Policy Report on CEWP PI CECoSC China Europe Cooperation on Sponge Cities

December 2021

Introduction

The China Europe Water Platform Partnership Instrument project China-Europe Cooperation on Sponge Cities (CEWP PI CECoSC) aims to enhance Europe-China cooperation on water management in urban areas. Project outcomes include policy, regulation and management recommendations. This Policy Report and its Background Document summarizes the dialogue and the outcomes of CECoSC project. The Policy Report will contribute to the High Level Policy dialogue at Europe-China Ministerial Level.

Both Chinese and European cities face increased risk of floods and droughts, as well as a shortage of clean water. In both China and the European Union, the traditional responses to those challenges, particularly related to stormwater, are predominantly reactive and problem-driven rather than pro-active and opportunity-driven. A reactive, problem-driven approach focuses only on minimizing a specific risk e.g. waterlogging, while what is now being advocated, is a pro-active approach which aims to minimize several risks, e.g. climate vulnerability, in a comprehensive way, and at the same time maximizes the benefits emerging from these adaptations. This new approach is emerging in China and many European cities which are transitioning towards a sustainable and water-sensitive urban future, using ecological principles and deployment of Blue-Green Infrastructure. This new approach is referred to in this Policy Report as *a Sponge City Approach*.

In 2014, China adopted a national policy referred to as the Sponge City Program[1]. Similar ideas on stormwater management emerged in Europe and the United States, with an increasing number of cities implementing innovative stormwater management policies. In recent years, the focus in China and Europe has shifted from the application of traditional 'Grey Infrastructure' measures to Nature Based Solutions that improve cities' capacities to retain, detain and purify water, thereby strengthening their liveability. In parallel, research programs, demonstration programs and pilot projects have generated new insights and tools, and expanded the evidence base for the design and engineering of such blue-green solutions.

Globally, cities are increasingly under pressure to adapt to rapidly changing socio-economic, climatic and environmental conditions. Governments are compelled to consider cities' current and future water challenges while also handling other, often related emerging challenges, including climate mitigation, social inclusion, aging infrastructure, resource shortages, financing and pressures on cultural heritage. The increased frequency and intensity of extreme weather events are driving cities to become more climate-resilient. Long-term planning strategies that result in flexible, enabling infrastructure that can be adapted easily to respond to changing climatic, economic and demographic conditions are now a necessity. New concepts and approaches as well as innovative urban design processes that identify and use synergies across infrastructure sectors are needed to create Sponge Cities solutions which maximize benefits while minimizing risks. 'Traditional' Integrated Water Resource Management (IWRM) needs to be replaced with a nexus that also includes energy, transport, food and material flows. In addition, a successful transition towards the adoption of such a new, more holistic *Sponge City Concept* will require new governance and institutional frameworks.

The main objective of this Policy Report is to identify the key challenges (city) governments are facing to effectively address the complex task of Sponge City implementation. While most cities have developed good policies and plans, effective Sponge City implementation remains challenging. This Policy Report focuses on the questions 'what' needs to be done to achieve more effective Sponge City uptake, as well as on 'how' the underpinning institutional capacities can be strengthened. It is built upon the key principle "minimize risks & maximize benefits".

This Policy Report:

- identifies main hurdles based on experiences from practice (partner cities & experts)
- provides policy recommendations to effectively address these challenges with a total systems approach
- outlines contours for future cooperation (research lines, knowledge exchange and joint learning, financing instruments)

Key findings

Both China and Europe are making progress in the operationalisation and wider uptake of *the Sponge City Approach* which minimizes the economic and social risks and maximizes benefits of Sponge City planning and practice. This requires to connect water to fields such as urban (spatial and landscape) planning, public health, energy and transport which is in alignment with the Sustainable Development Goals, in particular SDG 6 (Water) and SDG 7 (Energy) and SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action)). Rather than having rigid, generic, national standards for (urban) water system's performance by local, customized indicators which acknowledge the difference in local conditions in cities, e.g. differences in climatic conditions, infrastructure development level, locally available capacity and resources and local cultural and social preferences. This development will shift Sponge City implementation responsibilities from the national to the provincial and local government. This subsidiarity trend is occurring in China. Though subsidiarity and flexibility are key principles in European Water Legislation the implementation in some Member States is still top down.

[1] *According to the Chinese Technical Guidelines on Sponge City Construction (SCC), a sponge city is a city which functions like a sponge that absorbs, stores, and purifies rainwater and releases it for use when needed. This requires that the urban fabric both above and below the ground act as an active component in storm water management and beyond to include all elements in the urban water cycle such as waste water treatment, groundwater, surface waters, water quality and water supply. Similar concepts are being used in Europe and beyond, such as sustainable urban drainage systems (SUDS), low impact development (LID), water sensitive urban design (WSUD) and integrated urban water management (IUWM), blue-green infrastructure (BGI) and more recently Nature-Based Solutions for (see also Fletcher et al., 2014). In this document we use the term sponge city concept which refers to this type of solutions as part of a holistic approach of stormwater management.*

The following actions would support such a successful transition towards a more holistic Sponge City Approach:

Embrace a Total Systems Perspective across Spatial Scales and Disciplines

Current Sponge City projects tends to focus on individual (sectoral) projects, specific components of the water system and specific neighborhoods of the city, often resulting in fragmentation and disconnected activities, neglecting coherence between the elements of the water system at the local, regional and national level, synergies with the ecological and economic system and lacking consideration for wider societal benefits from human-nature relations.

Adopt a Long- term view

Current practice of Sponge City construction planning is too often based on steady state conditions, drawn from observations and experiences in the past, and thus do not consider long-term changes and uncertainties in climate, urbanization, economy technology and so on. Sponge city construction's long lifespan means that it is important to strategically plan to address long-term changes and to avoid installing interventions that reduce future flexibility.

Improve Stakeholder Participation

It is widely acknowledged that stakeholder participation and a multi-disciplinary approach are crucial in the effective implementation of Sponge City constructions, but is still absent in the practice of implementation. Local residents and representatives of local businesses, but also experts from various disciplines and departments are to be involved in co-creating the plan, in particular in the early, conceptual phase of planning. Their participation discloses local knowledge and specific expertise, relevant to the designers and raises awareness and support among stakeholders towards proposed interventions.

Advocate Blue Green Infrastructure (BGI)

Blue Green Infrastructure (BGI) is a proven effective and efficient way to address climate resilience - dealing with both extreme rainfall, extreme temperatures and droughts - and to improve the quality of life and biodiversity in cities. Though BGI is an effective way to minimize risks and at the same time maximize benefits this set of solutions is still not mainstreamed in urban infrastructure planning and its funding. As BGI provides an opportunity to serve as a leverage to reach multiple goals it can potentially – and is proven to - lead to cost-effective solutions.

Create Partnerships to Finance BGI

BGI provides a wide range of benefits. When these benefits are valuated and corresponding beneficiaries identified, partnerships with stakeholders from various domains can be formed in order to combine multiple funding sources (public and private) for implementation and maintenance of Sponge City constructions. So far these funds largely come from public works sectoral budgets, which are limited and under pressure as BGI claims have to compete with claims from other sectors.

Appraise Impact

Sponge City constructions are often exclusively evaluated in terms of meeting a technical design standard. Yet, this does not capture the many direct and indirect, intangible benefits which are diffuse and endure through time. New monitoring and evaluation approaches are available to quantitatively and qualitatively measure their

performance and systemic impacts, meanwhile influencing maintenance and repair as well as replacement schemes.

Policy Recommendations

The following policy recommendations aim to be of service to policy makers to translate the key findings into action.

Recommendation 1: Use the Three Point Approach (3PA) to plan a resilient urban water system

An integrative, holistic approach to stormwater management builds on the Three Point Approach for planning and designing resilient water systems. The **Three Points Approach (3PA)** offers an integrative framework to facilitate the design and decision making process when managing stormwater[2] (see Figure 1). Point 1 represents the traditional planning practice of technical optimization, designing facilities that protect us up to the level of the Design rainstorms. However, one day an Extreme event will occur and the protective system is overloaded and fails. Minimizing the damage in case of such Extreme Rain events is the second planning objective (Point 2). The domain of Normal Rain represents the everyday situation. Instead of being a hindrance, drainage and protection facilities ought to provide added value and services to society every day. Maximizing these benefits is the third objective of planning a resilient 'Sponge City' water system (Point 3).

[2] C.F. Fratini, G.D. Geldof, J. Kluck & P.S. Mikkelsen (2012) Three Points Approach (3PA) for urban flood risk management: A tool to support climate change adaptation through transdisciplinarity and multifunctionality, Urban Water Journal, 9:5, 317-331, DOI: 10.1080/1573062X.2012.668913

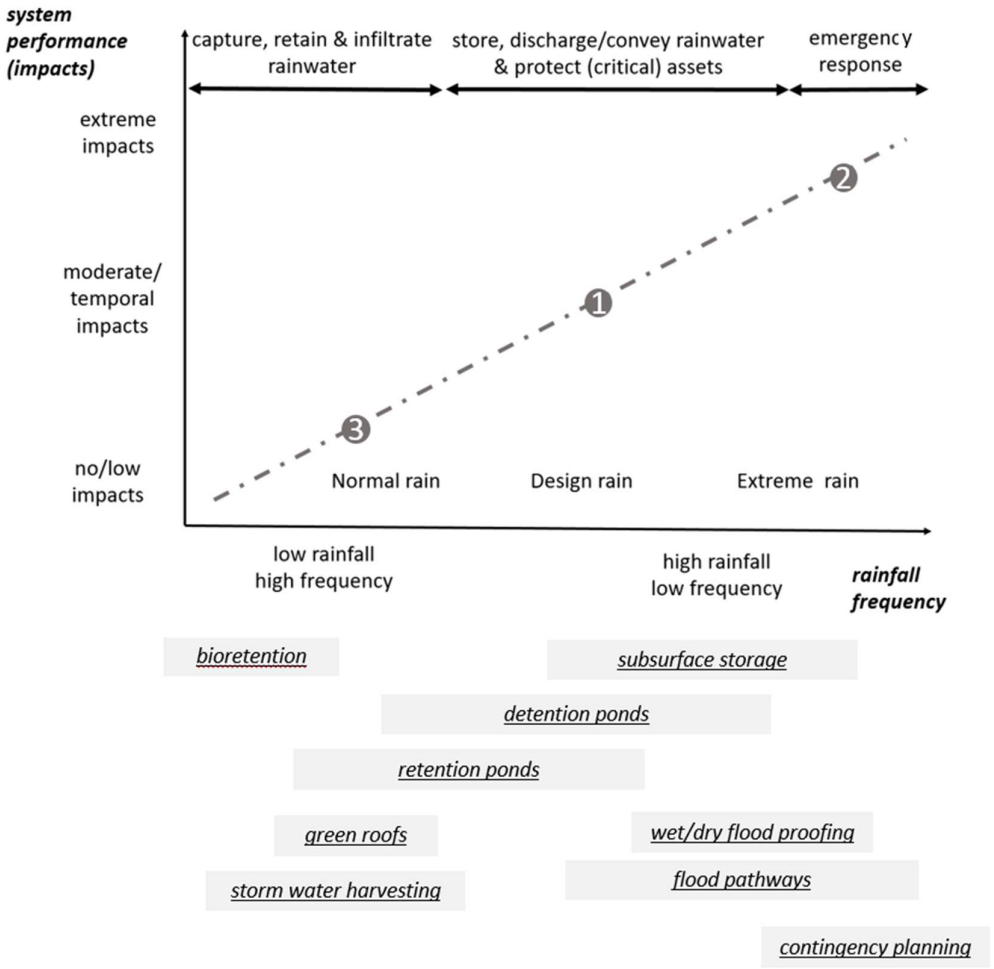


Figure 1; The 3- point approach and illustrative measures to deal with its three planning objectives. Figure inspired by Fratini et al. (2012).

The principles underlying the 3PA are valid for each city, irrespective of the differences in local conditions. However, the scope (position or range) of the three domains may differ from city to city, dependent on the return periods of rainfall, droughts and inundation depths. What is considered extreme in one place could be normal in another. Consequently, standards and solutions will depend on the local conditions, now and in the future. That is why there is a need to allow for flexibility in the design standards for urban drainage infrastructure, (i) adapted to each place and with a log-term view and (ii) considering the broader environmental, social, cultural and economic value of such infrastructure. Too stringent national standards may lead to maladaptation.

Local customization also allows us to move away from standards based on return periods to guidelines based on the amount of normal, design and extreme rainfall expressed in mm rain depth. Rain depths – and related storage volumes - are much easier to understand for non-experts than return periods.

Recommendation 2: Upgrade existing (grey) infrastructure using BGI

In many cities the existing (subsurface) urban drainage system has reached the end of its lifetime and/or does no longer comply with the prevailing standards (such as design

storm criteria) and/or comprises a Combined Sewer System (CSS). Installing BGI in urban areas will help reduce runoff into the piped sewage system by managing water above ground, by retention, detention and infiltration.

Blue-Green Infrastructure plays an important role in realizing this 3PA, as facilities can be designed to handle Design rainstorms, to minimize damage of extreme rains and to maximize ecosystem services, health and added value every day. BGI however requires integration in the urban space, above ground, subsurface and in buildings. Hence, BGI needs to be carefully planned and designed.

In general the use of BGI reduces capital costs and operational costs while environmental and social co-benefits are maximized; BGI contributes to the amenity of the city as a whole. There is increasing and worldwide evidence that renewal or upgrading of existing grey infrastructure is more expensive using grey solutions than using BGI. Tools to evaluate this cost-benefit balance are increasingly available but require customization to the national and local financial and institutional system.

Recommendation 3: Engage Citizens and Experts from other disciplines in BGI implementation.
BGI is new to many of us. Communities, citizens and experts from other disciplines need to get acquainted with BGI and its benefits and terminology. Successful implementation requires an understanding of their needs, their ideas and their engagement as of the beginning of the planning process, from higher level government officials via social workers, media to the homeowners and tenants. To raise awareness local governments have to initiate and support community engagement activities and demonstration projects. A wide range of (creative and visual) techniques and tools is available to facilitate this dialogue and foster co-creation with the local stakeholders.

BGI planning, design, implementation and maintenance also requires a multi-disciplinary approach, including civil engineering, landscape architecture, urban planning, urban ecology, social sciences, economics and financing expertise. Involving the relevant departments and bureaus in the planning, realization and maintenance of BGI is therefore key to the success of every project.

Recommendation 4: Improve Strategic, Tactic and Operational Asset Management
In support of efficient and effective (strategic, tactic and operational) asset management of our Blue, Green and Grey Infrastructure, a quantitative framework to continually assess the performance of infrastructure, at the level of each individual intervention as well as across the whole system. Regular monitoring of their performance and impact is needed to steering maintenance and planning renovation or replacement.
Strategic and tactical asset management is supported through strategy building – i.e. exploring different alternatives off setting against future uncertainties, such as climate change and economic scenarios. By exploratory scenario building one will get better insight in the impact of short term and long term options, tipping points and potential lock-ins. Adaptive pathways can be identified, enabling exploration on alternative sequences of interventions for multiple futures, and illuminating path dependency of options. These insights will enable decision makers to anticipate on timely interventions to provide safety for now and for the generations to come. Moreover, results allow for long term financial planning and defining cost reduction / benefit maximization strategies.

Recommendation 5: Establish an Asset Register of BGI
An essential precondition for this asset management is the availability of an up-to-date, standardized (imposed by regulation or directive) and accessible register - data base and digital maps - of all water management assets in each individual city. Data in this system should be reliable and, to that end, be verified regularly. This register should hold a description of all the Sponge City elements, BGI and grey, including their performance indicators and records as well as guidance on their operational management and maintenance.

Recommendation 6: Enable vertical and horizontal interactions (and learning) to support new Governance arrangements
Foster education and knowledge exchange between national and local governments, and for example planners, designers, engineers and ecologists, between governmental organisations, practitioners, researchers from many disciplines and a wide range of stakeholders to operationalize the 3PA and effectively implement BGI. Stimulate learning by doing - allowing for mistakes we can all learn from them – and knowledge sharing in communities of practice, aligning top-down and bottom-up approaches. Allow for local initiative and differences. The question arises whether the *subsidiarity* principle (authority and decision making should take place at the lowest appropriate governance level, as applied in the EU Water Framework), may provide guidance to achieve this? This principle aims to enhance flexibility and to devolve power to local governments in order to deliver fit for purpose governance at local level (such as deployment of customized policies and standards to local conditions). Open-source tools and standards for managing and exchanging data within and between organisations at city, provincial and national levels are needed to facilitate these interactions.

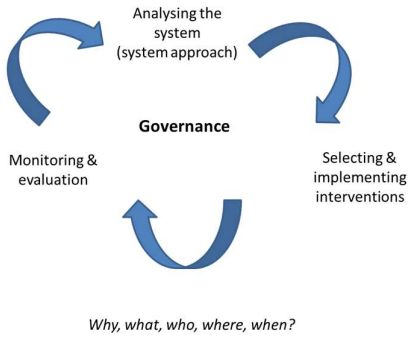
Recommendation 7: Look for Synergies with other Sectors
A total systems perspective across spatial scales and disciplines requires Sponge City planners to take a broader scope. They have to integrate other elements and objectives in their plans – rather than merely sticking to the water management issues - and make sure that other sectors include relevant Sponge City constructions in their plans. Public authorities are increasingly acknowledging the inherent connections between water supply, water resource, and environmental water and other sectors such as energy, transport, building and resources recovery, to establish collaborative mechanisms for infrastructure related decisions. Though this cross-sectorial cooperation is challenging due to differences in procedures, approaches, language and so on the benefits of aligning Sponge City constructions with other national and local objectives and policies such as low-carbon, circular and smart cities outweighs the efforts of seeking contact and consensus with other sectors.

Future Cooperation

The Key Findings and Recommendations formulated above demonstrate the challenges of a successful transition towards a more holistic approach to an urban water management, in which the risks of water are minimized while the benefits of the solutions are being maximized. Flooding, drought, water pollution, water resources depletion,; all these risks need to be tackled in a comprehensive way, preferably with sustainable and circular measures that also deliver other services and benefits in terms of health, ecology, amenity, beauty, recreation, rest and liveability. Tools and practices that can support cities and governments in such a development are needed in both Europe and China. Hence, there is a shared research challenge that would benefit from close cooperation and exchange of knowledge, skills and practical experiences. This section therefor contains ideas and suggestions for future cooperation and also considers the current funding options. It is structured accordingly:

1. Joint research challenges
2. Knowledge exchange and joint learning
3. Funding; China/EU financing mechanism and programs to support 1 and 2

The overarching objective of future collaboration is to facilitate implementation of the Three Point Approach (3PA), as recommended above. Flooding, water logging, drought, urban heat, water quality and ecological preservation are all problems that need urgent attention, as already the current human, economic, ecological and social losses are inacceptable; and climate change, ongoing urbanization and economic development will only aggravate the need to take action.



The width of these problems however goes beyond the scope of any research project. Focus on selected elements is needed, but always considering their wider social, economic and ecological impacts and context. We have to (1) analyse the water system in its relationship with the total physical, ecological and social systems; we (2) have to develop, select and implement effective Interventions to reduce risks and maximize benefits; and (3) we have to monitor and evaluate their performance, not only to study their effects but also to improve our understanding of the total system and our control actions. Learning by doing will be an essential element of the process to successfully implement a safe, healthy and beneficial water system in the limited spaces of the urban environment, in coherence with the system in the rural outskirts of the drainage basin.

All three elements (System analysis, Interventions and Monitoring & evaluation) are essential for the process to operationalize the 3PA. Each element requires tools & practices, own approaches and fit for purpose governance arrangements to obtain a result (outcome). This together creates a framework that can be used to identify knowledge gaps and needs for innovation and pilot testing of potential solutions, as illustrated in the table below.

Parties agreed to elaborate further on this 3PA operationalization matrix in 2022, to identify the research needs in a systematic way. But 'no-regret' collaborative research actions can already be started for the urgent water management problems in both China and Europe and the Recommendations formulated above.
Urgent water management problems in both China and Europe that would benefit from a collaborative research approach were identified and unravelled by using this matrix. Highest priority problems, crossing the domains of 3PA (see Recommendation 1), include:

- How to optimize retention and detention for flood protection and prevention of water logging;
- How to preserve ecological values by understanding and managing links to urban water incl. CSO-control and water quality;
- Reduce the carbon footprint in construction and maintenance of urban water management interventions;
- How to enhance system's resilience to better manage extreme weather events incl. big rain events, long lasting drought and the urban heat island effect.

Addressing these problems as soon as possible is in line with Europe's priorities in climate adaptation, mitigation and ecological recovery programmes, as amongst others formulated in the Green Deal programme, the Paris Agreement, the EU Adaptation Strategy and its Flood and Water Framework Directive. Similar priorities are set in China after the Ecological Civilisation and Green Economy as new targets have been set with regards to green construction, carbon emission reduction and liveability of cities. These targets are translated into 14th five-year plan (FYP).

Joint research challenges
An overview of approaches, tools and governance arrangements needed to implement a 3PA in European and Chinese cities was outlined, and it was agreed that collaboration should start as soon as feasible on three selected **topics**:

1) *Advanced planning support toolbox for holistic, nature-based urban water management.*
In order to facilitate planners and designers to specify sponge city requirements, as well as to help competent local authorities to appraise sponge city projects across cities, it is proposed to develop a planning support Toolbox, based on Deltares' Climate Resilient City Toolbox (CRCT) and the Urban Water Balance model/SDF-curves generator (UWBM).

The Toolbox helps cities to:

- quantify how much detention (sponge) capacity would be needed for extreme storm events;
- how much retention capacity would be needed for ecological purposes, using the VCRa;
- with planning appropriate and sufficient blue-green infrastructure, to be retrofitted in existing urban areas or realized in new urban developments in order to maximize the resilience of these areas, for extreme climate conditions, safety for waterlogging and flooding and social and economic wellbeing of its residents.

After customised to the local conditions, the Toolbox can simultaneously evaluate interventions by their Sponge City performance indicators (including retention and detention capacity for ecological and flood protection purposes, water quality indicators, carbon footprint reduction, urban heat island reduction etc.), as well as construction and maintenance costs.

The Toolbox may contain two tools: one web-based form for *urban renewal projects* by authorities to host participatory co-design sessions with local stakeholders. Another AutoCAD plug-in form for *new urban development projects* by designers to make urban designs with sponge features. Forged in these forms, the toolbox is dedicated to stimulate the local operationalisation of sponge city concept and maximise the governance effectiveness of local Sponge City projects by bridging various disciplines and connecting stakeholders during the planning process.
This project could be executed by CAUPD and Deltares, in close collaboration with the other partners.

2) *Smart technologies/digital tools to support nature-based urban water management.*
To keep track of urban water quantity and quality elements for planning, operation and management, and to provide documentation for co-benefits a range of digital tools may proof useful, as well as GIS as a platform that can be approached from multiple professions and to support Sponge City constructions registration as a basis for good asset management. Ambitious goal: Development of digital monitoring sensors, including sensors for monitoring co-benefits of nature-based urban water management elements.

The effectiveness, benefits and co-benefits of blue-green infrastructure can likely be enhanced by integrating these technologies with existing grey solutions, but the integration depends on documentation of water management efficiency and claimed co-benefits. Smart monitoring can be used both in the planning phase, in the management phase, and in the knowledge sharing and monetizing phase. A joint project to develop and pilot-test such solutions would benefit both China and Europe.

3) Assessment criteria for holistic urban water management.
To advance international collaboration on nature-based urban water management, it is essential to provide overviews of the national objectives, criteria and values to have a common starting ground. Too often the knowledge exchange between actors from different regions or different professional arenas is hampered by confusion about the contextual frame each actor is operating within. A system for comparable registration of targets, assessment criteria and methods employed in urban water management across regions and professions could be a valuable starting point. This may be in the form of developing a uniform terminology and provision of a digital registration platform.

Knowledge exchange and joint learning

In addition to joint research, the consortium will strive to continue collaboration through knowledge exchange and joint learning. Here, the preferred form would be under the umbrella of a continued EU-China program for collaboration on urban water management. Prioritized activities are staff exchange, for instance 3-6 months visiting scholarships to be exchanged between alike institution, and through the continued development of joint publications. Additional modes of collaboration may include bilateral collaboration between a European and a Chinese partner institution, and continuation and extension of educational programs and students' assignment within the topic of urban water management. To sum up the following activities for continued knowledge exchange are considered:

- Staff exchange, preferably within a programmatic cooperation similar to CEWP
  Joint publication like research papers, conference contributions, and/or educational material
- Bilateral collaboration on specific projects
- Educational programs.

China/EU financing mechanism and programs to support 1 and 2

Key to address the above mentioned joint research challenges will be the continuation of this long-term collaboration through a dedicated EU –China funding programme for research and innovation. This will require that the EU commission and MOHURD, with support of MOST for the more fundamental research, take the lead on this agenda of urban water management research. The proposed 3PA-matrix could serve as a framework on which this program could be built.