

# From Red to Green: Let a Hundred Eco-Cities Blossom

*The case of Tianjin Eco-city*



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# 1. Introduction

It is increasingly recognised that cities have a key role to play in sustainable development. Currently, more than half of humanity lives in cities and it is projected that in 2050 cities will be home to 66 per cent of the world's population (United Nations Department of Economic and Social Affairs, 2015, p. 1). Especially developing countries are affected by the rapid urbanisation process of the twenty-first century, the largest part of which is yet to take place in the next few decades (Cohen, 2006). It is assumed that urbanisation, which can be defined either as a process (of becoming more urban) or a state (characterised by the fact that a large proportion of the population lives in urban areas)<sup>1</sup> goes hand in hand with economic development (Cohen, 2006). For this reason urbanisation is assigned high policy priority in present-day China (Cao, Chen, Pang, Zheng, & Nilsson, 2012).

China has experienced one of the fastest urbanisation rates in the world. In 1980, 20 per cent of China's total population – 191 million people – lived in cities. In the year 2011, this number had increased to 690 million people, which amounted to 51.3 per cent of China's total population (Chan, 2012). Nowadays, already more people live in China's cities and towns than in its countryside and, according to government estimates, by 2020 60% of the population will be living in cities (Normile, 2008). Urban population growth in China, unlike that in other developing countries, is not primarily fostered by natural increase. This can be ascribed to China's one-child family planning policy.<sup>2</sup> Instead, it is rural-to urban migration and the transformation of rural settlements into cities that have been the main determinants of recent urbanisation in China (Cao et al., 2012).

Even though cities are seen as the driving forces of development, there is also a number of problems associated with China's rapid urbanisation. Thus it is evident that the major environmental and health issue of air pollution is associated with the process (McMichael, 2000). Less visible issues that are concomitant to urbanisation in China are for instance insufficient housing and health services for migrant rural workers (Meng, 2012).

Rapid urbanisation in China and its associated challenges to sustainable urban development have led to radical changes in city planning, including the development of eco-cities, which are ecologically less damaging and simultaneously enhance comfortable and healthy living (Cheng & Hu, 2010). Sino-Singapore Tianjin Eco-city (SSTEC)<sup>3</sup> is one of these newly designed cities. It has been built from scratch on previously unused land (Baeumler et al., 2009). As its name already suggests, SSTEC is a cooperation project between the governments of Singapore and China (Baeumler et al., 2009). The city is located at 45 km from the city centre of Tianjin and 150 km from Beijing (Baeumler et al., 2009). The development of the city started in 2008 and is expected to provide a new home to 350,000 permanent residents on an area of 34.2 km<sup>2</sup> (Baeumler et al., 2009).

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<sup>1</sup> In this thesis we use 'urbanisation' in both of its meanings.

<sup>2</sup> China's one-child policy has recently been abolished; a two-child policy has been adopted in its place.

<sup>3</sup> Throughout this thesis, Sino-Singapore Tianjin Eco-city (SSTEC) and Tianjin Eco-city are used interchangeably.

Tianjin Eco-city is intended to serve as a model for other cities that are facing similar sustainability challenges (Hald, 2009). In this thesis we shall examine Tianjin Eco-city's contribution to urban sustainability. A widely recognised definition of urban sustainability has been given by Haughton and Hunter (2004), who define a sustainable city as a city "in which its people and businesses continuously endeavour to improve their natural, built and cultural environments at neighbourhood and regional levels, whilst working in ways which always support the goal of global sustainable development" (p. 26). In order to be able to recommend SSTECH as a useful model for urban sustainability, it is necessary to know in what way and to what extent SSTECH will be successful in addressing urban sustainability challenges in China. Therefore this thesis will try to answer the following research question:

*To what extent and how can Tianjin Eco-city contribute to urban sustainability in China?*

It is our hope that the results of our research can be used to improve the eco-cities of the future and thus contribute to urban sustainability in China. This is a particularly urgent issue because in the next decades hundreds of millions of additional rural Chinese citizens will make the transition to urban life (Economy, 2014).

Incorporating sustainable development issues in city planning is a complex task that may strongly benefit from an interdisciplinary approach (Repko, 2012). This complexity is already visible in the concept of urban sustainability. Urban sustainability is often considered from a strictly environmental point-of-view, but exclusively addressing urban sustainability within the environmental dimension is like viewing the problem through a microscope. It is therefore preferable that other dimensions of urban sustainability be covered as well. In contrast, the holistic notion of sustainability encompasses multiple disciplinary notions of urban sustainability. Drawing on Haughton and Hunter's definition of urban sustainability, it is clear that in addition to the natural environment also the built and cultural environment should be considered in order to enable a holistic view of urban sustainability. Accordingly, urban sustainability is at the interface of multiple disciplines that provide important insights in the issue. Moreover, because no single discipline has thus far been able to address the issue of urban sustainability, it has remained an unresolved societal issue (Ministry of Foreign Affairs of the People's Republic of China, 2013).

A necessary step in the interdisciplinary research process is the identification of multiple potentially relevant disciplines (Repko, 2012). In accordance with the above definition of urban sustainability the following disciplines can be identified as possible providers of insights in the issue of sustainable urbanisation in China: development studies, economics, environmental studies, human geography and social sciences. Of these disciplines, we identify environmental studies, development studies and social sciences as the most relevant ones. This selection can be justified as follows.

First, the field of environmental studies includes the natural and the human environment and analyses their interaction. It may be noted that the interaction between both domains is indeed altered by urbanisation. For China, urbanisation has come with multiple environmental problems, air pollution being one of them (McMichael, 2000). Now, from an environmental studies perspective it is important to pay attention to the multiple negative

impacts – such as air pollution, energy consumption, waste production and water contamination – that occur in cities. Since eco-cities aim at contributing to a better urban environment, they should focus on addressing these impacts. On the basis of insights from environmental studies, it can be determined whether eco-cities are effectively contributing to urban environmental sustainability. Therefore environmental studies offers a highly relevant perspective for determining the contribution of eco-cities to urban sustainability.

The second relevant discipline is the interdiscipline of development studies. We assume that eco-cities are built in an effort to pursue urban sustainable development. Urban sustainability comprises both sustainability of the built environment and a sustainable way of living for all city dwellers, which includes among others a certain standard of living wellbeing and equality (Diappi, Bolchini & Franzini, 1998). Hence, the theme of urban sustainability is a suitable topic for development studies, which addresses poverty and inequality (Potter, Conway, Evans & Lloyd-Evans, 2012). Such social issues can, moreover, only be understood in their geographical context, because the lives of city dwellers are partly shaped by the built environment and the structures and processes that characterise the urban environment. Development studies covers this aspect by incorporating insights from human geography, including urban and regional planning (Potter et al., 2012), and may thus also provide knowledge about the regional and global context of urban sustainability. In this way human geography, which was also identified as a possibly relevant discipline, is covered by development studies.

Finally, the third relevant discipline is social sciences. This is an interdiscipline that comprises anthropology, sociology, psychology and pedagogy. For this research project we have narrowed this gamut to the disciplines of sociology and psychology. These are particularly relevant because they create an in-depth view of human behaviour and its interaction with society. Since the majority of the urban sustainability issues derive from the interaction of humans with their environment (Wong & Yuen, 2011), it is important to understand the driving forces behind sustainable behaviour and to find out how interactions between institutions and the population affect the development of urban sustainability.

The discipline of economics will not be addressed separately. As shown in Figure 1, on our holistic approach economy is included in society as a whole, and both economy and society are included in the natural environment (Roorda, Corcoran & Weakland, 2012, p. 84). By recruiting environmental studies, social sciences and development studies we fully cover the domain of the natural environment and, hence, the society, while the latter of these includes the economy. This implies that the economy is considered without explicitly invoking the discipline that studies it.



Figure 1. The image shows the economy as one of man's activities, which is in turn a part of the natural environment. Adapted from "Fundamentals of Sustainable Development," by N. Roorda, P. B. Corcoran & J.P. Weakland, 2012, p. 84).

For the three interdisciplines of environmental studies, development studies and social sciences, we have formulated the following three sub-questions, respectively:

- *To what extent can Tianjin Eco-city effectively contribute to urban environmental sustainability?*
- *To what extent and how can Tianjin Eco-city contribute to urban social sustainability in China?*
- *In what way would the relationship between institutions and city-dwellers influence urban sustainability?*

The present thesis is structured as follows. First, in chapters 2, 3 and 4, the above sub-questions will be answered. For each discipline, the notion of urban sustainability will be defined and the problems associated with urbanisation in China will be outlined. Based on this, the contribution of eco-cities to the challenges of urbanisation will be examined from the perspective of each of the three disciplines. After the three sub-questions have been answered, the phase of interdisciplinary integration starts by identifying differences between the insights provided by the different disciplines. When necessary, disciplinary concepts and/or theories will be adapted to enable the creation of common ground between the incongruent disciplinary contributions. This common ground serves as a foundation for creating transparency between the different insights in that it allows the construction of a more comprehensive understanding, i.e. a coherent account that answers our central research question (Repko, 2012). The thesis ends with a so-called 'action horizon' that offers the opportunity to reflect on the research and make proposals for future research.

## **2. Environmental studies (by Pien van Berkel)**

### *Urban environmental sustainability in Tianjin Eco-city*

#### **2.1 Introduction**

Cities affect, and are in turn affected by, environmental change. To begin with, cities concentrate people, enterprises, motor vehicles and waste (Dodman, 2009). They are therefore centres of energy consumption, greenhouse gas production and soil, water and air pollution (Corfee-Morlot et al., 2009). Since the majority of the world population consists of urban dwellers, cities are blamed for being important contributors to global environmental change (Dodman, 2009). Being a country that undergoes high rates of urbanisation, China is likely to suffer increasingly from urban-sourced environmental and pollution problems (Wong, 2011). In turn, with more and more people residing in cities, potential impacts of environmental change are also growing (Bai, 2007). The location of cities along rivers and coastlines makes these areas especially vulnerable to environmental changes as sea level rise or water pollution (Hald, 2009).

Since cities are the main contributors to environmental change but simultaneously experience the downsides to this change, they must be considered important players in addressing environmental change. Some even argue that an urban setting can provide opportunities for the conservation of natural resources. Thus Dodman (2009) states, “the relative proximity of homes and businesses in cities can encourage walking, cycling and the use of mass transport in place of private motor vehicles” (p. 185). In addition, though cities may be the single largest ‘source’ of global greenhouse emissions, urban residents tend to emit a substantially smaller volume of greenhouse gas per capita than people living elsewhere in the country. This is because cities are also concentrations of technological innovation (Grimm et al., 2008; Dodman, 2009).

The Chinese government has taken serious initiatives to develop eco-cities in an attempt to address the negative environmental effects of urbanisation (Wong, 2011). Not all initiatives, however, have been successful. For instance, the eco-city of Dongtan near Shanghai is considered a failed project on account of several reasons. One of these reasons includes the planned location of the eco-city on a conservation wetland, which could be ecologically harmful to the estuary of the Yangtze river (Cheng & Hu, 2010; Chang & Sheppard, 2013). With the development of Sino-Singaporean Tianjin Eco-city, the present hope is that cities in China, instead of being the main contributors to current environmental problems, will form part of the solution in the future.

In this disciplinary chapter the potential environmental effectiveness of Tianjin Eco-city is evaluated. This is relevant because of failures of previous eco-cities in China and because Tianjin Eco-city aims to be a model for many more eco-cities to be developed in China (Hald, 2009). Multiple studies emphasise the importance of the concept of effectiveness in evaluating environmental policy (Adger et al., 2003; Termeer et al., 2011). I use the definition by Adger et al. (2003), who define effectiveness as “the capacity of a decision or policy alternative to achieve its expressed objectives” (Adger et al., 2003, p. 1105). A policy can be considered effective when its strategies and tools contribute to its

desired outcomes (Adger et al., 2003). In the case of Tianjin Eco-city, the desired outcome is urban environmental sustainability. To describe this, reference is made to Satterthwaite (1999), who defines sustainable cities as “cities whose built form, government structure, production systems, consumption patterns and waste generation and management are compatible with sustainable development goals for the city, its wider region and the whole biosphere” (p. 6).

Because Tianjin Eco-city has not been fully developed yet, effectiveness evaluation based on actual outcomes is not possible. However, an indicator system with 26 key performance indicators (KPIs) was produced to guide the development of the eco-city (Yu, 2014). In formulating these KPIs, reference was made to national standards in China and Singapore, as well as international standards (Qiang, 2009). These KPIs can be used to determine the potential environmental effectiveness of Tianjin Eco-city. In an attempt to examine Tianjin Eco-city’s (potential) contribution to urban environmental sustainability, I have formulated the following research question:

*To what extent can Tianjin Eco-city effectively contribute to urban environmental sustainability?*

To determine the potential environmental effectiveness of Tianjin Eco-city, an effectiveness evaluation is carried out for which several steps are to be taken (Baak & Van Zanten, 1990). Since eco-cities in China were designed to counter the adverse environmental effects of urbanisation, section 2.2 starts with outlining these challenges to urban environmental sustainability. From there on, the KPIs for evaluation are selected. Effectiveness evaluation focuses on the ability of a policy to achieve certain goals, however, this does not guarantee that the goals are formulated in an adequate way. Therefore, in section 2.3 criteria that are used for the evaluation of the KPIs are presented. Section 2.4 examines the extent to which Tianjin Eco-city complies with these criteria. After a discussion, this chapter ends with a conclusion.

## **2.2 Challenges to urban environmental sustainability in China**

It should be noted that the spatial extent of environmental impacts caused by cities varies from local via regional to global. The importance of taking into account the spatial extent of environmental impacts caused by cities is recognised by Satterthwaite’s (1999) definition of urban sustainability, which includes “the city, its wider region and the whole biosphere” (p. 6). A number of empirical studies support this view. Grimm et al. (2008) argue that urban areas are hot spots that drive environmental change at multiple levels, producing demands on services that nearby and distant ecosystems provide. Besides, Marina Alberti (1996, 1999) agrees that cities affect and are affected by natural systems beyond their physical boundaries. Moreover, Doughty and Hammond (2004) argue that the environmental impact of a city is greater than its surrounding region and claims that cities only survive because of networks with their hinterlands or bioregions.

Grimm et al. (2008) identify five major types of environmental change that are affected by urbanisation: changes in land use and cover, biogeochemical cycles, climate,



hydrosystems and biodiversity. Urbanisation in China displays a similar pattern and Tianjin faces many of the same problems as other cities in China (Hald, 2009). Figure 3 shows these five types of environmental change.

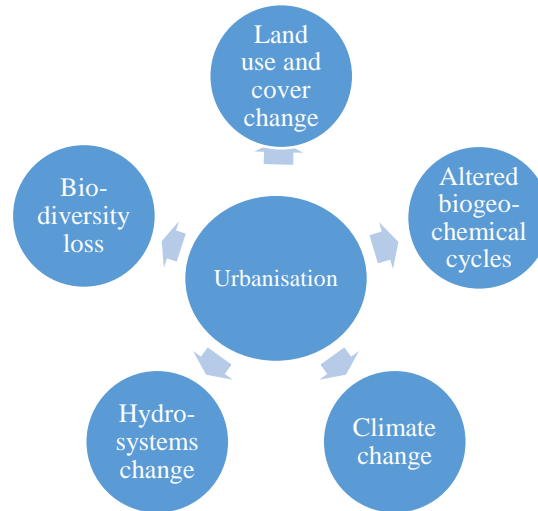


Figure 2. Urbanisation and its associated environmental changes

#### *Land use and cover change*

Urbanisation drives land use and cover change at the local to regional level through building cities and supporting the demands of urban populations (Grimm et al., 2008). Regionally, urbanisation in China threatens agricultural land supply because urban development leads to the conversion of cultivated land to urban settlements and industrial sites (Chen, 2007; Wong & Yuen, 2011). In China, construction accounts for 21 per cent of the total loss of cultivated land (Chen, 2007). Soil not only functions as a provider of food, fibre and fuel, but also serves as a source for greenhouse gases and forms an integrated part of biogeochemical cycles (Chen, 2007). Moreover, urban expansion is associated with decreased land for public service facilities, infrastructure and ecological environment (Hald, 2009).

#### *Altered biogeochemical cycles*

Urbanisation is also responsible for changes in biogeochemical cycles, which affect the city, its wider region and the entire biosphere (Grimm et al., 2008). Air pollution is one of the most prominent environmental issues of urbanisation in modern-day China (Wong, 2011). The spatial extent of air pollution is local to regional (Bai, 2007). Air pollution in Chinese cities is a result of the increased coal burning and automobile use that accompany economic expansion, which has outpaced the societal capacity to implement pollution-control measures (Grimm et al., 2008). The fact that China is home to 16 of the 20 most polluted cities in the world can to a great extent be ascribed to motorisation (Hald, 2009). The ever growing number of cars bought in China in combination with urban sprawl causes many cities to experience severe traffic congestion, resulting in even more serious air pollution (Hald, 2009; Wong & Yuen, 2011).

Pollution in China is not only due to increased automobile use. Waste production is another environmental issue that causes air and water pollution. Solid wastes generated in Chinese large cities are on the rise (Wong, 2011). This trend is driven by the continuously

increasing amounts of garbage, of which a large part is buried or left in the open (Hald, 2009). Waste generated by cities entering air and water transport affects biogeochemical cycles locally to regionally.

#### *Climate change*

The increase in traffic volume and coal burning does not only contribute to air pollution, the concentration of transportation and industry in urban centres turns cities into point sources of carbon dioxide and other greenhouse gases, which contribute to global and regional climate change (Bai, 2007). Grimm et al. (2008) argue that almost 80 per cent of global carbon emissions are attributed to cities. Another factor contributing to the production of greenhouse gases is low energy use efficiency in China, which is around 33 per cent; 10 percentage points lower than that of developed countries (Hald, 2009).

#### *Altered hydrosystems*

Rising water consumption has seen the decline in storage of water in both surface and ground level, making water a scarce resource for a large part of China (Wong, 2011). Especially for cities, water quality is worsening. About 420 cities among 661 cities in China are short of water, with 113 suffering severe shortage (Hald, 2009, p. 29). Water shortage is further enhanced by water pollution and water quality decline as a result of wastewater discharge and garbage (Wong, 2011).

#### *Biodiversity loss*

Urbanisation reduces species richness because cities are homogenising forces because some urban-adapted species become common in cities worldwide at the expense of indigenous species (Grimm et al., 2008). Cities affect biodiversity within the city, but also on a regional and global level because the urban footprint extends far beyond municipal boundaries (Grimm et al., 2008). Biodiversity enhances ecosystem stability, functioning and resilience, which enables ecosystems to maintain themselves in the face of disturbance (Adger, 2000).

In this section I outlined the most important challenges to urban environmental sustainability in China. It should be noted that some of the challenges are interrelated. For instance, cultivated land loss not only results in a decrease in biodiversity, it also limits the ability of a system to absorb carbon dioxide. Also, coal burning and automobile use cause air pollution while simultaneously increasing climate change.

### **2.3 Methodology**

As was already mentioned in section 2.1, it is not possible to measure actual outcomes of Tianjin Eco-city, because the project is not fully developed yet. Therefore, in this chapter the goals set for Tianjin Eco-city are evaluated as it is assumed that “specific and challenging goals result in higher performance than moderate or easy attainable goals, vague goals or no goals at all” (Shanin & Mahbod, 2007, p. 227). The challenges to urban environmental sustainability, as identified in the previous section, are used as a reference for selecting the KPIs for evaluation, because for the scope of this research it is not possible to evaluate all 26

KPIs. Table 1 shows the five major types of urban environmental change as identified by Grimm et al. (2009), and their associated KPIs. Some KPIs address issues in multiple categories, for instance a larger proportion of green trips contributes to addressing the issue of climate change, but also addresses air pollution. To avoid repetition, the KPIs are only covered in the category that most responds to them.

Table 1.

*Five major types of urban environmental change and associated KPIs*

<b>Category</b>	<b>Key Performance Indicator</b>
Land use and cover change	Net Loss of Natural Wetlands
Altered biogeochemical cycles	Ambient Air Quality
	Per Capita Daily Domestic Waste Generation
	Overall Recycling Rate
Climate change	Carbon Emission Per Unit GDP
	Proportion of Green Trips
	Usage of renewable energy
	Proportion of Green Buildings
Hydrosystems change	Per Capita Daily Water Consumption
	Usage of Water from Non-Traditional Sources
	Quality of water bodies within the Eco-city
Biodiversity loss	Net Loss of Natural Wetlands
	Per Capita Public Green Space

The KPIs that guide the development of Tianjin Eco-city are evaluated on several criteria. First of all, it is examined whether the KPIs are *significant* in making a contribution to urban sustainability. This is done by assessing whether these are set at a high enough level. Significance is measured by comparing the eco-city's targets with national and international standards. Secondly, it is researched whether the KPIs are *attainable*, which is whether the KPI is capable of achieving its expressed objectives by means of the right strategies and tools, according to the definition of effectiveness by Adger et al. (2003) that is maintained throughout the present chapter. Finally, the *relevance* of the KPIs will be examined, because according to Satterthwaite's (1999) definition of urban sustainability, to be sustainable a city should not only contribute to environmental performance on the local level, but should also contribute to addressing regional and global environmental issues. Table 2 shows the criteria used to classify the KPIs.

Table 2.

*Criteria for evaluating Tianjin Eco-city, success factors and classification*

<b>Criteria</b>	<b>Success factors</b>	<b>Classification</b>
Significance	Targets are set at a high enough level compared to national and international standards.	0 When the KPI is set at a low level compared to Chinese and international standards  1 When the KPI is set at a level similar to Chinese and international standards  2 When the KPI is set at a high level compared to Chinese and international standards
Attainability	The instruments and tools contribute to achieving the goal. Goals should not be out of reach.	0 When the instruments and tools do not contribute to achieving the KPI  1 When the instruments and tools to a certain extent contribute to achieving the KPI  2 When the instruments and tools contribute to achieving the KPI
Relevance	The policy has a positive impact on environmental sustainability in the wider region.	0 When the KPI has a negative impact on environmental sustainability on the regional and/or global level  1 When the KPI does not affect environmental sustainability outside its municipal area  2 When the KPI has a positive impact on environmental sustainability on the regional and/or global level

**2.4 Tianjin eco-city and its compliance with evaluation criteria**

The potential effectiveness of Tianjin eco-city is determined by the extent to which the KPIs are significant, attainable and relevant. Table 3 at the end of this section summarises compliance of the KPIs with these evaluation criteria.

Land use and cover*Net Loss of Natural Wetlands*

Decrease in agricultural land was identified as a major environmental challenge to urban environmental sustainability in the category land use and cover change. The KPI assigned to this challenge is *Net Loss of Natural Wetlands*, which aims for no net loss of natural wetlands (Government of Singapore, 2015). This KPI is judged as significant, because the target cannot be set at a higher level. On top of that, the target is higher than targets put forward in

national plans that aim for protection of 50 per cent of natural wetlands and 70 per cent of important wetlands (Baeumler et al., 2009). The attainability of this KPI varies according to different authors. In the study on Tianjin Eco-city, Baeumler and colleagues (2009) and Yu (2014) argue that SSTECC is not built at the expense of farmland or land with rich biodiversity because the Chinese government has set the condition that eco-cities should be built on non-arable land. As a matter of fact, the eco-city project is believed to contribute to revitalising non-arable land and polluted water resources. In addition, the spatial density of Tianjin Eco-city is relatively high; it amounts to about 10,000 persons per square kilometre (Baeumler et al., 2009; Baeumler et al., 2012). High density or compact cities do not only save land but also contribute to more efficient provision of infrastructure services such as public transportation or district heating by their limited travel distances (Chen, Jia, & Lau, 2008; Baeumler et al., 2009). A study guided by Caprotti (2015), however, shows that Tianjin Eco-city is to be built on wetlands, which are “a significant global carbon sink” (p. 505). Environmental damage may arise from the destruction of wetlands accompanying eco-city construction, turning the wetlands in ‘carbon leaks’ and with this contributing to regional and global climate change. Even though there are efforts to protect and restore wetlands in China, not all wetlands put under protection can be restored (Caprotti et al., 2015). Hence, these findings challenge the attainability and relevance of the KPI.

### Biogeochemical cycles

#### *Ambient Air Quality*

Air pollution is identified as one of the most prominent environmental issues of urbanisation in China (Wong, 2011). The KPI that refers to this issue is *Ambient Air Quality*, which states that air quality in the eco-city should meet China’s Standard for Ambient Air Quality for at least 310 days and the SO<sub>2</sub> and NO<sub>x</sub> limits cannot be exceeded on more than 155 days (Government of Singapore, 2015). This indicator is judged as insignificant, because for Tianjin the number of days air quality should meet the national standard is 320 (Baeumler et al., 2009) and in the Chinese low carbon indicator system the target is set at a minimum of 320 days in 2015 and 347 in 2020 (Yu, 2014). To achieve this target, coordination with surrounding jurisdictions is required because air quality “is a target that cannot be fully controlled by actions in the SSTECC alone” (Baeumler et al., 2009, p. 119). To illustrate, (future) inhabitants of Tianjin Eco-city may still suffer from the adverse effects of regional air pollution because of the city’s nearness to Beijing and Tianjin as pollutants do not recognise frontiers (Wong, 2011). This challenges the attainability of the KPI. If SSTECC takes action to cooperate with surrounding jurisdictions to address air pollution, a contribution can be made to regional environmental sustainability.

#### *Per Capita Daily Domestic Waste Generation*

The second KPI addressing pollution is *Per Capita Daily Domestic Waste Generation*, which limits per capita waste generation to 0.8 kg per day by 2013 (Government of Singapore, 2015). This target is significant because it is set at a lower level than in other national and international cities. For reference, in the USA per capita waste production is 2.18 kg per day (Baeumler et al., 2009). Whether this target is attainable as well depends on the tools that are

used to achieve this target. Several initiatives have been developed to minimise waste in Tianjin Eco-city. A first attempt is to only sell processed vegetables, because “peels and other organic waste are generated when raw vegetables are prepared” (Baeumler et al., 2009, p. 81). However, to minimise spoilage these processed foods are sold in packages, which eventually increases waste production. Another waste reduction measure in the eco-city includes the shift towards reusable, recyclable and/or biodegradable packaging. Additionally, in the eco-city it is not allowed to offer plastic bags for free. Waste incineration takes place outside the eco-city, as Caprotti et al. (2015) describe: “urban waste will be . . . rapidly ejected from the protected environment of the eco-city (p. 509). Therefore, the KPI is judged irrelevant because it affects the environmental and carbon footprints of landfills outside its area (Baeumler et al., 2009).

### *Overall Recycling Rate*

Besides minimising waste generation, the city’s recycling rates are addressed by the KPI *Overall Recycling Rate*, which strives for a 60 per cent recycling rate by 2013 (Government of Singapore, 2015). This recycling rate is optimistic given that the country’s average is only 20 per cent (Baeumler et al., 2009). If successful, SSTECH would be among cities with the highest recycling rates. In comparison, Singapore’s current recycling rate is 51 per cent (Baeumler et al., 2009). Therefore, the target is significant. The attainability of this target is dependent on residential and business cooperation. Several challenges to achieving this target can be identified. First of all, the new community does not have a history of recycling. Therefore, a program of incentives, education and prohibition of waste materials is required, while current plans for SSTECH strongly emphasise adopting technological solutions to achieving environmental objectives (Baeumler et al., 2009). The KPI does not address recycling in the eco-city’s surroundings.

In section 2.2 I found that besides waste production, coal burning and motor vehicles were important contributors to changing biogeochemical cycles. The KPIs relate to these issues are covered in the next section.

## Climate

### *Carbon Emissions Per Unit GDP*

The KPI that addresses climate change directly, is *Carbon Emissions Per Unit GDP*, which limits carbon emissions to 150 tonnes of carbon per one million US\$ (Government of Singapore, 2015). On a national level, this KPI is significant, because the national average is 750 tonnes. However, international targets are substantially lower (Baeumler et al., 2009). According to Baeumler et al. (2009), this KPI is easily attainable because the eco-city aggregates energy-efficient industries which have significantly lower carbon emissions per unit of GDP. The indicator is not relevant because it does not clarify total carbon emissions. An additional KPI for per capita carbon emissions could be useful.

### *Proportion of Green Trips*

At least 90 per cent of trips within the eco-city should be in the form of green trips by 2020 according to the KPI *Proportion of Green Trips*. Green trips refer to non-motorised transport, i.e. cycling and walking, as well as trips of public transport (Government of Singapore, 2015). A study by Baeumler et al. (2009) classifies this KPI as ambitious, because it is higher than international benchmarks: “only a few cities in developed and developing countries have ‘green transport’ shares 70 percent or higher” (p.v). Therefore, this KPI is classified as significant. Considering China’s traditionally high share of non-motorised transport, at first this KPI may appear easily attainable. However, two challenges to achieving this KPI were found. In Tianjin Eco-city, the use of public transport is encouraged by designing the city in such a way that 100 per cent of the population lives within 400 metres of some form of public transportation (Baeumler et al., 2012, p. 48). Walking and cycling are encouraged; however, it has been argued that the eventual success of raising the share of walking, cycling and public transportation depends on the design of the city. The choice for large 400 by 400 metres block design poses a risk to the envisaged walk-able communities (Baeumler et al., 2009; Economy, 2014). Another factor influencing the level of public transport is the level of motorisation. It is projected that the Tianjin Eco-city community will have an income level above average, which is associated with higher motorisation rates. On a regional level, this KPI is relevant because Tianjin Eco-city is connected to Beijing and Tianjin by regional metro and other public transport connections (Baeumler et al., 2009).

### *Usage of Renewable Energy*

The KPI *Usage of Renewable Energy* aims to increase the proportion of renewable energy used in the Eco-city to a least 20 per cent by 2020 (Government of Singapore, 2015). This is similar to targets set for the EU and higher than national standards (Baeumler et al., 2009). Therefore, this KPI is categorised as significant. To achieve this target, geothermal heat and solar energy are used to provide the energy needed for, for instance, hot water and street lighting (Baeumler et al., 2009). The fact that there are few sources or possibilities for renewable energy in Tianjin poses a challenge to the attainability of the KPI (Baeumler et al., 2009). Also on a larger scale, contribution of the KPI to environmental sustainability is absent.

### *Proportion of Green Buildings*

The KPI on *Proportion of Green Buildings* requires all buildings in the eco-city to meet green building standards (Government of Singapore, 2015). This KPI is judged as significant given the fact that the percentage of green building in Tianjin was practically zero in 2008 (Baeumler et al., 2009). Besides, this target meets the requirement of the Chinese low carbon indicator system and SSTECC’s Green Building Standard is higher than the national standard (Yu, 2014). Green buildings reduce carbon dioxide production because these do not demand much energy by using energy-efficient equipment and systems (Baeumler et al., 2009). Therefore, this KPI is classified as attainable; however, this KPI does not make reference to the area outside the city.

## Hydrosystems

### *Per Capita Daily Water Consumption*

In section 2.2 it became clear that China is facing huge water shortages. The KPI *Per Capita Daily Water Consumption* addresses this by stating that daily water consumption by each person should not exceed 120 litres by 2013 (Government of Singapore, 2015). This target reflects current consumption trends in Beijing and Tianjin, but compared to international standards this target is advanced (Baeumler et al., 2009). To achieve this goal, Tianjin Eco-city uses green technologies such as water recycling and waste treatment systems (Low, Liu, & Wu, 2009). Besides, water pricing is used as a demand management tool that provides incentives for water conservation which will help to maintain low per capita consumption of water (Baeumler et al., 2009). Therefore this KPI is judged as attainable. The KPI does not address water consumption in the eco-city's surrounding area.

### *Usage of Water from Non-Traditional Sources*

Another KPI that addresses water shortage in Tianjin Eco-city is the KPI *Usage of Water from Non-Traditional Sources*: by 2020, at least 50 per cent of the eco-city's supply should be from sources such as desalination and recycling (Government of Singapore, 2015). This is another ambitious KPI that, when achieved, will represent a substantial advance compared to development in Chinese cities and will put SSTECH into the same category as Singapore, a world leader in water reclamation (Baeumler et al., 2009). Therefore, this KPI is classified as relevant. It is believed that this KPI is easily attainable because Singapore is a core partner in the eco-city project. A challenge to achieving this KPI is posed by that fact that water reclamation is capital expensive and has high operation costs (Baeumler et al., 2009). Despite this, the KPI is judged as attainable. The KPI does not contribute to environmental sustainability outside its area.

### *Quality of Water Bodies within the Eco-city*

The last KPI in the category hydrosystems is *Quality of Water Bodies within the Eco-city* which states that all water bodies in the eco-city should meet Grade IV of China's latest national standards by 2020 (Government of Singapore, 2015). This is an ambitious target as in 2006 only 22 per cent of water bodies in the area met this standard (Baeumler et al., 2009). Therefore, this KPI is significant; however, achievement of this KPI is not within full control of SSTECH alone. Achievement of this KPI requires coordination with surrounding jurisdictions, therefore efforts are made to protect and regulate water disposed into the river upstream of the eco-city (Baeumler et al., 2009). Therefore, this KPI contributes to environmental sustainability on the regional level.

## Biodiversity

### *Per Capita Public Green Space*

Eco-cities contribute to biodiversity by creating parks and green spaces in the city. The KPI *Per Capita Public Green Space* states that public green space should be at least 12 square metres per person by 2013 (Government of Singapore, 2015). This target is set at a higher



level than the target set for Tianjin and according to Economy (2014), the city will feature more green space than almost any other Chinese city. The target is aimed to be achieved by green design of buildings or integration of nature areas and waterbodies into the urban setting. Wong (2011) argues that eco-cities “incorporate functions of nature in a miniature manner to serve the interests of human developments” (p. 140). He adds that this will encourage citizens to depend on the exploitation of natural processes to achieve urban comfort levels, rather than using fossil derived power for heating and electricity. Caprotti et al. (2015) argue that because Tianjin Eco-city is built on wetlands, this negatively affects species diversity on the regional level.

Table 3.

*Performance of KPIs on significance, attainability and relevance*

Categories	Key Performance Indicators	Classification			Total
		Significance	Attainability	Relevance	
Land use and cover	Net Loss of Natural Wetlands	2	1	0	3
Biogeochemical cycles	Ambient Air Quality	0	1	2	3
	Per Capita Daily Domestic Waste Generation	2	1	0	3
	Overall Recycling Rate	2	0	1	3
Climate	Carbon Emission Per Unit GDP	1	2	1	4
	Proportion of Green Trips	2	1	2	5
	Usage of renewable energy	1	1	1	3
	Proportion of Green Buildings	2	2	1	5
Hydrosystems	Per Capita Daily Water Consumption	1	2	1	4
	Usage of Water from Non-Traditional Sources	2	1	1	3
	Quality of water bodies within the Eco-city	2	1	2	5
Biodiversity	Per Capita Public Green Space	2	2	0	4
<b>Total</b>		19	15	12	46

## 2.5 Discussion

Tianjin Eco-city addresses the urban environmental issues that were identified in section 2.2; for every category of urban environmental change, Tianjin Eco-city has formulated at least one KPI. Generally, these KPIs are significant, i.e. they are set at a high enough level to make a contribution to urban sustainability. However, it was found that in practice not all of the KPIs are attainable as well, as for most KPIs multiple challenges to achieving the target were found.

It is remarkable that for the indicator *relevance*, i.e. the impact on the city’s wider region, most KPIs perform poorly. This is in line with what Joss and Molella (2013) argue: “there seems to be a disconnect between the eco-city – as a separate ‘environmental space’ – and its hinterland” (p. 124). This means that the eco-city’s significance as part of its wider regional development may end up being quite limited. In their analysis of Tianjin Eco-city, Baumler et al. (2009) also highlight the risk of viewing the city’s sustainability features in

isolation and argue that the city's wider impact can only be determined when it is treated as part of a larger regional context. Wong (2011) stresses the same issue: "Tianjin Eco-city has demonstrated a close matching in objectives and action plans but the city is merely a nodal point in the sea of a large currently degraded urban environment and will have a negligible or little impact in terms of ecosystem coverage." (p. 145).

Even though Caprotti et al. (2015) are generally sceptical about the eco-city's contribution to urban sustainability, they argue that Tianjin Eco-city can be viewed as "a potential incubator of new technologies and ways of doing that will have beneficial impacts at the macro-scale of wider urban China" (p. 513). The eco-city is an experimental zone where processes and mechanisms aimed at environmental transition can be tested. As such, it is envisioned to become a model eco-city that is replicable by other cities in China (Baeumler, Ijjasz-Vasquez, & Mehndiratta, 2012, p. 47).

Naturally, this study has its limitations. First of all, not all KPIs were evaluated. Additional research that evaluates the other KPIs is recommended. Secondly, when targets are not set at a high enough level, i.e. they are insignificant, they are more easily attainable. This means that the scores on attainability for the KPIs *Ambient Air Quality*, *Carbon Emissions Per Unit GDP*, *Usage of Renewable Energy* and *Per Capita Daily Water Consumption* are of less value since these KPIs are not likely to make a significant contribution to urban environmental sustainability.

## 2.6 Conclusion

In this chapter, the following research question took a central stage: *to what extent can Tianjin Eco-city effectively contribute to urban environmental sustainability?* I found that for Tianjin Eco-city to be environmentally effective, it should focus on addressing the challenges to urban environmental sustainability in the following five categories: land use and cover, biogeochemical cycles, climate, hydrosystems and biodiversity. The KPIs in these categories were evaluated on significance, attainability and relevance. Overall, the KPIs proved to be significant, as most targets were set at levels higher than Chinese and international standards. For most KPIs, however, challenges to achieving the goal were found.

I recommend that before Tianjin Eco-city's model is replicated by other eco-cities to be built in China, improvements are made to increase its attainability and significance, so that future eco-cities can contribute to urban environmental sustainability in practice. Examples of improvements include the development of pedestrian-friendly community spaces and stimulation of residential and business cooperation instead of relying only on technological solutions. Furthermore, collaboration with the region outside the municipal boundaries is necessary to meet targets concerning air and water pollution. In doing so, Tianjin Eco-city can also make a positive contribution to sustainability in its surrounding environment, which increases the city's relevance.

In spite of the improvements that need to be made, I conclude that Tianjin Eco-city can, to a certain extent, contribute to urban environmental sustainability. Generally, the KPIs are significant, however, the tools used to achieve these KPIs are not all satisfactory. However, Tianjin Eco-city can be viewed as a model eco-city and the lessons learned from it can be applied to newly built eco-cities in China.

### **3. Development studies (by Anne Lotte Jacobs)**

#### *Urban social sustainability in Tianjin Eco-city*

##### **3.1 Introduction**

This interdisciplinary thesis tries to find an answer to the research question “To what extent and how can Tianjin Eco-city contribute to urban sustainability?” To this end, the present chapter addresses the following sub-question from the perspective of development studies:

*To what extent and how can Tianjin Eco-city contribute to urban social sustainability in China?*

First, in section 3.2, the relation between development studies and the concepts of sustainable development will be explained. Next, in section 3.3, the concept of (urban) social sustainability is addressed. This hopefully enhances understanding of the insights development studies can provide regarding urban social sustainability in China’s eco-cities. In section 3.4, contemporary urban issues in China related to urban social sustainability and eco-city development will be discussed. After that, section 3.5 will focus on the goals set and the attempts made by Sino-Singapore Tianjin Eco-City (SSTEC) in relation to urban social sustainability. Finally, section 3.6 addresses the extent to which Tianjin Eco-city contributes to urban social sustainability. This will be done by relating the goals and attempts of SSTEC to the previously discussed contemporary Chinese challenges of urban social sustainability and the guidelines for urban social sustainability in section 3.2.

##### **3.2 Development studies and sustainable development**

Development studies initially dealt with social issues such as poverty and inequality. However, since ‘sustainable development’ has become such a widely used development path, the discipline can no longer ignore the relation that pursuing development has with the environmental component (Potter, 2012, p. 104). A holistic approach to development must therefore include both environmental and social aspects. The term ‘sustainable development’ was brought into common usage after the United Nation’s Brundtland Commission published the rapport *Our Common Future* (United Nations, 1987). The Brundtland commission defines sustainable development as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (Potter et al, 2012). Development refers to what people try to achieve within the context of their environment, that is: the place where they live (United Nations, 1987). Since development studies is concerned with enhancing development, something that includes the fulfilment of people’s needs, the field must also deal with sustainability questions.

The Brundtland definition of sustainable development is not fully clear-cut and from a development studies point of view there are some ambiguities attached to ‘sustainable development’. First, Potter (2012, p. 103-108) points out that there is a mismatch between ‘the power and consequential political economic authority of neoliberal capitalism’s free-

market message and the eco-development message that sustainable development promotes'. The former message is for example concerned with gaining as much profit as soon as possible, exploitation of nature, and market-driven principles that cause inequalities, while the eco-development message seeks to realise conservation of nature and considers a much larger scale in both time and space. A second ambiguity involves the social and ecological dimension of sustainable development. Economic growth may be good for people's quality of life but it may also harm the environment. A third ambiguity lies in the fact that the various approaches to sustainability – such as ecological environmentalism or human, people-centred development or the combination of both – are influenced by neoliberal thinking among contemporary policy makers (Potter, 2012, p. 104).

### **3.3 Urban (social) sustainability**

#### China and sustainable urban development

Wang and Xu (2005) and Cheng et al. (2006) argue that the Chinese government took the initiative of proposing people-oriented development strategies to build sustainable and harmonious cities. As Hald (2009) argues, environmental, human and economic development concerns come together, in China's aims to use both a market economy and integration into the global economy for improving environmental and social conditions. The present disciplinary chapter focuses on this social aspect of sustainable development, specifically in the urban area, employing development studies with a people-oriented angle.

#### Urban (social) sustainability and eco-cities

The literature offers some explanations of what sustainable development in the city entails. According to Diappi, Bolchini & Franzini (1998), urban sustainability includes “attention to the quality of life (and not only an increase in income), equality between persons in the present (intra-generational equality), inter-generational equality (the inhabitants of the future deserve an environment with the same if not better quality than what we enjoy today) as well as the social and ethical dimensions of human well-being” (Introduction: research subject and survey scale para. 2). Besides that, development can only take place if it does not go beyond the load capacity of the natural systems. It seems that the focus is on human well-being, since these authors also state that:

Only by considering the urban values as *resources* capable of promoting human well-being is it possible to identify a more complex concept of sustainability whose objective is based on a series of factors for which only some involve the physical-ecological quality of the urban environment (Diappi, Bolchi & Franzini, 1998, Introduction: research subject and survey scale, para. 7).

Haughton (1999) presents five principles of sustainability that can be used as guidelines for urban sustainability: futurity (inter-generational equity), social justice (intra-generational equity), trans-frontier responsibility (geographical equity), procedural equity (treating people openly and fairly) and inter-species equity (the importance of biodiversity). These principles

have specific meanings in the urban context (Keirstead & Leach, 2007). Regarding geographical equity, urban sustainability is not just about sustainability within the city itself but also requires that those cities are integral to the region's and to global sustainability (Satterthwaite, 1999, p. 6; Keirstead & Leach, 2007) "where the regional and global systems [...] provide material inputs and receive waste outputs" (Keirstead & Leach, 2007, p. 331). This can be also applied to social matters. Geographical equity prevails when access to a range of public services and facilities for residents and the quality of the living environment is equalised across geographical areas (Kay, 2005; Macintyre, MacIver & Sooman, 1993).

Yu (2014), who seeks to explain the term eco-city, states that 'there has not been a commonly accepted definition for eco-town (or city) either in academic research or in practice (Joss, 2011; Satterthwaite, 1997; Yu, 2010). However, it is obvious from both academic research and practice that the concept of the eco-city is based on the philosophy of sustainable development (Yu, 2014). This includes social aspects and therefore eco-cities need to incorporate urban social sustainability. This includes for example building affordable and mixed housing; creating social justice and opportunities for all and promoting non-automobile transport (Roseland, 1997).

Dempsey, Bramley, Power and Brown (2011) state that a limited amount of literature focusses on the social dimension of urban sustainability, referred to as urban social sustainability. Urban social sustainability deals with the question 'what are the social goals of sustainable development?' within the context of the city. There are multiple answers possible and consensus is lacking (Hopwood et al., 2005; Littig & Griessler, 2005) however multiple contributory factors are identified. Table 4 presents an overview of contributory factors to urban sustainability as identified in the review of literature by Dempsey et al. (2011, p. 291).

Table 4.

*Contributory factors to urban sustainability.*

Non-physical factors	Predominantly physical factors
<ul style="list-style-type: none"> <li>• Education and training</li> <li>• Social justice: inter- and intra-generational</li> <li>• Participation and local democracy</li> <li>• Health, quality of life and well-being</li> <li>• Social inclusion (and eradication of social exclusion)</li> <li>• Social capital</li> <li>• Community</li> <li>• Safety</li> <li>• Mixed tenure</li> <li>• Fair distribution of income</li> <li>• Social order</li> <li>• Social cohesion</li> <li>• Community cohesion (i.e. cohesion between and among different groups)</li> <li>• Social networks</li> <li>• Social interaction</li> <li>• Sense of community and belonging</li> <li>• Employment</li> <li>• Residential stability (vs turnover)</li> <li>• Active community organizations</li> <li>• Cultural traditions</li> </ul>	<ul style="list-style-type: none"> <li>• Urbanity</li> <li>• Attractive public realm</li> <li>• Decent housing</li> <li>• Local environmental quality and amenity</li> <li>• Accessibility (e.g. to local services and facilities/employment/green space)</li> <li>• Sustainable urban design</li> <li>• Neighbourhood</li> <li>• Walkable neighbourhood: pedestrian friendly</li> </ul>

Reprinted from “The social dimension of sustainable development: Defining urban social sustainability,” by N. Dempsey, G. Bramley, S. Power & C. Brown, 2011, *Sustainable development*, 19(5), p. 291.

From the literature I concluded that urban social sustainability should include the following:

- quality of life (Diappi, Bolchi & Franzini, 1998);
- social and ethical dimensions of human well-being (Diappi, Bolchi & Franzini, 1998);
- intra-generational equality (Diappi, Bolchi & Franzini, 1998) and intra-generational equity i.e. social justice (Haughton, 1999);
- inter-generational equality (Diappi, Bolchi & Franzini, 1998) and inter-generational equity i.e. futurity (Haughton, 1999);
- geographical equity (trans-frontier responsibility) (Haughton, 1999);
- procedural equity (treating people openly and fairly) (Haughton, 1999).

These will together with the concepts in Table 4 serve as guidelines for the assessment of Tianjin Eco-city regarding urban social sustainability.

### **3.4 China's contemporary urban social sustainability challenges and the solution of eco-city development**

In the previous section the concepts of urban sustainability and urban social sustainability were discussed. This section deals with the contemporary urbanisation challenges in China that are related to social urban sustainability and discusses the usage of eco-city development in China to address these challenges.

#### Contemporary urban social sustainability challenges in China

##### *Urbanisation*

China is undergoing the largest scale of urbanisation in history and the process is taking place at high speed. According to National New Urbanisation Plan (2014–2020) unveiled by the central government in 2014, the proportion of permanent urban residents among China's total population will rise to 60 percent by 2020 (Li, Zhao, Liu & Zhao, 2015). This fast urbanisation and industrialisation are accompanied by a fast increasing gross domestic product (GDP) and expanding urban infrastructures but are raising many problems as well (Hald, 2009; Wang & Xu, 2005; Cheng et al., 2006). For example, the strong growth of urban population of the past three decades was accompanied by a rapid expansion of urban areas which led to the loss of agricultural land. This affects the food production and has social impact on the farmers, who find themselves displaced in the process (Baeumler et al., 2009). Regarding urban social sustainability the city environment should be able to promote quality of life and human well-being while taking the ethical and social dimension into account (Diappi, Bolchi & Franzini, 1998).

##### *Employment*

Urban development can be complicated by the imbalance in employment structure. The changes in China's industrial structure may result in a lack of jobs despite economic growth. Unemployment and inadequate employment are among the major factors contributing to urban poverty in China. According to the United Nations an annual increase in urban jobs of about 25 million was needed during the 12th Five-Year period (2011-2015) but on average just over 9 million jobs have been created each year (United Nations Development Program, 2013). Employment and accessibility to employment are contributory factors to urban social sustainability (Dempsey et al., 2011).

##### *Migrants*

Migrants are attracted to cities mostly because of their economic and educational opportunities, but once these migrants have arrived they often will not be registered as city residents. This gives them a 'half-urban' status that does not grant them the same benefits as people with urban household registration. Hence, they will have little protection in case of unemployment or incapacity. Besides that, migrant workers often live in poverty, have bad working conditions and face health problems due to these conditions. Moreover, their children lack education and their families are separated. The integration of migrants into the city is restricted by the household registration system, since the system makes use of services

and benefits that put pressure on the city's capacities. This results in unequal access to such services and benefits (United Nations Development Program, 2013). This unequal access is in conflict with urban social sustainability since an equitable society should be free of 'exclusionary' or discriminatory practices which hinder individuals from participating economically, socially and politically in society (Pierson, 2002; Ratcliffe, 2000).

### *Transport*

Traffic congestion is one of the most serious problems in China's cities (Hald, 2009). This is partly caused by poor urban planning and city administration. There is insufficient traffic management, many road networks are of bad quality and disconnected with public transportation. Often there are no sidewalks and infrastructure for non-motorised transport is lacking (United Nations Development Program, 2013). This is a problem for urban social sustainability because sufficient public transport routes and the provision for walking and cycling can have an impact on the extent and nature of accessibility in a given place (Dempsey et al., 2011).

### *Health*

Living in the city comes with multiple health threats due to pollution and unhealthy lifestyles. Changes in diet and exercise are causes of an increase in chronic diseases among city dwellers, such as diabetes and high blood pressure (United Nations Development Program, 2013). Good health is essential for human well-being and quality of life, two contributors to urban social sustainability, and is influenced by the city's environment (Dempsey et al., 2011).

### *Public safety*

Another problem in many Chinese cities is their liveability. Cities need to be stable places, where rights are protected and where people can pursue livelihood and other opportunities. Social conflict and group protests are reactions to poverty, inequalities, and insufficient city management. Much of the existing dissatisfaction is about economic concerns. (United Nations Development Program, 2013). Safety is a contributory factor to urban social sustainability (Dempsey et al., 2011).

### *Housing*

Chinese cities are dealing with a lack of affordable housing despite the implementation of affordable housing programs to help low- and moderate-income households to buy or rent decent homes (Zou, 2013). On the national level urban housing prices increased 115 per cent in the period from 2003-2010 (National Bureau of Statistics of China [NBSC], 2011; Fig. 1). The housing programs are being criticised for not being effective, equal and sustainable (Zou, 2013). Equitable access to decent housing is a measure of social justice and therefore an aspect of urban social sustainability. Besides the Chinese government is aiming at maintaining social and political stability and providing affordable housing is seen as an effective way to alleviate public discontent (Zou, 2013), which is complimentary with the former challenge of public safety.



## Eco-cities in China

According to Hald (2009), China's leaders aim to use the country's transition to a market economy and its integration into the global economy to solve environmental and social problems, also on an urban level. The main social sustainability issues which China's cities are dealing with were discussed in the previous section. Caprotti, Springer and Harmer (2015) state that "China has devoted significant political will and economic resources to the development of newly-built eco-city projects, reflecting the Chinese government's goals to build a 'harmonious society' in which environmental sustainability and social stability are mutually reinforcing". The city is to become a place where its inhabitants can experience comfortable, clean and healthy living without the problems of environmental degradation and deterioration that now plague China's fast-growing cities. The fact that the Chinese government focuses on the construction of a harmonious society is expressed in a resolution passed by the Central Committee of the Chinese Communist Party in 2006 (Warner & Zhu, 2010). Eco-city development is one of the approaches used by China to confront urban growth and sustainability challenges. Tianjin Eco-City is an example of this relatively new concept of eco-cities. The aim of the city is to be a model for other cities facing similar urban challenges (Hald, 2009). Entrusted by the Ministry of Housing and Urban-Rural Development a Chinese low carbon eco-city indicator system was formulated by a research team guided by Yu (2014) to define, guide, and assess low carbon and eco-city development in China. 30 Key performance indicators (KPIs) are divided into four categories: Efficient Use of Resources, Friendly Environment, Sustainable Economy and Harmonious Society (Yu, 2014).

### **3.5 Tianjin Eco-city social goals and attempts**

This section discusses the ways in which Sino-Singapore Tianjin Eco-city (SSTEC) is attempting to address social sustainability issues and which goals are set to this end. In the next section we will see how this relates to the guidelines of urban social sustainability (3.3) and the contemporary urban challenges in China (3.4).

Given the city's goal to tackle environmental as well as social issues, one may wonder for which people this is accessible and realistic. According to Caprotti, Springer and Harmer (2015), the Singaporean website of the Sino-Singapore Tianjin eco-city (SSTEC) project states that 'Tianjin Eco-city [...] does not seek to cater exclusively to the well-off' (Tianjin Eco-City, 2013), although they consider it far from clear how this is to be achieved in practice. The World Bank report on SSTEC mentions the risk that the eco-city will become an exclusive 'eco-enclave', rather than a sustainable society (Baeumler et al., 2009).

According to Yu (2014) Tianjin Eco-city has proposed building 10% affordable housing. However it is not clear who will benefit from this affordable housing since "typically renters must be working in the eco-city, and the proposed industries within the eco-city are mainly specified as high-tech, creative industries". Additionally, Caprotti, Springer and Harmer (2015) state that, in spite of the fact that Tianjin plans to designate 20% of all residential units as public housing, several of their respondents noted that the prices for this

‘public’ housing would still ‘only attract residents of above-average wealth’. Their finding is consistent with the statement of a public-housing sales representative who told that ‘public-housing prices were on average [only] 15% less expensive than other housing in the eco-city’. This is an indication that Tianjin eco-city will probably be home to people falling within a narrow socioeconomic range (Caprotti, Springer and Harmer, 2015).

This is consistent with the way in which the eco-city is promoted. As regards the marketing of the city, it is clear that it is aiming at the high-end market promoting the possibility of a wealthy lifestyle with a quality of life that is more in line with the lifestyle of the socio-economic elites than with average contemporary city life in China. Tianjin can be considered as the ‘development of [an] exclusive ‘green’, ‘safe’ and ‘comfortable’ urban area in a context of wider environmental degradation’ (Caprotti, Springer and Harmer, 2015; Shen and Wu, 2011). The technologies used in the city to enhance a healthy and clean environment, such as water-filtration and air-filtration systems, do benefit the residents of the eco-city but not the surrounding urban environment of the municipality of Tianjin (Boland, 2007).

Because of the city’s design, Caprotti (2013) questions whether Tianjin will be able to accommodate the development of a community. The city has playgrounds and open areas within its residential blocks, but these blocks are separated by wide avenues. Moreover, due to the construction of enclosed car parks on ground level, every block is actually located one level higher than the avenues. These car parks thus form walls, resulting in ‘walled communities’. In addition to this, the blocks are also surrounded by gates with guard posts that turn the communities into gated ones as well. Another reason why Caprotti (2013) questions the possibility of developing a cohesive community is the earlier mentioned fact that the property prices are very high, which could result in exclusion of people of a lower socioeconomic range (Caprotti, Springer and Harmer, 2015). Moreover it is not clear how the aim of implementing public participation and democratic decision-making mechanisms, which is mentioned in the development plan of the whole Tianjin metropolitan area from 2006 to 2020, will be realised within the SSTECH project (Caprotti, 2013). According to Tidball & Krasny (2007) a city’s resilience is partly built on ensuring social diversity. This requires the ‘existence and interaction of a wide range of stakeholders from different backgrounds in the urban arena and in the urban development process. Caprotti (2013) concludes that these factors are absent from the Tianjin Eco-City project.

In 2012 the BBC reported that Tianjin plans to have parks and green spaces around the city, so that free recreation facilities will be within a maximal reach of 500 meters. According to a Tianjin real-estate agent, the city wants to reserve at least 40% of the community’s land area for green space. Other Chinese communities do not have this kind of targets. This green space ratio can be considered an environmental indicator that is to provide a sense of comfort and well-being (Caprotti, Springer and Harmer, 2015).

The BBC also noted that people are allowed to walk or cycle anywhere, so that they will not feel socially excluded from certain areas (Vince, 2012). The ‘eco valley’ that runs through the centre of the city has cycling routes and a tram. The official website states that ‘at least 90% of trips within the Eco-city should be in the form of green trips by 2020. Green trips refer to non-motorised transport, i.e. cycling and walking, as well as trips on public transport’ (Government of Singapore, 2015). The public transport network will include the

residential suburbs and make it possible to reach lower-demand destinations (Baeumler et al., 2009).

Regarding employment China daily reported that the 2000 relocated villagers are assured a job according to the officials (Garst, 2010). One objective of SSTECH is balancing employment and housing supply (Baeumler et al., 2009). The official website of the project states that ‘at least 50% of the employable residents in the Eco-city should be employed in the Eco-city by 2013’ (Government of Singapore, 2015). When the economic structure of SSTECH will not generate sufficient local employment opportunities more transport in and out of the city will be needed (Baeumler et al., 2009).

### **3.6 Does Tianjin contribute to urban social sustainability in China?**

The present section discusses to what extent Tianjin Eco-city addresses the urban social challenges listed in section 3.4 and is following the guidelines of urban social sustainability mentioned in section 3.3. Since SSTECH is still in development, the available information from the literature and on official websites are limited and not definitive.

Eco-city development, as exemplified by the SSTECH project, is one way in which China wants to handle the first challenge of *urbanisation* and its sustainability issues (Hald, 2009). The extent in which Tianjin Eco-city is indeed improving urban sustainability is the question of this thesis and will be dealt with in the final conclusion. For now it is discussed to what extent Tianjin Eco-City promotes urban social sustainability that is the quality of life and human well-being considering the ethical and social aspects.

A second challenge is the amount of sufficient *employment* in Chinese cities. SSTECH’s goal set for 2013 was to have at least 50% of the employable Tianjin residents employed in the eco-city (Baeumler et al., 2009). There is no data available about the present state of local employment. Even when the goal will be reached still 50% of the residents have to travel for their jobs which increases transport in and out the city which could be unfavourable for the environment and transport in the wider region.

*Transport*, a third challenge of Chinese cities, is concerned with congestion, insufficient access to public transport and a lack of space for non-motorised transport (United Nations Development Program, 2013). Tianjin is addressing this by setting the goal of at least 90% of the trips within the Eco-city being green trips by 2020. This could be considered as an ambitious goal since the Chinese low carbon eco-city indicator system requires at least 60% green transport in 2015 and 80 % by 2020 (Yu, 2014). Extra attention is paid to walk and cycling trails. Moreover, public transport will be responsible for most of the green trips and has to make lower demand destination accessible (Baeumler et al., 2009). This could decrease feelings of exclusion which is beneficial for peoples quality of life and wellbeing. Accessibility itself is also one of the contributing factors to urban social sustainability.

Fourth, *health* problems of SSTECH residents could partly be elevated by the promotion of walking and cycling since it is beneficial for a healthier lifestyle. However it is not clear yet to what extent the design of the city will actually increase the amount of physical activity of the residents. Health issues also arise due to pollution (United Nations Development Program, 2013). Tianjin uses air and water filtration systems to protect its residents against pollution (Boland, 2007). Moreover, the use of green spaces may also

contribute to the residents' health by providing a sense of comfort and well-being (Caprotti, Springer and Harmer, 2015).

Tianjin has no specific policy to address a fifth urban challenge, that is the problems *migrants* face due to the restriction by the household registration system. Hence unequal access, which is conflict with urban social sustainability, is not specifically tackled regarding this issue.

Finally, sufficient and affordable *housing* and *public safety* are two main challenges in Chinese cities. Tianjin Eco-City is criticised because only be affordable and attractive to people who are more wealthy than the average Chinese, in spite of the planned 20 % public housing (Caprotti, Springer and Harmer, 2015). The goal of 10% affordable housing falls short according to the Chinese low carbon eco-city indicator system which states that the percentage of affordable housing should at least be 20% in 2015 and 30% in 2020 (Yu, 2014). The exclusion of the poor from the eco-city is conflicting with social justice because exclusion is a violation of the demands of social justice (Barry, 1998). Tianjin does not seem to meet this condition when it is considered as being an 'exclusive eco-enclave'. The contradiction between this 'healthy' and 'comfortable' eco-enclave and the city's region, indicates geographical inequity because of unequal access to services across geographical areas. Urban sustainability should be integral to regional and global sustainability but it seems like Tianjin Eco-city does not meet this requirement of urban sustainability.

According to Miao (2003), Pow (2007) and Shen and Wu (2012) the use of gated communities in Tianjin eco-city is in line with a 'rapid trend towards a retreat to gated communities in China's urban centres' which can be seen as an 'instrument for forging social segregation' (Wu, 2005, p. 236; Caprotti, Springer, Harmer, 2015). According to the United Nations Development Rapport (2013) social conflict and group protests arise due to inequalities, insufficient city management and dissatisfaction of the public. Hence, I argue that unequal access to and social exclusion from comfortable eco-cities such as SSTECH could therefore be a threat to public safety. Besides, the lack of social diversity could restrain social resilience.

In spite of the green spaces and playgrounds it remains a question whether it will be possible to develop community and cohesion considering the use of gated and walled communities. Sense of community and cohesion are both contributing factors of urban social sustainability. These factors could also be limited by a lack of public participation and democratic decision-making (Caprotti, Springer and Harmer, 2015). The absence of public participation and democratic decision-making are also problematic because exclusion from deliberation is a violation of the demands of social justice because it is itself one dimension of the experience of social exclusion (Young, 1990). Social exclusion is a violation of the demands of social justice because it conflicts with equality of opportunity and is associated with an inability to participate effectively in politics (Barry, 1998).

### **3.7 Conclusion**

Let us return to the sub-question: "To what extent and how can Tianjin Eco-city contribute to urban social sustainability in China?" One should keep in mind that the answer is predictive and not definite since SSTECH is still in development and urban social sustainability is not a

static state but rather a dynamic process. It is found that social justice, an essential aspect of urban social sustainability, might be violated by a lack of both affordable housing and public participation. Moreover, exclusion and unequal access could threaten public safety. The lack of public participation and the construction of walled and gated communities might hinder social cohesion and a sense of community. Additionally the eco-city does not seem to meet the requirement of geographical equity. However, the significant promotion of green transport and green spaces, might be favourable for accessibility and the residents well-being and health. The latter is also enhanced by the installation of air and water filters.

Based on the findings, it is expected that Tianjin Eco-city will only to a limited extent contribute to urban social sustainability in China since, in contrast to health and well-being, social justice (including equal access and inclusion) public safety, public participation and social cohesion are being insufficiently addressed while the demand for geographical equity is missing. The social and ethical aspects of the 'comfortable' and 'healthy' SSTECS should get priority when the city wants to make a significant difference in the Chinese urban landscape.

## **4. Social Sciences (by Bacchus Eggenhuizen)**

### *Tianjin Eco-city and China's urban procedural features*

#### **4.1 Introduction**

Urban sustainability can provide a higher quality of life, economic growth and environmental protection. In this paper, the widely recognised definition of urban sustainability by Haughton and Hunter (2004) is used. Important elements are equity (social, geographical and in governance), environmental protection, and minimal use of non-renewable energy sources, economic vitality, individual wellbeing and community self-reliance (Maclaren, 1996; Hashemi & Siong, 2014).

The development of urban sustainability relies on the interaction between the environment and context provided by institutions and the attitude and behaviour of its citizens towards sustainability. Participation of civil society and the population is important in the transition to a sustainable society, and also in the creation of an eco-city (Baeumler et al, 2009). China's culture influences policy development and implementation and the way government and the population interact with each other. It is important to study the relation and interaction between institutions and the population to determine the influence it has on urban sustainability. The question this chapter tries to answer is:

*In what way would the relationship between institutions and city-dwellers influence urban sustainability in Tianjin Eco-city?*

The first section will discuss sustainable behaviour in China. The second will examine the cultural characteristics. The third section describes the development of policies and in what way there is interaction with the population. The fourth contains the case study of Tianjin Eco-city and how interactions between city-dwellers and institutions come to practice. And the last part will put all the previous information in a theoretical framework, namely the attitude, behaviour and context (ABC) theory from Stern (2000), to understand the outcome of the relationship between institutions and city-dwellers and how this can be of influence on urban sustainability.

#### **4.2 Sustainable behaviour in China**

The rapid economic growth in China due to the industrialisation process increases the ecological footprint of the Chinese and damages the environment. This economic growth is necessary to increase the quality of life since a large part of the population still deals with problems like poverty, bad housing and low standards of education (Li, Cheng, Beeton, Sigler & Halog, 2015). It can be difficult for a part of the population to make sustainable choices in life because of the limited access to basic needs (Liu & Leiserowitz, 2009). Shen (2015) uses Maslow's (1943, 1970) hierarchy of needs model to show that sustainable development and sustainable choices are included in the highest level of needs; self-transcendence. Therefore, in conditions of low economic prosperity and insecurity, the

population's attitude is more concerned with the lower levels of needs. Also according to Stern (2000), people who value the characteristics of self-transcendence are more likely to participate in sustainable behaviour. Because of the low-income standard compared to EU and US, it is harder for the average consumer to behave in a positive manner towards sustainability.

Although a part of the population is limited in their basic needs, there is still support for sustainable development. But the lack of resources impedes the transition to behaviour. Because of their limited capability to make sustainable choices, Chinese citizens expect from the banking and business sector to contribute to sustainability (Sachs, 2012). There is great support from the population to enhance a sustainable breakthrough but there are several barriers. For example public support is unorganised; China has an autocratic authorial system in which the population has little influence on the development and implementation of policy. Nevertheless China has the largest investments in green technology and a comparative survey showed that the Chinese scored the highest on support for environmental statements (Ho, 2001, Pew research center, 2013). The high environmentalism can be explained by the way citizens are directly confronted with environmental issues in their daily lives. These environmental issues are related to lower levels of Maslow's hierarchy of needs, for example air pollution is one of the main causes of death (UNDP, 2013) and this addresses the safety level. Especially in the more urbanised East part of China, there is more resistance against policies that threaten quality of life (De Jong, Wang & Yu, 2013).

Although there is a high environmentalism and investments in sustainability citizens need to adapt to a sustainable way of life to contribute to urban sustainability but changing this behaviour takes a long time. Even if the setting where people live in is sustainable it cannot provide sustainability on every level. According to Harris (2006), the Chinese government has taken measures to improve sustainability, but new environmental regulations are not always effective outside certain boundaries like big cities. The relationship between institutions and citizens is an important factor for developing and implementing policies concerning urban sustainability. China's culture is of great influence on this relationship and a determining factor for the extent of which the population has any influence on these policies.

### **4.3 Culture**

Since problems concerning urban sustainability rise at a fast pace, it may seem logical to 'force' people to live a sustainable live (Bres, 2011), although forcing contradicts Western philosophy on sustainability. This may be different in China, since they have a different culture and this is an important factor in the interaction between institutions and the population concerning policy development and implementation. China's culture influences the relationship between institutions and the population. This influence of cultural heritage is an important factor to understand the process of policy development and implementation. Hofstede (2005) created 5 typologies of culture; these can help create a context of the relation between citizens and the government. The 5 dimensions are: Power Distance (PDI), Individualism/Collectivism (IDV), Masculinity/Femininity (MAS) Uncertainty Avoidance

(UAI) and Long-term Orientation (LTO). Table 5 shows the index of China in comparison to western countries.

Table 5.

*Cultural scores of the Netherlands, Sweden, the UK and China.*

<b>Culture Index</b>	<b>NL</b>	<b>Sweden</b>	<b>UK</b>	<b>China</b>
Power distance (PDI)	38	31	35	80
Individuality (IDV)	80	71	89	20
Masculinity/femininity (MAS)	14	5	66	66
Uncertainty avoidance (UAI)	53	29	35	30
Long-term orientation (LTO)	44	33	25	118

PDI refers to the degree to which members of society accept unequal distribution in power. A large degree indicates that society accepts a hierarchical order in which power is not equal, and does not need any justification. Politics is characterised by little dialogue between all stakeholders and more enforcement by a strong centralised and polarised government with a weak participation of society. China scores relatively high which means that it is more likely that the population accepts the power difference and the inequalities between them that are characterised by a centralised autocratic government.

A high IDV refers to individualism where people are expected to take care of themselves. While a low IDV refers to collectivism in which case people are bounded together for example by family and take care for each other. There is an emphasis on harmony, interdependence, avoiding conflict and a more introvert attitude. Lower human rights standards and per capita income are common within these cultures. China scores low compared to the Western countries, which implies a strong state and general consensus among the population. Relational ties are very important and people speak less their mind than in high IDV cultures.

MAS refers to the degree of a masculine society where emotional gender roles are distinct in the sense that men should be assertive and tough whereas women are tender and careful. In a feminine society gender roles overlap with each other. Masculine societies tend to be less secularised and have a more performance-based attitude. Economic growth is important and power is based on the strongest, as in a political party or company. Although there is no difference with the score of the UK China is a more masculine than feminine society compared to EU countries.

In a high UAI society, people have firm guidelines concerning belief and behaviour and are more intolerant towards unconventional behaviour and ideas. Society is uncomfortable with uncertainty. A low UAI society has a more flexible and relaxed attitude towards uncertainty. Since China has several characteristics of both high and low UAI, and the score is not distinctively different from other countries, this paper will not apply the UAI index. There is too much ambiguity to draw any conclusions concerning their behaviour.

High LTO societies tend to be more pragmatic in making choices for the future, instead of cultivating values of the past and present. Low LTO societies are more focused on short-term results. People in high LTO countries tend to attribute more value to characteristics like persistence and ordering social relations by status. China's culture is more



a high LTO than low. Which is reflected by high savings instead of high consumption, long-term profits and grand-scale projects.

The culture indexes are introduced in this part of the paper because it will be applied further on as part of the explanation how interaction between governance and society comes to play.

#### **4.4 China's Governance**

China is 'a socialist state under the people's democratic dictatorship led by the working class and based on an alliance of workers and peasants' (Hald, 2009). The CCP (The Chinese Communist Party) has a monopoly on the restriction of opposition. There are several other parties but they have no real power on policy and can only function under the rules set up by the CCP (Hald, 2009). The informal side of influence, that is the personal networks, can prevail over the formal organisation structures; personal connections are used to achieve goals and to keep a form of arbitrary power (De Jong et al, 2013). There is a big difference between how a government should operate concerning sustainable policies in western literature and how China's government develops and implements policies (UNDP, 2013). The traditional way of governance in China is based on the belief of 'divine right' in which the CCP has full authority. The Western democratic approach to politics, where there is a separation of power, is the opposite of China's (Li et al, 2015). Policy making usually goes top-down where lower branches of the government follow the guidelines set out by the CCP.

Environmental sustainability is treated with serious concern in China, however economic growth is still prioritised in the five-year plan (Zhang, 2012). China's approach to develop a more sustainable city is more technocratic than eco-cratic, combining economic growth and technological advancement rather than emphasising civic engagement (De Jong et al, 2013). The reason for a more technocratic approach derives from public authorities that aim to improve working environments, attractive living, boosting the GDP growth, prestige and recognition, while citizens are more focused on the improvement of living standards (De Jong et al, 2013). Although there is a discrepancy between the goals of public authorities and citizens, the technocratic approach still can have a positive effect on urban sustainability.

The political reforms of the past decades have resulted in a weaker central government. This is due to political modernisation where there is greater decentralisation and an increasing complexity of society, this has led to more powerful local governments (Hald, 2009). While the CCP provides guidance, they delegate authority to monitor and enforce environmental policies to local governments; these choose to support creating jobs in polluting factories over environmental protection to support the residents since environmental policies strain local economy (Hald, 2009).

The structure of the government along with the belief of divine right indicates on a high PDI score. While the emphasis on economic growth, technocratic approach and the importance of prestige are indicators for a masculine (MAS) society.

## 4.5 Civil Society

Participation of society is an important cornerstone of environmental sustainable policy implementation. The success of policy implementation depends on acceptance of the parties involved; goals concerning urban sustainability have to be recognised by all stakeholders (Ensering & Koppenjan, 2007). Roseland (2005) describes the approach for sustainable development and emphasises the importance of the bottom up approach. He states that 'real' change comes from civil society and public participation. In this way, there is a larger probability to improve equity, equality and empowerment. Democracy is a part of sustainable development and requires community mobilisation and participation not through a strong state forcing its will over citizens (De Jong et al, 2013). Especially local government has the influence to increase participation of civil society, but the CCP is concerned about organisations with political intentions. The participation of organisations could empower local communities and challenge their authority (Enserink & Koppenjan, 2007).

The number of NGO's is rising but civil society is still weak compared to western standards. NGO's haven a conflicting role with the central government because they are considered a threat to national political unity since they have a political mission and express their views on policy matters (De Jong et al, 2013). Nevertheless, decentralisation causes local governments to have insufficient funds and not enough capacity to provide public services, NGO's can. But the central government prefers to have organisations that are under their influence to express their authority. However GONGO's (Government operated non-governmental organisation) can bridge the gap between government and civil society. They can extend goals beyond the original guidelines from the state (Hald, 2009). Civil society however remains underdeveloped and still does not play its decisive role in urban environmental policy making. The influence from bottom-up structures relating to putting issues on the state's agenda has been minor (Hald, 2009). A problem in China is political transparency that is not as common as it is in Western countries. By not involving a civil society or an informed constituency there is not always a democratic process. Yet they have a system that reached many goals (Hald, 2009). While most theories in sustainable development imply that democracy and participation is important for developing sustainable policies and developing sustainable cities, China does not yet has a form of dependence on civil society or participation of the population. Although the civil society can contribute in a considerable way to policymaking and implementation there is little evidence that these groups are active in urban governance (Hald, 2009). Instead, China focuses more on economical big players in government and business sector for urban development (Bres, 2011). Eco-city development is more likely to happen due to state actions than societal forces and urban planning is coupled with stricter government planning and more compliant citizens (De Jong et al, 2013)

In the last five-year plan there is more attention for pollution and sustainable urban development but the way it should be implemented is still through enforcement (De Jong et al, 2013). The assumption that to improve sustainability, it must be a part of the consciousness of society is based on Western context (Li et al, 2015).

According to Friedmann (2005) the concept of a civil society and its contributions to sustainability is a characteristic of western liberal democracy. Because of the different

cultural heritage in China the same concept of a civil society is inapplicable. This is because of the Confucian tradition, which sees society as vertically, intertwined with institutions under control of the state and the private embodied by the public with slight autonomous status (Hald, 2009).

A weak civil society and the characteristic of a compliant population indicates a high PDI and a more collectivistic society (IDV).

#### **4.6 Eco-city**

The grand scale SSTEAC (Sino-Singapore Tianjin Eco-City) project is under supervision of the SSTEAC Framework Agreement and is a collaboration between the Chinese and Singaporean governments. It consists of several public and private sector participants from both countries (Baeumler et al, 2009). The CCP stated in a policy goal that the aim of an eco-city like Dongtan and Tianjin is to create a harmonious society in which there is the construction of an economic, ecological and social stability (Caprotti et al, 2015). Compared to Western standards of ecological modernisation, China has a different approach, which is based more on an economic-technological method. China is building eco-cities not only for urban sustainability but also as an incentive for global investors; the Tianjin Eco-city will also create a platform for businessman and political leaders to strengthen the partnership of both countries involved (Hald, 2009); which indicates a masculine society (Hofstede, 2005). The development is top-down structured where actors with a lot of power are more included in planning and implementation than civil society (Bres, 2011). The development of the Tianjin Eco-city is based on technological implementation, not civic engagement (Joss, 2011). The economical-technical approach to build the Tianjin eco-city is lacking in social sustainability. A reason for this is a focus on the dominating debate of possible contradictions between economic growth and ecological protection (Yu, 2014).

One of the elements that can contribute to the failure of city development is a weakened civil society that does not participate in the development of an eco-city (Hald, 2009). A civil society emphasises societal needs that are unnoticed by the state, especially for groups in the population, which are not part of the mainstream urban society like farmers and migrant workers (Hald, 2009). The UNDP set out 11 principles for good governance to make urban sustainability possible, under which participation of society is one of them in which China is lacking.

China's authoritarian system is able to enforce development, however since local governments gain more power due to decentralisation, more participation of additional foreign stakeholders and dispersion of responsibilities take place. This makes it harder for all stakeholders to combine goals and there is a greater chance for conflicts (Hald, 2009). When eco-city Dongtan was being developed, project members indicated that residents were aware and consulted of the project. But it only was mentioned in broad terms (Hald, 2009). There was no evidence there was any form of civic engagement present during the development of Dongtan. Eventually Dongtan failed because of differences in visions and goals of developers and local stakeholders. An example is the conflict between real-estate agents who want more profitable housing and developers who wanted more affordable housing to create a social

sustainable city. Another point was that the project relied too much on foreign design instead of being locally driven (Bres, 2011).

Although the development plan for Tianjin Eco-city states that there should be an improvement of public participation and democratic decision-making, it does not mention how these objectives are to be achieved (Bres, 2011). The input that does emerge from a form of civil society is from well-educated and high income classes in China (De Jong et al. 2013). Although eco-cities should be open to all classes in society, it is common that a large part of the residents will be from the upper class (Caprotti et al, 2015, Hodson & Marvin, 2010). The city must be accessible for different kinds of citizens to become social diverse and avoid becoming an eco-enclave in which only the upper class of society is to gain access (Baeumler et al, 2009). One of the most important indicators is affordable housing to prevent this social segregation. Socio-economic conditions of the population are an important influence on the sustainability of a city (Hald, 2009). The development should be socially inclusive if Tianjin Eco-city wants to become a harmonious city (Baeumler et al, 2009). It seems that the government understands that 'extra-economic' issues like poverty and inequality are destabilising, and the absence of this social aspect in the plans for Dongtan are more included in the development of Tianjin Eco-city (Caprotti et al, 2015). Although there are several quantitative indicators such as barrier free access and affordable public housing, which should allow the city to become heterogeneous in relation to its citizens, the absence of participation by the local citizens contradicts the goal of a harmonious community (Caprotti et al, 2015).

The lack of certain characteristics of urban sustainability can be explained by the cultural heritage. These cultural factors can also provide a different approach to the development of urban sustainability. In his master thesis, Bres (2011) compares the way sustainable cities are created in the EU and China and how culture influences this process. Since China relies more on an autocratic system, compared to democratic in the EU, the Chinese government and citizens have a different interaction with each other. China's culture may allow it that the chances of policy success are less dependent on participation. The state led policy making could be effective when it comes to developing eco-cities because the loyalty and compliance of citizens leads to a good vertical integrated structure (De Jong et al, 2013). A city has the power to influence the behaviour of its residents by implementing policy interventions like recycling laws and traffic management (Baeumler et al, 2009).

The attempt to create eco-cities on a large scale indicates a high LTO.

#### **4.7 Theoretical Framework**

This section provides a theoretical framework to create a better understanding how the interaction between institutions and city-dwellers is of influence on urban sustainability.

There are several theories to explain and predict behaviour, yet these focus only on internal or external factors. For example the theory of planned behaviour (Ajzen, 1988, 1991). Which states that behaviour is an assembly of attitude towards behaviour, subjective norms and perceived behavioural control, which are internal factors. And the Symbolic Interactionism theory (Blumer, 1969) where behaviour towards objects and others is based on

the meaning assigned to these; that derives and modifies out of interactions in society, which is an external factor.

Although individual motivations and attitude are important factors in determining behaviour (Fishbein & Ajzen, 2010), several studies identified a gap between attitude and behaviour (Salonen & Ahlberg, 2012). Contextual factors can influence behaviour as well as facilitate environmental behaviour (Olander & Thorgerson, 1995; Thorgerson, 2005; Steg & Vlek, 2009). The notion that there is a dynamic interactive relationship between people and their context is presently accepted in the study of pro-environmental behaviour (Demarque, Apostolidis & Joule, 2013).

The ABC theory of Stern (2000) (Guagnano et al. 1995) is a model that explains when environmentally significant behaviour occurs. This theory is an integrative model that combines internal and external features of environmental behaviour (Rhodes et al, 2015). The assumption is that behaviour (B) is a product of personal attitude (A) and contextual features (C). Attitude consists of personal beliefs, norms and values. While contextual factors include a broad array of factors like interpersonal influences, public policy, institutional and legal aspects (Stern, 2000).

The theory states that the connection between attitude and behaviour is the strongest when there are little to none existing contextual factors. And the connection is weak when contextual factors are either strongly positive or negative present, which results in reinforcing or discouraging certain behaviour. This implies that if certain behaviour is not favoured by context factors, and the more this behaviour is difficult to perform (time consuming, expensive etc.) the lesser it depends on attitude. The Figure 3 below applies the model to recycling.

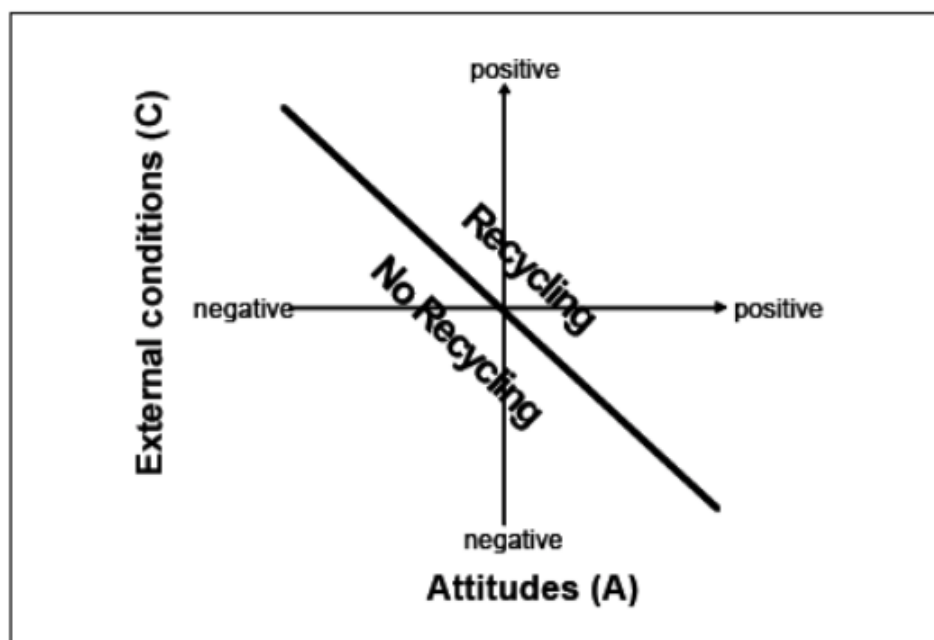


Figure 3. The Attitude-Behaviour-Context Model applied to recycling.

This means when it is neither easy nor hard to recycle, because there are neither positive nor negative context factors like a recycling facility close by (C), people who are in favour of recycling (A) will behave positive toward recycling. When applied to sustainable policies and positive environmental behaviour, if an eco-city creates positive contextual factors regarding urban sustainability for example, easy access to green public transportation, it is likely that citizens will behave in a more environmentally sustainable way and take the bus to work instead of a car.

According to Stern (2005) making positive changes in the context is more effective in influencing behaviour than changing attitudes of individuals. Therefore, the ABC model can be a valuable tool for policy development and implementation in conditions of low compliance (Jackson, 2005)

In general, the attitude of the Chinese population is positive towards urban sustainability development (A). This is due to the confrontation with for example health and economic issues as elaborated on in section 4.2. Another aspect, which is determining for the attitude is the Chinese culture; citizens are compliant (A) with the authority of the state. However, the positive attitude is not enough for a large part of the population to behave in a sustainable way (B) because of contextual restrictions like economic prosperity. The government could be a positive contextual influence on sustainable behaviour. The autocratic position (C) creates an environment where the government can enforce certain behaviour on its citizens. There are also negative characteristics to this position of the government, which can discourage sustainable behaviour. The technocratic approach (C) to sustainable development, which is dealt with in 4.4, does not emphasise civic engagement and is more focussed on economic development than ecological protection. Also, local governments have conflicting goals considering sustainable development.

In some aspects it can be more difficult to perform sustainable behaviour due to these negative contextual influences. This is in line with the Western perspective on sustainable development. However, the organisational structure of the government and its arbitrary power might be a positive influence. The cultural indexes by Hofstede (2005) described in 4.3 can provide an explanation. China's cultural heritage (C) creates an environment where due to the large power difference and a masculine collectivistic society, citizens are more likely to accept the power and decisions of the state (A). When a positive context is provided by the design of Tianjin Eco-city it can lead to more sustainable behaviour (B) and urban sustainability even when there is a lack of certain aspects of urban sustainability like an active civil society.

#### **4.8 Conclusion**

*In what way would the relationship between institutions and city-dwellers influence urban sustainability in Tianjin Eco-city?*

The relationship is one-sided, it is a hierarchical top-down approach from the government to the population. The cultural heritage generates the hierarchical governmental structure with a compliant population, which allows only a small extent of public involvement and an active

civil society. Due to the dominant CCP dictatorship, Chinese citizens have little to none influence in the development and implementation of policy concerning urban sustainability in Tianjin Eco-city.

The limitation of public involvement and arbitrary power of the government results in a limitation of social equity and equity in governance which are two characteristics of urban sustainability. This is in contrast to Western philosophy of sustainability in general which states that an active participation and input from citizens and civil society is an important cornerstone of policy development and implementation.

So the question arises if policy is sustainable on its own meaning; can the development and implementation of policy concerning urban sustainability survive if there is no active participation of society and is enforced on the population?

Because of the difference in culture between China and Western countries it may be so that the autocratic way of policy development can succeed in developing an eco-city and improving urban sustainability.

Since China is a collectivist society (IDV) individuals are less likely to speak their mind and are under more social pressure to abide by the rules provided by the government, which they are more likely to accept because of the dominant PDI.

The masculine (MAS) emphasis on economic growth and environmental protection through technological advancement can benefit the quality of life for the citizens of an eco-city and is likely to create support from the city-dwellers. Combined with the goal for a sustainable future from the long-term orientation (LTO) this results in grand-scale projects like Tianjin Eco-city.

Even though China does not suffice to characteristics of urban sustainability (social equity and equity in governance), their culture does allow for grand-scale implementation of policies with little resistance of society. Therefore the implementation of urban sustainability policy does not have to be limited by the lack of public involvement. The development of Tianjin Eco-city can have a positive effect creating a context where people are stimulated to behave in a constructive manner to further enhance urban sustainability.

## 5. Common ground

In this chapter, we will first outline differences between the above disciplinary findings that involve their concepts, assumptions and insights. After that, techniques to solve these incongruences, i.e. conflicts, are used for creating common ground between the findings. At the end of section 5.2, Table 6 will provide a summary of the techniques used.

### 5.1 Identification of differences between the disciplinary findings

All three disciplines deal with *urban sustainability* but use a different focus. In the chapter on environmental studies (Chapter 2) the focus is on the environmental aspect of urban sustainability, whereas the chapter on development studies (Chapter 3) focuses on social and ethical aspects of urban sustainability. The chapter on social sciences (Chapter 4) deals with urban sustainability in the broadest sense of the term. The disciplinary findings differ with respect to their concepts, assumptions and insights. The findings that do not conflict are addressed in the so-called ‘more comprehensive understanding’.

#### Conceptual differences

First, the chapters on development studies and social sciences use different phrases – *public participation*, *civic engagement* and *social inclusion* – to refer to a single phenomenon.

A second conceptual difference is found in the definition of *policy effectiveness*. From an environmental studies perspective, policy effectiveness is defined as the capacity of a policy to achieve its desired outcomes, with a focus on the content of the policy and its consistence with sustainability goals. However, in Chapter 4 it is argued that in order for policy to be effective, the loyalty and compliance of citizens is necessary. That is, successful policy implementation depends on acceptance of parties involved. This means that from a social sciences point of view, effectiveness of policy is obtained through the process of developing and implementation of a policy, whereas in environmental studies effectiveness applies to the content of the policy.

Third, both Chapter 2 and 3 use the concept *resilience*. However, in Chapter 2 the concept is used to refer to ecological resilience, whereas in Chapter 3 community resilience is addressed.

#### Differences in assumptions

A first difference in assumptions between disciplines involves development studies and social sciences. From a social sciences perspective, *public participation* is seen as an instrument to improve policy effectiveness, whereas development studies sees *public participation* as a normative value because it is an aspect of social justice, which is a requirement for urban social sustainability.

Besides, environmental and development studies cherish different assumptions about the same concepts. For instance, according to development studies green spaces in the eco-city are of importance for a sense of comfort and wellbeing, whereas in environmental studies



these areas are supposed to improve biodiversity and absorb carbon dioxide. The same holds for green transport. From a development studies point of view green transport is important since it enhances accessibility and generates a feeling of inclusiveness. Environmental studies attaches value to green transportation because it reduces air pollution and greenhouse gas emissions. Similarly, walking and cycling are encouraged, because these activities are profitable for healthy lifestyles and decrease a feeling of exclusion while they also reduce environmental pollution.

A last difference in assumptions is found in the importance of *scale* for urban sustainability. An important insight is that in order to be environmentally sustainable, the local, regional as well as global impacts need to be taken into account. That is, urban areas are integral to global environmental sustainability. In the chapter on development studies it is stated that Tianjin Eco-city is at risk of becoming an exclusive ‘eco-enclave’. This is in conflict with the assumption that urban sustainability ensures both geographical equity and social justice. One reason for this is that it is expected that Tianjin Eco-city will mainly attract people with higher incomes, resulting in the exclusion of lower income groups. Another reason is that eco-cities do not contribute positively to development in towns and villages outside their area. Hence, Chapter 2 and 3 both emphasise the importance of considering the city’s wider region when pursuing the goal of urban sustainability. However, the disciplines have different assumptions about why this is important: from an environmental studies perspective it is agreed that cities affect and are affected by natural systems beyond their physical boundaries, but in development studies the city’s wider region should be considered because of geographical equity and social justice.

### Differences in insights

We have found one difference in insights that involves all three disciplines. Environmental and development studies both deal with urban sustainability challenges and SSTECS’s possible solutions to these challenges. We refer to this as *sustainability policy*. However, social sciences focuses on the sustainability of the policy; *the policy process*, which is obtained through public participation in developing and implementing policy.

## **5.2 Creating common ground**

In this section the previously identified conflicts between concepts, assumptions and insights are redefined, extended or organised to create common ground. For a summary of these conflicts and the techniques used, see Table 6 below. In section 5.3 the common ground is used to achieve a more comprehensive understanding.

### Common ground for concepts

*Public participation, civic engagement and social inclusion.*

These three concepts show much similarity and there is no real conflict among them. Using the technique of redefinition to construct a description that is compatible with all of these we come to the following: the concepts are all concerned with the promotion of the involvement

of all layers of the population in the development of Tianjin Eco-city, i.e., with *public involvement*. However, it should be noted that there is a slight nuance between the concepts. Where public participation and civic engagement are used to refer to the involvement of the public in the development and implementation of policy, social inclusion alludes to the range of people that can be part of the eco-city.

#### *Policy effectiveness*

The concept of policy effectiveness is defined in different ways by environmental studies and social sciences. This apparent conflict can be solved by using the technique of organisation, which allows us to clarify the relationship between both definitions. The commonality between the different disciplines resides in the success of the policy. In the chapter on environmental studies, success depends on the content of the policy, whereas according to social sciences success is dependent on the acceptance of policy by stakeholders. These different notions of policy effectiveness are interrelated. Success of a policy depends on *both* the content of the policy *and* the acceptance of the process of decision-making by citizens. Therefore, involving stakeholders in the policy process is a possible way to improve policy effectiveness. This relationship is illustrated in Figure 4.

#### *Resilience*

Both development studies and environmental studies use the concept of resilience, but the disciplines define the concept in different ways. The technique of extension can solve this conflict by extending the meaning beyond its original domains. Ecological and community resilience both refer to the ability to flexibly respond to disturbances. Also, both definitions address the need for diversity (social diversity and biodiversity) in creating resilience. Consequently, resilience can be used for both domains.

#### Common ground for assumptions

##### *Public participation*

The conflict between viewing public participation (previously redefined as public involvement) as an instrument to enhance sustainability of the policy process and as a normative value for social justice can be solved by using the technique of organisation. The commonality of these different assumptions is that public participation promotes urban sustainability. In the chapter on development studies public involvement is considered a necessary condition for urban sustainability because it is a precondition for social justice. Hence it concerns a normative value of urban social sustainability. However, from a social sciences perspective it is argued that public involvement has an instrumental value for policy development and implementation. These two assumptions are complementary. Public participation contributes to urban sustainability because it is a precondition for social justice and because it enhances the sustainability of the policy process (see Figure 4).

##### *Environmental studies and development studies: different assumptions, same concepts*

Environmental studies and development studies share many concepts, but have different assumptions about them. For instance, both fields of study believe green spaces are

important. However, from an environmental point of view this is because of biodiversity while the reason for development studies is that these green spaces enhance wellbeing. These assumptions do not challenge one another. Rather, they are complementary. The same holds for green transport. Therefore, the technique of extension is used. The interrelatedness of the two disciplinary assumptions appears from the fact that environmental problems bring about social problems: issues with public health may thus result from pollution. As Alberti (1999) argues, “environmental change has direct effects on human health and wellbeing” (p. 154). Besides that, development can only take place if it does not go beyond the carrying capacity of the natural systems involved (Diappi, Bolchi & Franzini, 1998).

### *Scale*

Environmental and development studies both emphasise the importance of scale in urban sustainability but have different assumptions about why this is important. We solve this apparent conflict by the technique of organisation. The commonality between environmental studies and development studies is that they both stress the importance of the geographical scale, but do so for different, complementary reasons, i.e., in relation to natural systems and geographical equity respectively.

### Common ground for insights

#### *Sustainability policy/sustainability of the policy*

Though some confusion may arise from the distinction between the insight of sustainability policy and the insight of sustainability of the policy process, this problem can be tackled by the technique of organisation, which allows for a clarification of the relationship between these insights. The commonality between the insights is that they both deal with sustainability policy. But whereas environmental and development studies consider the *content* of the sustainability policy as the determining factor for sustainable policy, social sciences is concerned with the *process* of developing and implementing sustainability policy. The different disciplinary perspectives are interrelated, because a sustainability policy will be successful to the extent that in the process of developing and implementing it involvement of the public has been allowed. On the other hand, public involvement does not necessarily lead to success of a sustainability policy, because the content of such a policy is another determining factor. Sustainability policy can therefore only be successful when its content as well as its process are sustainable: the insights are interrelated. Figure 4 shows this relationship.

Table 6.

*Conflicts between concepts, assumptions and insights and the techniques used for creating common ground.*

	<b>Conflict</b>	<b>Technique</b>
Concepts	Public participation/civic engagement/social inclusion	Redefinition
	Policy effectiveness	Organisation
	Resilience	Extension
Assumptions	Public participation	Redefinition
	Environmental studies/development studies	Extension
	Scale	Organisation
Insights	Sustainability policy/sustainability of the policy	Organisation

### 5.3 More comprehensive understanding

Now that the conflicts have been solved and common ground has been created, we can attempt to answer our research question: *To what extent and how can Tianjin Eco-city contribute to urban sustainability in China?*

Figure 4 visualises that the determinants of urban sustainability are the effectiveness of environmental policy, urban social sustainability and the sustainability of the policy process. Therefore, if Tianjin Eco-city is to contribute to urban sustainability, it needs to comply with these conditions.

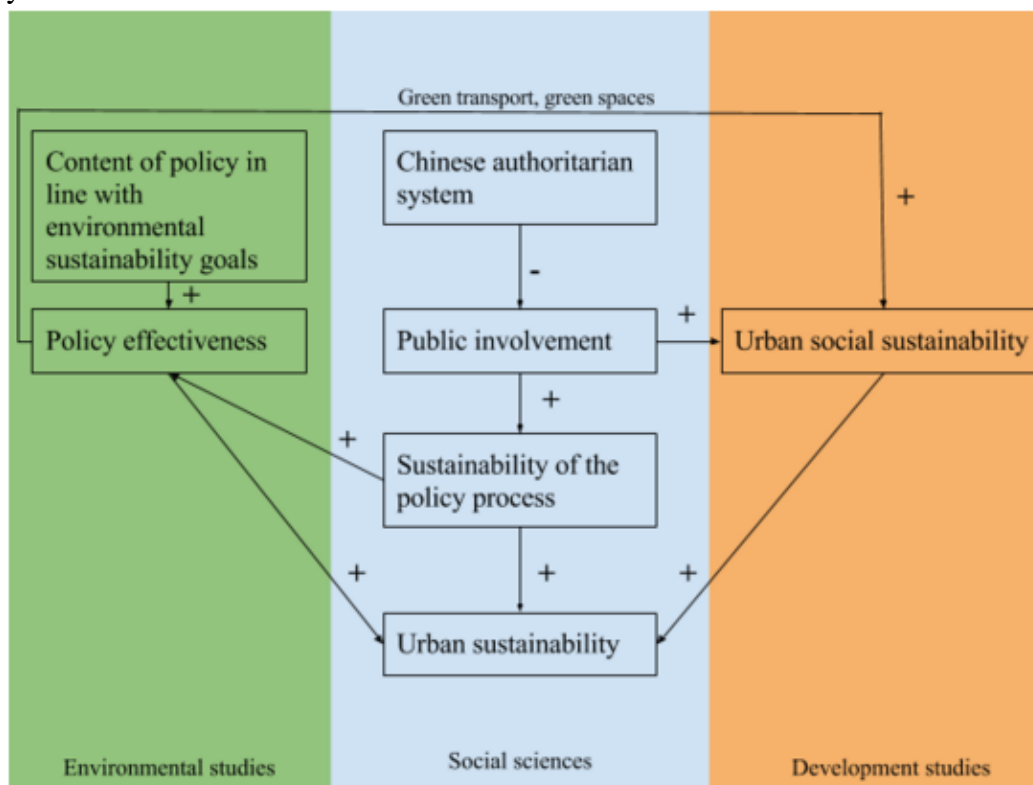


Figure 4. Urban sustainability and its drivers.

Figure 4 shows that the three determinants of urban sustainability are all related to public involvement. First of all, public involvement is a requirement for social justice and as such for urban social sustainability as well. It is also beneficial to social cohesion, community resilience and public safety. Moreover, public involvement is itself a value of urban sustainability. Besides, public involvement positively influences the sustainability of the policy process, because public involvement creates public support for the policy. And on top of that, public involvement is an instrument for improving policy effectiveness by improving the sustainability of the policy process.

From this it can be concluded that public involvement is one of the most important determinants for the success of Tianjin Eco-city in achieving urban sustainability. It was found that public involvement in Tianjin Eco-city will probably be lacking, because Tianjin Eco-city will only be inhabited by people of a narrow socioeconomic range. In addition to this, the Chinese cultural heritage tends to generate hierarchical governmental structures that allow only a small measure of public involvement with little influence of Chinese citizens in the development and implementation of policy. The resulting absence of public involvement in Tianjin Eco-city will limit the degree urban sustainability. On the other hand, the Chinese culture does allow for grand-scale implementation of policies with little resistance of society. This implies that the implementation of Tianjin eco-city policy does not necessarily have to fail as a result of the absence of public involvement.

Another determining factor for the success of Tianjin Eco-city in achieving urban sustainability is the design of the city. Green spaces and green transport are likely to contribute to urban sustainability, since they can decrease greenhouse gas production and enhance health and wellbeing. However, the construction of walled and gated communities may constitute be an obstacle to social cohesion. This situation may be improved by the development of pedestrian-friendly community spaces.

More importantly, it should be noted that Tianjin eco-city must be considered in relation to its hinterland. The eco-city's significance as part of the wider region may be quite limited. Tianjin Eco-city runs the risk of becoming an exclusive eco-enclave with limited geographical equity and social justice. Only a moderate amount of people will be able to benefit from the 'green' and 'comfortable' urban area. Besides, eco-cities do not contribute positively to sustainable development in towns and villages outside their area. And finally, they may suffer from pollution produced elsewhere and from rising sea levels on account of global climate change.

In short, we argue that the eco-city of Tianjin is expected to contribute to urban sustainability only to a limited extent. The various characteristics of urban sustainability are not balanced in its concept. Given our understanding of urban sustainability, the development of Tianjin Eco-city contributes chiefly to the environmental aspects of urban sustainability while the equally important social, ethical and procedural aspects are insufficiently addressed. In consideration of the geographical context, moreover, Tianjin Eco-city's contribution to regional and global sustainability will be limited. Despite its aim of serving as an example for future eco-cities, this role model should not be replicated without taking its shortcomings into consideration.

## Conclusion

By using an interdisciplinary research approach, we have been able to give a more complete picture of the degree of urban sustainability in SSTECH in comparison to the separate findings of the individual disciplines. This is due to the fact that the various disciplines focus on different aspects of urban sustainability, allowing the interdisciplinary approach to provide a more comprehensive assessment of the degree of urban sustainability in SSTECH. By combining the disciplinary findings and showing their interactions, we have been able to create an understanding that is greater than the sum of its parts.

We have identified environmental studies, development studies and social sciences as the most important disciplines for addressing urban sustainability. From the outset, we have assumed that they are equally important. It could be argued that environmental and development studies are more important as contributors to answering our research question, because they address the extent to which Tianjin Eco-city *directly* contributes to urban sustainability, i.e., by means of its policy content. Social sciences, on the other hand, studies the institutional and procedural characteristics of urban sustainability and, in doing so, provides the context for environmental and development studies. Given this, one could argue that the disciplinary insights are of different value. However, we believe that on account of their interactions, the disciplines are of equal importance.

Another possible criticism is that the economical aspect has not been explicitly discussed, even though – together with the social and environmental aspects – it constitutes one of the core aspects of sustainable development. China employs a more globally integrated market economy and economical resources to facilitate the transition to a ‘harmonious society’ in which environmental sustainability and social stability are mutually reinforcing. From this perspective, the economical aspect can be seen as a means to enhance social and environmental aspects. Therefore, we decided to focus our research directly on the latter aspects. In spite of this it would be desirable to analyse the economical sustainability of SSTECH, because when pursuing a holistic approach to sustainability the economy needs to be included as well.

Interdisciplinary research has the tendency to focus on the ‘big picture’ instead of specific delimited problems, which can result in a loss of depth in comparison to other research designs. Although this paper succeeds in answering to the research question, its reflection on actual contributions of SSTECH to urban sustainability is not particularly detailed. In this respect, disciplinary research tends to lead to more specific answers that are less complex and easier to grasp. Accordingly, disciplinary solutions to urban sustainability issues tend to be more clear-cut, which makes them easier to implement, also because governments usually prefer well-structured problems and a range of demarcated solutions to choose from. Nevertheless, urban sustainability is a complex issue and disciplinary research could provide an oversimplified picture of the situation, which could result in inadequate solutions after all.

Since Tianjin Eco-city has not yet fully been constructed, our research based itself on projections, resolutions, goals and guidelines. It is therefore not yet possible to exactly assess the degree of urban sustainability of the project. We have mainly mapped out the limiting and

contributing factors to SSTECC's urban sustainability. Future longitudinal research may point out whether the goals and guidelines of the project will be met and decide whether these goals and guidelines actually contribute to urban sustainability. Longitudinal research on the successes and failures of Tianjin Eco-city with respect to urban sustainability is necessary because the project is as yet unfinished, but also because sustainability is itself a dynamic process and not a steady state. In addition, the project deserves research by a discipline such as economics, in order to reach a more in-depth analysis. If future eco-cities will be able to learn from SSTECC's deficiencies and successes in realising urban sustainability, China may become a country with a hundred blossoming eco-cities.

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