13. Ecological cities, illustrated by Chinese examples

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A number of ecological initiatives have received support from the Chinese government. They range from alternative building methods (emphasizing the need to insulate the house better) to using alternative ways of dealing with drinking water and sanitation. The question considered in this chapter is, to what extent these disjointed initiatives also contribute to building the much-needed ecological city of the future. Ecological initiatives can be undertaken at three levels – city level, neighbourhood level and individual initiatives – spontaneously, triggered by incentives or price increases.

This chapter will first review the reasons behind the concern about more ecological cities (ecocities). Subsequently, we introduce the approach of the Switch project, which embodies an increased ecological attitude towards water and environmental issues.[2] This will also mean a discussion about sustainability and following an integrated approach to the problems mentioned. Kenworthy (2006) mentions ten dimensions for sustainable city development in the developing world. They will be presented as a possible analytical framework to decide whether certain initiatives qualify for the ecological city label. An overview of how China deals with these issues will be given. Examples of some Chinese ecocity and ecoprovince initiatives will be studied, before formulating some conclusions. The question will be asked whether China is heading, with ecological cities, only for more ecological urban water systems or for a very different, more integrated approach to a number of related environmental issues.

SUSTAINABLE URBAN DEVELOPMENT AND ECOLOGICAL CITIES

The purpose of the chapter is to explore what ecological cities in China would look like. Kenworthy (2006) lists ten dimensions for sustainable city development in the Third World, that is useful as a reference framework.

Sustainable development is a normative concept. In 1987, the World Commission on Environment and Development provided a definition of sustainability that is still often used. Brundtland (1987) defines sustainable development as development that meets the needs of the present generation without compromising the needs of future generations.

The literature struggles over what to put into the sustainability concept, while the environment continues to degrade. Mohan Munasinghe, vice-chairman of the UN Intergovernmental Panel on Climate Change (IPCC) tried to bring together the economic, human and environmental aspects of development. His analytical framework is called, sustainomics (Munasinghe 2007). Through sustainomics he offers alternative mechanisms to help us bring environmental degradation and social cost into the analysis and applies his methodology to greenhouse emissions and the transport sector in Sri Lanka. At the same time, he criticizes the traditional cost–benefit analysis, a reason why Opschoor (1974) used already damaged functions as a possible alternative approach.

Earlier this chapter suggested letting the weight of the issues play a role in the definition of urban sustainability (van Dijk and Mingshun 2005). According to van Dijk (2006), urban management should help take steps towards more ecological cities. One definition of a more ecological approach to urban development would be a strategy combining:

1. Integrated water resources management: closing the water cycle
2. Energy management, reducing greenhouse gases
3. Waste minimization and integrated waste management
4. Integrated transport policies
5. Objectives concerning justice, for example, promoting an equal distribution of the benefits
6. Integration in the framework of urban management, while also managing urban risks.

There are definitional problems as shown in the literature (Finco and Nijkamp 2001). One can find very idealistic, very sectoral, or issue-based definitions of ecological cities and sometimes values play a role such as the distributional issue: should the Chinese be denied the level of energy consumption of average US citizens?

REASONS FOR MORE ECOLOGICAL CITIES

Not only higher energy prices, but increased emissions of CO_2 force a reconsideration of the priorities for the future in developing countries.

Besides traditional urban environmental issues such as urban pollution, traffic congestion and inappropriate waste collection, the results of rapid urbanization and of climate change force cities to think more about their future.

There is water stress in many countries (Seckler *et al.* 1998). A deteriorating environment accelerates the trend towards a gradual shortage of fresh water. While freshwater supplies are clearly limited, for most people water scarcity is caused by competition between water uses and by political, technological and financial barriers that limit their access to water (Falkenmark and Lundqvist 1998). The Switch program intends to generate new efficiencies from an integration of actions across the urban water cycle in order to improve the quality of life in cities.[3] It also promotes urban agriculture projects, as part of the integrated approach to water use and reuse.

UNESCO-IHE carries out a European Union supported Switch project on ecological cities that defines sustainability as the process and the ecological city as the result. Global changes such as climate change and volatility, urbanization and industrialization, population growth, urban sprawl and rural–urban migration put pressure on cities. A sustainable urban water system is a basic feature of an ecological city, but is it enough? The Switch project, according to the proposal, intends to improve water governance and to translate scientific innovations into improvements of day-to-day management of urban water and sanitation. The approach focuses on closing the urban water cycle, defined as the link between the resource, its use for drinking water and eventual reuse to allow the water to flow back into the resource. From the literature, we know that reuse is currently at a price of 30 to 40 euro cents per m^3, while desalinated water may cost around 1 euro per m^3. Unfortunately the latter is always produced at sea level, implying transportation costs in most countries.

The Switch approach has three characteristics:

1. It relates storm water to drinking water and water treatment
2. It emphasizes a more ecological approach and
3. It emphasizes a more integrated approach to the different water related issues.

Integration could take place in the framework of urban management as discussed in van Dijk (2006). Issues discussed in that book are the integration of the different sectoral interests, the role of planning and management, the importance of economic, financial, social and environmental criteria (and how to combine them), who are the decision-makers and how do we deal with the strict and the loose meaning of sustainable urbanization.

ACHIEVING SUSTAINABLE URBAN DEVELOPMENT

Achieving sustainable urban development may also be phrased in terms of considering water and sanitation integral parts of urban infrastructure planning. The Switch vision emphasizes three unique aspects:

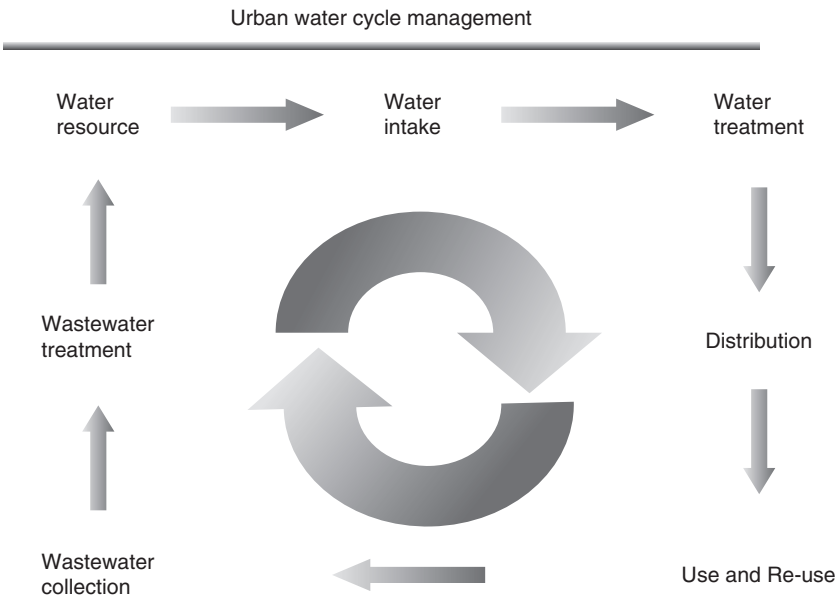
1. Thinking in terms of systems of interrelated components (system engineering)
2. Emphasis on a more ecological approach to sustainable urbanization and
3. Emphasis on a more integrated approach to different water related issues.

Part of the first approach would be developing indicators to monitor constantly our status with the aquatic urban environment and to take corrective actions if certain variables reach threshold levels. Modelling the system and emphasizing decision support systems is inherent to this vision.

A more ecological approach to sustainable urbanization implies moving from traditional environmental technologies to more ecosan options in the ecological city of the future (van Dijk 2007b). It will be necessary to focus more research on the topic of ecological cities, to study certain phases in the process of becoming more environmentally conscious as well as how to interest some of the major urban actors in these issues. However, the coordinating role of local governments and urban managers should not be underestimated. In fact, it is their task to coordinate a multiplicity of actors. Such is the essence of urban management: participatory, inclusive and with all actors concerned taking into consideration equality, the environment and economic development.

In the case of an integrated approach, it needs to be clear what will be integrated, how and by whom? Integrated Urban Water Management (IUWM) is acheivable in each of the cities, if we work towards a plan. A major assumption of this approach is that if we follow a holistic approach we will have better results. We assume that policy will be the result of scientific research, rather than consultancy reports. Such plans may be too ambitious for big cities like Beijing and we may have to content ourselves with providing strategic direction for moving towards a more ecological city.

Strigl (2003) stresses that a real improvement in ecoefficiency, requires a fundamental change in culture, structure (institutions) and technology. Switch intends to develop, apply and demonstrate a range of scientific,



Source: van Dijk (2007a).

Figure 13.1 A picture of the water cycle, showing where costs and revenues can be expected

technological and socioeconomic solutions tested to determine their contribution to the achievement of sustainable and effective urban water management schemes. It implies a multidisciplinary approach for Switch that is the integration of the technological means, socioeconomic aspects, environmental concerns and health considerations.[4]

How do we hope to achieve this in the Switch project? Learning alliances have been created consisting of interested stakeholders to discuss the issues and to identify directions for research. The researchers hope to provide a broader perspective to the members of the learning alliance and to increase the range of options between which they can now make an informed choice. Why is Switch different? Because the project promotes sustainable and integrated urban water management, to make the city a better place to live. It is closing the urban water cycle for the city of the future. With theme six on institutional and financial issues, we hope to link governance and finance issues strategically to other more technical research activities undertaken in other themes. The idea is that if the other work packages (each theme has four to six work packages) have a problem

with the institutional context or financing they would ask theme six what the governance structure could be and how to get to a structure that would work, also in a financially sustainable way.

Our point of departure is closing the urban water cycle. In Singapore, no water gets lost between the resource, the use for drinking water, the treatment and reuse. The following figure illustrates this. Each flash in the figure represents a point where costs are made and revenues can be obtained. It is also possible to deal with the process in an integrated way, as they do in Singapore. In that case, the costs and charges could be integrated in one exercise (for the costs) and one bill for the customers.

BOX 13.1 RESEARCH UNDER SWITCH BY WORKING PACKAGE 6.4

Working package 6.4 explores the social, economic and environmental implications of alternative technologies in urban water systems. It intends to make estimations of the efficiency and sustainability of the alternative technologies. Cost–benefit analysis and lifecycle analysis are methods used for the evaluation. Wuhan, China is one of the cities under study, in particular a neighbourhood where wastewater treatment and reuse in the neighbourhood will take place. A comparison will be carried out between the *new* technology (decentralized wastewater treatment) and the *old* technology (centralized wastewater treatment system) to help decision makers develop and select efficient and sustainable technologies for their water systems.

The research under Switch working package 6.4 is summarized in Box 13.1, focusing in particular on a case study undertaken in Wuhan in November 2007 with a doctoral student, Mrs. Xiao Liang.

A THEORETICAL FRAMEWORK FOR SUSTAINABLE CITY DEVELOPMENT

Kenworthy (2006, pp. 67–86) lists ten dimensions for sustainable city development in the developing world, which give a good impression of the issues at stake. His list is comprehensive because Kenworthy considers a sustainable city characterized by:

1. A compact, mixed urban form that protects the natural environment, biodiversity and food-producing areas
2. The natural environment permeates the city's spaces and embraces the city, while the city and its hinterland provide a major proportion of its food needs.
3. Freeway and road infrastructure is de-emphasized in favour of transit, walking and cycling infrastructure, with a special emphasis on rail. Car and motorcycle use are minimized.
4. There is extensive use of environmental technologies for water, energy and waste management – the city's life support systems become closed loop systems.
5. The central city and subcentres within the city are human centres that emphasize access and circulation by modes of transport other than the automobile and absorb a high proportion of employment and residential growth.
6. The city has a high quality public culture, community, equity and good governance. The public realm includes the entire transit system and all the environments associated with it.
7. The physical structure and urban design of the city, especially its public environments are highly legible, permeable, robust, varied, rich, visually appropriate and personalized for human needs.
8. The economic performance of the city and employment creation is maximized through innovation, creativity and uniqueness of the local environment, culture and history, as well as the high environmental and social quality of the city's public environments.
9. Planning for the future of the city is a visionary debate and decision process, not a predict and provide computer driven process.
10. All decision-making is sustainability based, integrating social, economic, environmental and cultural considerations as well as compact, transit oriented urban form principles. Such decision-making processes are democratic, inclusive, empowering and engendering of hope.

We would like to use this list of characteristics to find out if certain initiatives in Chinese cities qualify for the label *ecological city* or ecological neighbourhood. These principles are quite broad and come from someone with a transport background (points 3, 5, 6 and 10). Integration for Kenworthy looks at the world from a transport sector perspective. Further there is a vision behind it and an integrated strategy is necessary to implement the solutions to the implicit problems. Finally, the importance of appropriate technologies for water and sanitation is only mentioned under point four.

AN OVERVIEW OF THE ISSUES IN CHINA

There are numerous examples of problems with the water cycle in China. Just to mention some examples: the impact of climate change on water resources and development in China (*China Daily*, 2 July 2004), as well as the risks linked to the current practice of water management for Chinese rivers (CICED 2006). Flooding is common, just like pollution, but the river is also important for irrigation, drinking water, transport and fishing activities. In the northern port city of Tianjin, the river became polluted and consequently the population could not drink the water for weeks. This is a big city and the impact of upstream pollution was enormous. The risks this time are not so much the risks of flooding, but of not supplying clean drinking water to the big cities on the coast (Pahl-Wostl and Kabat 2003). There were reservoirs to serve Tianjin and Beijing, but the water was not available at the crucial moment. Currently, the city is using a desalination plant, but it will also benefit from the south-north river linking programme, which connects the northern Yellow and southern Yangtze rivers.

In the integrated urban water cycle, managing water resources, drinking water supply and wastewater treatment are three important stages, each with specific problems in China. The water situation in China can be termed, water scarcity. Particularly in the north, there is not enough water for the different types of use and for the big cities, which have high per capita consumption figures, probably due to substantial water loss. For that reason, China has embarked on a number of river linking projects (WWF 2005).

The main problems with water and pollution in China are as follows.

1. Water prices are not realistic (*Financial Times* 20 March 2003), but efforts to increase water prices by 30 per cent have not been approved by the Municipal Commission of Development and Reform (*China Daily* 2 July 2004)
2. The river transfer project is extremely costly (*Financial Times* 20 March 2003)
3. Pollution has led to algae in the Yellow Sea (*NRC* 17 June 2004)
4. The risks in the water cycle are substantial
5. The emphasis is on the hardware and not enough attention is paid to managing the systems in a more optimal way.
6. Even the Three Gorges Dam may cause serious ecological risks.

There is a trend to focus on obtaining the most advanced technology for China and on counting that to be sufficient. Not enough attention goes to managing existing water supply and treatment systems properly. Hence

many water resources are polluted, drinking water is scarce and the quality of the water produced by the water treatment plants is not always appropriate. Environmental norms have gained a high level in China; though, unfortunately, not always applied seriously. The State Environmental Protection Agency (SEPA) is not very powerful, compared to the Ministry of Construction, which is responsible for the construction of water and sanitation facilities. Recently, the SEPA obtained the status of a Ministry, which will make it easier to deal with the environmental issues, in different Chinese provinces.

The goals to be achieved, in the water sector according to China's 11th five-year plan are ambitious. The planners want to reduce, for example, water consumption per industrial unit by 30 per cent and to increase the coverage for water and sanitation facilities in line with the Millennium Development Goals (MDGs). The governance structure to achieve this is relatively simple (centralized through the role of the Ministry of Construction and the corresponding line offices at the city and district level), but also excludes broader participation of all stakeholders. Water and sanitation facilities are, for example, not owned and managed by local authorities, which makes ownership vague and hinders innovative local solutions, innovative ways of financing (there are some Build, Operate and Transfer [BOT] projects in this sector) and means acheiving very little cost recovery. This makes it possible to recover the cost for water treatment through the drinking water bill, however. The current price per m^3 is only 3.5 Yuan, of which 0.5 Yuan is for wastewater treatment, which is much too low.[5] Unfortunately, in the case of ecological initiatives taken at the neighbourhood level to recuperate grey (lightly polluted) water, the treatment charge will not be repaid to the inhabitants, while they do pay the 0.5 yuan for large scale treatment.

WATER STATUS OF CHINESE CITIES

Beijing is the capital of the People's Republic of China, lies in the northern part of the country and is geographically on the edge of a desert. Because of its geography, Beijing has low average rainfall. Beijing's average precipitation is 640 mm per year, 80 per cent of which is concentrated during the period of June to September. The population of Beijing is 15.38 million, of which 3.2 million people reside in the periurban districts and counties of the metropolitan area. Because of the dramatic economic development during the last 20 years, Beijing has been urbanizing rapidly, with an average annual official population increase figure of 2.48 per cent. Ground water is the primary source of water for agriculture and industry and, recently, has

shown a gradual decrease. Water scarcity, depletion of underground water stocks and environmental degradation are the main problems faced by Beijing. Given the negative effects on the environment, Beijing has decided to direct businesses, which utilize large amounts of water, out of the city (*China Daily* 10 April 2004).

Wuhan is also one of the largest cities in China, with total area of 8494 km^2 and a population of 8.3 million. Unlike Beijing, Wuhan has much richer water resources, ranking first among the largest Chinese cities. Called *water city* in China, Wuhan is located about halfway along the several thousand kilometre reach of the Yangtze River and has nearly 200 lakes of various sizes. The water area makes up 25.8 per cent of Wuhan's entire territory. Although Wuhan has abundant water resources, the Yangtze River and many lakes suffer from serious pollution. In 2000, Wuhan's wastewater discharge totalled about 2 million cubic metres per day of domestic sewage and about 25 per cent of that was industrial wastewater. Water quality in Wuhan has significantly decreased over the last 15 years, making the concern for sustainable urban water management in these cities greater than in other cities.

In 2003, an environmental study of Tai Lake near Shanghai carried out by a Dutch consulting firm together with UNESCO-IHE showed the seriousness of pollution on the water resources and the need to introduce wastewater treatment plants. What has been done so far and to what extent the risk of pollution of the water resources have been limited by treating used water properly is not clear. It is our experience that the Chinese started building water treatment plants before the feasibility study was finished. Now they are not always working at full capacity nor turning out the expected quality of water. Recently another effort to clean Tai Lake was announced. Ten billion euros will go into cleaning it (*De Pers* 29 October 2007). According to these plans, it would take five years to clean the lake while the problem will be gone in eight to ten years.

In the example of Tianjin in the north, where the river became polluted, because of an upstream industrial accident, there was no riverbank infiltration system to mitigate the negative effects of the pollution. In addition constructed wetlands, which help to clean the water, were not used as this approach required too much land use. Riverbank infiltration projects may be an alternative for constructed wetlands, which require much space, while riverbanks are available for this purpose. Moreover, the model of Singapore closing the urban water cycle completely may also be an appropriate option.

Thus Chinese cities are facing the pressure of a water crisis. More than 400 cities are lacking enough water resources and more than half the rivers are polluted. In 2004, 5.548×10^{12} m^3 water was used for agriculture,

industry and domestic activities. Meanwhile 6930×10^8 m^3 wastewater was discharged from Chinese cities, but no more than half the amount of wastewater is subject to secondary treatment (China Bulletin of Water Resources 2004).

INITIATIVES AT DIFFERENT GEOGRAPHICAL LEVELS

First, many initiatives are taken at the level of the city. In China, the real promotion of ecological neighbourhoods comes from the national level through subsidies, like 30 per cent of the construction cost in the case of Wuhan. Rotterdam is also an example of a city trying to become more ecological. It took part in the Clinton initiative and is currently considering storing CO_2 in its port area (van Dijk 2007a).

Even provinces want to get the label ecoprovince and take initiatives to achieve this. In China, this usually means competition and a prize given to the most ecologically friendly province or city.

Finally, individual initiatives can be noted, spontaneously or triggered by incentive of price increases. Environmental awareness may not yet be very developed in China and more time and policies that raise the consciousness of the people may be needed to achieve more activities at this level. People may save energy and tend to use less water than in developed countries, but this is partly due to the level of development, availability and price. Individual households usually install water heaters on the roofs of houses. In certain cities this is becoming a trend; the question is whether the systems are efficient enough to convert large numbers of people.

THREE APPROACHES TO URBAN WATER MANAGEMENT IN ROTTERDAM, THE NETHERLANDS

A city needs enough water for its population and industries, so it needs water resources. However, a city also needs institutions that secure good use of the water. The current setup in The Netherlands is complicated and the fragmentation of institutions makes integrated water management at the city level difficult. Given the need for a city like Rotterdam to deal with the risks involved in urban water management, we will now suggest three alternative approaches.

The first option is an integrated approach to water management, combining drinking water and surface water, management perspectives, which

are currently separated, institutionally in The Netherlands. However, for such an approach, the current institutional context is too complicated and not appropriate for the problems Rotterdam is facing. Integrating the production of drinking water with surface water management was the option chosen by the city of Amsterdam. The authorities announced a merger between the water board and the municipal water company, which would lead to water chain management, where the customer would eventually pay only one bill for all water related services.

The second alternative is closing the water cycle to deal with water in a more efficient way. Closing the water cycle means not losing any of the scarce resource and controlling the quantity and quality constantly. Such an approach would favour integrating the management of the whole water cycle. Singapore has managed, for example, to close the water cycle and in principle, no water gets lost between resource and users. All of it is cleaned and made available for reuse. In the Dutch context, it would mean a closer cooperation between the water utilities and the water boards. It would also imply a different role for the municipalities. However, this may be easier than continuing to clean dirty water from the rivers to discharge it again after treatment to the North Sea.

The third option is to strive for a more ecological city, where integrated water management would be part of a broader approach to the urban environment. The term ecological city could be used for an approach to urban management that combines water with environmental management and focuses on long term urban sustainability (van Dijk 2006). The perspective is broader than just water related environmental issues. Examples in the European context are Hanover and Hamburg, which invite debate on the ecological city of the future.

Considering these options, a more effective management of the water system and making it more sustainable is needed. Water management can be undertaken by central government or by communities. In Europe, typically, the task is allocated to the city level, which makes it interesting for Rotterdam as they develop plans to deal with water in a different way (van Dijk 2007a).

CHINESE ECOCITY INITIATIVES

There are a number of Chinese ecocity initiatives. There are a large number of similar initiatives, ranging from simple water and sanitation technologies for the western part of the country (through a project financed by The Netherlands) to sophisticated ecological projects in the framework of the 2008 Olympic Games in Beijing. The Chinese authorities exhibit a

preference for large modern high tech solutions; even if they know they cannot always manage the technology properly. They are less willing to pay for management support, training or software; while given the high energy use per unit of Gross Domestic Product (GDP) and the huge water consumption in per capita terms, there is scope for improvement on the efficiency of the system through better management.

Shanghai plans to build on an island at the mouth of the Yangtze River the city of the future (*Economist* 23 September 2006; *Trouw* 9 November 2007; *Financial Times* 15 September 2006). The idea is that the city will be self sufficient in energy and water and will generate almost no carbon emissions. Petrol and diesel vehicles will be banned in favour of solar powered boats and fuel-cell-driven buses, according to the *Economist*. The city should number around 500 000 inhabitants in 2040 and will house an agro park of 27 km^2 to grow food in a sustainable way (*Trouw* 9 November 2007). Finally, the *Financial Times* describes energy conservation at the level of the house and shows the use of water conservation (rain water harvesting). The houses will use only one-third of the energy consumed by a normal house, while the energy will be renewable, for example, through windmills. The project received attention and press coverage, but the question is what happens to diminish pollution in neighbouring Shanghai city, with 20 million inhabitants and many polluting industries.

THE CASE STUDY IN WUHAN: AN ECOLOGICAL NEIGHBOURHOOD

The case study in Wuhan concerned a project of about ten buildings with seven or eight floors per building. The project would receive a 30 per cent subsidy for using energy saving techniques, but one of the conditions was that the project would also recycle their grey water.[6] Energy savings were based on double-glazing and the use of ground source heat pumps. The geothermal heat pump uses a system of pipes absorbing latent heat from the ground and transferring it to the home's heating and hot water systems.

The Taiyue-Jinhe (Tai) project is about establishing an ecological residential area with low energy consumption and a water recycling system. It is located in Jinyin Hu district, which is a suburban area of Wuhan city. Because there are two big lakes: Jin Lake and Yin Lake, the district is called Jinyin Hu (lake). Jinyin Hu district was an agricultural production field 20 years ago, mainly for rice production. Presently Jinyin Hu district is under development as a residential space and ecological park.

Table 13.1 Space distribution in the considered housing project

Land use	Area amount (m2)	Percentage
Residential buildings	51400	49
Green area	23800	23
Paths	8800	8
Artificial lakes and rivers (include wetland)	12100	11.6
Total	104500	100

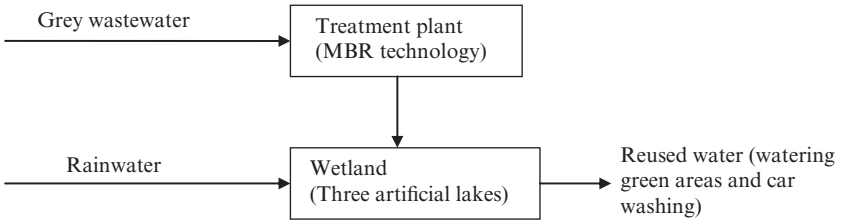
Source: Tai project introductory document.

The Tai project began in 2006 and the residential building was completed and sold in 2007. The water recycling system was due to be completed in 2008. The Tai project is involved in a national level energy saving programme (initiated by the Ministry of Construction) on the condition that energy saving and water recycling systems are included. This programme was organized by the Chinese Ministry of Construction, which also issues permits to build water recycling systems. Moreover, the Tai project could get a subsidy from the Ministry of Construction. At present there is no policy on water reuse system construction in Wuhan.

In all there are 6970 m^2 areas with 1162 households (around 3253 residents) in the Tai project, and all buildings are equipped with energy saving facilities. The space distribution of the project is shown in Table 13.1, which reveals that half of the area is for residential buildings and the green and lake areas account for 35 per cent. Due to financing issues, only ten buildings are involved in the water recycling system. They are the No. 5 building to the No. 14 building, including 228 households with approximately 1140 people.

There are two main parts to water recycling: water reuse and rainwater harvest. The water reclamation technology used by the Tai project is Membrane Bio-Reactor (MBR) with wetlands. Two pipes are constructed in the residential buildings to collect wastewater: one for grey water and another for black water. Only grey water is recycled, the black water goes directly to the municipal sewage system. The MBR method is the first step and wetlands is the second step for wastewater cleaning. Rainwater is collected through drainage pipes in the buildings and beside the paths. After the rainwater is collected, it moves directly into the wetlands. Finally, the reused water is pumped from the wetlands and used to water the green areas and wash cars.

Figure 13.2 depicts the water recycling system for the Tai project. The



Source: Interview with the manager of the Tai project.

Figure 13.2 Water recycling in the Taiyue-Jinhe project

Table 13.2 Information on the wastewater treatment plant

Capacity	10 m^3/hour
Occupied area	80 m^2

Source: Interview with the Tai project manager.

information on the wastewater treatment plant is represented in Table 13.2, which shows that the capacity of the wastewater treatment plant is 10 m^3 every hour. If the plant works 14 hours continuously every day, the amount of reclaimed water produced could be 140 m^3 each day. As mentioned above the Ministry of Construction will subsidize 30 per cent of total investment in the water recycling system (wetland excluded).

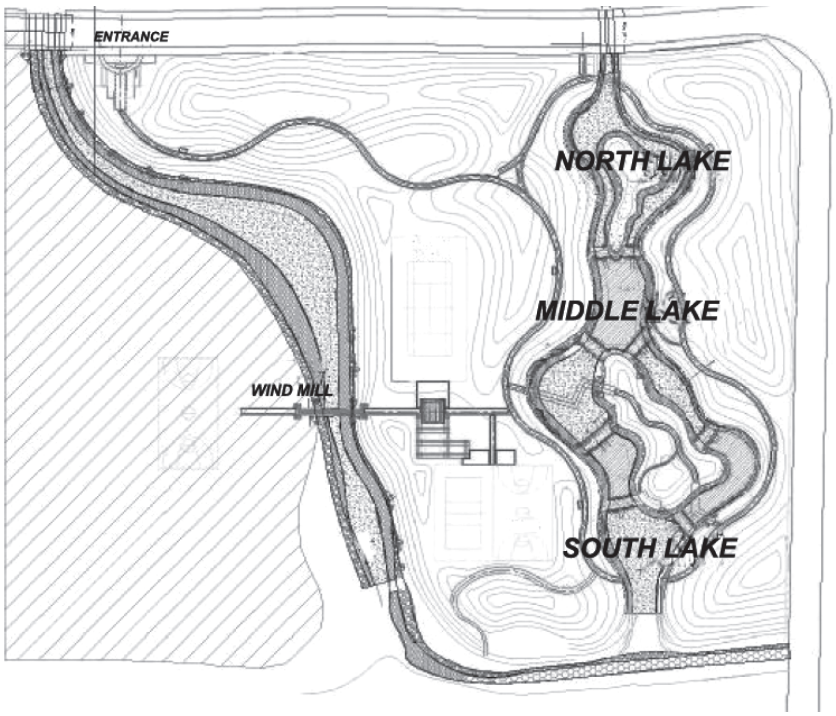
Table 13.2 illustrates the investment funding distribution. The initial investment amount for the wastewater recycling system covers the design fee, equipment installation, plant construction and pipe construction costs.

The wetlands consist of three lakes: North Lake, Middle Lake and South Lake, which is shown in Figure 13.3. The water moves from the south to the north due to water level differences. In the middle, is a windmill, which transfers the water from outside the lake into the wetland in order to keep enough water in the wetland. There are several pumps in the northern lake to transfer reused water. Unfortunately, we found, during our fieldwork in October 2007, that the houses were almost finished (to be occupied in December 2007), but the grey water treatment facility was not yet built. The question is whether this will still happen, since the project developer considered thermal isolation more important and expected to get the subsidy anyway. When we checked in the summer of 2008, it had still not been finished. For the apartment buyers, thermal isolation is an asset, but they were not very interested in separating grey and black (heavily

Table 13.3 Investment funding distribution (million yuan)

The initial investment on water recycling (excludes land fee)	Real estate company (70%)	Government subsidies (30%)
24	16.8	7.2

Source: Interviews by Xiao Liang with Tai project manager.



Source: Tai project introductory document.

Figure 13.3 The wetland

polluted) water, since this would incur additional cost and they would not get their money back.

The Xiao Liang study aims at completing financial and economic analyses on the alternative decentralized system in urban water management (also Zhang 2006). The expected outcome of the research may contribute to developing and selecting sustainable plans for urban water management, by:

1. Determining costs and benefits for the alternative systems from the point of view of social economics
2. Financially appraising the alternative systems
3. Exploring the sustainable financing plans
4. Comparing the economic competitiveness of the alternative systems with that of the existing centralized system

CONCLUSIONS

There is currently no definition of what an ecological city would really be. We need to agree on what we consider the important criteria for sustainability and we would go for stakeholder planning to assure that all partners will work together for the common future of the city.

Stating that it requires an integrated approach is not enough, because one could integrate the analyses of the issue (look at them in relation to each other), the approach chosen to deal with the issues and finally the activities undertaken to solve the problems.

In Beijing there are about 30 000 ecological initiatives and other Chinese cities are also trying their best. The question is whether this is enough to counter a looming environmental crisis. Praising sustainable development is a beginning, but not enough. Private developers are looking for new ideas, but they are mainly interested in cost savings and attractive alternative options for their projects. Given that a number of the problems relate to water governance, an institutional analysis is required to identify the different bottlenecks.

The urban agriculture projects mentioned have a very specific background and the question is, which elements can be repeated and to what extent. These projects are an example of ecosanitation and elements of an ecological city. The six principles for a more ecological approach mentioned above could also include the promotion of urban agriculture.

Ecological cities are more than ecologically managed closed urban water systems. Sustainable urban water management is just the beginning. Changes in the behaviour of consumers will be required, just like a combination of better water management, collection, treatment of solid waste and striving towards integration (Van Dijk and Oduro-Kwarteng 2007). Water demand management may be a good start at the household level, just like separation at source and composting at home is a good start for ecologically friendly solid waste management.

In China, the initiatives are broken into three distinct levels, but there is no real integrated approach at the provincial[7] or city level.[8] The institutional framework of provinces taking the initiative, provincial

capitals trying to do something and a state level Ministry of Construction to approve projects are in place, while the state level Environmental Protection Agency that does the regulation, does not function properly at the moment.

Consultancy firms claim that sustainable urban development starts with integrated design (DHV 2007). However what's important is convincing people that it is essential to do something to improve one's environment. As the Dutch government claimed in a media campaign: The environment starts at home. More is necessary than consultancy reports. Good research showing what works and why would help to come up with realistic suggestions for ecological cities of the future.

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Financial Times 15 September 2006
NRC 17 June 2004
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2. The Switch project (Sustainable Water Improves Tomorrow's Cities' Health) with support from the EU is seeking a paradigm shift in urban water management. Its purpose is to make water treatment more sustainable and protect the quality of drinking water sources. In addition it wants to reduce risks such as water related diseases, droughts and flooding.
3. Nine cities around the world serve as demonstration cities and a learning alliance framework will be established in each demo city. Through the learning alliance platform, the barriers to information sharing are broken down and the process of technological and institutional innovation is speeded up.
4. The research project WP 6.4 is part of Switch. The emphasis is in particular on the financial and economic analysis of urban water management in demo cities, an important topic that often requires more attention.
5. The current rate is 11 yuan to the euro.
6. Grey water is wastewater generated in households, excluding water containing human excreta or urine, but including water from kitchens, bathrooms and laundry rooms.

7. Fujian province for example wants to develop into an ecological province (*China Daily* 27 August 2002). Wang (2006) describes a case study of Hainan ecoprovince planning. There are also initiatives in Zhejiang and Shandong provinces (China.org.cn, 26 August 2003).
8. Foshan (Guangdong province) is another ecocity.