CHAPTER 4

Environmental Planning for Sustainable Development[1]

Tan Yong Soon

A clean and green environment offers a high quality of life for its residents as well as enhances economic growth. Singapore, a tiny island state with very limited land and resources, has been able to achieve a good balance between economic growth and environmental protection. This requires clear visions, long-term environmental planning and effective implementation.

Land Use

Long-term and integrated land-use planning plays a major role in protecting the environment. At the macro level, Singapore's development is guided by the Concept Plan, a strategic, long-term land use plan that maps the land-use vision for Singapore over the next 40 to 50 years, and is reviewed every ten years. This process is spearheaded by the Ministry of National Development and Urban Redevelopment Authority, but is really a collaborative effort involving all relevant agencies, especially environment and economic agencies, working together to ensure that the environment is protected in tandem with development. Consequently, land resources are used optimally so that quality of life improves even as Singapore continues to develop and its population grows. One level down, the Master Plan translates the broad, long-term strategies of the Concept Plan into detailed plans, even to the extent of specifying the permissible land use and density of development for every parcel of land.

Environmental controls are factored into land-use planning to ensure the developments are properly sited. Major land users with potential to cause extensive pollution are grouped together and located as far away as possible from residential areas and town centres. Through the process of developmental control and building plan approval, a developer of a project has to satisfy the planners and environment agencies

[1]An earlier version of this chapter was first published in *50 Years of Environment: Singapore's Journey Towards Environmental Sustainability* (World Scientific Publishing, 2015).

of its environmental pollution controls to limit its impact on the environment and ensure the compatibility with the surrounding land use.

Environmental pollution control requirements have to be incorporated into the design of the development, particularly with regard to environmental health, drainage, sewerage, and pollution control. Industries with the potential to cause extensive pollution and major developments that are likely to have major impacts on the environment are required to carry out pollution control studies covering all possible adverse environmental impacts, as well as the measures recommended to eliminate or mitigate these impacts.

Pollution control for industries goes beyond the planning and development phase. Even after approval is given, pollution levels are closely monitored. Pollution standards are reviewed over time and adjusted with improvements in technology.

As many green spaces as possible are set aside for recreation and the protection of the environment and biodiversity. Some nature areas, designated as national parks or nature reserves, are protected by legislation enacted by the Parliament. These nature areas are limited in land-scarce Singapore. Where areas rich in biodiversity are not protected by legislation, they are kept from development for as long as possible. Chek Jawa, a 100-hectare wetlands with different ecosystems and biodiversity located on the southeastern tip of Pulau Ubin, an island off the northeastern coast of the main island of Singapore is an example. Most land parcels are however open for multiple use. To enhance green areas, where appropriate, the drainage reserves along roads and canals are turned into green corridors and park connectors. The offshore Semakau landfill, Singapore's only remaining landfill, has been designed and operated to conserve the biodiversity of the surrounding areas and protect and preserve the marine ecosystem. It is also an idyllic and scenic attraction, open for activities such as educational tours, guided intertidal walks, bird watching, sport fishing or overnight stargazing. As a result of such careful planning, Singapore's green cover has grown from 35.7% to 46.5% between 1986 and 2007.

Land will always be a scarce and precious resource in Singapore. Going forward, Singapore will have to continue putting in significant effort to explore innovation in land and space optimisation. Aiming to take advantage of R&D to develop groundbreaking and pioneering technological solutions to increase Singapore's land capacity for its long-term development needs and to create alternatives for future generations, the National Research Foundation has allocated S$135 million from 2013 to 2018 for a land and liveability national innovation challenge that would "create new space cost-effectively and optimise the use of space to sustain Singapore's long-term growth and resilience".[2]

[2] National Research Foundation, Singapore (NRF) (2014), National Innovation Challenges. Retrieved 10 January 2015 from http://www.nrf.gov.sg/about-nrf/programmes/national-innovation-challenges?

Critical Environmental Infrastructure

Land also has to be set aside for critical environmental infrastructure such as drainage, sewerage, water supply as well as waste disposal facilities. Projections of future land requirements for such infrastructure are also factored into the Concept Plan so that adequate land is safeguarded for these needs. Selected areas that are ecologically rich will also be safeguarded. Having a good infrastructure in place is important.

Drainage

Singapore is located in the equatorial belt with abundant rainfall. Regular and severe flooding will occur if the storm water drainage infrastructure is not adequate. Managing flooding from heavy monsoon rains is important as floods cause not only great inconvenience and disruption to people's lives but also potentially tremendous damage to properties. In some flood incidents, lives might even be lost. Adequate storm water infrastructure requires setting aside extensive land parcels to build the drainage system. Hence the environment and water agencies, in consultation with URA, HDB, JTC and other development agencies, prepared and put into action a comprehensive Drainage Master Plan, taking into consideration current and future land use as well as intensities of developments. The Drainage Master Plan also sets aside land for widening existing storm water drains and canals as well as for building future drains, canals and detention facilities to minimise future flooding in tandem with developments. New policies are also introduced, such as requiring higher platform levels for developments, and getting new developments to implement on-site detention measures to reduce peak runoff discharged from their sites during intense rainfall. As a result, flood-prone areas have been reduced to 36 hectares at the end of 2013, from about 3,200 hectares in the 1970s.

Sanitation

Sanitation is another critical infrastructure, as otherwise diseases will spread. A Sewerage Master Plan was developed drawing from the apportionment of proposed land uses under the Concept Plan. The Sewerage Master Plan served as a detailed guide for the development of sewerage facilities, specifying corresponding projected sewage flows based on pre-determined zoning, and even micro-level design considerations of sewers and the layout of the sewerage facilities. Under the Sewerage Master Plan, Singapore was divided into a number of sewerage catchment zones, based on the contours of the island. A centralised sewage treatment plant served each zone, where the sewage was treated to international standards before the treated effluent was discharged into the sea. Pumping stations were installed to transfer sewage flows to the plants.

The design of Singapore's sewerage management system requires a clear separation of storm water and sewage streams and systems. Ensuring sewage goes into a central sewerage system and is kept separate from storm water has been critical in keeping waters in and around Singapore clean. This separate sewerage system is a more effective and economical approach in the long run as it ensures that the inland waterways, reservoirs, and the sea surrounding Singapore are not polluted by the discharge of untreated or semi-treated sewage and industrial effluent; and ensure all wastewater is collected for treatment before discharge into the sea or further processing to produce industrial or potable water. The separation of the systems also prevents storm water from entering the sewerage systems and causing overflows during heavy storms, as may happen in the case of combined sewers.

All premises are required to connect to public sewers. Developers of housing and industrial estates have to incorporate a sewer network to collect and convey sewage and industrial wastewater effectively into the public sewerage system. Proposals for development are scrutinised to ensure that they do not encroach on the public sewerage system (i.e. sewers, pumping, mains, etc.). This helps to avert any potential damage to the public sewerage system and, in turn, prevents pollution resulting from overflow or leakage of sewage. In addition, stringent sewer pipe laying and sanitary work requirements are also imposed through legislation.

With the development of NEWater (potable water reclaimed from treated wastewater, but is mostly used by industries as high purity water), sewage and industrial wastewater becomes used water, a resource that can be reclaimed for re-use. A deep tunnel sewerage system was built to consolidate the collection of used water into a central water reclamation plant for treatment and conversion to NEWater, freeing for redevelopment a number of parcels of land previously used for sewage treatment plants and pumping stations.

Water Supply

Achieving water sustainability is a strategic goal. Inland streams were dammed to form reservoirs, which were expanded. Estuarine rivers were also dammed up, the salty water flushed out to create large bodies of freshwater. The water catchment areas had to be protected to ensure storm water collected meets raw potable water quality. Where developments were necessary, such development was limited to residential estates and industries with clean and light uses. In addition to land-use planning, stringent pollution control was also required. Yet land scarcity does not allow us to have all water catchment areas to be protected. In fact, two-thirds of the island's land mass are water catchments areas, most of which are unprotected. Proper sanitation and strict regulation of sewage and industrial wastewater allow development in these unprotected water catchment areas.

NEWater or reclaimed water, the purification of used water to drinking water standards, and desalinated water combined can now meet up to 40 per cent of Singapore's water demand.

Waste Disposal

Land must also be set aside for an effective solid waste management infrastructure to ensure no potential threats to public health. Initially refuse were disposed of at sanitary landfills located on the main island, in areas that were not suitable for development without intensive preparation such as swampy areas, and far away from heavily populated areas. As land became increasingly scarce and with ever increasing solid wastes, Singapore introduced incineration in the late 1970s to reduce the refuse to be dumped into landfills to about 10% of its original volume. The closed landfills could be cleaned up and re-zoned for other uses. Heat from refuse incineration is recovered as electricity. However, land has to be allocated for refuse incineration plants and ash from refuse incineration is still required to be disposed of at a landfill, although the landfill requirement is much reduced. With no more swampy land available on the main island, an offshore landfill at Pulau Semakau was built for disposal of incineration ash and solid wastes that could not be incinerated.

Critical Success Factors: The 4 Ps

While the physical planning aspects—land use planning and critical environment infrastructure—are important, a good environment can only be achieved through the critical success factors of the 4P's—political leadership, public sector efficiency and effectiveness, private sector competitiveness and social responsibility and people participation and ownership.

Political Leadership

Political leadership is key to achieving a good balance between economic growth and environmental sustainability because there must be a clear vision from the very top that a clean and good quality living environment is important; a strong commitment to implement such a vision; and the ability to communicate that vision so that it can be shared and supported by everyone.

In the first 50 years, Singapore has had political leaders who possessed the foresight to see beyond economic development—that preserving the environment and growing the economy are not only not mutually exclusive, but complementary. Our leaders had the resourcefulness and mettle to take the long view and build capabilities, and also the skills to communicate the vision and persuade the people and

businesses to suspend some of their immediate needs that the foregone economic development could have met.

Public Sector Effectiveness and Efficiency

In addition to sound political leadership, an effective and efficient public sector is critical to achieving success. The political leadership must be ably supported by a public sector that helps to design good policies and implement them effectively. It has to organise and work as an effective integrated government, develop and manage infrastructure projects well, innovate, continually set high environmental standards and regulate judiciously. The public sector would also have to introduce the right mix of market mechanisms to deter polluters and to encourage the development of a vibrant private sector which can produce environmental goods and services efficiently.

Private Sector Competitiveness and Social Responsibility

The private sector is certainly in the position to contribute to new environmental goods, as business is often good at innovating and searching for opportunities. Thus the desalination plants and the latest NEWater plants and incinerator plant are all privately owned and operated on a Public-Private Partnership arrangement with the relevant government agencies. In fact, Singapore based companies such as Keppel, SembCorp and Hyflux have also made successful forays overseas, for example into China and the Middle East, to help deliver environmental and water services and supplies competitively.

The private sector must also be socially responsible. Companies have to abide by the environmental standards set up by the government. Businesses are encouraged to provide feedback to proposed new regulations and standards so that they can be introduced effectively, in a reasonable timeframe.

People Participation and Ownership

People must want a better environment for themselves and their children. Public participation and ownership are critical to a better environment. The first national public education effort was a month-long "Keep Singapore Clean" campaign in 1968. It took many years of public education to enable the public to develop a sense of civic consciousness, social responsibility and discipline. Such government led platforms have now been replaced largely with mass participation, sharing of long-term plans and bottom-up initiatives by a healthy civil society.

Initially people may be more attuned to their immediate needs and need to be persuaded of the benefits of a clean environment. But once people have reaped the

benefits of a clean environment, they would be inclined to desire it and may even be a few steps ahead of the government, if the government is slow in delivering a clean environment.

People have started to desire a clean environment, but they also have to organise and educate themselves, and to be motivated to assume the role of stewards of the environment for their children, to modify their behaviour, to help and not rely solely on the government to deliver a clean environment.

New Environment Challenges

Singapore has done well to protect its environment through effective environmental policy, planning and implementation. As a result of the good environment and concomitant economic progress, Singaporeans are better educated, widely travelled and hence, more environmentally sophisticated and demanding. We must continue to upgrade our environmental infrastructure and raise our standards to give our people a better quality of life. This is particularly important when climate change will pose tremendous dangers and unpredictable risks. We will need to take the necessary measures to mitigate and adapt to climate change.

We must move from the mindset of environmental protection to one of environmental sustainability. Sustainable development, as defined in the 1987 UN World Commission on Environment and Development report Our Common Future, is "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".[3] Singapore has already embarked on an environmental sustainability programme. It is an ongoing journey. The top-down approach to protecting the environment is still necessary but increasingly insufficient. An effective bottom-up approach is even more important now.

A Higher Quality of Environment

As Singapore progresses, Singaporeans will come to better understand the linkages between the environment and our health and social wellbeing, and that the quality of the environment is an important contribution to our quality of life. Good basic public hygiene and human health will no longer be sufficient. Our environmental infrastructure and standards must constantly be upgraded to truly meet first world standards. The challenge is to introduce and incorporate innovative environmental

[3] UN World Commission on Environment and Development (WCED) (1987), Chapter 2: Towards Sustainable Development, in *Our Common Future: Report of the World Commission on Environment and Development*. Switzerland: WCED. Retrieved 8 December 2014 from http://www.un-documents.net/ocf-02.htm

infrastructure/measures and make such facilities efficient and convenient for residents to practise environment-friendly programmes like waste recycling and energy conservation.

New forms of pollution threats and causes of environmental degradation need to be tackled effectively. The public deserves and will demand a higher quality of the environment.

Climate Change

Climate change, with the resultant rising sea level, extreme weather with very intense rainfalls and energy requirements, poses new challenges, not just infrastructural and economic, but also has tremendous important environmental, social and health impacts. We need to be able to address these issues and keep in mind the impacts in the future. More and more, we need long-term planning and policy and technological innovation to find effective and efficient solutions.

Environmental Sustainability

Singaporeans must want to live sustainably—environmentally, socially and economically. While many Singaporeans want a better quality of the environment, they must also be willing to pay, either in improving behaviour and habits so as to keep public places clean and reduce energy consumption, or footing the higher immediate economic costs required to safeguard the environment for future generations. Strong political leadership and committed public ownership will be needed to persuade and bring along the public to support a good environment. There will be a cost to improving the environment, but there is a greater cost to inaction.

Environment: Singapore's Competitive Advantage

Singapore has placed so much importance on the environment from our early days. Because of our unique circumstance as a city-state with no natural resources and hinterland, taking good care of our environment and making the most efficient use of our resources, is a necessity for us and not a choice.

Singapore environment agencies from the Anti-Pollution Unit (set up in 1970) to the Ministry of the Environment (set up in 1972 and later renamed as the Ministry of the Environment and Water Resources in 2004), and its agencies, PUB, the national water agency and the National Environment Agency, have always planned for the long term, innovated constantly and implemented effectively and pragmatically to help Singapore to develop in a sustainable way.

Land-use planning has always and will continue to be important to ensure that environmental considerations are incorporated in urban planning in Singapore. Environment agencies have and will continue to work with the urban planning authority to ensure integrated land-use planning. Critical environmental infrastructure must also be planned and implemented.

Our clean and green environment is our competitive advantage in ensuring a good quality of life for our residents as well as for attracting investments. As Singapore develops and grows into a first world country, it is even more important that we move successfully from the mindset of environmental protection to one of environmental sustainability. The political leadership's vision, the public sector's ability to help facilitate the execution of that environmental vision, the vibrancy of the private sector and the people's support for a good environment and taking personal responsibility and ownership, these are all factors which have brought us where we are today and are sources of great strength that will continue to propel Singapore forward.

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