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Urban Climate Change Adaptation in Asia-Pacific:

Green Jobs, Green Growth

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Robert Brears

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Freie Universität Berlin
NFG Research Group "Asian Perceptionsof the EU"
BMBF-Inititiative "Europa von Außen gesehen"
Ihnestr. 26, 14195 Berlin
Germany
Phone: +49 (0)30- 838 59462
Fax: +49 (0)30- 838 57096
www.asianperceptions.eu
Email: info@asianperceptions.eu

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Executive Summary

The Asia-Pacific region is one of the most vulnerable regions in the world to flooding. This vulnerability will only increase with rapid urbanization placing more people and infrastructure in harms way. At the same time, rapid urbanization is leading to environmental degradation reducing economic growth. The EU's world-leading experiences in city planning, infrastructure services and management creates the potential for Europe to export green infrastructure solutions to ensure rapidly expanding Asian cities have sustainable infrastructure. This also has the potential to create economic growth and job creation in Europe.

Policy Recommendations

- The EU needs to increase the availability of research and development funding for Small and Medium-sized Enterprises (SMEs) developing green infrastructural technologies for export. This funding could be generated from issuing green bonds. The EU should also provide green funding to EU Member States for distribution to green technology start-ups and universities commercializing green growth technologies for export.
- The EU needs to enhance city-to-city networks between Europe and Asia-Pacific to ensure best practices in implementing green infrastructural solutions in European cities are transferred to the Asia-Pacific region. These city networks, funded by the EU, can involve a range of actors. In particular, they should involve exchanges of urban planners in order to facilitate the sharing of information and expertise. It will also help foster the export of technologies from European cities to Asia-Pacific.
- The EU must create a development policy that ensures green infrastructural projects are implemented in schemes relating to urban climate change adaptation. In addition to providing financial assistance, the EU should provide a registry of green infrastructural development projects that EU-based engineering firms can tender for, ensuring lack of capacity is not a barrier to implementation of green infrastructural projects in the Asia-Pacific region.
- The EU should use regional fora to mainstream green infrastructural solutions as a way of ensuring cities to continue driving global economic growth in the face of climate change. This will increase the resilience of EU-Asia-Pacific trade to floods and other challenges arising from climate change.

Robert C. Brears is the founder of Mitidaption and has been a Visiting Fellow at the NFG, Freie Universität Berlin. He is an expert on the impacts of climate change and environmental risks to business, governance and society and adaptation strategies to mitigate these risks. He is a contributing author for the Johns Hopkins University's Global Water Magazine, China Water Risk and RepRisk. He has published widely on water security, water resources management, and related issues, and conducted field research around the world. (rcb.chc@gmail.com)

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1. Introduction

The Asia-Pacific region is one of the most vulnerable regions in the world to flooding. Over the period of 1986-2006, floods claimed more than 300,000 lives, and caused an estimated damage to the Asian economy of more than US$200 billion (International Centre for Integrated Mountain Development 2006). By 2012, floods were the most frequent disaster occurring in Asia (44 %) and had the highest human and economic impact. They accounted for 54 % of the death toll in Asia, 78 % of people affected and 56 % of all economic damages in the region (UNSDR 2012). Vulnerability to flooding will increase with rapid urbanization in the region. In 2005 five of the ten most populous cities in the world – Mumbai, Guangzhou, Shanghai, Ho Chi Minh City, and Kolkata – were vulnerable to coastal flooding. By 2070, nine of the top ten cities in terms of population exposure to climate change floods are expected to be in Asian developing countries (World Bank 2010). In addition to flood-risks, rapid urbanization in Asia is leading to rapid environmental degradation which in turn is impacting economic growth: In India, the cost of environmental degradation from urban sprawl reduces the country's GDP by nearly 6 %, or around US$80 billion, annually (LSE Cities, 2014). While in China the annual cost of environmental degradation was estimated to be $230 billion in 2010, or 3.5 % of GDP (NY Times 2014).

2. Climate Change Adaptation and Green Infrastructure

There are two approaches cities can take in adapting to the pressures of climate change: mitigation and adaptation. The most common response to mitigate the risks from storm and flooding has been to increase investment in conventional – or 'grey' – infrastructure such as dams and levees. However, engineers and decision-makers have come to realise the economic and environment costs of these solutions. For example, economically, grey infrastructure is often capital intensive in building, operating, maintaining and replacing. In addition, as grey infrastructure is mainly built to address a specific water management problem it can amplify risks downstream. For example, canals may amplify floods downstream resulting in harm to life and damage to infrastructure. Environmentally, grey infrastructure often degrades quality and quantity of water supply from ecosystem degradation (UNEP 2014). As such, there has been a turn to more long-term economically and environmentally sustainable Green Infrastructure (GI) adaptation solutions that provide equivalent or similar benefits to 'grey' infrastructure. Climate change adaptation involves cities taking action in response to current and projected climate change impacts and vulnerabilities. Actions taken do not have to only consist of protecting society from the negative impacts of climate change, such as a rise in sea levels. Instead, actions taken can build resilience to climate change, enabling society to not only survive and recover from climatic change, but even thrive in a changing climatic environment.

GI involves the use of natural or semi-natural systems that utilise nature's ecosystem services in the management of water resources and associated risks. GI solutions can be used to support the goals of multiple policy areas. For example, floodplains can reduce flooding risks to cities while simultaneously supporting agricultural production, wildlife, and providing recreational and tourism benefits (UNEP 2014). Unlike grey infrastructure, the value of GI solutions can appreciate over time with the regeneration of nature and its associated ecosystem services.

To reduce the impacts of floods, cities can use GI solutions to increase the water infiltration and storage capacity of wetlands and soils. Cities can also mitigate droughts by releasing water from natural storage features such as lakes and aquifers for human and natural use. Specific GI solutions include reforesting along riverbanks, reconnecting rivers to flood plains, constructing green spaces that hold and slowly release floodwater and construction of permeable pavements that enable surface water to infiltrate the soil below. The equivalent grey infrastructure solutions is dams and groundwater pumping, both of which are environmentally and economically costly. GI can also help cities purify polluted water through combinations of sediments, soils and vegetation that naturally filter out sediments and contaminants in water. The equivalent grey infrastructure solution is wastewater treatment plants (UNEP 2014).

3. Why Should Europe Get Involved? Answer: Jobs

The Europe 2020 Strategy for smart, sustainable and inclusive growth recognizes that climate change and unsustainable pressures on the environment pose challenges to long-term economic growth. Green growth, which in addition to achieving low-carbon, climate resilient and resource efficient growth, is a structural economic change driven mainly by technological change and innovation, new markets and changes in industrial patterns. Green growth is both a challenge and opportunity for a labour market and the skills of the workforce, both of which are key factors for enabling green growth.

The EU is both experienced and technologically-advanced in providing Environmental Goods and Services (EGS). Between 2002-2011 jobs in the green sector in the EU rose from 3 to 4.2 million full-time positions. During the recession (2007-2011), employment in the green sector increased by 20 % (European Commission 2014). In the water sector, it is projected that a 1 % increase in the rate of growth of the water industry in Europe can create between 10,000 and 20,000 new jobs (European Commission 2014). GI solutions and projects are part of a worldwide EGS market that is expected to grow to US$ 1.9 trillion by 2020 (IISD 2014).

Global spending on infrastructure and capital projects is estimated to reach US$9tn by 2025, up from US$4tn in 2012.: Emerging Asia, including China, India, Indonesia, Malaysia, the Philippines, Thailand and Vietnam will be the fastest growing region, accounting for 47.7 % of the global spend by 2025, up from 30.4 % in 2012 (Financial Times, 2014). However, with climate change means this 'business-as-usual' investment in infrastructure will not lead to a stable future, unless it achieves environmental and sustainability goals (WEF, 2013). Climate change adaptation strategies need to be incorporated into the design and planning phases. To meet the numerous challenges of climate change there needs to be an additional investment of US$ 0.7 trillion made per year, while an additional US$ 0.1 trillion of spending is required to adapt to the extremes of climate change (WEF, 2013). Overall, the EU has leading experiences in the city planning, infrastructure services and management necessary to meet the demands for green growth in the Asia-Pacific region, which in turn creates business and employment opportunities for European ESGs.

4. Europe's Policy Response to Green Infrastructure and Urban Sustainability

In 2013, the European Commission adopted the 'Green Infrastructure Strategy for enhancing biodiversity in urban areas'. In addition to health and environmental benefits, the Green Infrastructure Strategy sets out multiple social benefits from pursuing GI including job creation, making cities more appealing to live and work in, and allowing wildlife to thrive in both rural and urban areas. By 2017, the

European Commission will review progress on developing GI throughout Europe and publish a report on the lessons learnt along with policy recommendations for future action.

When it comes to urban sustainability of European cities, the EU's 'Environmental Action Programme to 2020: Living well, within the limits of our planet' states that most cities will face a common core set of environmental problems. Climate change is expected to have a significant impact on Europe's water resources. The Environmental Action Programme calls for the EU to further promote, and where appropriate expand, existing initiatives that support innovation and best practice in cities, networking and exchanges between cities, and encourage cities to showcase their leadership on sustainable urban development. To do so, the Environmental Action Programme states there needs to be definitions and agreements on a set of criteria to assess the environmental performance of cities, and steps taken to ensure cities have information about and access to funding for measures to improve urban sustainability.

5. How Can European Experience Help Asia-Pacific Cities?

At the urban level there are numerous European cities that have initiated GI projects as part of their climate change adaptation and urban sustainability strategies. Most notable are the cities of Copenhagen, Hamburg and Rotterdam. They provide best practices and lessons learnt for how cities in Asia-Pacific can initiate green urban flood management projects.

Case Study One: Copenhagen

In July 2011, a cloudburst inundated the City of Copenhagen with 100mm of rain falling in one hour, leading to nearly EUR 1 billion in damage to the city's infrastructure. With Copenhagen facing dry summers with sudden intensive rainfall and wetter winters from climate change, in addition to rising sea levels, in 2012 the city initiated the 'Cloudburst Management Plan' that over a 20-year period will guide adaptation strategies to counter extreme rainfall and a rise in sea levels. Specifically, the Cloudbust Plan calls for the implementation of blue and green adaptation measures at all levels to mitigate the risks of floods: from local urban development projects right up to city-wide planning. Initiatives will include channelling storm water away from housing and infrastructure through tunnels and canals into lakes or out to sea, as well as using green spaces and car parks as storage areas to slowdown 'rain to drain'. However, as Copenhagen lacks the financial resources and capacity to implement immediately all of the necessary citywide adaptation measures, an order of priority has been drawn up of the adaptation measures to be implemented over the 20-year period. There are four elements by which each

project is prioritised: risk, implementation, coherence and synergy. First, GIS maps are used to identify the parts of the City with the highest risk of flooding, which is then expressed in monetary terms to show where adaptive measures would have the largest financial effect. Second, areas where measures are easily implemented. For example, areas where it is simple for flood water to be drained into localities with no impact, such as draining rainwater into the harbour. Third, ongoing urban development projects are factored in as costs for flood projects can be reduced significantly if they are implemented in conjunction with renovation projects and new urban developments such as road and footpath renovations. Finally, areas where synergies can be gained, for instance using green spaces to reduce the volume of storm water entering wastewater treatment plants. To make the process more manageable, Copenhagen has been divided into 26 local water catchment areas with each catchment area assessed according to the four elements. As a result actions given the highest priority will be in areas with the highest flood risk, where measures are easiest to implement, and will achieve synergy with developing urban development projects.

Case Study Two: Hamburg

The City of Hamburg is growing and becoming denser each year. For example, around 6,000 new flats are constructed per year, increasing the city's sealed surface area by 60 hectares per annum. With increased surface areas and heavier storm events from climate change, more people and infrastructure are at risk of flooding in Hamburg each year. To reduce the risk of urban flooding the Ministry of Urban Development and Environment in partnership with Hamburg Wasser has launched RISA (Rain InfraStructure Adaptation) for the purpose of developing sustainable adaptation solutions for flood protection, inland flood control and water body conservation. The aim of RISA is to create a decentralised storm water management system utilising buildings, green spaces and water bodies, parking areas, streets and places. At the technical level, RISA is implementing pilot projects throughout the city, including buildings that will channel water into ponds that allow infiltration, purification and retention of rainwater, carparks that collect, retain, purify and then discharge rainwater, and the use of green multifunction spaces, including plazas, to channel rainwater from adjacent buildings and surface runoff into ponds for purification. At the administrative level the project integrates storm water management into urban and regional planning through joint municipal interdisciplinary teams involving spatial planners, traffic planners, urban drainage planners and civil engineers. RISA also involves the holistic communication of information and education to all relevant stakeholders (citizens, municipal officials, operating companies for drainage and the water body, engineering and consulting companies, universities, and others). The results of the project will support the development of a structural storm water plan that will provide guidance for administrations, experts and property owners for the implementation of new storm water management systems throughout Hamburg.

Case Study Three: Rotterdam

In Rotterdam, heavy rainfall is causing disruption and damage as water floods the streets and cellars of houses, while sewer overflows discharge directly into the canals and waterways. Rotterdam faces a growing risk of flooding because increased temperatures from climate change are resulting in heavier storms. For every one degree increase in temperature, rainfall is projected to increase by 14 %, increasing the likelihood of flood damage to public areas and buildings as well as disruption to transport. Rotterdam's Climate Initiative (RCI) adaptation strategy aims to create a city that is 'attractive, economically strong and climate proof'. The strategy consists of four core parts. First, ensuring the city's urban water system is in good working order through active maintenance and where necessary upgrading of the system to reduce the city's vulnerability to flooding. Second, reducing the pressure on the system by creating underground water storage spaces and linking these to other urban activities, for example an emergency underground water storage facility that for the rest of the time doubles as an underground car park. Above ground green roofs, urban vegetation and water squares are used to temporarily store and slowly release storm water, therefore ensuring infrastructure is not damaged. Third, encouraging and supporting the participation of all stakeholders in climate change adaptation, for example Rotterdam is promoting the 'Tile out, Green in' initiative in which inhabitants are encouraged to replace the paving in their own gardens with plants and vegetation. The purpose of this and other initiatives is to create a shared responsibility between public and private landowners for the collection of excess rainfall. Fourth, adding value to the environment, society, economy and ecology through adaptation projects. Rotterdam is providing an attractive location for sustainability-focused companies to test innovative environmental technologies, which enhances the local economy and creates 'green jobs'.

6. Implications of European Case-Studies for Asia-Pacific

The European experiences outlined in the case-studies provide five main implications for cities in the Asia-Pacific region:

First, urban planners need to identify the highest priority areas that require GI solutions. This ensures cities use limited financial resources wisely to provide as much affordable protection against infrastructural damage and economic losses from flooding events.

Second, urban planners need to seek connections between green infrastructure projects to maximise economic and environmental benefits. It is critical that GI projects are coherently planned so as to protect entire neighbourhoods rather than ad hoc locations. This way economies of scale are achieved through coordinated planning of GI projects, with synergies shared between each individual project. For example, a green space may protect a neighbourhood near a waterway while

channelling away flood water that would otherwise endanger an adjacent industrial neighbourhood.

Third, urban planners need to integrate green solutions into urban and regional plans. As flooding risks may originate outside the political and administrative borders of a city, urban planners need to work with regional planners upstream to ensure flood prevention measures do not increase the risk of urban floods. At the same time, urban planners need to ensure their measures do not adversely impact downstream populations.

Fourth, urban planners need to create ownership of green infrastructure solutions by involving local citizens and experts. To ensure livelihoods and human security is not degraded by urban flooding events leading to displacement of populations, all stakeholders need to be involved in GI projects so risks are understood and measures taken that enhance resilience to disaster.

Fifth, urban planners need to provide an enabling environment for companies to test GI technologies that will create green jobs. This way climate change adaptation can be used to stimulate local economic growth and employment opportunities for urban workers. It can also lead to increased exports of adaptation technologies, increasing national economic growth.

In addition, European experience in GI can bring about multiple benefits for cities in the region including:

- Less damage to infrastructure including water and energy systems: Climate change, along with rapid urbanization, is leading to more infrastructural assets vulnerable to damage from floods. Specifically, GI can be implemented at the local level to protect various types of infrastructure (e.g. water, energy, telephone systems) from local flooding risks.
- Less disruptions to the local economy: By implementing GI, cities can reduce the risks of flooding to vital areas such as industrial or commercial zones, ensuring economic activities continue uninterrupted during flooding.
- Protection of human health: GI can reduce the number of people losing their lives or injured during flooding by protecting vulnerable areas of cities. In addition, GI can be used to ensure water supplies remain contaminant free during flooding, and channel water away to avoid risk of water-borne diseases.
- Increased human security: Urban flooding has the potential to displace people, which can increase the likelihood of conflicts by amplifying drivers of these conflicts such as poverty and economic shocks. GI can ensure urban centres and neighbourhoods are protected from flooding, reducing the likelihood of displacement.
- Reduction of poverty: By implementing GI, cities in Asia-Pacific can reduce the likelihood of floods resulting in economic slowdowns, therefore reducing the likelihood of people becoming impoverished from climate change induced extreme weather events.

7. Platforms to Create Jobs and Green Infrastructure

EU funding should be used to support green entrepreneurship to enable European EGS firms to compete in the global and Asian EGS markets and increase the number of Europeans employed in the EGS sector. The European Structural and Investment Funds (ESI) are key sources of investment for promoting sustainable growth and job creation. In particular, the programme for the 'Competitiveness of Enterprises and SMEs' (COSME) and 'Horizon 2020' aim to contribute to economic growth by supporting projects dealing with green innovation, ecosystem restoration and re-naturing cities.

COSME, with a budget of EUR 2 billion over the period 2014-2020, aims to encourage the competitiveness of European enterprises. With SMEs, current and potential entrepreneurs and business support organizations as its main targets, the programme will provide better access to finance, deliver business support services, and promote entrepreneurship. COSME contains several financial instruments to promote green growth. Most notably it will provide SMEs with loans of up to EUR 150,000. It will also facilitate international business cooperation between the EU and its major trading partners.

Horizon 2020 recognises that innovative SMEs can become the engine of the green economy, facilitating the transition towards a resource efficient, sustainable economy. However, SMEs face multiple barriers in commercializing innovative solutions, including difficulty in accessing finance. Under Horizon 2020, a pool of EUR 26 million in funding has been made available for grants to innovative SMEs that focus on eco-innovation, in particular climate action and environmental issues, and which show ambition to develop, grow and internationalise their operations.

8. Conclusions

The Asia-Pacific region is one of the most vulnerable regions in the world to flooding. Over the past 30 years, more than one billion people in the region have experienced floods leading to significant economic losses. With rapid urbanization in the region, more people and infrastructure will be vulnerable to flooding, including several booming large Asian cities such as Dhaka, Kolkata, Shanghai, Mumbai, Jakarta, Bangkok and Ho Chi Minh City. At the same time, rapid urbanization in Asia is leading to rapid environmental degradation, which impacts on economic growth. The EU's world-leading experiences in city planning, infrastructure services and management means Europe can help cities in the Asia-Pacific attain green growth. As such, the paper's policy recommendations are:

- The EU needs to increase availability of research and development funding for Small and Medium-sized Enterprises developing green infrastructural technologies for export. The funding could be generated from issuing green bonds. The EU should also provide green funding to EU Member States for distribution to green technology start-ups and universities commercializing green growth technologies for export.
- The EU needs to enhance city-to-city networks between Europe and Asia-Pacific on green best practices in implementing green infrastructural solutions in European cities are transferred to the Asia-Pacific region. These city networks, funded by the EU, can involve a range of actors. In particular they should involve exchanges of urban planners in order to facilitate the sharing of information and expertise. It will also foster the export of technologies from European cities to Asia-Pacific.
- The EU must create a development policy that ensures green infrastructural projects are implemented in schemes relating to urban climate change adaptation. In addition to providing financial assistance, the EU should provide a registry of green infrastructural development projects that EU-based engineering firms can tender for, ensuring lack of capacity is not a barrier to implementation of green infrastructural projects in the Asia-Pacific region.
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For further information, please contact:

Anja Lutz
Head of Office
NFG Research Group "Asian Perceptions of the EU"

Freie Universität Berlin
Ihnestrasse 26
14195 Berlin, Germany
Phone: + 49 30 838 594 62
Fax: + 49 30 838 570 96
Email: info@asianperceptions.eu
www.asianperceptions.eu