How Can Hong Kong Use Its Natural Resources?

Ecosystem Services to Support Development Policy

July 2017

Shaun Martin

思匯 CIVIC EXCHANGE

ExxonMobil

About Civic Exchange

Civic Exchange is an independent public policy think-tank established in 2000 in Hong Kong. Our vision is to shape a liveable and sustainable Hong Kong through civic education, research, public policy recommendations, and the development of practical solutions. Civic Exchange undertakes research in three major areas – air quality, nature conservation and the urban environment – with an overarching framework of promoting wellbeing.

For more information, go to http://www.civic-exchange.org

About the Author

Shaun Martin is a Civic Exchange project consultant, researching ecosystems and biodiversity. He is also an independent environmental consultant, focusing on education. He holds a BSc in environmental science from the University of Plymouth and a MSc in environmental management from the University of Hong Kong.

Table of Contents

Acknowledgements....4

1. Introduction....5

2. What Are Ecosystem Services?....7

3. How Does Hong Kong Currently Realise The Value Of Nature?....9

4. What Should We Aim For?....11

5. How Might This Approach Be Introduced?....13

5.1 Prioritisation

5.2 Ecological Assessment or Inventory Taking

5.3 Valuation and Option Identification

5.4 Implementation and Propagation

Endnotes....18

Acknowledgements

Civic Exchange would like to thank ExxonMobil Hong Kong Limited for its generous support for this report.

We would also like to thank contributors who lent their valued expertise and advice during the drafting of this paper: Mr. Ruy Barretto, Dr. Luke Brander, Mr. Jeffrey Chow, Dr. Maria Francesch-Huidobro, Dr. Billy Hau, Ms. Jenna Ho Marris, Dr. Michael Lau, Dr. Ng Mee Kam, Mr. Mike Kilburn, Ms. Reena Rollason and Ms. Jude Wu.

1 Introduction

The idea of maximising benefits provided by nature is not new to Hong Kong. Towards the last part of the 20th century, most of Hong Kong's population and industry still depended on the local ecosystem for food and resources. In the 1970s, the government used natural systems (alongside mechanical engineering) to conserve water sources and to protect settlements from landslides through extensive reforestation schemes.[1] The secondary effect of such schemes led to the formation of Hong Kong's country parks to protect these "new" forests, which has led to these areas being mostly undisturbed to the present day. Currently, about 40% of Hong Kong's land is country park or nature reserve.

Today, the Hong Kong Government is trying to address new environmental challenges through a series of action plans. The "Biodiversity Strategy and Action Plan" (BSAP, published December 2016) and "Climate Action Plan 2030+" (CAP30+, published January 2017)[2] detail these environmental concerns and indicate links with sustainable growth and development. The "Hong Kong 2030+"[3] development vision also addresses sustainable, green and environmentally regenerated aspirations for our city.

This paper will introduce the concept of "Ecosystem Services" (ES), a term mentioned in the BSAP and CAP 30+, and explore potential new ways for the Hong Kong Government to consider the value of our natural resources and its use. The hope is that this briefing paper will be the first step in greater study in this field, especially as a new Chief Executive and administration take office on 1 July 2017.

"Ecosystem Services" is the term used to describe what biodiversity and natural environments **do** rather than what they **are**. A Civic Exchange study from 2002 highlighted both the "direct and indirect use" values of natural services in Hong Kong and estimated the "quantifiable conservation value" of our natural resources to be from HK $1.8 billion to HK $6.5 billion (US $230 million to US$883 million) annually.[4] Given advances in knowledge and assessment since 2002, the value of these services could become a more integral part of our infrastructure planning, whilst still maintaining our highly competitive economy.

As our needs, climate and available resources change, so must our policy making responses. At the same time, certain issues, such as water and air pollution, have persisted far longer than they should have. Although technological and regulatory changes have brought improvement, there is a

continuing need for new, more effective tools to eliminate these and other problems.

There are potential barriers to such innovation, such as a lack of public interest or political action. In 2017, a Civic Exchange study surveyed public understanding of biodiversity, parallel to the government's BSAP public consultation process.[5] It found that 75% of respondents in Hong Kong did not fully understand what the term "biodiversity" meant. This makes it difficult to say whether the public cares about the issue, at a time when there are controversial proposals around natural resources – for example, to develop areas near country parks.

In another example, Civic Exchange released a 2017 report called 'The Illusion of Plenty' regarding a water scarcity problem that the wider public may not know about.

The report pointed to wastage, both by the Government and domestic users, of a natural resource whose true value has not been ascertained. As the Hong Kong Government spends more than HK $4 billion (more than US $500 million) a year importing fresh water from Guangdong, more attention needs to be paid to whether this "ecosystem service," our own local water supply, is being best used and conserved.[6]

The same risk applies to "green infrastructure" solutions included in development plans; if the public cannot understand or compare them to man-made alternatives, how can they make informed decisions?

If the Hong Kong Government can identify and articulate how environmental features form a part of development plans, the public and all relevant stakeholders will be able to understand the extent to which those plans meet both growth and conservation goals. If we create a culture in which nature acts as a functional infrastructure component, we can start to compare this to market solutions in providing the same services. Once we understand what nature contributes to development, its inherent value can help to end the misperception of development and conservation as being inherently opposed. Hopefully, it can lead to a better coexistence of environmental concerns and economic development.

This document aims to explain how we might advance along that path, and what we might hope to gain from doing so.

2 What Are Ecosystem Services?

Ecosystem Services (ES) are defined as something that nature does or provides that benefits human society. For example, forests can help prevent landslides; bees pollinate agricultural crops; mangroves minimise damage from extreme coastal weather; and oceans provide seafood. Any "service" that arises naturally can be included under this label. The concept is not new; it is simply a different way of looking at the value of our environment.

These services are usually grouped into four types for easier understanding, comprising one fundamental category of supporting services and three which convey direct benefits to human beings[7]:

Type	Description	Examples	Status in Hong Kong
Supporting Services	Processes that provide the conditions for other activities to be sustained over time	Soil formation, nutrient cycling, temperature stabilization	Vital to society yet not always acknowledged or easily quantifiable
Regulating Services	Beneficial outcomes that arise directly from natural ecosystem processes	Water purification, pollination, climate regulation, carbon absorption, erosion prevention	Vital to society yet not always acknowledged or easily quantifiable
Cultural Services	Ecosystems that provide recreational, educational, aesthetic or spiritual benefits	Ecotourism, environmental education	Highly noticeable, as a significant proportion of Hong Kong's population values and uses the natural environment for these services.[8]
Provisioning Services	Ecosystem goods or products that can be harvested and used directly	Food, raw materials, fresh water, medicinal products	Acknowledged, but majority of outputs are sourced abroad due to geographical constraints

Many countries have begun applying an ES approach in public decision making. Germany, for example, has implemented policies based on ES valuations including the Flood Protection Law, which allowed them to designate and validate new areas as flood plains (providing the regulating service of a larger area for drainage in case of flooding) instead of investing in extensive engineering projects to control similar events.[9 10]

3 How Does Hong Kong Currently Realise The Value Of Nature?

Hong Kong derives the vast majority of its raw goods and materials from overseas: The territory has only 7 square kilometres of actively farmed land.[11] It imports 90% of its fish and controls only 20%-30% of its own fresh water supply. Since the wider concepts of supporting and regulating ecological functions have only been recently articulated, there has historically been little reason to expand local ES. Hong Kong's existing processes and laws are focused on protection of the environment, rather than its reinforcement.

The primary administrative tool for reconciling development and the natural environment is the Environmental Impact Assessment (EIA), which sets out to "avoid, minimize and control" the impacts of submitted development plans. Within their Standards & Guidelines, the Planning Department also recommends providing mitigation for environmental or conservation impacts from specific projects or large scale developments (which include town planning).[12] Other local environmental laws refer to the "control" of noise, water and air pollution, requiring project works to comply with acceptable levels according to a process laid out in technical memorandums.[13] This regulatory approach does not consider the "service" benefits arising from reducing or removing a natural environment, only the physical changes. In a sense, they treat all natural settings as equivalent in value and in need of the same physical protections, without considering the ecosystem benefits that differ between them.

Currently, the Hong Kong Government has set out to identify and protect ES within its CAP30+ and BSAP policies,[14] [15] as well as in the actions of specific departments or bureaux. Both the CAP30+ and BSAP declare aspirations to define, monitor, conserve and mainstream Hong Kong's biodiversity, recognising that there are climate adaptation benefits, for example, from protecting and enhancing Hong Kong's rural and urban ecosystems. The Development Bureau has also committed to adopt eco-design elements and concepts across numerous areas, such as the Drainage Services Department's revitalisation of the Tsui Ping River[16] and Yuen Long Bypass Floodway Project (see Case Studies below)[17], the "Green and Blue Infrastructures" framework (within the Planning

Department's vision) and "Urban Forestry" (Greening, Landscape and Tree Management Section), for example.

Hong Kong Ecosystem Services Case Study:
Revitalization of the Tsui Ping River, Kwun Tong

As part of a larger effort to transform Kowloon East into a major economic centre, the Drainage Services Department plans to revitalise Kwun Tong's existing nullah to strengthen the flood protection capability while landscaping it to enhance ecological and environmental aspects. The development will highlight pedestrian connectivity and include public amenities such as arts and cultural spaces.

The project aspires to take a holistic approach to urban planning, yet it is not clear whether the Department has worked on stakeholder engagement with local residents and business owners or with other relevant government departments (such as the Environmental Protection Department or the Agricultural, Fisheries and Conservation Department) to identify or address previous environmental issues relating to the nullah.

These innovative and welcome recommendations seek a more proactive approach to development that utilises an expanded toolbox and targets wider co-operation between stakeholders, with benefits for both the economy and the environment. Yet they are still at a concept stage rather than heralding a paradigm shift in how Hong Kong approaches development. A truly effective approach will require all government departments to adopt the same principles, working on common goals to optimize the ES benefits of our environment.

4 What Should We Aim For?

Natural ES do what they do for free and cost comparatively next to nothing to maintain, providing both prosperity gains and enhanced security in doing so. Every business, community and individual relies, either directly or indirectly, upon services that nature provides. Yet consistent depletion or degradation of these fundamental services – through industrial, agricultural or urban development – reduces their efficiency and consequently increases the cost to replace them and decreases our wellbeing over time.[18] The burden of maintaining such prerequisite conditions is usually assumed to fall on the government, since private enterprise and individuals assume they are entitled to these basic services or conditions.

The threat of degradation can be particularly important where services have a domino effect, such as the loss of clean or sufficient water in one area leading to reduced biodiversity, industry and ultimately economic growth in others. Although some ES categories are very local and immediate in reach (e.g. growing a food crop can require only a small area of good land), the majority of vital supporting and regulating services have a scale and impact that can extend tens or hundreds of kilometres, such as gathering large volumes of water. Adopting an effective ES approach to sustain these services would therefore require institutionalising the recognition of ES across policies and plans for every affected department, public body and private enterprise, rather than using it to fill piecemeal gaps in the needs of a district or industry sector.[19]

Hong Kong ES Case Study:
Ecological Enhancement Work in the Yuen Long Bypass Project

In 2003, the Drainage Services Department re-engineered a 7-hectare wetland to compensate for ecological loss arising from the construction of the Yuen Long Bypass Floodway. This enhancement incorporated reed beds, three major ponds and bamboo clusters to alleviate floodwaters and to encourage biodiversity. In 2006, the area's management passed to the AFCD to oversee its ecological aspects.

The original focus of this project was significantly extended based on environmental concerns, although a "true" ES approach arguably might have used more natural functions and involved restoration of the entire river channel, providing more ways to alleviate flood waters. Such enhancements can also include leisure and cultural services that can add value.

A consistent policy framework can be directed towards maintaining or augmenting these services to increase sustainability, generate revenue and reduce costs.[20] In Australia, the reformed Murray/Darling Basin water management system of 2007 is an example of how the negative impacts of agricultural, industrial and urban activity on water quality and fish stocks downstream were recognised, and a policy developed to enable all stakeholders to benefit from the available water resources while maintaining water quality.[21] Treating industrial processes and riverine conservation independently, for example, would not allow these insights to be reached: there needs to be a wider evaluation of cause and effect that recognises the impact of the upstream environment and allows the 'best possible solution' to be reached.

This example illustrates how the preservation of naturally occurring ES to meet our needs can save money in two significant ways:

1. **Cost savings of using natural "engineering" instead of man-made solutions:** Rather than massive spending on defence against coastal erosion (both to set up and maintain), investments in maintaining or enhancing natural defence systems like mangroves and sand dunes could be more cost-effective.

2. **Cost-effective regulatory compliance:** Embedding or enhancing regulating services in particular, such as natural air purification by trees, can result in self-sufficient means to meet regulatory, environmental or conservation targets. Trees remove a significant amount of small particulate matter and other pollutants from the atmosphere, therefore, as a means to maintain air quality standards, they may complement or be preferable to scrubbers or similar alternatives. In addition to this, trees act as a carbon sink and provide shade in hot or sunny weather.

In the best case scenarios, ES might also be a source of revenue, through:

1. **Benefits received by landowners for enhancing ecosystem services:** Rather than converting into other land uses, landowners might be paid to maintain their land in such a way that regulating or supporting services provided by the natural habitat can work more efficiently, e.g. water purification or atmospheric carbon reduction. In some cases, the low cost of maintaining such services might give rise to new business opportunities if the resulting benefits are sufficiently valuable.

2. **Ecotourism that benefits communities:** By increasing the health and appeal of grasslands, waterways, ocean reefs or marine parks, tour operators and other recreational industries can grow in the affected area and pay back the communities (either directly or indirectly) for their maintenance of the habitats, generating new economic opportunities.

5 How Might This Approach Be Introduced?

Implementing an ES approach does not require the overhaul of current policies and processes. Hong Kong has already proposed and implemented several initiatives that take this approach. However, to be fully effective and efficient, the adoption of this new type of solution needs to be both widespread and integrated. It also needs to make the most of available expertise and build a new data foundation for decision making.

ES application methodologies are widely available thanks to global initiatives like The Economics of Ecosystems and Biodiversity (TEEB)[22] and the International Panel on Biodiversity and Ecosystem Services.[23] These aim to inform policy approaches and to help justify standalone biodiversity conservation schemes. These tools have been widely applied and endorsed by supporting partners like the United Nations Environment Programme, the United Nations Development Programme, the Food & Agriculture Organisation of the United Nations, and the European Commission.

The TEEB Stepwise approach, for example, recommends a prioritization framework for cities to apply ES to decision making and policy.[24] It advises stakeholders to prioritize the issues that are most relevant and to then assess which ES are involved or might assist in dealing with it. From this understanding, the appropriate valuation method can be chosen (whether qualitative, quantitative or monetary) and detailed studies performed. The results of the studies then form the basis of policy options and can include an assessment demonstrating the impacts of each option on stakeholders: a far more comprehensive approach than currently available.

5.1 Prioritisation

As with any resource constrained activity, acting efficiently will require an understanding of the goals of investing in the time and research involved. Future planning of this sort needs to be directed towards clear

and shared goals, such as improving resiliency, maximising use of space or minimising external resource dependencies. The identification of policy gaps or key risks that transcend policy areas and departments is therefore essential to ensure that this strategic transition is to have the most beneficial effect.

This is where one potential tension within this approach becomes apparent: as a policy approach, ES does not inherently take into consideration critically endangered species, nor does it prioritize ecological processes that do not directly benefit society. If only one single service is prioritised or identified in a development, its evaluation may undervalue or ignore other critical ecological functions arising from the same environment.[25]

Such limitations need to be addressed, especially if co-operation with conservationists and environmental non-government organisations is to be maintained. It should be noted that ES is just one conceptual approach to increasing appreciation and valuation of our natural environment and should be combined with other considerations in order to form a full picture of both our development and societal needs. Achieving appropriate decision making requires a mechanism that facilitates a trusting relationship between scientists, policy makers and economists. From that we can derive a consensus on policy direction. For governments that have favoured conventional economic growth and values in the past, this involves a change in mind-set that re-engages with the natural world – and an understanding that this may not be a quick transition.

5.2 Ecological Assessment or Inventory Taking

Acting on the identified priorities or risks will then require us to fill knowledge gaps around the processes and mechanisms that exist or can be readily adapted, as well as their interrelationships and the unintended consequences of changes to a given ecosystem.

During the BSAP consultations, one of the Focus Groups specifically concluded that a comprehensive ecological assessment must be conducted.[26] In the past, many localized assessments have been done but none providing an up-to-date, overall understanding of the services within Hong Kong, or upon which it depends. Such an assessment would be an invaluable tool in identifying which ES are present, where they are, which are significant (particularly in the context of the priorities identified), and which are at risk.

One might assume an ES approach to be more significant in the context of Hong Kong's rural areas, wetlands and country parks. However, the assessment can also consider ES in urban areas in the context of:

1. environmental issues such as poor air quality and “heat island” effects
2. climate issues such as mitigating the effects of typhoons and heavy rainfall
3. municipal issues such as wastewater management and public health
4. international obligations like carbon reduction commitments

This stage also presents a valuable opportunity to change perceptions so that green spaces, even in urban centres, are not assumed to be useless or underutilised. By acknowledging the value of ‘green infrastructure’, it provides reason to defer judgement on development until more is known without it being seen as lost value.

5.3 Valuation and Option Identification

From such a baseline study, authorities can refer to it and other ecological measurements (such as species richness and abundance) in their decision making. Understanding these natural services and their contribution to society and infrastructure could allow a comparison with exclusively man-made infrastructure, which includes the cost to build and maintain, thus giving a like-for-like valuation of each. This would make it clear to stakeholders the economic benefits that ES could deliver, whether on a case-by-case basis or across the whole territory.

Such information could also lead to an improved understanding of environmental risks, potentially benefitting investment in local innovation. Civic Exchange’s 2002 study calculated the “direct and indirect use” values of Hong Kong’s natural resources as being between HK$1.8 billion - HK$6.5 billion annually. (Local direct use examples included the fishing industry and outdoor recreation, while indirect use included flood mitigation and watershed protection.) A “TEEB for Business Coalition” Trucost report from 2014 identified US$ 7.3 trillion in environmental externalities for certain businesses globally.[27]

Although many of Hong Kong’s provisioning ES (like food crops and raw materials) are outsourced abroad, a comprehensive ecological footprint assessment should include the cost of meeting certain key needs so that we can understand the risks they pose. We can then identify options to lessen Hong Kong’s ecological footprint and reliance on threatened services, especially in light of future predictions of global water and food scarcity.

There is some concern that “valuations” of a service might be counterproductive in cases where the “value” implied by the assessment is lower than the dollar value of other development options. In such a case, the ES valuation might be seen as making the case for its own destruction. The way a service’s value is presented must therefore ensure

that policy makers and developers do not misinterpret them to justify "ordinary development.[28] Therefore, as well as using dollar values, human well-being measurements might also be extrapolated and included in a project's assessment, similar to how the Hedley Environmental Index is presented.[29]

Alternatively, while urban planning features such as green spaces and cleaner, healthier surroundings have the potential to improve public health (both mental and physical), increases in land and property value arising from these richer services might gradually force out original residents.[30] [31] While ES management may therefore improve the prosperity of an area or a project's 'value', these impacts must be managed so that the benefits do not only accrue to those who can pay more for them.

5.4 Implementation and Propagation

Since different ecosystems exist and influence at very different scales (compare an independent farm with a river valley, for example), attempts to benefit from them can also be somewhat scalable. Certain initiatives might work at a district level to address the particular issues of individual districts' geography, function or land-use. This would empower Hong Kong District Councillors with new perspectives and tools in decision making and enable them to contribute to the development of effective, sustainable infrastructure without being dependent on territory wide projects. Examples might include tree planting incentives under the Civil Engineering and Development Department's Greening Master Plan,[32] varying parameters according to local ambient or biodiversity needs.

At a regional or national level, TEEB suggests that the planning and application of this approach would most likely be spearheaded by an environmental authority, in this case the Environment Bureau in Hong Kong, with support from inter-departmental panels and advisory committees.[33] Such panels and committees are not uncommon for Hong Kong, especially in light of the formation of the BSAP Steering Committee and Climate Change Task Force to analyse issues of biodiversity protection and climate change adaptation and mitigation. The involvement of longstanding committees such as the Advisory Council on the Environment and Council for Sustainable Development, as well as prominent people from urban planning, policy think-tanks, environmental NGOs and the business community would also be able to add their expertise in integrating ES solutions into policy.

However, the choice of the leading Bureau is perhaps inconsequential: whichever it may be, it is essential that the implementation of this approach transcends bureau or department

remits. As the various examples cited have shown, the nature and consequences of these services might stretch across our food chains, living environment, recreational activities and working opportunities. It is not possible to realise the potential value of these services without a similarly trans-departmental approach, which can be problematic in Hong Kong where little effort is made to align departmental objectives.

For example, a recent Civic Exchange study on the availability of Public Open Space (POS) highlighted the links between public health and environmental factors while also showing the discrepancies of access to "open space" between different districts.[34] Addressing these issues effectively would require co-operation between the Planning Department; the Agriculture, Fisheries & Conservation Department; the Leisure & Cultural Services Department and the Highways Department to pave the way for better design and access to these spaces while simultaneously meeting their individual targets. Through involving the Environmental Protection Department, this might also incorporate native biodiversity and its additional benefits, especially in socially deprived areas.

Many key ecosystems extend across Hong Kong's borders, so it would be natural to work with external authorities to develop a better understanding of regional ES, reinforcing their benefits and conservation throughout the region. Platforms for co-operation and information sharing between regional government departments already exist, including the Pan Pearl River Delta Regional Co-Operation and Development Forums, which includes government representatives from Hong Kong, Macau and Guangdong province,[35] so the primary goal at this level would be to establish the scope and relative priority of shared objectives in order to ensure the best possible outcome for all parties.

The success of countries such as South Africa in identifying and subsequently developing conservation areas into a detailed implementation plan can offer some inspiration. Their National Biodiversity Framework set strategies and actions over a five year period, grouped around five strategic objectives, and serves to coordinate efforts between individuals and organisations involved in managing various elements of South Africa's biodiversity.[36] Though the strategies may prove imperfect or flawed in the long run, it is significant that they are almost entirely enabled by the increased knowledge resulting from a National Spatial Biodiversity Assessment.[37]

With the participation and collaboration of all affected departments, similar relevant action and implementation plans can be prepared for Hong Kong, along with the necessary support and monitoring services to sustain these services indefinitely. Such an initiative would be an enormous help in developing a sustainable, cost effective infrastructure plan to underpin the future development of the territory without seeing this as a compromise to the detriment of our natural environment.

Endnotes

1. Palmer, J., "Beyond the city, Hong Kong is creating its lost woodlands", *BBC*, 26 September 2016, http://www.bbc.com/earth/story/20160923-beyond-the-city-hong-kong-is-recreating-its-lost-woodlands (accessed 25 January 2017).

2. Environment Bureau, *Hong Kong's Climate Action Plan 2030+*, January 2017, Hong Kong: HKSAR Government, https://www.climateready.gov.hk/files/report/en/HK_Climate_Action_Plan_2030+_booklet_En.pdf (accessed 2 February 2017).

3. Development Bureau, *Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030*, April 2017, Hong Kong: HKSAR Government, http://www.hk2030plus.hk/ (accessed 25th April 2017).

4. Hopkinson, L & Stern, R., Wild but Not Free: An Economic Valuation of the Benefits of Nature Conservation in Hong Kong, February 2002, Civic Exchange, http://civic-exchange.org/en/publications/164987174 (accessed 24 August 2016).

5. Martin, S & Rollason, R., *The First Baseline Study of the General Public's Awareness and Attitudes Towards Biodiversity Consultation in Hong Kong*, January 2017, Civic Exchange, http://www.civic-exchange.org/en/publications/8290354 (accessed 15 January 2017).

6. ADM Capital Foundation (2017), *The Illusion of Plenty: Hong Kong's Water Scarcity*, Working Towards Regional Water Harmony. ADM Capital Foundation/Civic Exchange/WYNG Foundation. http://admcf.chdrmedia.netdna-cdn.com/wp-content/uploads/2017/05/Illusion-of-Plenty-Hong-Kong-Water-Security.pdf

7. Conservation International (2009), *Nature Provides: Ecosystem Services and their Benefits to Humankind*, Conservation International, p.2.

8. A Civic Exchange study in 2016 found that 24% of respondents had visited Country Parks over 4 times in 12 months. See Endnote 3.

9. Helmholtz Centre for Environmental Research – UFZ, "Facilitating Rivers to Flow and Saving Costs: Natural Flood Protection with Ecological Services at the Elbe", Naturkapital: Deutschland TEEB, 2010, http://www.naturkapital-teeb.de/en/case-studies/surveys-and-case-studies-with-interactive-map/detail-view.html?tx_teebfaelle_pi1%5Bcase%5D=13 (accessed 21 February 2017)

10. European Commission, "Science for Environment Policy: Flood Risk Management has improved in Germany", European Commission, September 2016, http://ec.europa.eu/environment/integration/research/newsalert/pdf/flood_risk_management_improved_germany_469na2_en.pdf (accessed 21 February 2017)

11. HKSAR Government, *Hong Kong: The Facts. Agriculture and Fisheries. May 2016*, Hong Kong: HKSAR Government, https://www.gov.hk/en/about/abouthk/factsheets/docs/agriculture.pdf

12. Planning Department, *Hong Kong Planning Standards and Guidelines: Summary*, June 2016, Hong Kong: HKSAR Government, http://www.pland.gov.hk/pland_en/tech_doc/hkpsg/sum/pdf/sum.pdf (accessed 15 February 2017)

13. Environmental Protection Department, *Technical Memorandum on Environmental Impact Assessment Process*, September 1997, Hong Kong: HKSAR Government, http://www.epd.gov.hk/eia/english/legis/memorandum/TM.pdf (accessed 15 January 2017)

14. As Endnote 1

15. As Endnote 2

16. Drainage Services Department, *Revitalisation of Tsui Ping River, February 2017*, Hong Kong: HKSAR Government, http://tsuipingriver.hk/en/ (accessed 26 April 2017)

17. Drainage Services Department, *Ecological Enhancement Work of Yuen Long Bypass Floodway Project*, June 2016, Hong Kong: HKSAR Government, http://www.dsd.gov.hk/EN/Flood_Prevention/Ecological_Enhancement/Ecological_Enhancement_Work_of_Yuen_Long_Bypass_Floodway_Project/index.html (accessed 23 March 2017)

18. Conservation International (2009), *Nature Provides: Ecosystem Services and their Benefits to Humankind*, Conservation International, p.4.

19. DEFRA, *What Nature Can Do For You*, January 2015, U.K. Government, https://www.gov.uk/

government/uploads/system/uploads/attachment_data/file/396840/pb13897-nature-do-for-you.pdf (accessed 2 February 2017)

20. Scarlett, L. & Boyd, J., *Ecosystem Services: Quantification, Policy Applications, and Current Federal Capabilities*, March 2011, Resources for the Future, http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-11-13.pdf (accessed 14 February 2017)

21. UNEP (2010), *Clearing the Waters: A Focus on Water Quality Solutions*, UNEP, pp.61-62.

22. TEEB, "The Economics of Ecosystems & Biodiversity", http://www.teebweb.org/ (accessed 15 January 2017)

23. PBES Secretariat, "Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services", http://www.ipbes.net/ (accessed 15 January 2017)

24. TEEB (2011), *TEEB MANUAL FOR CITIES: Ecosystem Services in Urban Management*, TEEB, p.11. http://doc.teebweb.org/wp-content/uploads/Study%20and%20Reports/Additional%20Reports/Manual%20for%20Cities/TEEB%20Manual%20for%20Cities_English.pdf (accessed 3 February 2017)

25. Carter Ingram, J., Redford, K. H. & Watson, J. E. M. (2012), "Applying Ecosystem Services Approaches for Biodiversity Conservation: Benefits and Challenges", S.A.P.I.EN.S, 5.1/2012.

26. Agriculture, Fisheries and Conservation Department, *Final Report of the Sustainable Use, Ecological Footprint and Ecosystem Services Focus Group*, 2016, Hong Kong: HKSAR Government, https://www.afcd.gov.hk/english/conservation/Con_hkbsap/bsap_links_to_resources/files/Final_Report_Sustainable_Use_EF_ES_FG.pdf (accessed 24 January 2017).

27. TRUCOST, "Natural Capital at Risk: The Top 100 Externalities of Business", April 2013, https://www.trucost.com/publication/natural-capital-risk-top-100-externalities-business/ (accessed 6 June 2017)

28. Ozdemiroglu, E. & Hails, R. (eds) (2016), "Demystifying Economic Valuation", *Valuing Nature Paper*, VNP04.

29. School of Public Health, The University of Hong Kong, "Hedley Environmental Index", http://hedleyindex.sph.hku.hk/html/en/ (accessed 5 March 2017)

30. Haffner, J., "The Dangers of Eco-Gentrification: What's the best way to make a city greener?", *The Guardian*, 6 May 2015, https://www.theguardian.com/cities/2015/may/06/dangers-ecogentrification-best-way-make-city-greener (accessed 20 January 2015)

31. Ng, M.K., "People-Making and Place-Making Urbanism", World Urban Campaign, http://www.worldurbancampaign.org/mee-kam-ng (accessed 3 February 2017)

32. Civil Engineering and Development Department, Greening Master Plan, July 2012, Hong Kong: HKSAR Government, http://www.cedd.gov.hk/eng/greening/doc/CEDD_GMP_Booklet.pdf (accessed 24 January 2017)

33. TEEB (2011), *TEEB MANUAL FOR CITIES: Ecosystem Services in Urban Management*, TEEB, p.31. http://doc.teebweb.org/wp-content/uploads/Study%20and%20Reports/Additional%20Reports/Manual%20for%20Cities/TEEB%20Manual%20for%20Cities_English.pdf (accessed 3 February 2017)

34. Lai, C., *Unopened Space: Mapping Equitable Availability of Open Space in Hong Kong*, February 2017, Civic Exchange, http://www.civic-exchange.org/en/publications/8290367 (accessed 3 March 2017).

35. HKSAR Government, "HKSAR participates in 11th Pan-Pearl River Delta Regional Co-operation and Development Forum and Trade Fair (with photos)", press releases, 25 August 2016, Hong Kong: HKSAR Government, http://www.info.gov.hk/gia/general/201608/25/P2016082500490.htm (accessed 7 February 2017)

36. Department of Environmental Affairs (2008). *National Biodiversity Framework.* Republic of South Africa.

37. Driver, A., Maze, K., Lombard, A.T., Nel, J., Rouget, M., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. (2004). *South African National Spatial Biodiversity Assessment 2004: Summary Report.* Pretoria: South African National Biodiversity Institute.

© Civic Exchange, July 2017
The view expressed in this report are those of the authors, and do not necessarily represent the opinions of Civic Exchange.

思匯 CIVIC EXCHANGE
23/F, Chun Wo Commercial Centre, 23-29 Wing Wo Street, Central, Hong Kong.
T (852) 2893 0213 F (852) 3105 9713 www.civic-exchange.org