong residential units contain several junctions, providing inhabitants with numerous chances to meet and greet one another and enhancing the sense of interest within the community. In contrast, the Commercial residential unit has a street design that extends along the entryway of the high-rise buildings, followed by several walkways connecting to the public area downstairs. The roads in the Commercial residential units have a cul-de-sac and curved layout. Each building has its own walkway leading to the shared space, decreasing the opportunities for people to interact with one another. Although the Commercial residential unit roadways are segregated from pedestrian and vehicle traffic to ensure the safety of inhabitants, and underground parking is available, occupants park their cars in the underground garage and take the elevator straight to their residences. This design lowers the likelihood of inhabitants encountering one another as well.

Impact on social capital

According to the discussion in section 5.3, the social network of the Hutong residential unit is stronger than that of the Commercial residential unit, and according to the remarks of the two interviewees in section 4.3.1, we find that the residents of the Hutong residential unit often meet and greet each other at the Hutong alley. When the road model of the community, like the hutong-residential unit, provides opportunities for residents to communicate and meet, it increases the social capital seen by the residents of the community and contributes to a harmonious and sustainable community building. According to section 5.3, the strength of social capital in turn influences the formation of pro-environmental behaviour. Consequently, a grid pattern of roads within a residential unit increases the social network of the community more than a cul-de-sac and curved layout, which is consistent with Mason (2010) and Abass and his colleagues (2019), who suggest that traditional residential communities with a grid pattern of streets have higher levels of community satisfaction and social network.

Suggestions for community roads design

Neighbourhood design elements that promote community cohesion by increasing pedestrian traffic and encouraging social interaction (Mason, 2010) which is characteristic of the roads in the Hutong residential unit. The majority of new residential neighbourhoods in China are currently constructed with curved internal streets and culde-sacs. However, in the future, new residential neighbourhoods will increase social interaction within the community by changing the road form and creating permeable, interconnected grid-like streets that provide more opportunities for residents to meet, as well as increasing the diversity of sociable design places around the community, increasing the number of venues for residents to meet and interact, thus increasing social interaction within the community and creating a more resilient community. More critical thinking on the design of residential roads and the social design of communities is presented in section 6.4.

5.4.2. Low-rise community and small residential unit

Community height data discussion and impact on social capital

From the interviews with residents of the two residential units in sections 4.3.1 and 4.4.1, it can be found that residents of the Hutong residential unit are more satisfied with their neighbourhood and community than those of the Commercial residential unit, and Hutong residents are also more actively involved in activities within the community, including this waste separation behaviour, than residents of the Commercial residential unit. Consistent with Siu's and her colleagues (2016) research, satisfaction with the community, particularly space or neighbourhood interactions, is positively connected with garbage collection behaviour. The implementation of waste separation and recycling in high-rise residential neighbourhoods is affected by different physical environmental, infrastructural, and socio-cultural elements than in low-rise residential structures (Yau, 2010; Xiao and Siu, 2018; Xiao, Luo and Li, 2021).

In order to solve the problem of waste segregation in high-rise residential buildings, the Hong Kong government has proposed the installation of a waste segregation facility, also known as a refuse chute, on each floor of a residential building (Yau, 2012). This design does provide more ease for inhabitants, who can simply push the appropriate button based on the kind of trash to have the subterranean bin travel to the correct position and deposit the trash into the refuse chute. However, the cost of such a facility, as well as the need to consider fire protection and ventilation, does add to the financial burden on the government. In those residential units where such refuse chutes are currently in use, when they first came into operation, residents were able to put out their garbage according to the sorting requirements. However, residents frequently encountered situations in which the facility was not working, so piles of waste were placed in the refuse chute room, which became so full that the sorting button was eventually removed, and residents simply pulled open the chute door and dumped their garbage at will. In addition, it is challenging to install such amenities on every level of an already-built high-rise housing complex. For such high-rise housing developments, the infrastructure of the public space underneath

the residential area must be taken into account. This will be discussed in Section 5.5.

When strolling on the street, people's perceptions of space, such as small, roomy, crowded, unfamiliar, gloomy, and balanced, are directly connected to the ratio of street width to building height (Wang, 2021). In 'The aesthetic townscape' (1983), the famous Japanese architect Yoshinobu Ashihara studied the relationship between the proportions of the roadway to the surrounding buildings on people's attitudes and behaviour. Yoshinobu Ashihara (1983) says that the width-to-height ratio of a street is 1, and that there is a feeling of evenness between height and breadth, which is the human scale and provides a sense of comfort. When the width-to-height ratio is more than 1, as the ratio grows, it also conveys a sense of isolation and lack of boundaries. When the width-toheight ratio is less than 1, it provides a sensation of confinement, and as the ratio continuously decreases, it causes a sense of growing depression and constriction, along with a willingness to escape (Table 5.1). From section 4.2.1.1, we learn that the width of an alleyway in a Hutong residential unit is around 4 metres, and the height of the structure is approximately 4 metres, resulting in a D/H ratio of approximately 1. This is why Hutongs typically provide individuals with a sense of comfort and why people want to remain and converse with them. According to the Urban Residential Area Planning and Design Standards (Ministry of Housing and Urban-Rural Development of People's Republic of China, 2018), the ratio of north-south building spacing to building height is 1/1.2, approximately equal to 0.83. It should not be less than 0.7, and the distance between left and right high-rise buildings is 13 metres. In order to maximise the utilisation of land, however, real estate developers do not build two high-rise buildings right in front of each other (see Figure 5.3), but rather stagger them (Figure 5.4). Even when there are public spaces, green areas, and gardens below a residential neighbourhood, inhabitants experience a feeling of despair and desire to leave the place as soon as possible to return home.

Table 5.1 The impression given by the different road width to building height ratios

D/H>=2	When the ratio is greater	
	than 2, it gives a sense of	
	distance, expansiveness	
	and border lessness.	
2>D/H>1	It creates a sense of	
	distance	
D/H=1	The closer the ratio is to 1,	Hutong residential unit
	the more proportional and	
	comfortable it feels.	
D/H<1	People would feel a sense	Commercial residential unit
	of oppression, narrow	



Figure 5.3 The high-rise residential buildings right in front of each other (picture from Google Map data ©2023)



Figure 5.4 The buildings have been places at an angle to increase land use, but increased inter-building shading (picture from Google Map data ©2023).

Suggestions for residential buildings height

Therefore, a suitable decrease in the height of residential buildings is a means of softening inhabitants' attitudes toward their surroundings while walking downstairs, thus enhancing chances for discussion, activities, and social networking among residents. Reducing the height of buildings and splitting the community into tiny units might allow community activities to begin on a modest scale before expanding to include the whole neighbourhood, however, in China, where a large population and consistent land use are government concerns (Long, 2014). Some scholars also suggest that compact urban forms that produce high-density urban districts are beneficial in reducing greenhouse gas emissions (Gainforth et al., 2016; Xu et al., 2019). However, such high-rise buildings have disadvantages for social capital among community residents and the formation of pro-environmental behaviours. But turning Chinese Commercial residential communities into a Hutong community style is impractical, due to the preciousness of land resources. Therefore, it is possible to build more low-rise buildings with relatively high density instead of high-rise tower style, while satisfying safety requirements such as building spacing and fire escapes. More detailed recommendations for the development of residential areas that are suitable for pro-environmental behaviour and social capital will be discussed in Chapter 6. Reducing building heights may be difficult to implement in some areas of China for some time, and it is not possible to increase social capital by reducing building heights in existing high-rise buildings. The need for public spaces of different scales to increase the amenity of the community and the sense of belonging to the community is discussed in detail in section 5.4.4.

5.4.3. Gated or non-gated community

Data discussion

From the pre-fieldwork research, we can conclude that Hutong residential unit is a non-gated community and the Commercial residential unit is a gated community, and through the discussion in section 5.2, we can conclude that Hutong residential units have a stronger social network and sense of community than Commercial residential units, a conclusion that is consistent with Forrest and Yip (2007), Deng (2017), and Sakip and her colleagues (2012) findings.

During the pre-fieldwork site survey, inhabitants of the Hutong residential unit liked to congregate in the alleyways and meet their neighbours, but occupants of the Commercial residential unit were seldom seen congregating in the downstairs common space. This pattern is consistent with the results of Gul, Sultan and Jokhio (2018), who found that non-gated neighbourhoods are more likely to walk than gated ones. When people's intention to hang out in the community is reduced, therefore reducing the opportunities for community residents to meet and interact, thus affecting the formation of social capital in the community. When community residents do not have a strong sense of belonging to the community, they may also not care about building a sustainable community, as shown the Commercial interviewee 1 and Commercial interviewee 2 interviews in section 4.4.1, where neighbourhood relations are weak, and residents do not take the act of waste sorting very seriously.

Impact on forming social capital

Nonetheless, other researchers (Bt Tahir¹ and Bt Hussin², 2013; Wilson-Doenges, 2016) claim that gated communities are safer than non-gated neighbourhoods because they provide security against crime; hence, more people walk. Some scholars have also

pointed out that gated crime rates are not significantly lower than non-gated community crime rates (Wang *et al.*, 2021), and in some areas, crime is growing in gated communities. (Wang *et al.*, 2021), and in some areas, crime is growing in gated communities.

By a fence or wall, gated communities are physically divided from the surrounding area (Blakely and Snyder, 1999). In Europe and the United States, gated communities consist of affluent single-family homes, but in China, they consist of high-rise buildings. Therefore, the philosophies of European and American gated and non-gated communities cannot be simply transferred to Chinese residential communities. Although gated communities offer inhabitants some official security and psychological protection, they also isolate them from the outside world and social networks (Sakip, Johari and Salleh, 2012; Ngai, 2013).

In China, gated communities are the common practice (Ngai Ming, 2013), and it goes without saying that the gate is a sign of safety and has a psychological influence on inhabitants. However, the gated community divides inhabitants from the street, which is the main civic space in China, with a dense network of streets that are richer in street activity and community interaction (Akers, Adriana Sandoval, 2015). lossifova (2014) refers to the street space on the periphery of a community as borderland, which can be a shared space for informal, unplanned and spontaneous encounters between two or more worldviews, lifestyles, ways of thinking, individuals or groups. In lossifova 's study, it is shown that in these traditional communities in China, people have a stronger sense of community belonging and neighbourhood relationships, and even when they move to commercial residential units in a better environment, they still miss the feeling of their old neighbourhood. She found that when communities are forced to add fences, residents slowly remove the fences one by one.

Suggestions for the form of the community

Every walkway in a Hutong residential unit may serve as an entrance or exit, while the Commercial residential unit has just a few entrances and exits. As suggested by Jane Jacobs in *Death in the Life of Great American Cities* (1993), numerous junctions and small-sized blocks may enhance cross-use by residents, create various pedestrian routes, and give liveliness to a neighbourhood. Therefore, it is possible, in the design of Chinese residential communities, to open up appropriately, connect to outside streets, increase entrances and crossings, so that residents' lives become more dynamic, and also to increase the social network of the community, the interaction between residents, and thereby promote environmentally responsible behaviour. Obviously, any modification must be based on maintaining the safety of the community.

5.4.4. Create different scales of public space

Data of public spac disscion and the ipmpact on communities'social capital

From section 4.2.1's observations of the spatial form of the two research sites, we may conclude that the Hutong residential unit has more spatial levels than the Commercial residential unit. Private space, semi-private-public space, small open areas, and larger open spaces comprise the four spatial ambience levels of the Hutong residential unit. The individual residence is a private space and serves as the occupants' personal area. The tiny courtyard shared by multiple residences is the semi-private-public area, which serves as both the residents' private space and their open space. For people outside the courtyard, the courtyard is a private environment that belongs to the residents who live inside. As the gates of the courtyard are frequently left unlocked and connect to the small public open space outside - the Hutong lane - the courtyard is a very important space in the Hutong residential unit, bridging the private and public spaces and connecting the courtyard's residents to those of the entire Hutong residential unit. As a small public space, the Hutong lane is also a place for Hutong residents to meet and greet one another, and people from the same lane will often sit at the entrance of the courtyard and converse, thereby fostering a stronger sense of community and fostering better relationships with their neighbours. The last level is the public area on the Hutong's edge, a location for interaction with the outside world. The Hutong lane is used for communication, whereas the road is used for commuting (Zhou and Zhang, 2015). In contrast, the examined

Commercial residential unit has only private space, which consists of the tenants' apartments, and public space, which includes green space surrounded by high-rise buildings, public construction equipment and underground parking garages. Despite the fact that the Commercial residential units give residents public space for everyday activities and contact, the size is quite big, and the public space provided for the whole community has resulted in a lack of engagement in this region. Smaller, more individualised streets and public areas draw people together and facilitate discussion and touch (Akers, 2015).

Suggesiuns for the public space design in the communities

The courtyard of the Hutong residential unit functions as a semi-private public area, comparable to what researchers in Europe and the United States refer to as the residential front yard. According to these researchers (Karuppannan and Sivam, 2011; Swapan, Bay and Marinova, 2019), this semi-private-public open space may be highly beneficial for enhancing the inhabitants' feeling of community and social networks. According to the study data in this thesis and the resident interviews, the social network of Hutong residential unit residents is stronger than that of Commercial residential unit inhabitants. Social capital is influenced by the location and size of the neighbourhood's communication space (Foster et al., 2015). This location of contact is lacking in high-rise apartments (Nguyen et al., 2020b), a bridging space between private and public areas. This is also a regular occurrence in Chinese residential communities, where public spaces, green spaces, and gardens are offered underneath neighbourhoods, but are underutilised, and people do not tend to strengthen local ties via the usage of these places. Depending on the spatial structure of the Hutong residential unit, a hierarchy of public spaces in Commercial residential units might be proposed. From small, neighbourhood-scale, semi-private, communal spaces that can be shared, to larger, community-scale, communal spaces with appropriate infrastructure such as green space, seating and opportunities for residents to interact. Beginning with the socialisation of immediate neighbours, residents will progress to the social activities of the whole community and build the social network of the community. Different forms of public

space can also contribute to the development of pro-environmental behaviour. For example, the research in the Hutong residential unit has led to community activities through talks on waste separation in public spaces. In elderly care centres there are also many activity rooms for socialising with the elderly. This is one of the reasons why the social network of Hutong residents is stronger than the social network of Commercial residential units. When the social capital of a community is increased, it also has a positive effect on pro-environmental behaviour such as waste separation and sustainable community development.

5.5. Could Removing External barriers foster pro-environmental behaviour?

External barriers data discussion

Due to the existence of barriers, people do not often engage in pro-environmental behaviour. The removal of the external obstacles is the most crucial intervention strategy for fostering environmentally conscious behaviour (McKenzie-Mohr and Smith, 1999; Allison et al., 2022b). The data of the question in section 4.3.1 why residents of Hutong and Commercial residential units do not engage in waste separation and recycling has shown that external barriers dominate the responses of approximately 80 % of Hutong residents. While residents of Commercial residential unit, who chose did not know that they were required to separate their waste most, cited not knowing how to do so and the inconvenience factor as reasons for not doing so. During the pre-fieldwork, inhabitants of the two research locations did not know how to sort their garbage and were unclear about how to sort their waste, as shown by the data in section 4.5.1. It is evident that these external barriers are influencing people's pro-environmental behaviour, an idea that is in line with Thondhlana and Hlatshwayo (2018), Domina and Koch (2016), and Zhang et al., (2016). Moreover, after the mandatory implementation of waste separation regulations in Beijing, the rate of infrastructure provision and knowledge diffusion increased in both research sites, and the participation of residents in waste separation behaviour increased in both communities. The two research sites were able to remove external barriers from the residents, mainly through knowledge dissemination, infrastructure such as waste separation bins, and the help of volunteers and instructors.

5.5.1. Increasing recycling knowledge

Dynamic impact on waste separation behaviour and suggestions

When individuals lack environmental understanding, their pro-environmental behaviour may decrease (Fatima, Khan and Goh, 2015; Amoah and Addoah, 2021a). The Beijing government helps citizens comprehend garbage separation by installing waste separation awareness boards in each neighbourhood and labelling the various containers with the proper waste. The Beijing government also promotes this information through social media such as the Internet and television. Some communities, such as the Hutong residential unit in this thesis, have also organised several seminars on trash separation to enable people to have a better understanding of environmental issues. This thesis collected preliminary fieldwork data of Hutong residential units during a trash separation knowledge lecture.

Some academics (Wi and Chang, 2018c; Parra *et al.*, 2020) believe that environmental education should be expanded for both students and citizens. Consequently, environmental behaviour may be altered. This is also one of the interventions proposed by the Behaviour Change Wheel theory (Susan Michie, Atkins and West, 2014); by increasing people's knowledge, they gain psychological competence, and their behaviour consequently changes. Environmental education is an effective way of promoting environmentally responsible behaviour (Wi and Chang, 2018c). Nonetheless, the method of education must vary based on the circumstance. For instance, the majority of inhabitants of the Commercial residential units in this thesis are youthful and middleaged individuals who are often interested in learning new things via the internet and like to receive information online.

In section 4.5.2, the question "when your household is unsure an item is recyclable, what do you do". According to statistics collected in the pre-fieldwork, 71% of Commercial residential unit residents decided to search online. In the post-fieldwork statistics, 21 % of tenants in the Commercial residential unit preferred to check online, which remains one of the top three options for occupants of Commercial residential units, although the percentage has fallen. Internet and APPs may thus be used to disseminate environmental information in communities with a large number of young people, such as the Commercial residential community in this thesis. Middle-aged and young individuals who are skilled with mobile phones and electronic devices will continue to be more passionate about utilising apps than the present elder population as they grow. Although this is beyond the scope of this thesis study, it appears that middle-aged and young people have been using electronic devices and social software for a longer period of time-based on current social phenomena; therefore, educating middle-aged and young people about pro-environmental behaviour through the use of mobile phone software and the internet is a feasible option. In neighbourhoods where the majority of inhabitants are elderly, such as the Hutong residential unit, Internet use may be rustier than among young individuals. For these types of older residents to engage in a genuine trash separation activity, it is necessary to organise additional lectures and practical waste separation activities. Education at school is also very important. Developing proenvironmental behaviour from a young age equips students with the information, skills, and attitudes that will inspire them to contribute to the advancement of society in the future (Parra et al., 2020). In sections 6.5 and 6.7, recommendations for forming proenvironmental behavioural education are provided.

5.5.2. Be convenient ----equipment

Communities' equipment data discussion

The data in section 4.3.1 on why residents did not participate in waste segregation showed that, apart from not receiving information about the need to segregate waste, residents felt that there were no segregated bins at home or in residential units, or that

it was more convenient to use the general bins. According to these statistics, locals believe that the infrastructure is insufficiently equipped and inconvenient. On the post-survey questionnaire, the majority of respondents from both residential units felt that the neighbourhood was well-equipped with bins for separate waste streams. In addition, a greater number of people engaged in garbage segregation than in earlier research. According to the post-study data, we can see that the form of recycling in the Hutong residential units is different from that of the Commercial residential units. First, the building form is impacted by the fact that Hutong lanes are smaller and cannot be fitted with segregated bins, but the broader streets at the edge of the Hutong residential unit community are equipped with such bins. In addition, a mobile trash collection car visits the Hutong neighbourhood each morning and evening. It stops at selected areas in the Hutong at a predetermined time to make it simpler for adjacent households to throw out their garbage. This is helpful for the inhabitants of the Hutongs since it saves people considerable time going to the trash separating containers. In contrast to the Commercial residential unit, there are only two drop-off points, which is inconvenient for some residents who live far from the drop-off stations. Additionally, although one of the dropoff stations is open 24 hours a day, this also causes residents to put out waste at random during the post-fieldwork period. In accordance with Ando and Gosselin (2005) and Bernstad (2014), it can be concluded from the data in this thesis that the availability and accessibility of infrastructure is one of the elements that drive residents to sort their garbage. In addition, the mobile refuse collection vehicle at the Hutong residential unit provides an additional place for residents to interact with each other at a set location and time each day, thus once again facilitating the formation of social capital among residents. In contrast, the existence of a Commercial residential unit with an all-day refuse collection point does not guarantee the opportunity for residents to meet. The proposal to increase social interactions and thus promote social capital development by controlling the availability of infrastructure is proposed in sections 6.5 and 6.7.

Dynamic impact on waste seperation bevaliour and recommendations

The lack of necessary residential facilities is likely one of the most significant barriers to

people's participation in recycling activities. Knickmeyer (2020) believes that convenience is one of the most important factors in increasing household recycling sorting behaviour, and the absence of such facilities is likely one of the most significant factors in preventing people from engaging in recycling activities. Therefore, in order to improve people's waste sorting behaviour, it is essential to provide the full range of equipment-sorting bins, and for the drop-off locations of residents living in high-rise buildings, we can consider establishing a corresponding number of waste drop-off stations proportional to the size of the residential unit, so that residents in different locations are accommodated. This will enable inhabitants in various places to be within walking distance of one another. In addition, the establishment of the time for putting out the garbage, despite the fact that Commercial residential units have an all-day waste collection point, allows residents to dump their garbage out at any time. However, if there are no supervisors, mixed trash will develop. For instance, the Hutong residential unit has two collection hours in the morning, and evening, and the high-rise residential area may also coordinate collection times with high pedestrians. In addition, in the case study of the six units, Unit 4 and Unit 5 provided convenient facilities and disinfection tools for the residents, but these did not improve the residents' waste segregation, and it seems that this "convenience" did not really reduce the time spent by the residents.

Some scholars suggest the use of smart recycling bins (Xue et al., 2019; Pelonero, Fornaia and Tramontana, 2020) to make it easier for residents to put out their waste and for the government and researchers to conduct statistics and research. These smart recycling bins are used in conjunction with incentives to promote more active and correct waste disposal. This approach has been used in some communities in Shanghai, China, and has worked very well (Luan, Xiaona, 2018; Zhou et al., 2021).

5.5.3. Volunteer and supervisor

The role of supervisors and volunteers in the research sites and the impact on forming separation behaviour

In response to the question regarding volunteers and mentors at the two research sites in section 4.5.2, the majority of residents indicated that volunteers and mentors existed, and approximately 80 percent of Hutong residential unit residents felt that they were highly effective, as evidenced by a post-fieldwork question "What should you do if your family is uncertain if an item is recyclable?" 46.34 % of Hutong residents opted to request volunteers and mentors, which was also the most popular option. Although over 63 % of Commercial residential unit residents did not seek volunteer assistance, about 26% of the Commercial residential unit's inhabitants believed that the volunteers were useful in expanding their understanding of garbage separation and recycling. The presence of volunteers and supervisors is a kind of prompt, and McKenzie-Mohr and Smith (1999) believe that prompts may be categorised as visual or aural. The visual prompts for garbage separation and recycling are the posters and banners that appear in residential units and across the city. Volunteers and managers provide the voice prompts for residents at these garbage disposal facilities.

In addition to the two research sites in this thesis, the data from the six residential areas provided by Blue map shows that the volunteers in Unit 1 have been explaining, instructing and persuading residents to put out their rubbish when they find that they have done so incorrectly, and after a month, most of the residents in Unit 1 have been able to comply with the sorting regulations. In contrast, in many other units, including the Commercial residential unit in this thesis, volunteers and recycling employees did not play a primary role in explaining and motivating, but rather a secondary one in sorting. Over time, residents have come to believe that even if they don't have to separate their waste, they will eventually be helped to sort it a second time.

In addition to the role of volunteers and supervisors in prompting and persuading, a social norm is also formed in the community. When the volunteers point out the incorrect behaviour of the residents and demonstrate the proper method to throw out the garbage, a norm is gradually established in the community, the act of taking out the trash becomes apparent, and a direct connection is established between the people. People's recycling

habits will evolve over time.

Suggestions for the supervisors and volunteers

The situation of volunteers turning into cleaners occurs. We cannot rule out the fact that when waste sorting regulations were first introduced, various communities and residents would actively participate for a bit, but as time went on, the focus shifted from waste sorting to other things, such as the Covid-19 pandemic and self-quarantine. A reduction in government regulation has also resulted in the elimination of prompters in favour of secondary sorters in residential units. To prevent volunteers and supervisors from becoming cleaners, the government should establish distinct roles for supervisors, with an emphasis on prodding, persuading, guiding, and limiting residents' dependency on secondary sorting. This will result in the creation of a sorting behaviour that, if sufficiently stable, will persist even if the supervisors are removed.

5.6. Evaluation and Models

This section will present a summary of the interventions used in this study and their effects based on the previous content. A new model of pro-environmental behaviour for community development in China will be designed based on the findings of this thesis, and two sets of specific interventions will be suggested for different community types.

5.6.1 Summary of factors influencing pro-environmental formation from findings

The results and arguments in this thesis lead to the conclusion that the interventions used in this study had a positive effect on the formation of waste segregation and recycling behaviours. This thesis examines the factors that shape the pro-environmental environment through three themes: governance, social structure and infrastructure design. Findings indicate that the existence of mandatory regulations had a positive effect on community behaviour regarding trash segregation, and that the effect was evident in

the early stages. However, as government regulation decreased, people were less scared of mandatory regulations. Incentive interventions are a method of persuading people to alter their behaviour by appealing to their own interests. Initially, citizens may be influenced to do the right way by the threat of penalties. However, as they realise that few individuals would be penalised, they are less inclined to fear this factor. In order to induce pro-environmental behaviour, a mix of incentives and punishments is necessary. Social capital also has a favourable influence on the development of pro-environmental behaviour, and the stronger the social capital of a community, the greater the effect on pro-environmental behaviour. Furthermore, the architectural style and spatial layout of a community impact the social capital of its residents and, subsequently, the formation of pro-environmental behaviour. The more public spaces and semi-public private spaces correspond to the form of interpersonal communication, the more conversation between neighbours may be encouraged, similar to the spatial layout of the Hutong residential unit, which consists of many layers of space. Finally, it is necessary to address the barriers that prevent residents from participating in pro-environmental behaviour, such as knowledge of waste segregation, the provision of adequate infrastructure and the reduction of additional mobility burdens for residents. Table 5.2 summarises the factors influencing the formation of pro-environmental behaviour and the effects studied in this thesis.

Table 5.2 Summary of factors influencing pro-environmental formation from findings

Factors	Interventions	Specific methods	Purpose	Effects
Governance	Legislation	Mandatory waste	Deterrent effect	Effective in
		separation	of the law to	the first
		legislation	motivate	period
			residents to	Weakening in
			change their	the later
			behaviour	period
	Incentive	-fine	Rewards act as a	Rewards are
	(Penalty	-collect points to	guide for	useful
	and	redeem daily	residents to	Fines are
	rewards)	necessities	change their	effective
			behaviour and	upfront and

			mindset, and fines can control littering behaviour	less effective in the later stage
Social structure	Social capital	-community trust -community belonging -Participate in the activities - Utilisation of public space	Promote social interactions among the community, resulting in strong social capital and proenvironmental behaviour	Hutong residential units have stronger social capital and are conducive to the development of proenvironmental behaviour
Infrastructure design	Community urban plan	-the form of community (Road, low-rise building, non-gated community) -different scales of public spaces	The change in the built environment, the form of the public space, which increases the social activities and contacts of the inhabitants, and the formation of proenvironmental behaviours	The architectural style and spatial layout of the Hutong residential unit is conducive to the formation of social capital and proenvironmental behaviour in the community
	Removing external barriers	-knowledge -equipment -volunteer and supervisor -convenient	Reducing the presence of barriers for residents and creating convenient conditions, resulting in a low-cost state	The behaviour of residents in both communities has improved considerably in the early stages. In the later stages, if there is not enough convenience

		and lack of
		supervision,
		the sorting
		behaviour will
		gradually
		weaken

5.6.2. A model for the promotion of pro-environmental behaviour

On the basis of the results of this thesis, a new pro-environmental behaviour model for Chinese communities is proposed (Figure 5.5), which combines the two theories employed in this thesis, the Behaviour Change Wheel theory and the Community-Based Social Marketing - Fostering Sustainable Behaviour. It has been made simpler and easier to use. The first step is to identify the pro-environmental behaviour that is meant to be implemented using the model; in this thesis, it is the behaviour of sorting garbage in the community. The second stage is to identify the barriers that prevent this behaviour from happening, which may include a lack of knowledge, a lack of sufficient infrastructure, and the belief among residents that it is too time-consuming and expensive. These barriers can be identified through observation, questionnaires, interviews and other methods to find out what residents really think. During the pre-fieldwork for this thesis, it was determined that a lack of knowledge about trash separation among residents, a lack of infrastructure, and the difference in the architectural style of the two communities caused the difference in the behaviour of the two communities towards waste separation at a later stage. Thirdly, the Capability, Opportunity, and Motivation (COM-B) model was utilised to classify the identified obstacles. The COM-B model is an essential component of the Behaviour Wheel, which clearly indicates the intervention-required regions of the target behaviour. As indicated in Figure 2.18, the corresponding COM-B is then identified in the Theoretical Domains Framework (TDF), and the right interventions are selected. Once all interventions have been identified, they are initially tested in a small-scale area to determine if they are effective. Based on changes in people's behaviour and attitudes, the interventions are then modified, and targeted laws and regulations are introduced

and disseminated on a large scale, even nationally.

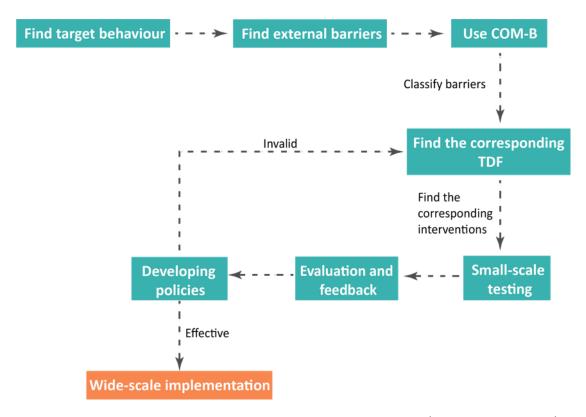


Figure 5.5 The model of promoting pro-environmental behaviour (Cartography: author)

Table 5.3 The example of finding interventions process

Target	Barriers	COM-B	TDF	Intervention
behaviour				
Recycling	People don't know	Psychological	knowledge	Education
behaviour	how to separate	capability		
	the waste			

In addition to the new model created above for the development of pro-environmental behaviour, the selection of particular interventions is summarised in two alternative guidelines (Table 5.4 and Table 5.5) based on the findings of this thesis, depending on the type of community. These two types of guidance are given in terms of governance, infrastructure and social structure for the choice of specific interventions. The main

difference between the two forms of guidance is that some communities, such as the Hutong residential unit in this thesis, have strong social capital and may utilise this strong social capital as an intervention to encourage pro-environmental behaviour within the community. For communities without strong social capital, such as the Commercial residential units in this thesis, the first step is to improve the social capital of the residents by increasing the number of activities in the community and controlling the opening hours of public spaces to increase the opportunities for residents to meet, thereby gradually developing social capital. The social capital may then be used to promote proenvironmental behaviour. The second difference is that Guidance 1 is also applicable to communities with different levels of public space, such as the architectural form and layout of Hutong residential units. Guidance 2 applies to ordinary Commercial residential units, where the intervention has an urban plan component. This part cannot be done directly by the community itself but requires government support in terms of funding and facilities. It is, therefore, necessary for the future of promoting pro-environmental behaviour in the community to be a collaborative effort between the government and the public.

Table 5.4 Guidance 1 For communities with strong social capital

Types	Interventions	Specific methods
Governance	Legislation	Enactment of mandatory legislation
	Incentive	penalty and rewards
Infrastructure	Removing barriers	The facility is adapted to the location
		Volunteer and supervisor (Guidance)
		Knowledge dissemination (lectures, events)
	Urban plan	Rational use of public spaces
Social structure	Social capital	Promoting pro-environmental behaviour
		through the use of strong social capital

Table 5.5 Guidance 2 For communities with weak social capital and where the built form of the community needs to be improved

Types	Interventions	Specific methods
Governance	Legislation	Enactment of mandatory legislation
	Incentive	penalty and rewards
Infrastructure Removing barriers		The facility is adapted to the location
		Volunteer and supervisor (Monitoring and
		reminding)
		Knowledge dissemination (App, websites
		and events)
	Urban plan	Public space for different levels and scales
		Reducing the Gated-Community if
		appropriate
		Rational use of public spaces (Controlling of
		the infrastructure availability and times)
Social structure	Formation of strong	By increasing community activities, and
	social capital	changing the shape of public space
	Use social capital	Promoting pro-environmental behaviour
		through the use of strong social capital

5.7. Impact of covid-19 on this thesis

During the fieldwork for this thesis, the worldwide pandemic of Covid-19 was experienced, which had a substantial influence on the post-fieldwork data and results. As the disease occurred during the post-fieldwork period, the thesis changed the offline research to online questionnaires and interviews, which affected the number of participants in the post-fieldwork, particularly in the Commercial residential units, resulting in a difference in the number of participants between the pre-and post-fieldwork. And the Commercial residential unit did not have a mobile phone chat group, which made it difficult for many residents to complete the online questionnaire, resulting in a significant difference in the number of participants between the two communities.

During the pandemic, the Chinese government's priority was pandemic prevention; hence, monitoring of waste separation requirements and penalties were not properly

implemented, resulting in many residents not taking the waste separation regulations seriously. During the rapid spread of the Covid outbreak in China, which began in January 2020, the priorities of the state, government and community were to reduce and control the spread of the outbreak, reduce infection and mortality rates, and increase medical management of the sick. In addition, during the epidemic, the Chinese government required residents to stay at home and stop all outside activities; Some local government desiced lockdown the cities (Ren, 2020). These forms of management greatly affected the implementation of waste separation regulations and prevented residents from leaving their homes to participate in waste separation. Although two years after the outbreak, the Chinese government has continued to make outbreak management a priority. As a result, many residents do not take this legislation on waste separation seriously. This had the effect of interfering with the behaviour of many residents in the Commercial residential units, resulting in less than expected results.

Second is the influence on social capital. At the height of the pandemic, the Chinese government-imposed home quarantines, community lockdowns, and city closures, which resulted in residents being confined to their homes during the pandemic, reducing the opportunities for residents to meet in public places and everywhere else, and residents were, of course, reluctant to risk meeting others at the time. We can also observe from section 4.5.2 that participants in post-fieldwork do not choose to ask their neighbours about uncertain items, even if they have a strong social capital, in the short term, which is during the epidemic, thus reducing the social connection of the community inhabitants. The epidemic had a negative effect on the formation of social capital by reducing the dependence of residents on others. It also hinders the long-term development of social capital in the community. If other communities like the case of the commercial residential unit in this research, have no online community activity during the epidemic and residents choose not to meet with their neighbours for fear of being infected with Covid. This is very detrimental to the social capital development of the community, let alone the sustainability of the community.

Additionally, some communities that would otherwise be non-gated communities are fenced off and forced to become gated communities because this makes it easier for the municipal governments to manage and control the population of the community in and out so as not to cause the pandemic to spread to a larger extent, which is an advantage of the gated community. However, as discussed in Section 5.4.3, gated communities are conducive to the formation of social capital. The advent of this pandemic has had both direct and indirect effects on the data collecting, results, and conclusions of this thesis.

6. Conclusion

6.1. Introduction

How to make the environment sustainable has been studied in several nations since the end of the 1980s (Larrinaga and Bebbington, 2021). However, most environmental impacts result from direct or indirect human actions (Liu, Han and Teng, 2021). Therefore, academics in Europe and the United States have investigated ways to generate proenvironmental behaviour changes that contribute to developing sustainable ecosystems, societies, and communities. Personal values (Steg et al., 2014), attitudes and beliefs (Sharma and Gupta, 2020), and social norms (Farrow, Grolleau and Ibanez, 2017; Keizer and Schultz, 2018) are among the studies that impact pro-environmental elements. Although China began to focus on environmental development and responses in 1993 (Geping, 1993), China is a latecomer to the study of pro-environmental concerns and has been highly impacted by research on environmental behaviour conducted in Western Europe and the United States (Wang, 2019), hence some ideas are sometimes directly applied to urban environment development in China. In addition, the notion of community in China and the architectural style of residential neighbourhoods varies from those in Europe and the United States. This leads to the study question for this thesis: what is the link between providing pro-environmental behaviour acts in China and sustainable behaviour?

This thesis applied a realism research philosophy to social science research. By observing the behaviour of the inhabitants of the research sites and collecting data, the thesis identifies the relationship between the pro-environmental behaviour of the inhabitants and the factors that change people's behaviour in sustainable communities. The thesis combines qualitative and quantitative research techniques, such as observation, surveys, interviews, and secondary analysis, with in-depth study and analysis around three themes: government, social structure, and infrastructure. This thesis goes beyond the superficial phenomenon of the presence and absence of pro-environmental behaviour to

investigate the influence of legal penalties, positive incentives, social capital, and infrastructural elements on people's pro-environmental behaviour change and how these actions are happening and evolving in the real-world context of Chinese communities. The impact of Covid on the implementation of waste segregation legislation, the development of sustainable communities and the social capital of residents are also examined. As the greatest developing nation (in terms of population size), China is already the world's most significant daily output of municipal trash. Domestic trash separation is one of the proenvironmental behaviours typically promoted in Europe and North America. However, in China, very few cities have officially adopted waste separation rules, despite the Chinese government's intention and resolve to implement this policy nationwide. Therefore, waste segregation recycling behaviour is the primary pro-environmental behaviour studied in this thesis, and suggestions are made for the development of pro-environmental behaviour in Chinese urban areas.

This thesis is based on both the behaviour change wheel theory and the communitybased social marketing-fostering sustainable behaviour theory. Behaviour change wheel theory is a theoretical framework developed by Michie, Atkins and West (2014) to guide and intervene in behaviour change and to provide different directions for intervention strategies and policy development. However, it has been utilised less in proenvironmental behaviour research, and even fewer scholars in China have employed it. This thesis is the first to apply the behaviour change wheel theory to the study of proenvironmental behaviour in Chinese communities. McKenzie-Mohr and Smith (1999) propose the community-based social marketing-encouraging sustainable behaviour theory as an intervention for fostering sustainable behaviour change. Both theories provide treatments and advice on many facets of behaviour change, including defining target behaviours, choosing interventions, formulating policies, and putting them into effect. As the Beijing government has implemented required separated home garbage legislation and created management procedures, consequently, this thesis is an application of the two theories to the study of pro-environmental behaviour in the community by using them in reverse, in the sense that the original two theories suggest that the target behaviour be analysed, and the corresponding interventions are developed prior to their application in practice. In the context of this thesis, the efficacy of interventions applied to behavioural change in waste segregation is analysed and examined by combining the two theories with the known management approaches used by the government. It is also a new attempt to study pro-environmental behaviour by confirming the efficacy of the selected intervention approach using intervention techniques that are known to be utilised in practice; suggestions and feasible intervention strategies for altering pro-environmental behaviour in the community are provided. The two theories are merged in the research process, from a preliminary study to identify the barriers to sorting behaviour experienced by residents to a later study to analyse and assess the Beijing government's interventions, including regulations and infrastructure. Additionally, the influence of social capital and architectural interventions that the Beijing government did not implement on trash segregation behaviour was evaluated. All of these characteristics were shown to impact waste segregation behaviour to varying degrees.

This thesis focuses on two different types of residential units in Beijing, the Hutong residential unit and the Commercial residential unit. It is separated into two investigations, pre- and post- the obligatory adoption of legislation requiring the separation of household garbage in Beijing. The study compares the changes in residents' behaviour and attitudes before and after the implementation of the government's strategies and methods. The pre-fieldwork was conducted through questionnaires, interviews and observations. Due to the effect of the Covid-19 outbreak, the post-fieldwork was completed online by means of electronic surveys, online interviews, and secondary data analysis of the online data collected. In this thesis, the data collected was analysed according to three different themes, including governance, social structure and infrastructure, in order to find out the extent to which different elements influence proenvironmental behaviour. Overall, although the residents of the two residential units are in the same general environment - the implementation of the waste separation policy in Beijing - the behaviour, attitudes and motivation displayed by the residents of the two

communities are different. The analysis of behavioural changes in the two communities reveals the intricate interplay between the strength of social capital, building form, infrastructure accessibility, and regulatory effort.

The following section provides an overview of the thesis, beginning with a summary of the effects of each of the four interventions on the development of waste separation behaviour and recommendations for the future development of pro-environmental behaviour in China, based on the four sub-research questions from section 6.2 to section 6.5. Section 6.6 will provide suggestions for follow-on pro-environmental behaviour research based on the new model. This is followed by policy development suggestions based on the thesis' results, including governance, social capital, and community structure design principles in section 6.7. In section 6.8 and section 6.9, some limitations of this thesis are discussed along with suggestions for further research.

6.2. The roles of legislation and incentives in delivering sustainable community and influencing human behaviour

The first sub-question is: What roles do legislation and incentives play in delivering sustainable communities and influencing human behaviour?

Mandatory regulations and policies can have a positive effect on the development of pro-environmental behaviour, and when incentives are employed as an intervention, rewards are more likely to foster the development of pro-environmental behaviour than explicit punitive measures. When individuals alter their behaviour, it contributes to the sustainable development of the community's environment. Through the use of legislation and incentive interventions, people's behaviour changes in order to promote sustainable communities, which is a slow and gradual process.

6.2.1. The impact of mandatory regulations on pro-environmental behaviour

According to the findings of this thesis, the adoption of such coercive policies, despite the fact that they may most directly alter the behaviour of residents, is not a decision made voluntarily by residents, and this is the reason for the majority of residents' ambivalence. Residents alter their behaviour since the legislation is coercive, and they will be punished if they do not comply. Mandatory regulations with punitive measures such as fines have a deterrent effect on people (W. Li et al., 2020). This is a perilous strategy, since individuals may acquire negative attitudes when their independence is compromised or constrained by such mandatory classification regulations. Additionally, when locals realise that the government has been negligent in enforcing this necessary legislation and was not applying the penalties, residents' garbage sorting practices have typically returned to their previous un-sorted status. Therefore, mandatory regulations should not be considered as a deterrent and a source of fear, but rather mandatory regulations and policies should focus on the attitude and willingness of residents to change their behaviour and develop positive attitudes, so that residents can follow their subjective attitudes and willingness to engage in pro-environmental behaviour, such as waste segregation, even in the absence of mandatory regulations. It is not only a deterrent that terrifies people.

6.2.2. The influence of penalties as a method of incentive on the formation of proenvironmental behaviour

When the legislation on waste separation was first implemented, there was a significant improvement in the behaviour of the residents of both research sites, as well as the behaviour of the whole Beijing citizens. As stated before, individuals' pro-environmental conduct begins with the deterrent and punishment from the law, such as fines. Nonetheless, this system of penalties is not an effective and lasting deterrence for the community. Obviously, we cannot deny that fines are a deterrent for some individuals, as the post-fieldwork questionnaire revealed that fines are one of the reasons why some residents engage in garbage separation. But so long as the government does not

determine and penalise that the probability of illegal littering has reached a certain level, even if the government doubles the number of penalties, people will not modify their irrational behaviour since some residents will believe there will be no real punishment. In order for penalties to be an effective form of discipline, the government must actively execute its monitoring function. Certainly, increased supervision will also consume government funds, but in the initial phases of enforcing mandatory regulations, communities are under strict surveillance, residents' behaviour is monitored, and a system of penalties is promptly implemented when violations are discovered; only then will mandatory policies produce an effective level of compliance with residents' behaviour and attitudes.

6.2.3. Top-down and bottom-up management approaches in the Chinese context

China's environmental behaviour has traditionally followed a top-down method of governance, which is unique to the Chinese governance approach (Schroeder, 2014). From section 2.1.2.4, we know that the management model of Chinese communities is to follow orders from the national government to the local government, which in turn transmits instructions to the street office, which in turn directs and advises the individual communities to complete their tasks. Although communities ostensibly listen directly to the local government in the field, in practice they still follow orders from higher levels, which are passed down the hierarchy to implement the appropriate policies. The regulations in this thesis are those implemented by the local government in Beijing. Other cities, such as Shanghai, have regulations on waste separation that differ from those issued by the Beijing government. However, the regulations are also cascading down to each community. Using a top-down strategy by making rules and implementing regulations, the city's local government is an external driver of behavioural change. However, this strategy was unable to maintain residents' waste separation behaviour for an extended period of time, to the point that some people now think that the government is wasting money and performing ineffective work. In other words, a top-down strategy does not make waste segregation a long-term sustainable practice. In addition to external factors exerting pressure from the top-down method, bottom-up support from public participation is required. This bottom-up strategy involves not only informing residents directly about the repercussions of having to sort their garbage, but also including them in actual conversations and choices and collaborating to design targeted strategies. The residents are willing to take part in this pro-environmental initiative from the inside, with a positive attitude and a commitment to their own actions. When the majority of residents are involved in pro-environmental activities, they can also monitor each other, help and encourage other residents to participate. Linking top-down and bottom-up components is a primary focus of the local government. It is the responsibility of the community to collect resident input and provide prompt assistance to individual inhabitants. A well-developed community organisation that gathers resident needs, comments, and feedback from residents and feeds back to the local government links the top-down to the bottom-up, creating an effective cycle. In summary, to establish a genuinely sustainable state, the adoption of pro-environmental practices such as waste separation in China needs a combination of a top-down approach from an administrative perspective and a bottom-up approach from a process perspective.

6.2.4. Using social media to increase social capital and pro-environmental behaviour formation in communities

It is not feasible to get an accurate depiction of the policy's implementation from the statistics and information presented in the official reports alone. Instead, this thesis is supported by private social media accounts that do not display the same figures as the official accounts. This is because the government does not specify how data is monitored, how it is computed, or how collected garbage is disposed of when it publishes information. This has a substantial impact as the data lacks transparency. If the residents feel their efforts are meaningful, the government must provide this information and how the various wastes are processed at the disposal facility. Residents would also post messages on social media expressing their desire for the community or government to address the current trash separation issues in their neighbourhoods. The government and

community may utilise this to assist with the waste separation issues stated by people actively, so not only resolving the community's issues but also fostering a greater feeling of engagement and belonging (Figure 6.1). With the aforementioned software, the Blue Map app (see chapter 4.4.2.1), communities may collaborate to construct feedback software in their own communities, where citizens can submit images to indicate non-separation of garbage, as well as other deficiencies and ideas. This will aid in the community's focused management of the targeted manner.

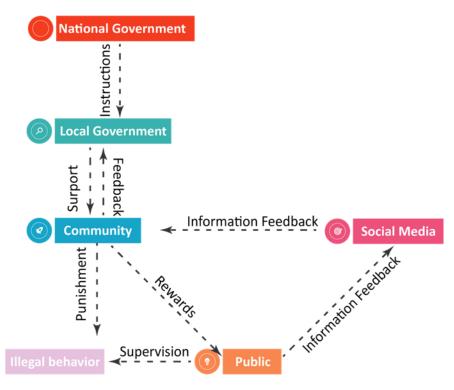


Figure 6.1 The relationship between Government, Community, Public and social media (Made by author)

During the global Covid pandemic, the Hutong residential unit's Elderly Care Centre made good use of social media (WeChat group and live broadcasts) to keep in touch and always interact with the residents. In addition to asking residents about their daily needs, the social media was also used to spread awareness about health protection and to keep the residents of the Hutong residential unit socially networked even when they were not allowed to leave their homes. This is a way of keeping the community connected even in the event of an emergency. This also strengthens the community's sense of belonging

and builds a sustainable community.

6.3. The role of social capital in fostering pro-environmental behaviours

The second sub-question of this thesis is: Does social capital play a role in fostering proenvironmental behaviours in a community?

Evidence from previous research highlights that social capital has a positive effect on the formation of pro-environmental behaviours. The stronger the social capital, the greater the likelihood that inhabitants will adopt and practise pro-environmental behaviours, and the longer they will persist. Stronger social trust in the community, social connection to the community, more free time for residents, more time spent in the same community, increased community participation, and a well-designed public space all have an effect on the building of social capital in urban China, according to this thesis.

Social trust is the foundation of a community's social capital. It is an expression of the willingness of community members to trust others and can reflect the closeness of community ties. High-quality social capital also influences social trust, as stronger social relationships, or neighbourhoods, foster mutual trust, while strong social capital and social trust foster a feeling of community membership, which in turn reinforces social trust. This is the connection between these three mutually reinforcing factors (Figure 6.2). As shown by this thesis, residents of Hutong residential units have a high degree of mutual trust and a strong feeling of community belonging. Furthermore, they are able to communicate more with their neighbours and have greater social capital than residents of Commercial residential units. This tight relationship encourages more rapid recycling behaviour and compliance with government regulations. When community social trust and social belonging are developed, a community norm emerges from the behaviour of individuals, and when a representative and the more trusted individual begins to act in an environmentally friendly manner, other residents will follow suit. This is the formation of a social network that spreads the individual norm to the community as a whole through

social interaction and information exchange between residents.

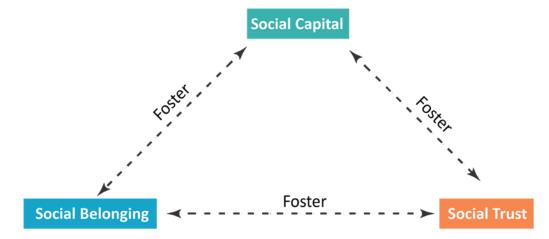


Figure 6.2 The relationship between Social Capital, Social Belonging and Social Trust (Made by author)

In addition to being an essential aspect, public engagement constitutes the social capital of the community. The public engagement referred to here is different from public participation in policy making, which was mentioned above. This refers to community-level engagement in community management policy debates and activities. Different social backgrounds and educational levels are accommodated in the community-appropriate activities. For instance, in this thesis, the majority of residents in the Hutong residential unit are elderly people, who are typically less able to use the internet and mobile phones than younger people. Therefore, workshops, games, and activities on waste separation are frequently held in the Hutong residential unit so that the elderly can learn about the advantages of separating waste in these ways. This sort of public involvement, information, and education on pro-environmental behaviour may dramatically enhance the percentage of resident participation in pro-environmental behaviour and serves as a driving force in the community. It also enhances people's feeling of community and engagement with their neighbours and encourages the establishment and growth of social capital.

Additionally, the amount of free time residents has and the length of time they have lived in the neighbourhood seem to impact the building of social capital in the community. As

in the case of the Hutong residential unit in this thesis, where the majority of the residents are elderly retirees, communities with a greater number of residents with free time have a stronger level of social capital. The majority of young and middle-aged individuals in China are confronted with job pressure and social competitiveness, so they can only devote their free time to working and pursuing additional possibilities. This is in stark contrast to working conditions in Europe and the United States. Additionally, the amount of time spent in a community has an impact on the relationships among residents. The majority of Hutong people have resided in the neighbourhood for a considerable length of time, and some may have ancestral homes. Therefore, they have more opportunities to develop social relationships with their neighbours. However, in residential communities near firm headquarters in China's first- and second-tier cities, there are often employees from other cities who are recent migrants and who frequently change their addresses. Residential communities in China now have no control over age, employment history, or education. It is difficult for people living in the same community to share the same age group and social background as in the Hutong residential community. This is one of the reasons for the weakness of neighbourhoods in China today. These issues of Chinese society are beyond the scope of behaviour change campaigns.

The last element to note is the social infrastructure or public place. A public space where people interact with one another, converse, and form relationships. Eric Klinenberg (2018) emphasises the significance of public places in his book '*Palaces for the people*'. A public area that fosters community cohesiveness through fostering public involvement, neighbourhood connectedness, and a feeling of belonging. In the Hutong residential unit in this thesis, there is an elderly station for the community's residents, which provides assistance with daily needs and often helps with meal reservations and supplies, as well as an elderly activity room, a massage room and a chess room. During the pre-fieldwork, there were many residents of the community playing cards and chatting in the activity room. However, in the Commercial residential units, there are also public spaces, such as green areas and children's play areas, which do not seem to draw community-wide activities. It can be argued that the design of public spaces in many residential areas in

China is somewhat ostentatious in pursuit of so-called high-end communities and high green space coverage, but these public spaces only serve the function of walking and do not contribute to the formation of social capital within the community through shared activities.

Therefore, it is quite simple to carry out research in the Hutong residential community, which has a model of a self-contained community and a feeling that the residents are friendly and helpful to each other. The elderly station offers a range of activities and workshops for the elderly, and locals sign up and engage in them in groups. This is because the community has faith in the station manager and the community-organized programmes, and residents like following his lead. This has resulted in the creation of a modest bottom-up model. As a result of this deep social relationship, it is also simpler to engage in pro-environmental behaviour.

In China, social capital has always been a significant factor. According to the literature, social capital has been in China in the form of neighbourhoods from the Spring and Autumn period (since 770B.C.E.), and the mutual assistance of social capital has been a promoted social value in China. The social capital is a valuable, non-monetary resource that has not been used efficiently, but is used to assist one another. In the area of proenvironmental behaviour formation in China, a link between social capital and the creation of pro-environmental behaviour is absent; this is the contribution of this thesis to pro-environmental study. The idea of promoting pro-environmental behaviour through social links between communities, such as waste separation and recycling, is operational in China. As it appears that neighbourhood relations in China have been deteriorating in recent years, it is imperative that we maintain the formation and maintenance of this social capital. As a result, the government must strengthen the social capital of communities by increasing the formation of relationships between residents and enhancing social trust and a sense of community belonging.

However, in the process of this study, Covid had an impact not only on the research

process but also on the formation of social capital in the community. During the epidemic, Chinese management policies, such as home quarantine, city closures and reduced travel, reduced the opportunities for residents to meet and communicate with each other on a daily basis, thus reducing the social network between communities. However, for this unavoidable disease, other communities can learn from the Hutong residential unit by using social media to enhance the daily communication and contact between residents during the epidemic.

6.4. The impact of individuals living spaces and neighbourhoods design on pro-environmental behaviour

The third sub-question topic concerns the design and development of communities'-built environments: How do the design of living space and neighbourhood design influence pro-environmental behaviours?

By selecting two residential communities with different built environments, this thesis compares the current high-rise residential units in China, in which it is more difficult to implement pro-environmental behaviours, such as waste segregation, than the historical and traditional neighbourhood residential units. The form of the community also influences the sustainability of social relations among its residents. In this thesis, the traditional neighbourhood of the Hutong residential unit has more social capital than the Commercial residential unit's members. The form of streets and footpaths, the number of purposeful places around the community, the density of buildings in the residential area, the gated or non-gated community, and the hierarchy of public spaces all have an impact on the social capital of the community's residents. Social capital is an intervening factor in pro-environmental behaviour, as seen in previous section 6.3.

Due to China's large population, land use in residential areas is dominated by the construction of more high-rise buildings in order to conserve land resources. High-rise

communities, such as the Commercial residential units described in this thesis, are the predominant form of the residential community in China. However, these high-rise buildings have an impact on the pro-environmental behaviour of people. In this thesis, for instance, it is more challenging to separate and manage household garbage recycling in a Commercial residential unit than in a Hutong residential unit. Due to frequent garbage disposal, it is not practicable to offer sorting facilities on every level of a high-rise residential structure with limited public space. This has an impact on the convenience of the residents living on the upper floors. In the absence of supervision, residents continue to mix and discard their trash. In contrast, residents of the Hutong residential unit, which is situated in a low-rise structure in the historic area, have a very small distance between the interior and outdoor garbage collection vehicles, and a semi-private courtyard for the temporary storage of household waste. Residents in high-rise residential units have a negative attitude toward garbage separation and recycling due to the inconvenient nature of high-rise structures. Due to the difficulty of living in a high-rise, residents are less likely to participate in other environmentally conscious behaviours.

In addition, high-rise housing negatively impacts neighbourhood relationships, social capital, and community satisfaction. This thesis did not find that the infrastructure of Commercial residential units is inferior to that of Hutong residential units; instead, the Commercial residential community has more green spaces and playgrounds for children. In contrast, when residents are in a public area surrounded by high-rise buildings, they feel depressed and want to leave as soon as possible. Even though the neighbourhood was designed with areas for interaction, the surrounding environment discourages inhabitants from remaining. The Hutong residential unit lacks green spaces and squares, yet people prefer to congregate and converse on the hutong road. This is due to the harmonious proportion between the height of the surrounding buildings and the road, which gives people a comfortable feeling and makes them approachable. In addition, the public space of the Hutong residential unit includes not only the fully open public space of the green areas and squares, but also the semi-private spaces of the courtyards and the small public spaces of the residents of the Hutong road that belong to the entire

road's residents, allowing for increased interaction with neighbours and passersby. The utilisation of semi-private and semi-public areas strengthens social relationships in the neighbourhood and fosters a feeling of community for individuals of all ages (Karuppannan and Sivam, 2011). In contrast, tenants of Commercial residential apartments do not have access to semi-private spaces for small-scale neighbourhood interaction outside of their own residences. Consequently, the development of residential communities must take into account the establishment of a multi-level open space concept inside the community. In contemporary China, living in low-rise detached buildings is reserved for the affluent, while the majority of commoners reside in Commercial residential units similar to the one described in this thesis, and there is a mentality that the higher the building, the more exclusive it is. However, it is this 'upmarketness' that socially isolates communities from one another.

Moreover, some academics (Maclean, Ewan and Kennedy, 2006; Xu et al., 2019) claim that compact, high-density urban forms and spatial structures have positive impacts on greenhouse gas emissions. High-density core urban areas are 2-2.5 times less energy and GHG intensive than low-density suburban developments (Maclean, Ewan and Kennedy, 2006). While it is often a good idea to increase the number of floors in a residential community (Muñiz and Rojas, 2019), multi-story flats are compact communities that consume less energy than single-story homes, and the residents of multi-story homes can use public transportation intensively, thereby reducing greenhouse gas emissions from transportation. However, despite the fact that this sort of high-density housing might make a city more environmentally sustainable by decreasing automobile dependence, it has a detrimental effect on the social capital of its citizens. Instead, it affects the sustainability of the community. Making cities compact, and thus reducing greenhouse gases, cannot be achieved by raising floors; high densities can also be achieved with low-rise housing of up to four storeys (Akers, Adriana Sandoval, 2015), for example, in Shanghai's lane neighbourhoods with a population density of 625 per hectare and a residential height of three storeys, and in Manhattan's Grand Street neighbourhood with 541 people per hectare and only two to three storeys. Consequently,

for future Chinese communities, building heights and densities could shift from the currently popular high-rise model to a low-rise model, similar to the residential form of historic districts, with an increase in the number of buildings within the same community, which could permit a small number of high-rise buildings.

The Hutong residential unit's road layout is grid-like and very regular, and the horizontal and vertical pedestrian streets provide several road nodes, hence enhancing connectedness. This grid-like street design improves the frequency of walking and, thus, the likelihood of meeting neighbours (Ozbil et al., 2019). In contrast, the cul-de-sac and curved layout of the Commercial residential units in this thesis is a common form of street in Chinese residential communities, which appears to increase the beauty and interest of the curves in the plan, but in reality, decreases the frequency of walking and the likelihood of meeting residents. The cul-de-sac and curving layout are less permeable and linked than the grid design. The broader Hutong road in the Hutong residential unit has a range of cost-effective service outlets, such as stores and restaurants, that suit the demands of the Hutong residents. Residents may pick the quickest path on foot depending on their objective, and when they gather at this destination, the region becomes a hub of communication and activity. Today in China, some of the shops around Commercial residential units are more oriented toward business outside the community, while the residents of the community instead choose to meet their needs in an extensive collection of shopping malls some distance away.

In today's Chinese residential communities, gated communities are predominantly built. Even if the roadways inside the community are extended and converted to a grid layout, with more nodes and social spots around them, they are isolated from the outside world by the community's walls and gates. Although the purpose of this gated community is to boost security and lower crime rates, residents are led to feel that the outside world does not belong in the neighbourhood. However, as shown by the Hutong residential unit in this thesis, the crime rate does not vary from that of Commercial residential units. The design of the gated community seems to be an attempt by the developer to foster a

feeling of security. However, the gates and walls have weakened the community's sense of community, which is not favourable to the formation of a social network inside the community. In recent years, the security environment in China has been relatively secure, and the rate of crime has been meager. In this perspective, it seems that gated communities are very costly; in designing residential communities in China, there is no need to promote a false feeling of security by sacrificing social relationships.

6.5. The impact of removing external barriers on fostering proenvironmental behaviour

The fourth sub-question in this thesis is about external barriers to the implementation of pro-environmental behaviour: Could removing external barriers help people foster pro-environmental behaviour in a community?

The thesis identifies external barriers to the implementation of pro-environmental behaviour in a community through pre-fieldwork at two research sites and finds that removing external barriers can improve pro-environmental behaviour in a community through post-fieldwork. These external factors include knowledge of pro-environmental behaviour such as waste segregation, the availability of infrastructure to meet residents' perceived conveniences, and the help of volunteers and mentors to provide prompts and reminders. The longer the pro-environmental behaviour is maintained when infrastructure is easily accessible, and volunteers and mentors are constantly reminding citizens, the greater the accessibility of the infrastructure.

In the pre-fieldwork questionnaire, it was determined that the residents of two research sites lacked understanding about trash separation. In the months preceding up to the adoption of Beijing trash separation legislation, information was spread through community boards, events, television, and the internet about how to separate waste and the penalties for not doing so. After the official implementation of the legislation,

residents sorting behaviour improved as a result of sorting education. Environmental knowledge positively influences the promotion of pro-environmental behaviour (Amoah and Addoah, 2021a). However, this environmental knowledge should not focus on knowledge of how to sort waste but should also inform residents about the environmental benefits of such pro-environmental behaviours. This will assist residents in comprehending the significance of their actions and boost their motivation to act. In China, schools are actively incorporating pro-environmental behaviour education into their curricula (Ministry of Education of the People's Republic of China, 2020), with the goal of developing pro-environmental behaviour from a young age. As a result, by the time these students reach middle age, their pro-environmental behaviour and attitudes are much more advanced than those of the residents of the Commercial units in the thesis. It is also evident from this thesis that elderly residents of the Hutong residential unit have better and more consistent waste separation practices than younger and middle-aged residents of the Commercial residential unit. Although young and middle-aged persons absorb and retain knowledge faster than the elderly, they are less likely to participate in pro-environmental behaviour due to a lack of time or because they are less fearful of mandatory regulations than elderly people. Therefore, we should pay more attention and encourage middle-aged and young people to participate in activities and behavioural adjustments in order to build pro-environmental behaviour.

According to the conclusions of this thesis, the Hutong residential unit has a more convenient infrastructure for waste separation. As the width of the Hutong road is insufficient for the trash separation bins, this has resulted in a novel method of garbage collection in the Hutong residential units, in which waste collectors drive motorised bins to collect the separated waste at the scheduled times and locations. However, in China's present Commercial residential units, a similar infrastructure is used, with a series of trash separating bins underneath many buildings, but with varying opening hours and distances for residents. This is why residents of Hutong residential units are better at sorting waste than those of Commercial residential units, as Hutong residential units have more convenient and appropriate recycling facilities and services, taking into account the

type of housing and the built environment. The recycling facilities and services are more suitable for the residents. This low cost, low time consumption for residents, low proximity, as well as reduced infrastructure for the community, should be the model for the development and encouragement of pro-environmental behaviour in China. At the same time, while Hutong residents are waiting in line to put their rubbish out, the mobile recycling truck becomes another social place for residents to socialise, thus contributing to the formation of social capital, which is a social place we did not anticipate. Thus, in the development of other pro-environmental behaviours, the formation of social capital among residents can also be facilitated by controlling the opening hours of infrastructure or spaces.

When Beijing first started implementing waste separation regulations, communities were provided with volunteers and supervisors at the recycling stations to assist in guiding the community in separating garbage, and their presence functioned as a supervision role as well. This was an effective, prompt intervention, reminding people to dispose of trash appropriately and gradually creating a social norm in the community. But with the global outbreak of the Covid-19 disease at the same time as the regulation was being implemented, governments redirected their priority to combat the virus. As a result, less attention has been paid to the issue of waste separation in Chinese communities, and as a consequence, many communities have developed the phenomenon of secondary sorting by community cleaners to meet waste separation standards. This has transformed the psychological condition of some residents from having to sort their garbage to having someone assist them in sorting their waste even if they don't, as was the case in the Commercial residential unit in this thesis, and the residents' sorting behaviour is challenging to sustain in the future. Although the availability of such secondary sorting is convenient for residents, it does little to promote environmentally conscious behaviour. To decrease the reliance attitude, the government should specify that the duty of community volunteers and supervisors is to assist, supervise, and monitor, not to sort.

6.6. Evaluation and models

This thesis uses the theories of The Behaviour Change Wheel (BCW) and Community-Based Social Marketing Fostering Sustainable Behavior (CBSM). This thesis verifies the rationale and practicability of governance, social capital, and infrastructure design interventions derived from residential waste segregation. This leads to an assessment of the formation of pro-environmental behaviour in Chinese communities and the selection of interventions for different types of communities. This new theory integrates and simplifies the BCW and CBSM perspectives. Regarding proposals for interventions, the Hutong residential unit has a high level of social capital, which may be employed as an intervention. In the case of the Commercial residential unit, other interventions such as organising community events and controlling the locations and form of public spaces are needed to form good community relations before they can be utilised. For other proenvironmental behaviour studies, the government should follow the approach of identifying the target behaviour, finding the barriers, selecting the appropriate intervention policy, implementing it on a small scale, evaluating and correcting it, and then developing the policy before promoting it on a large scale. It is crucial that the recommended treatments are not implemented without an immediate shift in proenvironmental behaviour. Otherwise, there is a considerable danger, as shown by this thesis, that the majority of individuals would lose motivation and become less likely to sustain their waste separation behaviour over time. The key to aiding people in adopting pro-environmental behaviours is selecting the most effective intervention.

6.7. Policy implications

Based on the thesis presentation and study, a number of conclusions are formed on how to contribute to the development of pro-environmental behaviours. This thesis proposes three themes from governance, social capital, and infrastructure as directions for behavioural intervention tactics to promote pro-environmental behaviour and the

development of sustainable communities. However, these characteristics need significant government backing. This section will provide some recommendations for the future growth of environmentally conscious behaviour in China regarding policy, social capital, and infrastructure.

Governance

1 In order for China to participate in pro-environmental actions such as trash separation, mandatory legislation and regulations are required as a limit and direction. The implementation of laws must guarantee that information is transparent, and procedures are open to ensure that residents not only fear the law, but that their impression of the policy's efficacy rises, hence enhancing their desire to participate in pro-environmental behaviour.

2 Financial penalties and incentives can be adopted alongside each other. Supervision can be increased by employing supervisors or resident volunteers, and when unlawful behaviour is found, timely penalties can be imposed, which can quickly create awareness of pro-environmental behaviour. Combined with monetary rewards in the form of points or price reductions for doing the right thing, more residents can be attracted to pro-environmental behaviour.

3 Increase the acceptability of required restrictions by residents. Depending on demographics and educational backgrounds, there could be a variety of environmental education and awareness campaigns and pro-environmental activities to engage residents in learning and understanding the benefits of pro-environmental behaviour for the environment and society, as well as for themselves.

4 Enhance the infrastructure required for environmentally responsible conduct similar to waste separation. To make it easier for residents to engage in pro-environmental behaviour. Consider the rationalisation and scientific arrangement of facilities to reduce external obstacles and enhance the propensity of residents to participate in pro-environmental behaviour.

5 The government should clarify the role of volunteers and supervisors in the formation of pro-environmental behaviour. Volunteers can provide guidance and help but must not

be the choice of residents to do it on their behalf. Supervisors should also play a supervisory role, pointing out and explaining the correct approach and reasons when unreasonable pro-environmental behaviour is found, and helping residents to form correct pro-environmental behaviour.

6 The Chinese government should decentralise, encourage and support public participation, including discussion of pro-environmental policies, mutual monitoring and reporting of non-environmental behaviour within the community. The government should listen to the feedback of residents on the internet and actively help to improve the situations mentioned by residents. Form a sound system of cooperation between the government and residents. This will increase the positive attitude and willingness of residents to engage in pro-environmental behaviour.

Social capital

1 There is a need for the Chinese government to evaluate the effect of social capital on pro-environmental behaviour. Strengthen the formation of social capital. Increase trust between people in the community. This can be achieved by increasing public participation in the community. For example, organising more community events to deepen understanding and trust between residents.

2 The government should urge the community to strengthen community norms and promote the advantages of pro-environmental behaviour, so that residents are mentally and psychologically motivated to engage in pro-environmental behaviour. This can also be done by using people who know more residents in the community as community representatives to bring about behavioural change in the community.

3 Each community is encouraged to build its own social media network, such as a WeChat group, to form and preserve social capital in the face of inevitable illness epidemics such as Covid-19. This allows locals to stay informed, exchange information with one another, and assist their neighbours.

4 It is recommended that each community help promote social capital development by controlling the opening hours and frequency of infrastructure and thereby increasing opportunities for community residents to interact.

Community structure design guidelines.

1 For the future residential community, building height should be decreased, and more low-rise structures should be constructed. Under the condition that daylight and fire safety requirements are met, building density may be raised suitably, and each community can add a few high-rise structures according to the size of the area.

2 The road pattern in the residential community consists mainly of a grid pattern with a high degree of permeability, and the road separates the community into various small-sized neighbourhoods before spreading to the social network of the whole community.

3 Depending on the demands of the people and the location of the community, various sorts of sociable spaces, such as coffee shops, bakeries, etc., may be offered to expand the possibilities for residents to meet, therefore enhancing the community's social capital.

4 The community may be opened up, and the gated community can be eliminated, boosting the community's connections with the outside world and the people's desire to interact. CCTV could be put around and inside the neighbourhood, as well as via the

5 In the residential community, there should be more public areas at different levels, including totally open spaces and semi-private spaces. And a limited variety of residential units that share a small semi-enclosed area, as well as public space. The accessibility of these places in these shared residential properties is generally balanced. Second, these modest semi-private and public places may be decorated by the inhabitants themselves, so enhancing communication and feeling among residents.

cooperation of neighbours and local businesses, to address safety concerns.

6.8. Reflections and Limitations

This thesis explores the factors that influence the development of pro-environmental behaviour in Chinese communities; however, further study is required to determine if these conclusions are applicable to residential areas across Chinese cities. Firstly, the two research sites in this thesis are located in Beijing, a first-tier city in China and the country's

capital, which naturally has a faster implementation of policies and regulations than other third or fourth-tier cities or even lower tier cities, and there are variations in the timing and prevalence of infrastructure provision. In addition, there are fewer volunteers, supervisors, and associated popularisation efforts. Second, this thesis does not take income into consideration. In this thesis, the Hutong residential unit is a particularly unique community, since there are not many such communities in China. The incomes of the residents in the Commercial residential units are likewise middle class. Thus, the residents' incomes of these two research sites are not indicative of the earnings of people in other Beijing neighbourhoods or China as a whole. This is due to the fact that in many other first-rate cities, like Beijing, there exist both wealthy and impoverished neighbourhoods. However, there is little evidence that China's higher income groups create more household garbage, but Ma and her colleagues (2020) indicate that Chinese rural populations with lower incomes are more inclined to recycle. The choice of community varies based on income, which affects the social background of people, their educational background, the community's infrastructure, and the interactions between members. Thirdly, only cities with historical monuments, such as Beijing, Shanghai, and Guangzhou, have the architectural form and layout of the Hutong residential unit described in this thesis. Some cities have selectively regenerated these historic areas and communities, but not all of them have retained their original residential and architectural layout, as in the case of the Hutong residential unit in this thesis. For example, in Beijing's Ju'er Hutong, the range of relationships between neighbours has deteriorated after regeneration (Zhang and Lu, 2016). Some unrenovated Hutong residential units may have issues such as filthy living conditions and occupants from diverse socioeconomic backgrounds. In addition, the sample size of this thesis with two pre- and post-fieldwork was not controlled for the same number, and there is a difference in the sample size of post-fieldwork in the two residential units, which may influence the findings.

There are also external factors that cannot be controlled that may influence the results of this research. Post-fieldwork, information posted on social media by users and official accounts was collected and analysed, as the majority of users posted information and

photos when they encountered problems and discontent. In contrast, residents who engaged in sorting behaviour or saw a community in better condition were unlikely to share them. In addition, some of the questionnaire's options that indicate a person is a good citizen, such as "I am participating in trash separation activities," may lead some people to pick this option, which could influence the findings. In addition to these, the rapid worldwide appearance of Covid-19 affected the sample size of post-fieldwork, resulting in a very small sample of Commercial residential units. This thesis has also affected the execution of sorting requirements, as the government has shifted its focus to Covid-19, therefore lessening the level of waste sorting regulations. As communities often face lockdowns and must live in isolation, the lack of opportunity to meet members in their communities has also affected the social capital of some community residents. Despite its limits, this thesis complements the study on the development of proenvironmental behaviour in Chinese residential communities by demonstrating that government, social structure, and infrastructure design give significant support to this growth. In addition to providing policymakers with knowledge of the elements that drive the formation of pro-environmental behaviour, the thesis identifies social capital as an under-explored factor that Chinese communities may employ to promote proenvironmental behaviour.

6.9. Future research

The above findings and reflections indicate the need for more study in a number of areas. This thesis is a comparison and analysis of the factors that influence the creation of proenvironmental behaviour in two Beijing communities. To develop meaningful and generally relevant results that may be used for the establishment of further proenvironmental behaviours, additional study is required. The study of this thesis was conducted strictly in the context of pre- and post-behavioural change of residents in the context of mandatory regulations, and as such, mandatory regulations comprised a relatively large portion of the intervention in this study, regardless of the fact that

regulations did not influence subsequent resident behaviour. In other words, in the early phases of the behavioural shift, people have no option but to comply with the government's waste separation requirements since they are required to do so by government-mandated regulations. There is no guarantee that government regulations will be enacted in the future for all pro-environmental behaviour formation; therefore, additional research is required to determine whether these intervening factors can also influence Chinese residents to become more pro-environmental and sustainable when they have multiple behaviour choices.

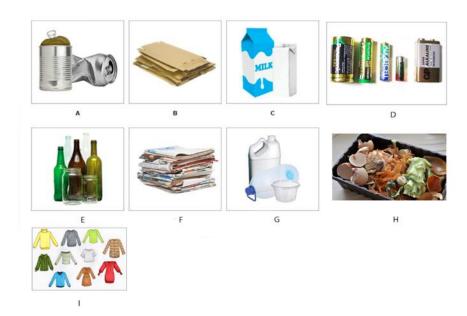
Besides, the relationship between public participation and government policy is a combination of top-down and bottom-up theories applied to the study of Chinese community residents' pro-environmental behaviour. Public participation in China has always been ambiguous, and although the government has consistently declared its support for fair participation, there is no comprehensive system in place to support public participation in policy making. Therefore, it is necessary to construct a policy of public participation that is suitable for the Chinese system and can be built from the bottom up to complement government policymaking.

The government also needs to play a supportive and leading role in the sustainable development of communities and the formation of pro-environmental behaviour among residents. The development of this process in China is a long and complex one, and future research in China should always take into account its own circumstances in order to develop interventions and models that are suitable for sustainable development in China.

Appendices

Appendices 1 Pre-fieldwork questionnaire

A) English version of the pre-fieldwork questionnaire
1. What is your age?
<14
15-24
25-34
35-44
45-54
55>
2. What is your gender
Female
Male
3. What is your occupation
4. Do you rent a flat in this area or own a flat in this area?
Rent
Own
5. How many people are in your household?
6. Do you know the reason to recycle items?
Yes
Why
No
7. Do you participate by recycling items at your resident unit?
Yes
No
8. If you answer is yes for question7, Why
9. If you answer is no for question 7, Why not?
It would be too messy / smelly
Do not have different recycling bins at home
I have bins at home but no recycling bins in the residential unit
I do not receive any information that I have to recycle items
Too busy / easier to use the general waste bin
I do not know how to recycle items
Other
10. If you do recycle what items do you think you will recycle?



11. When your household is unsure an item is recyclable, what do you do?

Place the item in the general bin

Place the item in the recycling bin

Search online

Ask neighbours for help

Other

12. Dose your residential unit offer recycling?

Yes

No

Not sure

13. Would you recycle if the service was made available by your residence?

Yes

No

14. Who is the most frequent recycler(s) in your household?

Adult female(s)

Adult male(s)

child(ren)

Everyone recycles

No one recycles

15. If your neighbours start to do recycle, will you follow them do it?

Yes

No

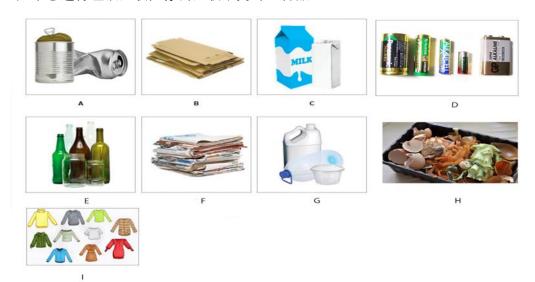
16. If you start to do recycle, will you suggest your neighbours to do it?

Yes

No

The Chinese version of the	pre-fieldwork questionnaire	for p	articipants
恋的年龄? <14	O 15-24	0	25-34
35-44 医的性别 女	O 45-54	Ο	55>
男 图的职业是			
医是租户还是房主? 租户			
房主 E您的住所中有多少人?			
图知道回收垃圾的作用吗? 知道 原因是			
• • • • =	垃圾回收吗?		
口果您回答是,为什么?			
我没有收到任何信息我必须 太忙/更容易使用传统的垃	页要进行垃圾回收 圾桶(不分类)		
	医	图的年龄? 《14	○ 15-24 ○ 35-44 ○ 45-54 ○ 35-44 ○ 45-54 ○ 35-44 ○ 45-54 ○ ○ 80 性別 女 男 然是租户还是房主? 租户房主 整然的住所中有多少人? 然知道回收垃圾的作用吗? 知道原因是

10. 如果您进行垃圾回收, 你会回收下列哪些物品?



- 11. 当你的家人不知道一个物品将如何分类, 您会怎么做?
 - 〇 将它投放在传统的垃圾桶
 - 〇 将它放在可回收垃圾桶
 - 〇 上网搜索
 - 〇 向邻居寻求帮助
 - 〇 其它
- 12. 您居住的区域是否提供垃圾分类箱?
 - O 有
 - 〇 没有
 - 〇 不确定
- 13. 如果您居住的区域提供分类垃圾箱, 您是否会进行垃圾分类?
 - 0 会
 - 0 不会
- 14. 在您的家中, 谁是最经常做垃圾回收?
 - O 成年女性 O 成年男性
- 0 孩子

- 〇 每个人
- 〇 没有人
- 15. 如果您的邻居开始做垃圾分类, 您是否会跟跟随其进行垃圾分类?
 - 0 会
 - 0 不会
- 16. 如果您进行垃圾分类, 您是否会建议您的邻居也进行垃圾分类?
 - 0 会
 - O 不会

Appendices 2 Post-fieldwork questionnaire

A)

16-24 25-34 35-44

1. What is your age?

English version of the post-fieldwork questionnaire

45-54
55>
2. What is your gender
Female
Male
3. What is your occupation
4. Do you rent a flat in this area or own a flat in this area?
Rent
Own
5. How many people are in your household?
6. At present, whether the unit is equipped with sorted trash bins?
Yes
No Do not know
7. Is there a knowledge board for popularizing waste sorting in the unit?
Yes
No
Do not know
8. Is there anyone in the unit to help classify?
Always somebody help
At the beginning had
Never
Do not know
9. Do you think these people improved your knowledge about recycling?
Yes
No
Did not ask for help
10. When your household is unsure an item is recyclable, what do you do?
Place the item in the other bin
Place the item in the recycling bin
Search online
Ask neighbours for help
Ask the volunteer
Other
308

11. Do you currently participate in the garbage classification of your unit? Yes No 12. If it is yes, why? Voluntary participation to protect environment Involuntary, fear of fines Involuntary, mandatory 13. How much do you agree with this garbage classification regulation? Strongly agree Mildly agree Neither agree nor disagree Mildly disagree Strongly disagree 14. Who is the most frequent recycler(s) in your household? Adult female(s) Adult male(s) child(ren) Everyone recycles No one recycles 15. During the Covid-19 period, did the unit provide any help to the residents? Yes No Do not know 16. During the Covid-19 period, did the unit organize online activities? Yes No Do not know 17. During the Covid-19 period, did the neighborhood help each other? (Eg: help to buy food, order food) Yes No 18. During this time, do you know your neighbour better than before? Yes No 19. Would you more like to ask your neighbour for help now? Yes No

1. 您的年龄?
15-24
25-34
35-44
55-54
55>
2. 您的性别
女
男
3. 您的职业是
4. 您是租户还是房主? 租户 房主
5. 在您的住所中有多少人?
6. 目前,小区是否配备了分类垃圾桶?有
没有
不知道
7. 小区内是否有垃圾分类普及知识板?
有
没有
不清楚
8. 小区内是否有指导人员帮助分类?
一直有
起初有
没有
不清楚
9. 你认为这些志愿者是否帮助增加了你对垃圾回收的相关知识?
有
没有 (A. + 1)
没有寻求过帮助
10. 当你或家人不知道一个物品将如何分类,您会怎么做?
将它投放在其它垃圾桶
将它放在可回收垃圾桶
上网搜索
向邻居寻求帮助
寻求志愿者帮忙
其它
11. 你目前有参与所住小区的垃圾分类吗? 有

The Chinese version of the post-fieldwork questionnaire for participants

B)

没有

- 12. 如果有,为什么? (多选)
 - 〇 自愿参加,保护环境
 - 〇 非自愿, 怕罚款
 - O 非自愿,强制要求的
- 13. 你同意垃圾分类法规吗?

非常同意

有点同意

既不同意也不反对

有点不同意

非常不同意

14. 在你家中, 所有人都参与了垃圾分类吗?

女性参加

男性参加

孩子参加

每个人都参与

没有人参与

15. 疫情期间, 小区/胡同有为居民提供任何帮助吗?

有

没有

不清楚

16. 疫情期间, 小区有组织网上活动吗?

有

没有

不清楚

17. 疫情期间, 邻里之间有相互帮助吗? (如:帮助买菜,订菜)

有

没有

18. 疫情期间, 你觉得是否比之前更加了解你的邻居?

분

不是

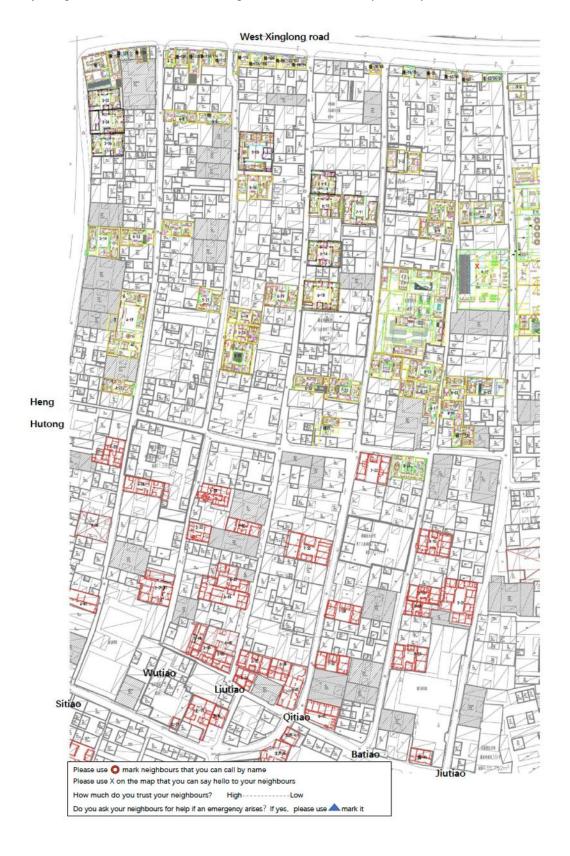
19. 现在是否更愿意向邻居寻求帮助了呢?

是

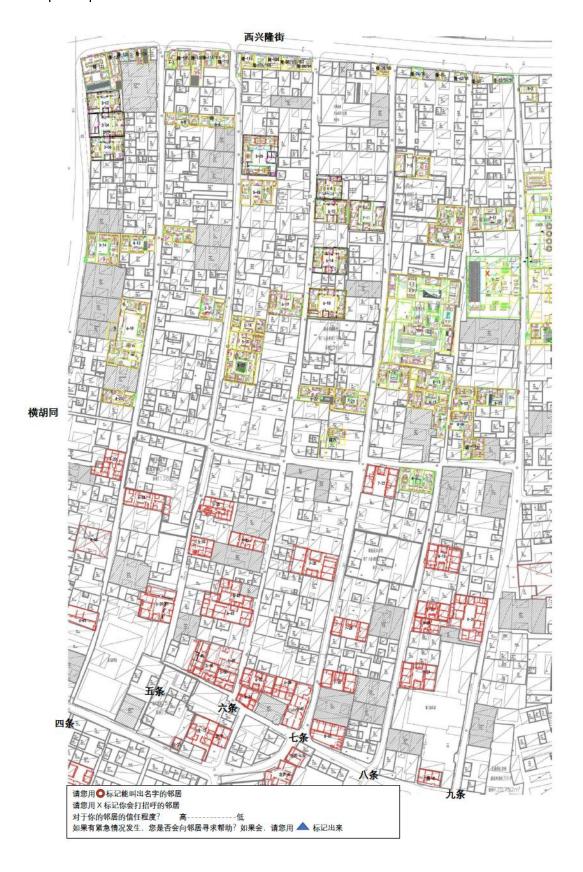
不是

Appendices 3 Pre-fieldwork social capital mapping and questions

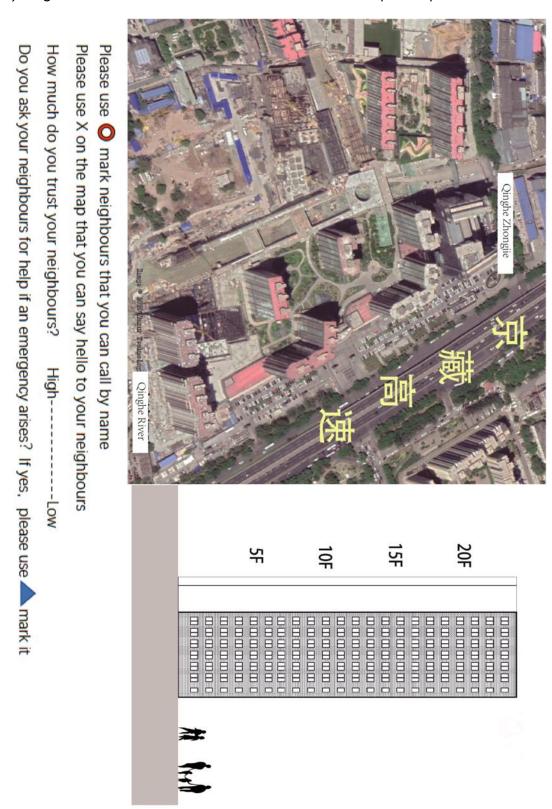
A) English version of the Hutong residential unit map and questions



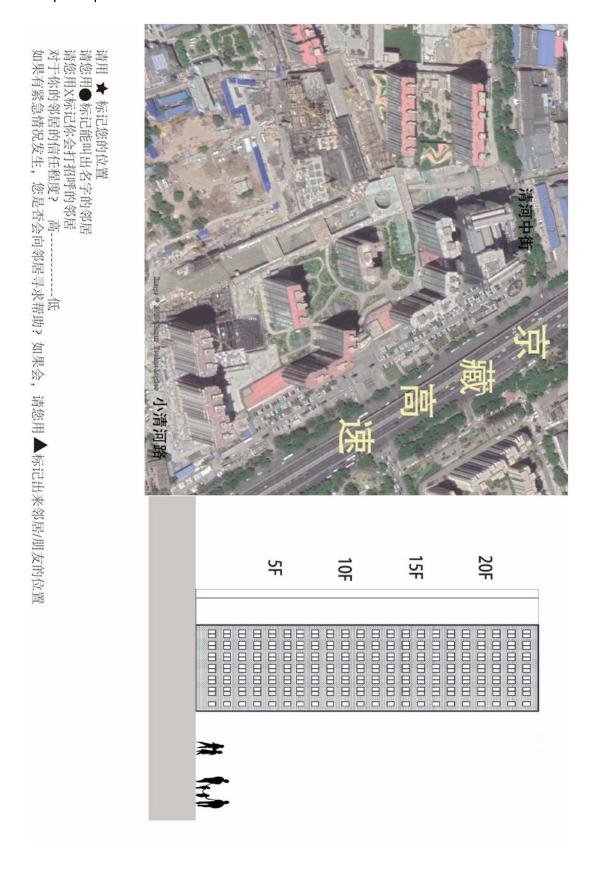
B) The Chinese version of the Hutong residential unit map and questions for participants



C) English version of the Commercial residential unit map and questions



D) The Chinese version of the Commercial residential unit map and questions for participants



Appendices 4 SPSS Results

A) Pre-fieldwork Age Group Wilcoxon-test of Hutong residential unit and Commercial residential unit

Test Statistics^a

1. What is your age?

Mann-Whitney U	468.000
Wilcoxon W	2421.000
Z	-8.316
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: District_Code

B) Pre-fieldwork Chi-square test between location and home ownership levels in Hutong residential unit and Commercial residential unit

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	22.194 ^a	1	<.001		
Continuity Correction ^b	20.538	1	<.001		
Likelihood Ratio	22.902	1	<.001		
Fisher's Exact Test				<.001	<.001
Linear-by-Linear Association	22.019	1	<.001		
N of Valid Cases	127				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 26.85.

b. Computed only for a 2x2 table

C) Post-fieldwork Chi-square test between location and home ownership levels in Hutong residential unit and Commercial residential unit

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.218 ^a	1	.641		
Continuity Correction ^b	.010	1	.922		
Likelihood Ratio	.231	1	.631		
Fisher's Exact Test				1.000	.484
Linear-by-Linear Association	.216	1	.642		
N of Valid Cases	101				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.63.

D) A comparison of the pre-and post-fieldwork age group in Hutong residential unit by Wilxocon-test

Test Statistics^a

1. What is your age?

Mann-Whitney U	2070.500
Wilcoxon W	5473.500
Z	-3.295
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Pre_Post

b. Computed only for a 2x2 table

E) A comparison of the pre-and post-fieldwork of the level of participation in the separation of waste in Hutong residential unit by Wilcoxon-test

Test Statistics^a

7. Do you participate by recycling items at your resident unit?

Mann-Whitney U	1440.500
Wilcoxon W	4843.500
Z	-5.947
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Pre_Post

F) A comparison of the pre-and post-fieldwork of the level of participation in the separation of waste in Commercial residential unit by Wilcoxon-test

Test Statisticsa

7. Do you participate by recycling items at your resident unit?

Mann-Whitney U	19.000
Wilcoxon W	209.000
Z	-8.369
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Pre_Post

G) A chi-square test for association was conducted between location and the choice of 'ask for help from the neighbour in the Hutong residential unit.

Chi-Square Tests						
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	
Pearson Chi-Square	4.084 ^a	1	.043			
Continuity Correction ^b	3.321	1	.068			
Likelihood Ratio	4.142	1	.042			
Fisher's Exact Test				.049	.034	
N of Valid Cases	127					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.09.

H) A Chi-square test for association was conducted between location and the willingness to recommend to their neighbours in the Commercial residential unit

Chi-Square Tests						
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	
Pearson Chi-Square	11.000 ^a	1	<.001			
Continuity Correction ^b	9.642	1	.002			
Likelihood Ratio	11.402	1	<.001			
Fisher's Exact Test				.001	<.001	
N of Valid Cases	127					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.16.

I) A Chi-square test of Hutong residential unit Pre and Post Choices comparison:

b. Computed only for a 2x2 table

b. Computed only for a 2x2 table

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	69.492 ^a	5	.000
Likelihood Ratio	92.251	5	.000
Linear-by-Linear Association	11.379	1	.001
N of Valid Cases	150		

a. 1 cells (8.3%) have expected count less than 5. The minimum expected count is 4.53.

J) A Chi- square test of Commercial Pre-and Post-fieldwork choices comparison:

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	36.656 ^a	3	.000
Likelihood Ratio	35.520	3	.000
Linear-by-Linear Association	.230	1	.632
N of Valid Cases	90		

a. 3 cells (37.5%) have expected count less than 5. The minimum expected count is 1.48.

K) A Chi-square test of Pre-fieldwork data between Hutong and Commercial residential units

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	28.942 ^a	4	.000
Likelihood Ratio	35.063	4	.000
Linear-by-Linear Association	2.901	1	.089
N of Valid Cases	139		

a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is 2.45.

L) A Chi-square test of post-fieldwork data between Hutong and Commercial residential units

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.329 ^a	4	.119
Likelihood Ratio	8.668	4	.070
Linear-by-Linear Association	5.867	1	.015
N of Valid Cases	101		

a. 5 cells (50.0%) have expected count less than 5. The minimum expected count is .19.

Glossary and Abbreviations

The following table describes the main terms definitions and abbreviations used through this thesis.

Term	Acronyms	Definition
The Behaviour Change Wheel	BCW	BCW is a theory used to guide the design and intervention of behaviour change (Susan Michie, Atkins and West, 2014).
Capacity, opportunity, and motivation behaviour model	COM-B model	These three components comprise the COM-B core model of BCW (Susan Michie, Atkins and West, 2014).
Commercial residential unit		Many modern residential high-rise buildings in the same unit
Community (in China)		a group of individuals who live in close proximity to one another within a designated geographical region (Ministry of Civil Affairs of Beijing, 2000).
Community-based social marketing	CBSM	The CBSM model is a strategy to promote sustainable behaviour at the community level (McKenzie-Mohr and Smith, 1999)
Hutong residential unit		Preserved historic residential buildings in Beijing's historic districts
Pro-environmental behaviour	PEB	minimising adverse effects on the environment while engaging in personal activities

Social capital		Social capital is any value added to the activities and economic outputs of an organization by human
		relationships, partnerships, businesses and co-operation'
		(Forum for the Future, 2011).
Theoretical Domains	TDF	14 theoretical domains that may
Framework		address the personal, sociocultural,
		and environmental elements of
		individuals (Susan Michie, Atkins
		and West, 2014).

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