Chapter 1
Understanding the Origins and Evolution of Eco-city Development: An Introduction

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1.1 Introduction

The world is increasingly urban. Since 2008, more than half of the world's population is living in urban areas. The number of urban residents is expected to continue to grow, especially in developing countries. In Asia, some 1.1 billion are anticipated to move to cities in the next 20 years (Kallidaikurichi and Yuen 2010). This includes 11 megacities, each with a population exceeding 10 million, for example, Beijing, Shanghai, Kolkata (Calcutta), Delhi, Jakarta and Tokyo. With the exception of Tokyo, the rest are in developing countries. The expanding urban population will require a whole range of infrastructure, services, housing and jobs, not to mention land. The urban land expansion could threaten agricultural land supply, cause growth in traffic volumes and increased pressure on the environment, and be massively unsustainable for the country and the rest of the planet. It is vital that sustainable urban development be pursued as cities continue to grow.

Dramatic urban demographic expansion and keen competition with globalization have called for urgent actions in the management of the human–environment interactions especially in the wake of rising consumerism. Consumerism has added to the worsening conditions of environmental degradation in the developed world and is spreading to the developing world, especially the fast growing economies of China and India in recent decades. To make matters worse, the global shift of manufacturing industries from advanced nations (since the oil crisis in the mid-1970s) to developing countries is also transferring sites of industrial and household wastes, and carbon emissions to the developing world (Randolph 2004, Jayne 2006, Roberts et al. 2009, Dicken 2005). For the latter the urge to use domestic consumption as a means to bolster economic growth, their more rapidly rising urban population, relatively low levels of environment-led technologies, management and civic awareness in environmental protection all contribute to the urgency for action.

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Indiscriminate material consumption patterns if unchecked can contribute to large amounts of wastes and unsustainable development of cities (Girardet 1999). Mounds of solid wastes on dump sites of many cities in developing countries visibly illustrate this challenge. Wastes of plastic materials, for instance, are durable and resistant to natural processes of degradation as their total natural decomposition may take hundreds or thousands of years. Furthermore, burning plastics could produce toxic fumes and manufacturing of plastics often creates chemical pollutants. The cycle of modern production, consumption and disposal which motivates urban metabolism must be re-examined from a new perspective.

Ecologists have long argued for equilibrium with basic ecological support systems, and since the 1987 Brundtland Commission, the notion of sustainable development has taken on renewed and urgent currency (Daly 1991, United Nations 1987, Silvers 1976). The notion of sustainable development enjoins current generations to take a systems approach to urban growth, and to manage resources – economic, social and environmental – in a responsible manner for their own and future generation's enjoyment in line with the Earth's carrying capacity. Over the years, various writers from a range of disciplines have expounded the concept, and suggested ways to measure, monitor and implement sustainability (see, for example, Aguirre 2002, Kates et al. 2005, Hasna 2007, Boulanger 2008). In the main, the objectives have been to direct urban development towards minimizing the use of land, energy and materials, and impairment of the natural environment while maximizing human well being and quality of life. The implication is that settlement patterns need to be liveable, attractive while sustainable, and this can be achieved through ecological planning.

Urban land use planning can no longer afford to be merely anthropogenic (human-centred). Instead, it has to also consider environmental issues including the interdependency of human and non-human species and the "rights" and "intrinsic values" of non-human species in our pursuit for a sustainable ecosystem. It has to be ecological. Ecological planning involves conceptual thinking in environmental urban sustainability, land use allocations, spatially designed and distribution patterns that contribute and lead to achieving such objectives of ecological balance. Yet, the in-principle outcome should not be detrimental to aggregate economic development without which environmental sustainability efforts might remain a lip-service. In other words, the logic and *modus operandi* of ecological planning should be also contributing to economic progress. How this is effectively done will be a challenging task ahead.

This book explores one of the widely emerging settlement patterns of eco-city. The premise, origin and evolution of the notion of eco-cities are examined in this chapter.

1.2 The Visions of Eco-city

Appealing to live harmoniously with nature is nothing new in human history. Ancient philosophers and thinkers in both Western and Oriental civilizations observed the omnipresent mightiness of natural forces in influencing human

habitation and cultural life. More than 2,500 years ago, Lao Zi had propounded the Taoist concept – Dao (the path), laying the core regulatory rule that stresses the essence of balanced and interdependent developments of Heaven, Earth and humans (Zhan 2003). Taoist thoughts giving due respects to nature are generic, universal, albeit aspatial in implication, and remain influential in modern societies where Taoism are practiced, for example, China and Taiwan.

An eco-city by its very appellation is place-specific, characteristically spatial in significance. It suggests an ecological approach to urban design, management and towards a new way of lifestyle. The advocacy is for the city to function in harmony with the natural environment. This implies that cities should be conceptualized as ecosystems where there is an inherent circularity of physical processes of resources, activities and residuals that must be managed effectively if the city's environmental quality is to be maintained. As Wolman (1965) suggested, there are major physical inflows to the city and outflows from it that should be accounted for, and more importantly, integrated to the rest of the biospheric web. To this recognition, eco-cities are designed with consideration of socio-economic and ecological requirements dedicated to the minimization of inputs of energy, water and food, and waste output of heat, air pollution, etc so as to create an attractive place to live and work.

The term "eco-city" is widely traced to Richard Register's (1987) book, *Ecocity Berkeley: Building cities for a healthy future*. Register's vision of the eco-city is a proposal for building the city like a living system with a land use pattern that supports the healthy anatomy of the whole city, enhances biodiversity, and makes the city's functions resonate with the patterns of evolution and sustainability. Some of the strategies used to manage this balance include building up instead of sprawling out, giving strong incentives not to use a car, using renewable energy and green tools to make the city self-sustaining. Eco-cities would characteristically comprise compact, pedestrian-oriented, mixed-use neighbourhoods that give priority to re-use of land and public transport. Since then, several similar themes such as "eco-neighbourhoods", "urban eco-village" and "eco-communities" have emerged, all emphasizing ways of making the city more environment-friendly and sustainable (Roseland 1997, Barton 2000). It should be stated that notions of ecological planning and design are not new in the planning literature.

Tracing the more recent Western civilization following the Industrial Revolution, a review of the work of nineteenth century planning pioneers such as Frederick Law Olmsted, Patrick Geddes and Ebenezer Howard would indicate views of landscape as a living entity and their concern for preservation of nature beauty and ecological function with planning tasks (Hall 1996, Welter and Lawson 2000). Geddes, for example, proposed the idea of a bioregion where he highlighted the importance of a comprehensive consideration of the interrelationship between cities and their surrounding ecosystem. He gave emphasis to survey-analysis-plan, in particular, that a regional scale survey of the ecological environment and the place-work-folk relationships should be conducted before developing any planning concept and development project. Similarly, Howard in his influential garden city concept argued for the importance of bringing nature back to cities, and suggested the need of decentralization and urban containment for managing urban growth.

Into the twentieth century, these early ideas were expanded on by Lewis Mumford and Clarence Stein, leading to the development of several greenbelt towns in USA (Parsons 1990, Luccarelli 1995). Mumford (1961, 2004) identified the unsustainability of urban development trends in the twentieth century, arguing for "the development of a more organic world picture, which shall do justice to all the dimensions of living organisms and human personalities" (p. 567). In his work published in 1938 "The Culture of Cities", Mumford (1997) associated cities as "a product of Earth [and as] a fact of nature". For him, urban culture was faced with crises, harmful to the local community culture. Urban sprawl accompanying massive suburbanization was particularly seen as having created a series of new social problems.

Moving on, others such as Ian McHarg (1969) have developed the concept of ecological planning, proposing the theory and methodology of ecological land use planning that explicitly connected ecology theory to planning and design practice and laid a new integration of human and natural environments. Urban ecological concerns of McHarg's *Design with Nature* published in 1969 spread fast in practical terms to continental Europe, especially the Netherlands. In Utrecht and Delft wetland layout, nature-imitating features (logs, stones, wild rose) were landscaped around office and housing blocks. Some old buildings in The Hague were dismantled and replaced with cuddle garden for children (Nicholson-Lord 1987: 110–111). Quite uniquely, the Dutch experience reflected a social-cum-human driven response with an artificial but natural setting to fit harmoniously into their habitat of dyke, polder and reclaimed land on which concrete structures have been introduced! It also had strong influence in North America on *New Urbanism*.

Several other planners and designers have also worked on applying the theory of landscape ecology to land use planning (see, for example, Dramstad et al. 1996), and developed new urban design theories related to *New Urbanism* (see, for example, Calthorpe 1993) in which they try to integrate an array of related concepts including ecology, community design and planning for a liveable and walkable environment. *New Urbanism* emerged in the 1980s as a strategy with new typologies in land use to deal with the ecological weakness arising from the massive scale of post-war sprawling suburbanization, which has led to a landscape of low-density, single family dwellings, almost totally automobile dependent lifestyle. With no intention to replace the low-density suburbia prevalent in the United States, a group of young American architects initiated building designs that capitalized on natural resources in constructing environmentally sustainable buildings.

A key development strategy is to promote sensitive urban development that preserves open space and ecological integrity of land and water, that is, a balance of city and country. These qualities may be achieved through a wide variety of means including urban consolidation, various methods to reduce traffic and urban heat island effect, encourage greater use of renewable energy, green roofs and public transport, a holistic approach to nature, history, heritage, health and safety, and a life cycle approach to energy, resources and waste. Much of the elements highlighted in *New Urbanism* such as transit, walkability, environmental sustainability and social integration came close to the present-day eco-city notions. Led by pioneers, Andres

Duany and Elizabeth Plater-Zyberk, this *New Urbanism* model which combined the "green design" ethic and individualistic home ownership "doctrine" of the American dream tradition gained acceptance in Kentlands, Maryland and Windsor in Florida, United States (see Kelbaugh 2002).

Another important source of thinking that has contributed to the conceptualization of eco-cities is indisputably the environmental ethics.

1.2.1 Environmental Ethics

History of environmental ethics could be traced to 1962 when Rachel Carson (1962) published her book *Silent Spring* that revealed the harmful effects of pesticides to humans and other creatures. With an initial concern over the death of birds, she showed how farming practices using DDT as a pesticide could affect the food web, and hence the living and public health. Despite being attacked for exaggerating the impact, her thinking and ideas were seen to have set the cornerstone of modern environmentalism. Her love of nature, especially birds and natural plants challenged the anthropocentric development practices that put humans as the central figure that count on Earth. Richard Routley (1973) followed suit by addressing the issue of human chauvinism in which humans were treated as a privileged class; all other species had been discriminated against. Again, this would not be helpful to ecological balance. During the 1970s, there were ethical, political and legal debates to support animal rights in the ethical thinking. The rise of "Green Parties" in Europe in the 1980s further condemned the anthropogenic approach that had contributed substantially to environmental devastation, and rising levels of pollution.

The key interpretation of the anthropogenic approach is that it serves human-centred instrumental values of identified ends but neglects the intrinsic values of all living things in existence that forms the basis of interdependent ecosystems. For example, trees with little or no commercial value are not looked upon as useful and therefore should be disposed of though their contribution to the ecological balance is considerable. Arguably, as humans have no ecological superiority compared to other non-human species on Earth and since the latter's extinction can affect human species' own existence, an anthropogenic approach is self-destructive.

Quite along the same line, the works of Naess (1973, 1989) in the 1970s and late 1980s exposed the aims of the deep ecology movement that supports the "biospheric egalitarianism". This egalitarianism stipulates principles that all living things are alike in having value in their own right, independent of their usefulness to others. Naess' idea has been interpreted as "an extended social-democratic version of utilitarianism", which counts human interests in the same calculation alongside the interests of all natural things in the natural environment. Nevertheless, the deep ecology theory was criticized as being inadequate, acting as "a disguised form of human colonialism", unable to give nature its due status, and being elitist serving "a small selected well-off group" (see Stanford Encyclopedia of Philosophy 2008).

Taken as a whole, activists promoting ethical environmentalism have acted as a counter force against the Western traditional ethical theories such as utilitarianism which are associated with the values (pleasure) and disvalue (pain) (ibid, Nash 1989). Whilst utilitarian followers are more inclined to support anthropogenic sources of pleasure and have little concern to non-sentient beings (for example, plants, mountains, rivers), ethical environmentalists attribute more intrinsic values to the natural environment and its inhabitants. The latter's environmental ethics correspond with the objective of eco-city promoters, and they share in many aspects the urgent need to manage production and consumption in a sustainable way.

1.3 Towards Sustainable Production and Consumption

Modern urban-industrial consumption patterns and habits differ in essence from those of the pre-industrial and feudal times characterized by low-productivity and consumption levels meeting largely basic needs. Not only is the modern industrial age much more productive in producing daily needs, but the consumer goods designated for the market place involve use of unnatural sources often harmful to the ecological system. More significantly, the prevailing market economy relies on large scales of consumption to justify its profitability and corporate survival or expansion.

Consumption cultures based on material possessions have increasingly been related to fashionability rather than durability. Consumerism and consumer ethic, according to Corrigan (1997, cited in Jayne 2006: 27), first developed among the aristocrats during the sixteenth century Elizabethan period but only blossomed after the Industrial Revolution in late eighteenth century with the advancement in industrial capitalism and its production technologies, that enabled consumption of rare consumer goods to reach a much larger cohort of consumers and could render them to show social prestige and status. A sharp turn took place in the post-World War II period. With further technological progress, aided by the Fordist mode of production and world-scale marketing strategies, consumer goods became highly accessible in developed countries, especially private automobiles. Today, in the midst of environmental preservation, consumerism has become a collective consumption lifestyle in the developed world and has also spread to the more affluent social groups in the developing world. In the face of increasing environmental degradation, unsustainable consumerism is being questioned and sustainable consumption is being elevated to the international forum as a balancing force.

Unsustainable consumerism in daily practice is inherently distinct from environmental ethic in theory discussed earlier. However, individuals with an environmental ethic and awareness could be contradictory in actions if consumption is seen as an individual's lawful right and he/she is not prepared to give up his/her preferences. Environmental ethical consciousness or citizen preferences, as Sagoff (1988) suggested, are judgments about what one should do whereas consumer preferences mean to do what one desires to possess or consume. Satisfying individuals'

massive scales of desires could be ecologically disastrous in some cases. But if enormous economic sacrifice is needed to achieve insignificant pollution or contamination control, the role of sustainable production and consumption acting as a compromising agent is very useful.

What is sustainable production and consumption? Sustainable consumption must be matched by sustainable production regulated by demand management which does reliable valuations of natural resources and arouses public awareness in recycling, reduction and reuse of materials. Technologies employed in the sustainable production processes are those that protect the environment, are less polluting and handle all residue wastes in environment-friendly ways. The methods of production would use much fewer resources and generate close to zero waste (Newman and Jennings 2008: 188–189, White 2002). In light of the large gaps between affluent nations and poor countries, meeting the basic needs of the latter is crucial to ensure environmental, economic and social sustainability which are interdependent and mutually reinforcing. For the urban poor in many African and Asian countries, for instance, sustainable consumption implies not so much material consumption of consumer goods but more the safeguarding of their living environment often built precariously on poorly serviced quarters of the cities.

The future direction of sustainable consumption would need to promote conserver lifestyle yet maintaining a high quality of life. Looking from the perspective of more developed societies, Newman and Jennings (2008: 191–198) have conceived a series of sustainable consumption strategies, as listed below:

(1) Voluntary simplicity strategy
Disapproving consumerism and viewing overconsumption as an illness in society, this strategy aims to assist people to find alternative ways to satisfy their needs and promote simple ways of living;
(2) Demand management strategy
Education is sought to educate consumers the ways in which to meet one's needs without consuming much non-renewable resources. The premise is however that reducing resource use should not mean lowering quality of life. Application of this strategy needs to be adopted at both household and corporate levels, in order to achieve a meaningful reduction as a consequence.
(3) Sustainable procurement strategy
Government and institutions, together with households should adopt purchasing programmes using the notion of sustainability. This sustainable shopping behaviour should build up more sustainable markets by consuming less. More attention should be directed towards more environmentally sound products.
(4) "Slow movement" strategy
"Slow food", "slow cities" and "slow traffic" are three elements of the "slow movement" strategy that are anticipated to help cut down consumption. "Slow food" is to counteract fast food and fast life in an attempt to rediscover the real taste of authentic and local/regional food sources and quality pace of life. "Slow cities" place emphasis on small towns and cities, with preference modelled after

the European late medieval and renaissance era. "Slow traffic" calls for traffic calming in favour of small road capacity emphasizing walking, cycling and transit.

The above strategies are apparently more relevant to more developed societies. Most of these societies are in post-industrial stage of development where material shortage is not a major issue. The notion of "small cities" appears idealistic and nostalgic in sharp contrast to the current global trend of mega-urbanization, taking place at grandiose scale globally. Given the diverse socio-economic backgrounds between the developed and developing worlds, it is understandable and logical that the strategies of sustainable eco-city development must follow the specificities and circumstances of the adopting countries.

1.4 Emerging Trends: Building One's Own Tailored-Made Eco-towns or Cities

Cities are different. Serving the identical purpose of environmental sustainable development, different countries have adopted different approaches in implementing their own eco-city development programmes or schemes. Criteria used and standards set would be localized in accordance with financial and technological capabilities that one could afford. The eco-city index system worked out recently by a group of Chinese researchers, for instance, has taken into consideration the local urban physical features as a basis of implementation reference (see Li et al. 2010). In approach, the "one size fits all" equation must be ruled out when dealing with environmental sustainable issues.

Eco-cities are on the rise in different parts of the world. In the Middle East, Abu Dhabi in 2006 has initiated a US$22 billion project to build the world's first carbon neutral city, Masdar. The city is planned on a land area of 6 km^2 for a population of 45,000–50,000, setting new standards in green living including clean power, desalinization plant run on solar power, magnetic trains for transportation (cars are not welcome), and 100% waste recycling. In the United Kingdom, the Prime Minister, Gordon Brown, announced in 2007 the building of 10 eco-towns across the country (BBC News 24 Sep 2007). A new planning policy statement was published on 16 July 2009 setting out the standards that eco-towns will have to meet.[1] The intention is to offer an opportunity to promote sustainable living and zero carbon development while also maximising the provision of green space and potential for affordable housing.

In China, eco-city building is proposed for not just the big cities like Beijing, Shanghai and Tianjin but also the small- and medium-sized cities of Yuxi, Wehai, Rizhao and Changshu, among others. Under the State Environmental Planning Agency *Guidelines for the Building of Eco-communities* (1996–2050), the intention is to promote the planning and construction of eco-communities across China. The objective is to apply sustainable planning and design principles in the building

of new communities. Since then, many countries have offered to help China develop eco-cities. The most advanced of these developments is the Tianjin eco-city developed by the governments of China and Singapore.

In 2007, the Chinese and Singapore governments announced the signing of a collaborative framework to plan and develop a 30 km^2 eco-city at Tianjin. By 2010, the basic infrastructure for the start-up area (4 km^2) has been completed. Development projects with a total gross floor area of more than 800,000 m^2 are under construction. Key performance indicators comprising both short-term and long-term targets for key aspects of the eco-city development such as water and waste management, air and water quality, green buildings and transportation, resource usage and conservation, public housing have been established. The aim is to achieve harmonious living with man, economy and environment. The Sino-Singapore Tianjin eco-city is planned with several distinguishing features including the use of clean, renewable energy; 100% green buildings, an efficient and easily accessible public transport system, extensive greenery, heritage conservation, water recycling and more efficient use of water resources, integrated waste management, development and strengthening of social harmony among residents and specialization in service industries.

Other Chinese cities have followed suit. In January 2010, Kunming (China) was honoured by the United Nations to be the "most leisure and liable green eco-city in China and United Nations liveable eco-city". Endowed with pleasant climate all year round and locational advantage, Kunming has become known as the Chinese brand of model eco-cities (ECN News 2010).

Recently, in 2009, the World Bank has launched the Eco2Cities program, containing many of the world's best practices as well as a comprehensive financial support, analytical and operational framework to help cities adopt the ecological approach as part of their city planning (Suzuki et al. 2009). Some of these best practices include Stockholm – how integrated and collaborative planning and management on the principle of a cyclical urban metabolism can transform an old inner city industrial area (Hammerby Sjostad) into an attractive and ecologically sustainable neighbourhood; Curitiba – how innovative approaches in urban planning, city management and transport planning (such as Bus Rapid Transit) are an investment in the city's economy and welfare; Yokohama – how an integrated approach in waste management combined with stakeholder engagement could significantly reduce solid waste; Vancouver – how a set of basic land use planning principles and inclusive planning can help to create a highly liveable city and region.

Environmentally, eco-city development is used as a new environmental paradigm to counter global warming, ecological degradation and unsustainable resource exploitation. Within this paradigm, ideas of green urbanism, sustainable building design or architecture, promoting more compact cities to fight sprawling are subsumed. Economically, building eco-cities as a green infrastructure has inevitably to be used as a form of new business opportunity serving the objectives of economic sustainability. In the eyes of Richard Register (2006: 214), developing green technologies and turning them to serve a vital economy would help us win a tough and expensive ecological war. Socially, eco-cities have to be made implementable and

applicable globally to be effective in countering environmental degradation, even in varied forms and standards. Implementing countries have to consider implementing it against their own budget constraints, key social concerns and development priorities.

1.5 Organization of the Book: The Chapters

The rest of this book is divided into three parts, covering (a) macro-level policies issues, (b) practice and implementation experiences, and (c) micro-level sustainable design and management measures. The intent is to provide both big picture as well as issue-specific discussion on eco-city planning, development and management. Each chapter is written by specialist authors.

"Part I: Macro Strategic Planning: Policies and Principles" comprises four chapters that primarily address some of the key policies and principles relating to eco-city planning and development, illustrated with case examples. Beginning the discussion is Peter Head and Debra Lam who in Chapter 2 have used a generic, strategic and policy-driven approach to examine "How Cities Can Enter the Ecological Age". In particular, they examine the ways in which eco-cities would continue to serve urban residents with clean and healthy necessities such as water and air. They believe feasible policy measures could be put in place through international and cross-border co-operations in low, middle, and high income countries. Eco-friendly-oriented business models will have potential to restrict ecological footprint and take humanity into the future.

Meine Pieter van Dijk's Chapter 3 "Three Ecological Cities, Examples of Different Approaches in Asia and Europe" explicates the interest of developing and developed economies in building eco-cities. Since the 1990s, different urban planning approaches have been used to create eco-friendly neighbourhoods within cities. Three cities are examined in this chapter – Shanghai's Dongtan, Singapore and Rotterdam. These cities offer examples of promising eco-city practices that address the negative effects caused by widespread pollution and mounting waste problems.

In Chapter 4, Carlos Betancourth in his "Eco-infrastructures, Feedback Loop Urbanisms, and Networks of Energy Independent Zero Carbon Settlements", using the context of Latin American cities posits a different urban growth approach based on eco-infrastructures. He argues that urbanization can be a sustainable process through an eco-infrastructure approach that seeks to reduce urban vulnerabilities and apply a series of strategic responses including feedback-loop urbanisms and networks of zero carbon settlements powered by renewable energies.

Scott Dunn and Walter Jamieson in Chapter 5 look at "The Relationship of Tourism and the Eco-cities Concept". Arguably, with rising numbers of cities over one million and tourists, urban tourism will not only imprint a deeper ecological footprint in high density urban agglomerations, but also will be a dynamic sector of

hospitality activities. In Asia and elsewhere, eco-tourism has been developed to meet the needs of local residents and tourists, and to protect heritage and environmental values. The planning and development process involves therefore policy measures that develop innovative sustainable tourism in line with the fundamental concepts of eco-cities.

"Part II: Implementation and Practice" contains five chapters. Its thematic focus is on the implementation process and practice of eco-city development from around the world – United Kingdom, China, Singapore, Malaysia, Kenya. Eleanor Smith Morris begins with the complex implementation process of the politically sensitive British eco-towns (Chapter 6). She reviews the ups and downs of eco-town proposals during 2009–2010. Having a rich tradition of new town development in the immediate post-war era, British new towns had brought little success in creating local employment that made public authorities suspicious of the prospects of the proposed eco-towns. Debates on the pros and cons of the proposals were on the agenda of both the Conservative and Labour Parties. The new Coalition Government of Conservatives and Liberal Democrats decided to keep four of the proposed eco-towns, and the general consensus is that eco-towns should be situated adjacent to existing centres of population, transport, infrastructure and employment. In terms of sustainability, the proposed British eco-towns are being tested if they could achieve zero carbon building development, as a source of housing supplier in offering affordable housing, and as a green infrastructure capable of managing waste effectively.

Tai-Chee Wong, in Chapter 7, focuses on the implementation of "Eco-cities in China" whilst he inquires whether eco-cities are merely "Pearls in the Sea of Degrading Urban Environments". Over the last 30 years, economic reforms have created tremendous amounts of material wealth accompanied by unprecedented level of consumption, particularly in the cities. Pollution hazards are so serious that China has now become the largest carbon emitter in the world. This chapter investigates the difficulties in developing an environmentally sustainable urban system via eco-city development while seeing its great potential as an instrument to improve the environment. Eco-city norms and standards such as energy saving, use of renewable energy, public transport, reforestation, recycling of water and other materials are expected to lead a new development path towards a more sustainable urban future in China.

Moving on to Chapter 8, Steffen Lehmann explores the ways in which greenery and green urbanism is being incorporated in city development. In his "Green Urbanism: Holistic Pathways to the Rejuvenation of Mature Housing Estates in Singapore", he argues for more compact, polycentric mixed-use urban clusters, supported by a well integrated public transport network. In mature and aged housing estates, however, rejuvenation and retrofitting by breathing in new air of sustainability is most appropriate. Management of waste, energy, water, public transport, materials and food supply must be done in an integrated manner by bringing in eco-city planning concepts. Further adaptation is required for cities such as Singapore situated in the humid tropical zone. He concludes that good urban governance and leadership is crucial to the success of eco-city development.

Asfaw Kumssa and Issac Mwangi address the sustainable housing problem in urban Africa, a basic need of eco-city development (see World Bank 2010). In their "Challenges of Sustainable Urban Development: The Case of Umoja 1 Residential Community in Nairobi City, Kenya (Chapter 9), they draw on rich local lessons to identify the causes of ineffective planning and implementation. Problems specific to the Umoja 1 Residential Plan include too low capacity of infrastructure provided to meet the residents" demand, poor standards of maintenance, and unreliable supply of clean water supply. Moreover, local interest groups have not actively participated in the communal affairs. Substantial improvement is thus needed.

Chapter 10 prepared by Chin-Siong Ho and Wee-Kean Fong investigates the potential of achieving environmental sustainability in a new growth area in Malaysia. In their "Towards a Sustainable Regional Development in Malaysia – The Case of Iskandar Malaysia", they explore if this economic-driven region in the southern tip of West Malaysia could combine the objective of economic sustainable development with that of environmental sustainable development. This chapter also refers to the success cases of low carbon cities elsewhere and examines the scenarios of transforming the Iskandar economic region into an environmentally sustainable urban region.

"Part III: Design and Micro Local Planning" consists of studies relating to ecological footprint, indoor air quality management and building design approach prepared in three respective chapters. Hoon-Chor Chin and Mingguang Li examine in Chapter 11 the methods of presenting ecological footprint information, a key source of measuring the carbon impact on the environment. Lately, the ecological footprint concept has been a useful tool to measure environmental impact and assess sustainability levels. The authors re-examine the notion of ecological footprint, arguing for a different approach to ecological footprint analysis, with results that help to identify several shortcomings, upon which site improvements could be made.

In Chapter 12, Selin Mutdogan and Tai-Chee Wong examine the efforts made by the Istanbul municipal government to construct a green building environment. In "Towards Sustainable Architecture: The Transformation of the Built Environment in Istanbul, Turkey", they first review international efforts, supported by technological innovations and rising environmental consciousness that had made contribution to building designs. By referring to sustainable architecture and green design in Istanbul, the study uses a chosen set of evaluation criteria to assess the green building standards that the central city buildings along Büyükdere Avenue might have achieved. Results revealed that though standards achieved were low, they reflected a progressive initiative to move towards a high level of urban ecological protection.

The final chapter (Chapter 13) is by Tan and G. B. Lebron who look at indoor air quality control of city buildings acting as shared public spaces in their joint research "Urban Air Quality Management: Detecting and Improving Indoor Ambient Air Quality". As a source of public health hazards, the "sick building syndrome" captures increasing public concern. For example, carbon monoxide is emitted at high concentration levels in buildings through burning of tobacco and incense, and its decay rates in air can be measured using the Fourier transform

infrared spectroscopy. The research uses many air-conditioned buildings in Singapore as test samples and basis of analysis.

The collection of papers in this volume provides but a glimpse of the many complex, sometimes inter-related issues of planning and implementing eco-city, a settlement type that is rapidly being created in both developed and developing countries. There is no singular recipe but a range of strategic responses and tools that cities and planners will need to examine and adapt to their own local circumstances in dealing with unsustainable consumption and growth. Eco-city development is not a fad. It is our future.

Note

1. Because of the protests from environmental groups and local residents who questioned the impact of eco-towns on the planning system, transport links, jobs opportunities and the environment, the building programme was scaled down and confirmed to four eco-towns in July 2009 (BBC News 16 July 2009).

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