

Roundtable on Financing Water

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Session 3. Hybrid (green-gray) water security strategies: a blended finance approach for implementation at scale

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BACKGROUND PAPER

Introduction

Evidence recorded over the last decade indicates that we about to reach or have already reached a tipping point related to climate change. The Global Commission on Adaptation (GCA) (2019) report stated: “*Climate change is one of the greatest threats facing humanity, with far-reaching and devastating impacts on people, the environment and the economy*”¹. The frequency of extreme events keeps increasing. In terms of overall losses, 2017 was the second-costliest year ever for natural disasters. Overall losses in 2017 (US\$ 330 bn) were far greater even than those in the extreme years of 2005 and 2008. Only in 2011 higher loss figures (US\$ 350bn) have been recorded and they were related to the Tohoku earthquake and floods in Thailand. The share of insured losses (US\$ 135 bn) is the highest figure in the period from 1980 to 2017. Munich Re NatCatSERVICE recorded 710 relevant loss events, which is above the average of 605 events per year of the last decade and much higher than the average of 490 events over the last 30 years (Munich Re 2018)². According to the GCA, rising seas and greater storm surges could force hundreds of millions of people in coastal cities from their homes and generate losses of more than USD 1 trillion yearly by 2050 in costal urban areas. Meanwhile a 2016 World Bank report indicates that the impacts of Climate Change will be channeled primarily through the water cycle and that water scarcity could cost some regions up to 6% of their GDP³.

In order to reverse these frightening trends in yearly losses that are the result of an increase in the frequency of hazards driven by Climate Change and an increase in exposure and vulnerability; it is urgent to understand the dynamics between our economic growth models and the environment. As urged by the GCA (2019), we need three revolutions for a better future: a revolution in understanding, a revolution in planning and a revolution in finance. It is key to understand the dynamics that emerge between our natural resources, socio-economic and institutional systems and identify the leverage points that may allow us to set in motion a different dynamic between them.

The ways we have achieved development in the last two centuries have resulted in an increasing depletion of our natural capital and exponential growth in our vulnerability and exposure to water, *environmental and climate risks*. A paradigm shift⁴ is required in the way we expand our cities and infrastructure networks and our economies in general. Can we conceive new ways to ensure wellbeing for citizens and achieve a paradigm shift towards low-carbon and climate-resilient development? An effective place to start is to challenge the way we invest and rethink (infrastructure) investment planning processes in the public and private sectors alike.

As promoted by the Task Force on Climate-related Financial Disclosures (TCFD)⁵ as well as the High-level expert group on sustainable finance (HLEG) the environmental externalities cause by investments as well as the climate risks these investments are subject to need to be considered when deciding what to invest on. Changes are required in the process of project origination and project preparation. Considering that most impacts of Climate Change will be channeled through the water cycle; project origination should ideally follow from a strategic planning process that considers the

¹ Global Commission on Adaptation. 2019. Adapt now: the urgency of action. <https://gca.org/global-commission-on-adaptation/report>

² MunichRe. 2018. Natural Disasters. Hurricanes cause record losses in 2017- The years in figures. Published 04-01-2018. <https://www.munichre.com/topics-online/en/climate-change-and-natural-disasters/natural-disasters/2017-year-in-figures.html>

³ World Bank Group. 2016. High and Dry : Climate Change, Water, and the Economy. World Bank, Washington, DC. <https://openknowledge.worldbank.org/handle/10986/23665>

⁴ Paradigm shift is defined as a fundamental change in approach or underlying assumptions.

⁵ More information on TCFD available here: <https://www.fsb-tcfd.org/>

dynamics of the water cycle, the watershed as planning unit and the role of healthy ecosystems as buffers that protect us against extreme events⁶.

The last decade we have grown in awareness of the role of ecosystems and/or green infrastructure in achieving water security in an uncertain future. Accordingly, an alternative “Nature-based” or “Building-with-Nature” engineering approach has emerged. This approach is understood as the enriching of the traditional infrastructure planning process with green and hybrid (green and gray) solutions along with traditional grey infrastructure. Green infrastructure is defined by the World Bank (2019) as *a subset of nature-based solutions (NBS) that intently and strategically preserves, enhances, or restores elements of a natural system to help produce higher-quality, more resilient and lower-cost infrastructure services*⁷. Green infrastructures are multi-functional and adaptive, making them a promising and robust long-term solution. Due to their characteristics, they can contribute to climate adaptation as well as to climate mitigation. They can provide a cost-effective approach to address deep uncertainty related to climate change by avoiding or delaying lock-in to capital-intensive infrastructure, allowing for flexibility to adapt to changing circumstances (OECD, 2013)⁸. Table 1 presents examples of hybrid water security strategies.

This new generation of infrastructure projects may hold the key to new economic development paradigms. Unfortunately, despite their potential and expected resilience dividends, the implementation of green and hybrid infrastructure strategies at the scale required to achieve water security remains a challenge.

Table 1: Hybrid water security strategies (Source: World Bank and World Resources Institute 2019, page 5)

SERVICE	GRAY INFRASTRUCTURE COMPONENTS	EXAMPLES OF GREEN INFRASTRUCTURE COMPONENTS AND THEIR FUNCTION
Water supply and sanitation	Reservoirs, treatment plants, pipe network	Watersheds: Improve source water quality and thereby reduce treatment requirements Wetlands: Filter wastewater effluent and thereby reduce wastewater treatment requirements
Hydropower	Reservoirs and power plants	Watersheds: Reduce sediment inflows and extend life of reservoirs and power plants
Coastal flood protection	Embankments, groynes, sluice gates	Mangrove forests: Decrease wave energy and storm surges and thereby reduce embankment requirements
Urban flood management	Storm drains, pumps, outfalls	Urban flood retention areas: Store stormwater and thereby reduce drain and pump requirements
River flood management	Embankments, sluice gates, pump stations	River floodplains: Store flood waters and thereby reduce embankment requirements
Agriculture irrigation and drainage	Barrages/dams, irrigation and drainage canals	Agricultural soils: Increase soil water storage capacity and reduce irrigation requirements

This discussion paper proposes an alternative approach to project origination and investment planning (public and private) that aims at closing the implementation gap of hybrid (green-gray) water security strategies by tackling important barriers for public

⁶ Denjean, B., Altamirano, M. A., Graveline, N., Giordano, R., Van Der Keur, P., Moncoulon, D., ... & Pengal, P. (2017). Natural Assurance Scheme: A level playing field framework for Green-Grey infrastructure development. *Environmental research*, 159, 24-38.

⁷ Browder, Greg; Ozment, Suzanne; Rehberger Bescos, Irene; Gartner, Todd; Lange, Glenn-Marie. 2019. Integrating Green and Gray: Creating Next Generation Infrastructure. Washington, DC: World Bank and World Resources Institute. <https://openknowledge.worldbank.org/handle/10986/31430>

⁸ OECD (2013), Water and Climate Change Adaptation: Policies to Navigate Uncharted Waters, OECD Studies on Water, OECD Publishing, Paris. https://www.oecd-ilibrary.org/environment/water-and-climate-change-adaptation_9789264200449-en

and private sector investments in green infrastructure. For water security strategies to translate into a pipeline of projects that are investable from a public and/or private perspective, a complete business case per deal that makes part of the strategy is essential. Therefore, in this discussion paper we propose a number of steps required to advance the business case of hybrid (green-gray) infrastructure projects and/or project clusters that go beyond the strategic and economic one, into the commercial, financial and management business case.⁹

The discussion paper set up and the focus of the approach proposed on public investment planning cycles and procurement and contractual arrangements is based on several assumptions:

Firstly, regarding the economics of water and water risks: **the management of water is an essential public good and a so-called natural monopoly**. Failures in how water and water risks are managed can be catastrophic and therefore these risks can't be effectively and entirely transferred to the private sector. However, as the public sector is often unable to raise the capital needed to make all necessary water security investments, the mobilization of private capital is crucial. Water is a private good – a commodity that can be bought from a supplier- and a human right at the same time. As a human right water cannot be treated equal as other marketable goods. The public sector role regarding the provision of water therefore remains key. Consequently, the proposed approach focusses on public investment process and public procurement as catalytic for an increase in Public-Private cooperation and ultimately of private investments in water security. The transaction costs faced by private sector willing to invest in water security at the watershed level are prohibitive in the absence of government coordinated action.

Secondly, green infrastructure projects differ significantly from gray. The communities of practice that are behind design and project origination operate under significantly different business models and scientific approaches. Public investment processes and project delivery and finance mechanisms in general, are geared towards the traditional grey infrastructure project. Therefore, it is key to understand the lenses of both, enable effective collaboration for the development of a middle ground and level playing field¹⁰. The approach proposed advocates for changes in both sides of the equation. **While planning and investment decision making processes need to be redesigned** and adjusted to accommodate a wider range of options - including hybrid (green-gray) projects-; the communities proposing green and hybrid infrastructure projects need also to develop the required evidence and shape these projects differently to fulfill minimum requirements that back up the investment of scarce public resources and/or secure the minimum returns expected by private investors.

Thirdly, **blended finance strategies, unusual partnerships and innovative financing mechanisms are required** to mobilize additional private resources towards hybrid water security strategies. The base for the use of most innovative financing mechanisms are performance-based contracts. As most hybrid projects have multifunctionality as main advantage, **performance-based contracts that allow for stacking of multiple benefits and revenue streams are key**.

As concluded during the recent Environmental Market and Finance Summit¹¹, **the future is in “mosaic” projects**. *Over and over, asset managers and market service*

⁹ More information on the 5 Case model can be found here. HM Treasury. Assessing Business Cases “a short plain English guide”.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/190609/Green_Book_guidance_short_plain_English_guide_to_assessing_business_cases.pdf

¹⁰ Idem 6.

¹¹ The summit was hosted by Forest Trends and AEMI. The summit main conclusions are summarized in the blog titled “Five Things We Can Do in the Next 24 Months to Mobilize Major Investments in Ecosystem

*providers told us that they're designing projects that can responsively serve multiple markets, depending on where the demand is. This allows them to stack funding from multiple sources: carbon offsets, sustainable forestry, water quality credits, recreational use payments, wetland and habitat mitigation, and other revenue streams.*¹²

Additionally, in a recent market sounding research process undertaken by Deltares in Peru, in cooperation with the Natural Infrastructure for Water Security (NIWS)¹³ project it was found that **hybrid (green-gray) infrastructure projects are seen as more attractive to project developers than green infrastructure projects alone**. Therefore, in the methodology proposed a central building block are hybrid infrastructure clusters. These are after organized into hybrid and multipurpose infrastructure projects and formal performance-based contracts that can be funded by different revenue streams; depending on local institutional conditions and context specific preferences and willingness to pay of beneficiaries.

Summarizing we propose an approach for investment planning and project origination that require the active participation of private sector, investors and (re)insurance companies in earlier phases of the strategic planning process. They are best positioned to support the planning authorities in the identification of key hybrid project clusters and their required phasing, that can be afterwards translated into a pipeline of projects with more attractive cash and risk profiles.

The divide: green versus grey infrastructure communities

There is a long list of factors that slow down the rate of adoption of green and hybrid strategies for water security. Some of the more often cited are: uncertain performance, higher (real and perceived) risk and an unattractive cash profile of NBS projects. However, the most fundamental challenge is that public and private investment processes are geared towards gray infrastructure “projects” as investment units and do not fit the characteristics of natural infrastructure investments. The following section presents how natural infrastructure is seen through the lens of the proponents of this approach versus the lens used by investors.

As shown in Table 2, the way hybrid infrastructure strategies are seen by eco-engineers and proponents in general versus financiers and project developers create an important divide in language and interests. The criteria they both apply to judge the potential of green and hybrid versus grey-only infrastructure strategies are fundamentally different. It is important to clarify that whether the project developer could be public or private, does not make a significant change in this divide; the only difference could be the capacity of the public project developer to carry more risks and financial losses than the private one.

Restoration and Climate Resilience, November 13, 2019. <https://www.forest-trends.org/blog/five-things-we-can-do-in-the-next-24-months-to-mobilize-major-investments-in-ecosystem-restoration-and-climate-resilience/>

¹² Idem 11

¹³ More information on the NIWS project lead by Forest Trends available here: <https://www.forest-trends.org/who-we-are/initiatives/water-initiative/natural-infrastructure-for-water-security-in-peru/>

Table 2. Natural Infrastructure seen through the lenses of proponents versus financiers and project developers (Source: Altamirano (2018))¹⁴

Green infrastructure proponents	Financiers and Project Developers
Ecosystems risk reduction potential	New technology, which means additional risk
Scale: watershed and society	Scale: project contractual boundaries
Stock: natural capital	Stock: cash balance- debt servicing capacity of the borrower
Multiple functions:	Multiple functions:
Multiple co-benefits	Multiple principals= contractual risks
Opportunities for co-funding	Higher construction and operation risks
Opportunities for community driven implementation and bottom-up planning	Additional transaction costs: coordination and contract management

While eco-engineers advocate for the attractiveness of ecosystems as buffers that protect us against extreme events, financiers and project developers see “green infrastructure” techniques as an innovation and therefore as a significant source of additional risk. In the project finance world, the riskiest phase of a project is the construction phase and the most important guarantee that this risk will be well managed is the track record of the implementing party with similar techniques. Therefore, the default policy in project finance is to opt for proven technology. A new technology could be a significant source of delays during “construction” and poor operational performance over time, threatening the viability of the projected cash flows. In addition, the lack of standardization across green infrastructure projects poses an additional investment barrier. Even if performance data were readily available, it would be difficult to compare across projects (as each is “unique” to a certain extent) and build a proven track record for this type of asset.

The proponents compare green versus grey infrastructure focusing mainly on the changes in natural capital stocks and economic evaluating costs and benefits at the watershed scale and from a societal perspective. As earlier pointed out by OECD a strong economic case for investment does not always translate into a compelling financial case¹⁵. Meanwhile in project finance, the main criteria to evaluate alternative investments are the project Internal Rate or Return (IRR) and Net Present Value. Both are calculated by considering the cashflows – positive or negative - that can be captured by the project under the given contractual boundaries, in terms of area and risks. A financing institution will also decide whether to grant a loan to the project developer based on the same cash balance, assessing their Debt Servicing Capacity.

The proponents of green infrastructure build the investment case on their capacity to fulfill multiple functions and to generate multiple co-benefits. This feature can improve the cost-effectiveness of investments and ideally lead to multiple sources of funding. However, in practice many of these co-benefits do not translate into revenue streams. Meanwhile multiple functions can translate into projects that are contracted by multiple principals (public and/or private) and as there may be trade-offs between these functions this could easily translate into significant contractual risks, during construction and operation of these projects.

Finally, an additional advantage of green infrastructure often highlighted is the possibility of bottom-up planning and community-driven implementation. Again, this advantage is seen as a disadvantage by the infrastructure investment community; as implementation arrangements that involve communities can easily translate into additional personnel required for coordination and in the case of public project

¹⁴ Enabling Adaptive Management; integrating ecosystems into the Master Planning process. World Water Week 2018. Keynote presentation for the session Mainstreaming Natural Infrastructure for Water Supply, Eyes on LAC session convened by IADB. August 2018, Stockholm, Sweden.

¹⁵ OECD (2018) *Financing water: Investing in sustainable growth*, Policy Perspectives, <http://www.oecd.org/water/Policy-Paper-Financing-Water-Investing-in-Sustainable-Growth.pdf>

developers into additional public servants required for oversight and contract management.

The solution is to find a new middle ground. Changes are needed in public investment cycles and procedures, as well as in the way green infrastructure projects are conceived. More attention needs to be paid to the design of appropriate implementation arrangements that improve their commercial, financial and management business case.

How do we create a bridge between the two perspectives? How do we make the case for the changes needed in our investment planning systems? The strategic business case of hybrid water security strategies needs to be strengthened to justify these changes. Positioning ecosystems as critical infrastructures and integrating them into our master planning process as allies in the challenge of dealing with an uncertain future and enablers of a paradigm shift may be a promising venue. How do we integrate ecosystems into our master planning processes and make sure the natural infrastructure pieces of our water security strategies do not get implemented at slower pace than our grey infrastructure ones?

Bridging diverse perspectives to prepare investable hybrid infrastructure clusters

We propose an approach that engages the (infrastructure) financing community and the proponents of green infrastructure strategies for water security in the process of designing project delivery and finance arrangements that fit the characteristics of hybrid projects. A process that involves all relevant public, private and community actors key for implementation and enables the translation of strategic plans (e.g. Integrated Water Resources Management -IWRM- plans) into clearly phased hybrid infrastructure clusters that can be absorbed by formal public investment planning processes and then translated into number of financially viable or even bankable deals making use of a blended finance approach. Blended finance is defined as the strategic use of development finance and philanthropic funds to mobilize private capital flows to emerging and frontier markets by the OECD and the World Economic Forum^{16 17}.

The approach called the Financing Framework for Water Security (FFWS) offers an interface between the project delivery and finance community and the water resources planning and watershed conservation communities. The FFWS guides stakeholders involved in a water security planning process through several questions to develop the five business cases of the investment program proposed and design fit for purpose implementation mechanisms. It guides the design of an implementation arrangement – choosing from a wide range of project delivery and finance options that vary from purely public governance options up to the creation of markets for private initiatives.

¹⁶ OECD and WEF (2015), Blended Finance Vol.1: A Primer for Development Finance and Philanthropic Funders. <https://social-finance-academy.org/uploads/wef-oecd-blended-finance-a-primer-development-finance-philanthropic-funders-report-2015.pdf>

¹⁷ OECD (2018), Making Blended Finance Work for the Sustainable Development Goals, OECD Publishing, Paris, <https://dx.doi.org/10.1787/9789264288768-en>.

Figure 1: The Five Business Cases for public investments



The Five Case Model is the approach for developing business cases recommended by HM Treasury, the Welsh Government and the UK Office of Government Commerce. It has been widely used across central government departments and public sector organizations over the last 10 years. The model forms the basis of project and programme business case guidance created by HM Treasury and the Welsh Government¹⁸.

By taking into account: a) the transaction characteristics (technical and financial), b) the level of service required over time and c) the institutional setting (stakeholders interests, strengths of local government, private sector and community and the incentives created by formal and informal institutions) authorities in charge of planning in close consultation with the community and all relevant stakeholders decide how to make the provision of the envisioned water services possible, what to do themselves, what to delegate and to whom and how to ensure financial sustainability of these investments.

The methodology has been applied in strategic planning processes in the Philippines (Jalaur River Basin, IWRM plan), Mexico (Oaxaca city resilience plan), Indonesia (Semarang resilience strategy) and has been further developed for the specific case of Nature-Based Solutions in the H2020 project NAIAD (NAture Insurance value: Assessment and Demonstration)¹⁹. We present in the following paragraphs in a nutshell the process and illustrate its use for Semarang in Annex 1.

Phase 1: Strategic and Economic business cases

The first step is to clarify the Strategic Case by making explicit theory of change of the hybrid water security proposed. How will the proposed combination of green and grey enable a paradigm shift towards resilient economic growth? For the development of the strategic business case of the entire hybrid (green-grey) infrastructure strategy we have developed a collaborative modelling protocol – using Group Model Building techniques- that allow for transdisciplinary collaboration. The collaborative modelling exercise starts by creating understanding of current system dynamics at watershed scale, identifying drivers for increasing vulnerability, trade-offs between development and

¹⁸ HM Treasury (2018). Guide to developing the project business case. Better business cases: for better outcomes. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749086/Project_Business_Case_2018.pdf

¹⁹ NAIAD project website: <http://naiad2020.eu/>

environmental degradation and vulnerability to water and climate risks and goes onto identifying points of leverage to drive a paradigm shift.

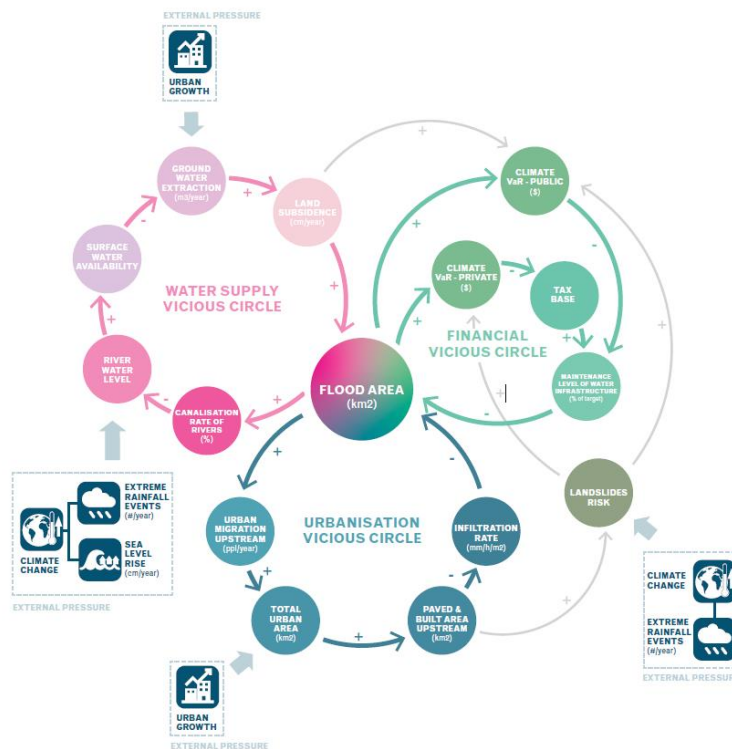
Once these have been identified, the design of alternative hybrid water security strategies is guided by several principles:

- ecosystems role as critical infrastructure,
- not green versus grey but aiming at the best combination of both given the problem at hand and the design constraints posed by the specific context,
- ecosystems as buffers that ensure systemic resilience and allow for the shift towards Natural Assurance Schemes (NAS)²⁰

Multiple variations and combinations of measures are considered and compared. The resulting preferred strategy will be a combination of structural measures (green and grey infrastructure), non-structural measures (information systems and early warning systems), and economic instruments to manage demand that prove cost-effective in solving the identified water challenges. This list of measures is then reorganized into hybrid clusters cluster to be analyze in more depth.

Using collaborative modelling²¹ techniques, shared understanding is generated, and the functionality and levels of service different hybrid infrastructure clusters can provide over time are made explicit. Based an explicit hierarchy of functions and the derived services alternative mechanisms to generate revenues are considered.

Figure 2: Dynamic between urban growth and vulnerability to water risks in Semarang²².



²⁰ Idem 6

²¹ Basco-Carrera, L., van Beek, E., Jonoski, A., Benítez-Ávila, C., & Guntoro, F. P. (2017). Collaborative modelling for informed decision making and inclusive water development. *Water resources management*, 31(9), 2611-2625.

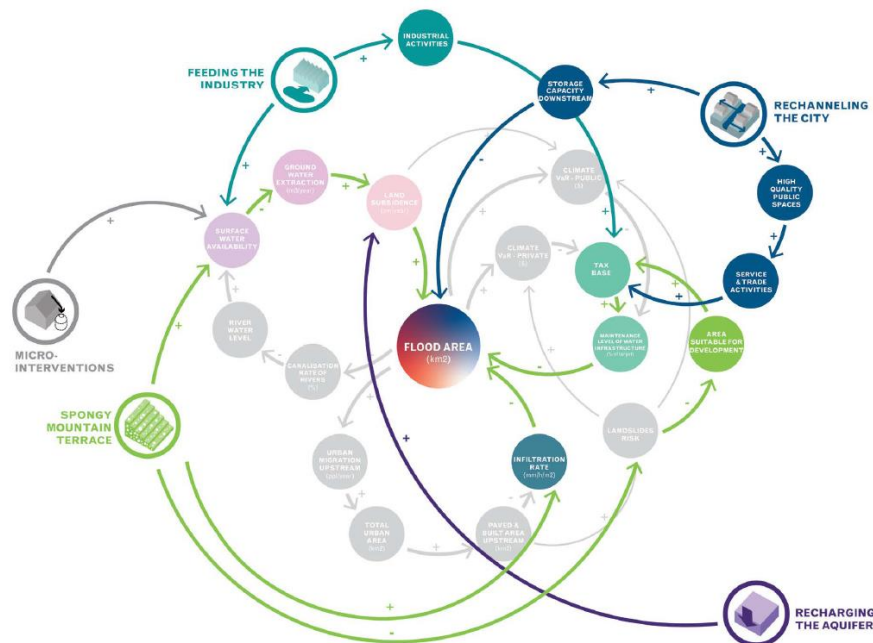
²² Semarang, steps to Inclusive Growth. *Water as Leverage*. 2019. MLA+, Fabrications, Deltares et al.

Collaborative modelling is about bringing those who develop analytical models to resolve complex water management problems together with stakeholders and decision-makers to improve the decision-making process. A collaborative modelling approach aims to enhance cooperation between stakeholders²³, as this is a critical factor for the implementability and sustainability of integrated river basin master plans. There are different types of collaborative modelling techniques²⁴, like Group Model Building (GMB) and Shared Vision Planning (SVP).

The result is a clear narrative of the need for investments and the incorporation of ecosystems into the resulting strategy. A good understanding of the drivers of water risks and the multiple benefits of the proposed strategy is a sound start point for the development of a blended finance strategy that mix different thematic concessional funds (ODA Water, Climate Finance, Conservation Finance, and others) and then in a synergetic way stimulate the creation of private markets.

Strategic investment pathways consisting of clearly phased hybrid infrastructure clusters that guide public and private investment decisions may have the potential to close the implementation gap of water security strategies. If the synergy embodied by these clusters is understood by investors, access to finance could become conditional upon timely implementation of other projects within an identified cluster. Figure 3. Strategic Case for Semarang: five urban typologies for Semarang and their impact on the dynamics between urban growth and water risks.

Figure 3: Strategic Case for Semarang: five urban typologies for Semarang and their impact on the dynamics between urban growth and water risks



Graph: The five concepts and their impact on the water management system and inclusive & resilient economic growth

²³ Grey D, Sadoff CW (2007) Sink or swim? Water security for growth and development. Water Policy 9(6):545–571

²⁴ Global Water Partnership (2017). Collaborative modelling. Engaging stakeholders in solving complex problems of water management. Laura Basco Carrera and Guillermo F. Mendoza. https://www.gwp.org/globalassets/global/toolbox/publications/perspective-papers/collaborative-modelling_perspectives_paper.pdf

Phase 2: the commercial, financial and management business case of hybrid investment projects

Starting from the phasing and clustering of projects agreed upon; the commercial, financial and management business case of hybrid investment projects is worked out. This process may involve rearranging of these clusters into investment projects or deals that improve the chances for successful implementation and sustainability in service delivery.

Whether the resulting deal will be hybrid green-gray projects, or separate Design-Build and Maintenance contracts for only green infrastructure, will depend on economics of scale and scope, as well as on the incentives different contract scopes create versus. All these factors are weighted against the long term goals the procuring authorities have. These choices are the result of a process of further design and selection, no different than how transport authorities decide whether to procure all lighting of roads separate from other routine maintenance activities, and how they decide the size and types of assets to include in a typical road maintenance cluster.

By making use of collaborative modelling techniques the following key aspects of green and hybrid infrastructure projects are clarified and agreed upon by the relevant stakeholders:

- **Hierarchy of functions:** combinations of measures that together ensure 2 to 4 main functions, for which it is clear how to prioritize in the case of trade-offs between them. This is a function not only of the physical processes, but ultimately a social construct that is influenced by how active different problem owners are and which function is valued more by public and/or private beneficiaries.
- **Function curves, Life Cycle Costs (LCC), cash and risk profiles of natural infrastructure measures:** the function curves, risk matrixes and LCC of grey infrastructures are often well known, however that is not the case for green infrastructure. A wide variety of technical expertise (e.g. ecology, morphology, civil engineering, and so forth) and simulation models need to be considered to arrive to the definition of these variables which ultimately shape the cash and risk profile of these hybrid investment projects.

Table 3 Hierarchy of functions of hybrid infrastructure clusters²⁵- NAIAD demonstration case Medina del Campo, Spain

Measure	Functions	Service	Type of good	Prevailing transaction governance	Responsible	Target group	Level of Service		
							KPI	BaU	Solution
1. Aquifer recharge	Recover surface ecosystems	Wetlands improvement	Public Good	Public Procurement	Municipality	Inhabitants or tourists	Surface of wetland improved (ha)	So far, undefined	So far, undefined
		Higher water availability	Common Pool Resource	Network of informal and formal arrangements	Municipality +CHD	Inhabitants and farmers	Net water availability (m ³ /)	So far, undefined	So far, undefined
2. Governance measures (WUA formation) and 3. Control of abstractions	Increase water table level	Higher piezometric levels	Common Pool Resource	Network of informal and formal arrangements	Municipality	Inhabitants and farmers	Exploitation index	1.6	> 0,8 to 1 in exploitation index
		Improvement of water quality	Common Pool Resource	Network of informal and formal arrangements	Municipality +CHD	Inhabitants and farmers	Surface of the aquifer with N and As levels within the thresholds		Nitrates: less than 50mg/l Arsenic: less than 10 mg/l
4. Transformation of the fields, and 5. Alternating crops	Improve water management	Access to produce higher efficiency/performance of crops	Private Good	Market and partnerships	CHD + MAPAMA	Farmers	So far, undefined	So far, undefined	So far, undefined

These two building blocks set the basis for further in-depth analyses that will lead to the identification of alternative revenue generation strategies (funding strategy) and the choice of a family of implementation arrangements. Depending on whether the services provided - not the assets- can be considered public, toll, common resources or private goods different sources of funding would apply; tariffs can be applied to private and toll goods and taxes or transfers would be required to fund public services. Then depending whether taxes, tariffs or transfers are identified as the most important source of revenue as well as whether the public or the private sector will be the main project sponsor, different types of implementation arrangements will be considered for further development of the full business case.

The different types of implementation arrangements are:

1. Public procurement route: here still different options are possible, from direct implementation by the public sector, up to concessional PPP's
2. Environmental markets, such as the mitigation market in the USA.
3. Stewardship²⁶ investments, by a private company.
4. Collective investment vehicles, such as water funds²⁷.

Although the design process will vary for different types of implementation arrangements, in most cases investments will lead to investment projects and/or the delegation of operation and maintenance activities to third parties. Whenever a public or private entity needs to implement the envisioned activities, they will need to decide whether to do that themselves, or to delegate it to another: public, private or community. In that sense, independent of whether the choice is for 1, 3 or 4; the project sponsor will have to make financing and procurement choices and for doing so we have developed a process that guide them in selecting the project delivery and finance mechanism that reduce transaction costs and ensure the right incentives are created for sustained service delivery.

²⁵ Altamirano, MA, Benitez, C. et al. Handbook for the Implementation of Ecosystem-based DRR. Financing Framework for Water Security. Deliverable 7.3 to the H2020 NAture Insurance value: Assessment and Demonstration (NAIAD). Manuscript in development.

²⁶ WWF. 2018. Water Stewardship Revisited. Shifting the narrative from risk to value creation. Alexis Morgan.

²⁷ Goldman-Benner, R. L., Benitez, S., Boucher, T., Calvache, A., Daily, G., Kareiva, P., ... & Ramos, A. (2012). Water funds and payments for ecosystem services: practice learns from theory and theory can learn from practice. *Oryx*, 46(1), 55-63.

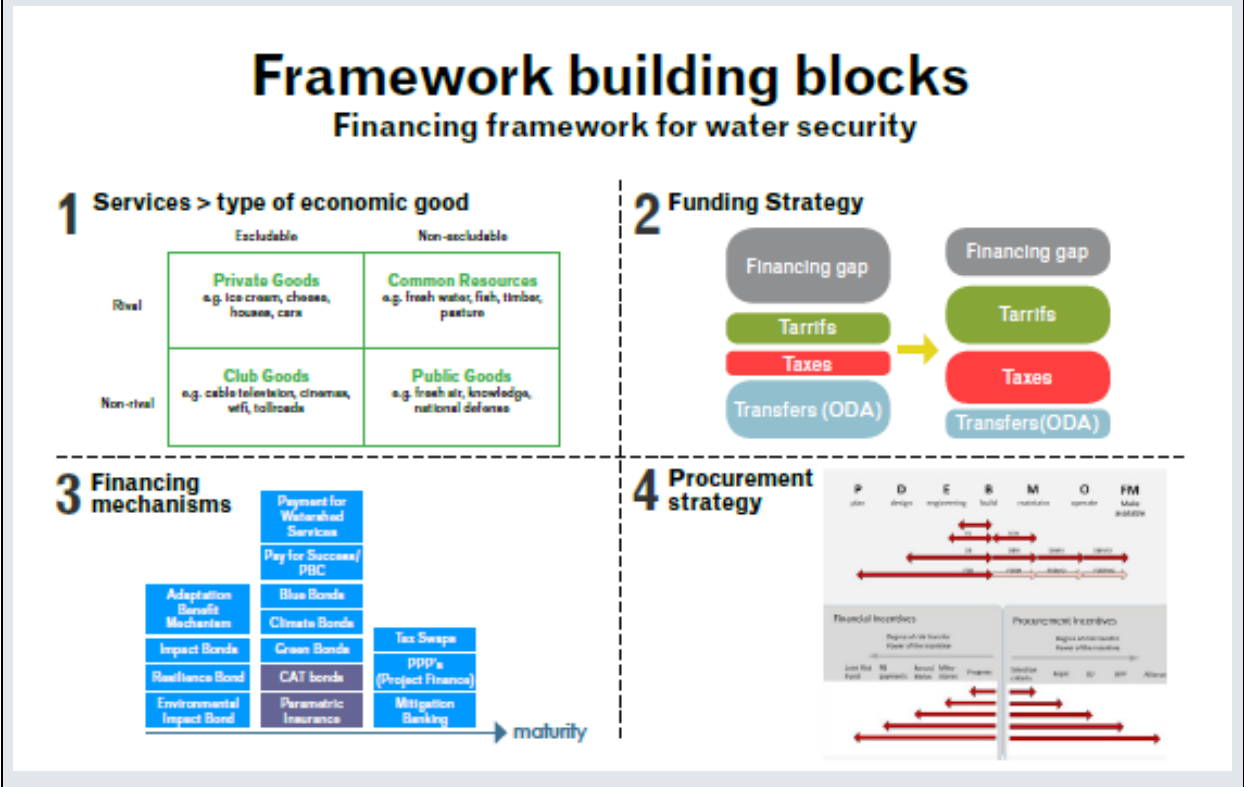
Box 1. Steps to design and implementation arrangement

Step one: define the main services the project will create and categorize this in types of economic goods. It is important here to bear in mind that we categorize the services the asset created by the project delivers, not necessarily the asset itself. For example, at forest may provide services that can be considered private (such as reduction of sedimentation rate of hydropower plants), yet the forest itself may be a public good. This categorization enable the identification which types of funding could be appropriate to ensure cost recovery.

Step 2: funding strategy: the funding of a project could be either public or private. In general terms the main sources of funding are what the OECD called the 3 T's: Taxes, Tariffs or Transfers. Once the sources of funding who ultimately pay for the project- are determined the mechanisms to arrange capital upfront (financing) and how to place the project on the market (procurement) are selected.

Step 3: Financing strategy: depending on the type of project and whether the project sponsor is public or private, a variety of financing instruments could be used. In the graph below we show for example a variety of innovative financing instruments for Climate Adaptation and DRR (Altamirano et al. 2019¹).

Step 4: Procurement strategy: which refers to the way in which the government agency or private project sponsor responsible for the project can choose to make use or to purchase the project. The graph shown here applies mainly to public infrastructures, while other sectors or types of transactions may need a different approach, such as the design of regulated markets or bottom-up community-based initiatives. At is shown in this graph in case of public procurement of infrastructures the government may choose to tender it as a full integrated contract (e.g. involving the private sector all the way from planning up to Operation and Maintenance) or choose for more traditional separate ones.



Financing a paradigm shift: a blended finance strategy

Even though at policy and strategic levels the value of resilience and the role of nature are being acknowledged, implementation of investments that reflect these values remains limited. The implementation challenge requires a different investment planning approach than the one applied so far. Concrete investment pathways to go from isolated

pilots up to full scale implementation of hybrid water security strategies need to be drafted jointly with, and agreed upon by, key actors: public procurers, infrastructure financing agencies and project developers.

Planning and investment decision making processes need to be redesigned and adjusted to accommodate hybrid (green-gray) projects and the proponents of green infrastructure need to develop the required evidence and shape these projects differently to fulfill minimum requirements that back up the investment of scarce public resources and/or secure the minimum returns expected by private investors.

To advance towards implementation at scale a blended finance approach is needed. Strategic investment pathways that coordinate interventions and instruments of different actors are required. Coordination is needed to develop a level playing field for private engagement and investment in hybrid infrastructure projects. Scarce public and concessional resources need be used in a catalytic way to significantly reduce risks and transaction costs for actors in the supply and demand side. A blended finance strategy for hybrid water security strategies will require the combination of multiple thematic streams of concessional finance (e.g. ODA, Climate Finance and domestic water finance) and contributions of different parties that goes beyond financial flows. The transformative potential of the right expertise at the table at the right time needs to be exploited in the way public investment planning and project origination takes place.

Public-Private-Science collaboration is required to develop shared understanding of mechanisms driving project risks and returns. This revolution in understanding could then inform a new generation of planning, project origination, project preparation and procurement tools and models that guide the selection of the most transformative and effective infrastructure investments.

Actors in the public and private sectors could drive this change by taking the following actions.

Firstly, public investment agencies and development finance in general must embrace a nexus approach to investments that challenge current silos. Even though great efforts have been done in implementing IWRM around the world and these planning process result in multisectoral strategies for water security, IWRM plans then are translated into thematic investment plans that divide gray from green infrastructure investment projects over different ministries. Often gray infrastructure elements are implemented at a faster pace than green ones. In most countries – given current allocation of roles along the whole infrastructure investment cycle - from that moment no one has a clear mandate to look after the implementation of the whole. Ideally, we could change our planning processes to involve earlier multiple sectors, MDB's and private sector and play a more active role in the shaping of clusters of projects that make sense not only in thematic terms but in terms of their commercial, financial and management business cases. These implementations of entire clusters and their required phasing could be then be guaranteed through interinstitutional agreements that make access to finance to any of the measures within one cluster, conditional upon the parallel implementation of the others. This approach could also enable the development of a blended finance strategy where multiple donors, MDB's and Climate Funds participate and reduce significantly the transaction costs incurred by and local national governments when aiming at developing a multisectoral investment plan considers adaptation.

Governments need to develop the instruments that allow them to “buy” or procure these solutions as easily and in the same standardized manner that they can purchase grey solutions. At the same time, they must also stimulate the creation of a private market of service providers through innovative procurement mechanisms available in the European Union, such as Pre-Commercial Procurement (PCP), Public Procurement of Innovation (PPI) and Innovation Partnerships.

Secondly, private investors should make people available to engage in these planning processes and share their expertise in shaping these clusters. Transparent platforms that allow for such exchanges and processes of market sounding are needed, so that the strategies and clusters selected have by design a stronger commercial and financial business case. An important referent in this field is the Water Resources Group (WRG) 2030 through their Analyze, Convene and Transform (ACT) approach. By creating a safe space for Public-Private dialogue they have achieved important changes in investment planning processes in countries like Peru (read Textbox 2).

Box 2. WRG2030 role in the promotion of green infrastructure in Peru (excerpt from WRG2030 digital article²⁸)

Peru: Green Peru: Green Infrastructure To Increase Water Access In One Of The Most Hydro Stress Cities In LAC

Sedapal, the state-owned water utility covering Lima city, has announced the execution of a Fund of almost USD 22 million (PER 73.5 million) in green infrastructure projects. The projects will reduce the water access gap investing in the middle and upper basins of the main surrounding rivers. 2030 WRG is the public-private dialogue platform where the guidelines and best practices for this process will be discussed.

The funds, collected through the Remuneration Mechanisms for Ecosystem Services established in 2015, will allow the implementation of green infrastructure projects such as lagoons, water harvesting, reforestation, terracing, and non-conventional water solution initiatives to reach those communities that have no access to water and sanitation in the neighboring areas of Lima, the Peruvian capital.

It is estimated that by the end of 2019, 100 projects will be selected and by the end of the year at least 5 or 6 projects will start its execution. According to Sedapal's

Asset managers and financial advisors have also a role to play, making investors aware of the synergies between different projects and that the performance of a single project they choose to invest on, will be strongly influenced by whether other projects on these clusters are implemented as well. Water risks are highly interdependent, therefore the risk, cash and impact profile of a single (infra) project can be hardly evaluated in isolation. - grey cant' be seen without ecosystems.

The finance community in general could take a much proactive role in the development of a transformational pipeline of water projects. Besides the development of a taxonomy for sustainable investments and the request of disclosure of climate and water risks, reporting on the contribution to SDG's could request disclosure of the active involvement of investors in water security planning processes, rewarding in this way their active involvement. New project finance models that fit the characteristics of green infrastructure cash profile are required, and only a finance community much more familiarized with this new asset class could make that possible.

The insurance sector has also crucial role to play given their in-depth expertise in risk management and the extensive knowledge they have of value at risk in different geographies. They could play a catalyzer role and drive the implementation of hybrid infrastructure strategies²⁹ by a) implementing risk-based premium based on models that take into account the resilience dividends of ecosystems, b) requiring minimum

²⁸ <https://www.2030wrg.org/peru-green-infrastructure-to-increase-water-access-in-one-of-the-most-hydro-stress-cities-in-lac/>

²⁹ Marchal, R., Piton, G., Lopez-Gunn, E., Zorrilla-Miras, P., Van der Keur, P., Altamirano, M.A., ... & Dartée, K. (2019). The (Re) Insurance Industry's Roles in the Integration of Nature-based Solutions for Prevention in Disaster Risk Reduction—Insights from a European Survey. *Sustainability*, 11(22), 6212. <https://www.mdpi.com/2071-1050/11/22/6212>

resilience standards and consideration of climate and water risks from the projects they finance as institutional investors and c) offering new insurance schemes and products that allow for the monetization of the resilience dividends of ecosystems. An example of the last is the parametric insurance policy to cover Mexico coral reef developed through a cooperation between the state government of Quintana Roo, the tourism industry, TNC and SwissRe³⁰.

However, in first instance insurance companies could support the development of transformational investment pipelines by sharing their data on historic losses and damage with municipalities (as is happening in Norway) and their expertise. By leading the discussion and development of catastrophic models that consider the effect of ecosystems in systemic resilience, they could incentivize investors to look at the portfolio in a systemic way.

The infrastructure community at large needs to be more involved. Their expertise in terms of project delivery and finance as well as of project management - for public infrastructure networks - needs to be part of the equation. Many of the taxation practices, funding and procurement choices experimented in the infrastructure world in the last three decades could enable leapfrogging.

The construction sector must start investing and expanding their eco-engineering expertise in their role as experienced project developers. These actors are crucial to the process of structuring bankable green/hybrid infrastructure projects and making green infrastructure suitable for performance-based contracting. Also the latest advances of the industry in digitalizing assets (e.g. BIM) and entire cities to improve asset management, are an unprecedented source of data for the modelling of water risks and alternative risk management strategies.

The private sector in general needs to be part of the planning and design process. However, how to make that possible? Even more for local and small companies that could be the ones driving the developments of disruptive business models that could enable the paradigm shift? Can we consider the use of concessional money to stimulate and make their participation in a consistent and transparent manner possible?

Table 2: Actions required of mainstreaming of hybrid infrastructure strategies for water security

MDB's and Climate Funds	Green infrastructure community
Financial instruments that shoulder "new" technology risks and fit the cash profile of green and hybrid projects	Developing the performance matrix and evidence, through monitoring and modelling
Promote cross-sectoral infrastructure delivery	Developing the risk management protocol of hybrid infrastructure clusters
Support countries in the development of the Climate and DRR rationale of hybrid infrastructure strategies for water security, and of blended finance strategies	Design-Build-Maintain guidelines for the industry
Documenting rigorously the evidence of the "paradigm shifting" potential of green infrastructure	
Develop blueprints of implementation and financing arrangements for different types of hybrid clusters	
Market creation: development of new type of hybrid infrastructure service providers	

Finally, Climate Finance could be a game changer. Concessional climate funds could drive the shift to new economic development paradigms by taking care of the

³⁰ <https://www.businessinsurance.com/article/20190607/NEWS06/912328933/Parametric-insurance-policy-to-cover-Mexico-coral-reef>

coordination and other major transaction costs involved in the transition and de-risking private investments. Significant efforts and investments are required to create a working market for hybrid infrastructure strategies and support the development of trustworthy suppliers of ecosystem services.

Question for discussion:

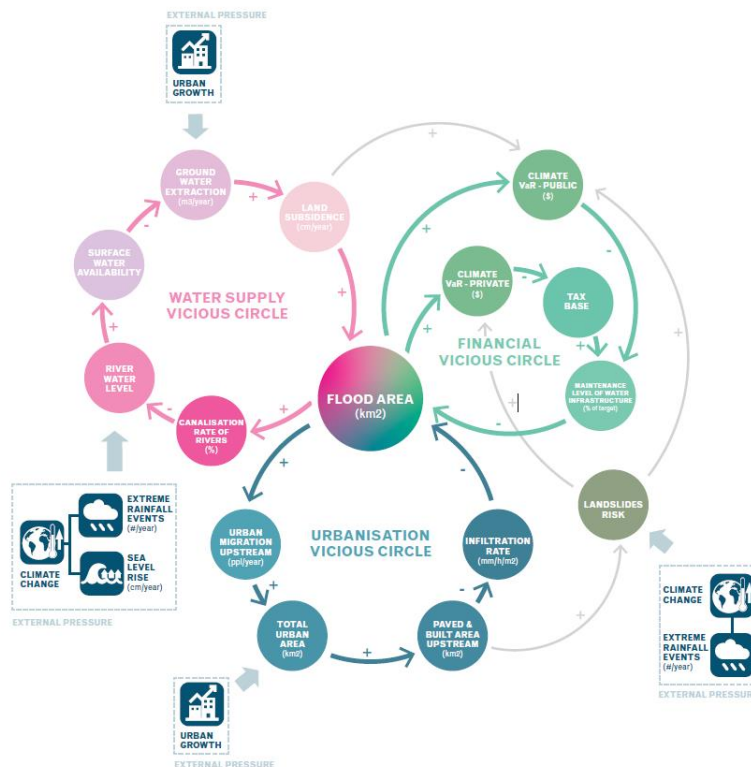
- Which changes do you think are required in current investment planning process of the public and the private sector for hybrid water security strategies to be implemented at scale? Which elements of the proposed approach do you agree or disagree with?
- Which role do you see for your organization in the closing of the implementation gap of hybrid water security strategies?
- How could Climate Funds, MDB's and donors cooperate in drafting the required strategic investment pathways? Which share of the transaction costs, transition risks and market creation activities are each of them best suited to cover?

Appendix I: Semarang: steps towards inclusive growth

Semarang is facing multiple interconnected water-related challenges. Urbanization as well as climate change increasingly exposes the city to flooding from both the sea- and mountain side. Additionally, long term groundwater extraction creates land subsidence and exhausts the available fresh water resources. Currently a wide array of measures has been employed to respond to the direct dangers at hand: polders, sea dykes and normalization canals for optimal discharge of water. Though these bigger scale measures are being successful, they don't address the causes of increased flooding, water scarcity and land subsidence, issues which will continue to grow if not addressed.

To address these issues, we need to tap into the abundance of water and store the water that is available. We also need to increase flood resiliency on a more local and decentralized manner, strengthening the finer network and exploiting the resilience dividends of nature. Following the watershed from upstream to downstream opportunities have been defined and explored, which shift the view of water as a threat towards beneficial. By adding the concept of 'cascading' to the current water management system, a series of elements of storage and utilization are created with a complementary and synergetic approach. Thus, creating a paradigm shift from "All the water out" towards "Not a drop of water gets lost". During this process we have defined five concepts for urban growth that have been further worked out into a long term investment program.

A paradigm shifting investment program: the strategic business case



The theory of change on how the investment program proposed drives a paradigm shift is presented in diagrams 1 and 2. Diagram 1 depicts several self-reinforcing mechanisms or vicious cycles that drive a process of exponential growth of vulnerability of the city as it grows and develops.

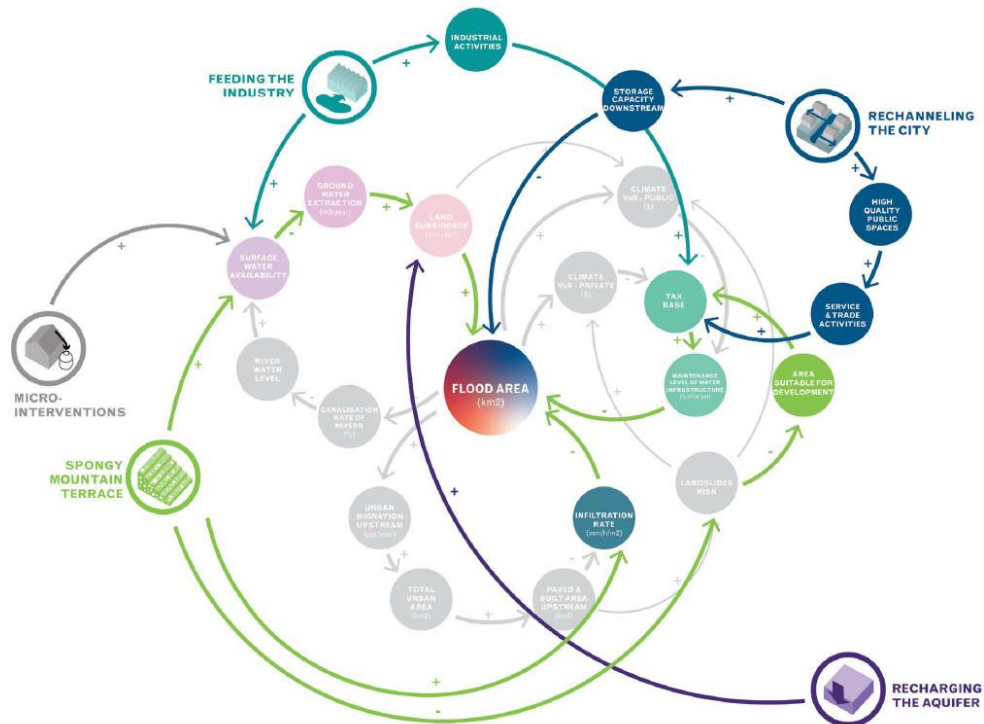
These are: Firstly, population growth and urban expansion cause the expansion of the urban tissue and an increase in paved and built area upstream of Semarang, which decreases the infiltration rate, causing higher discharge peaks during extreme precipitation events. A higher frequency of floods generates more attractiveness to moving upstream, reinforcing the initial reduction in infiltration rates.

Secondly, an increase in flood frequency increase the Climate Value at Risk for the private (damage of assets as well as foregone revenues during business interruptions) as well as for the public sector (damage to public assets such as infrastructure networks). The first, losses for the private sector erode the tax base of Semarang city. A lower tax base reduces the availability of resources for public spending on water infrastructure development and maintenance; impacting negatively the capacity of the city to deal with extreme events.

Moreover, an increased Value at Risk of public assets leads to higher expected damages. Less resources for maintenance in combination with higher expected damages leads to deteriorated maintenance levels of water infrastructure over time, reinforcing the initially increased Value at Risk of public and private assets through higher flood risk.

Thirdly, socio-economic activities in Semarang are heavily reliant on groundwater resources. Current abstraction rates are unsustainable, causing aquifer depletion and land subsidence. Land subsidence increases pluvial and coastal flood risk due to a relatively more low-lying coastal/downstream area over time. Increased flood risk has so far led to more canalization of the city for a faster discharge of water in the ocean; affecting negatively the availability.

The investment program proposed through five new urban typologies aim at setting I motion a new dynamic between water and economic growth to enable a decoupling socio-economic development from an increase on Climate Value at Risk of the public and private sectors. The implementation of all five in a phased manner will increase water storage and infiltration, increase in surface water availability and consumption and significant decrease to stop of groundwater extraction.



Graph: The five concepts and their impact on the water management system and inclusive & resilient economic growth

The five clusters considered are: micro-interventions, spongy mountain, rechanneling the city, feeding the industry and recharging the aquifer.

An Implementation Strategy for Cascading Semarang: the Commercial, Financial and Management Business Case

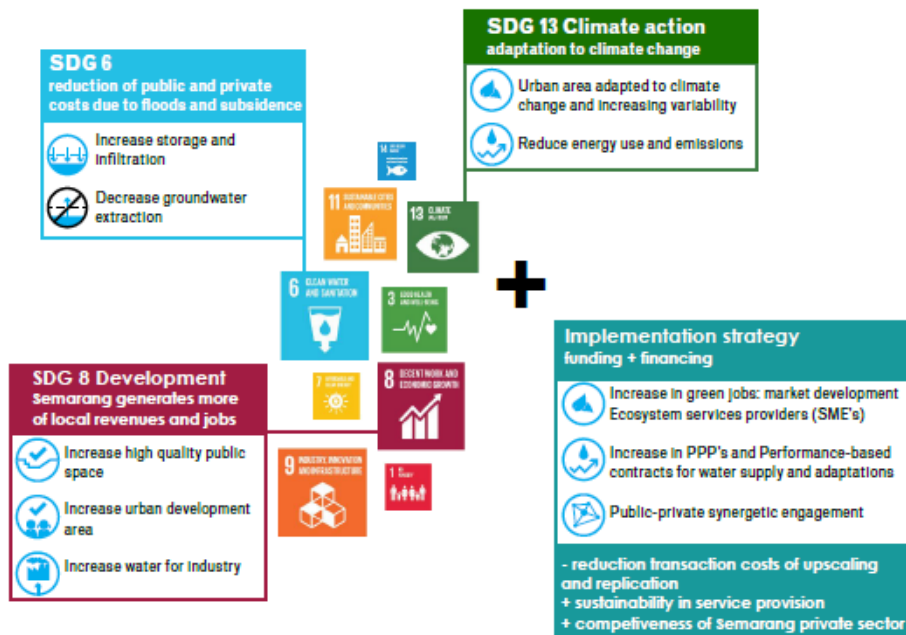
The ultima goal is to create a reinforcing strategy between economic growth (SDG8) of Semarang through an increase in the tax base, jobs and of local revenue sources, and the achievement of Water Security (SDG6) in the face of Climate Change. However, to ensure a high success rate and continuity in the improvements our concepts aim to achieve; we cannot do all these changes at once. First the evidence and citizens as well as private sector support and capacity needs to be developed through smaller size projects and sub(concepts) that impact important leverage points such as: groundwater infiltration rate and permeability of urban developments.

Characteristics of the proposed Implementation Strategy

The implementation strategy, which combines a large enabling environment component with specific implementation arrangements per concept has been designed to serve multiple goals:

- Increase in green jobs: market development Ecosystem services providers (SME's)
- Increase in PPP's and Performance-based contracts for water supply and Adaptation
- Public-Private synergetic engagement

While aiming at reducing significantly the Transaction Costs of upscaling and replicating the concepts at the Semarang and watershed level, ensuring sustainability in service provision and contributing positively to the competitiveness of Semarang private players in the water and urban development sectors.



Phased Strategy

As it has been explained before, does not seem possible to implement the whole Cascading Semarang at city and watershed level at once, because there is resistance to change at different levels and because there is limited implementation capacity -public and private- in place. Aiming at full implementation at scale at once would result either in too high transactions costs or reputational risks that may endanger the political support for the overall strategy.

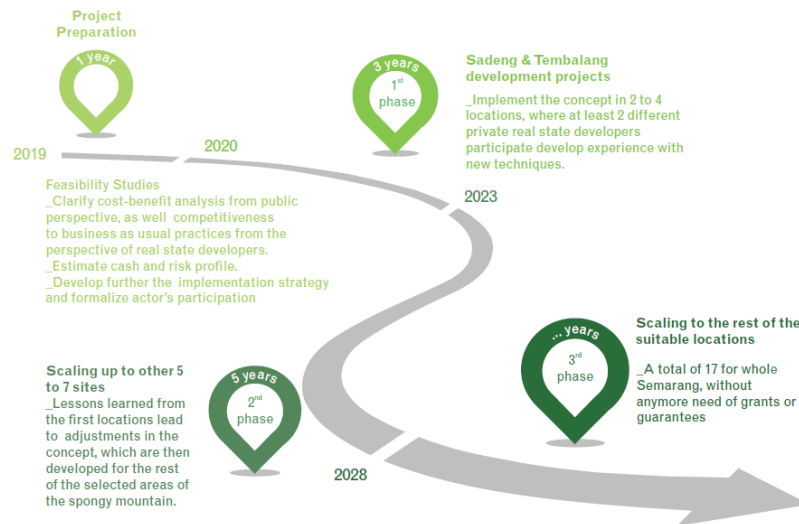


Diagram 3: Phasing in the implementation of Spongy Mountain cluster

Therefore is proposed to start with a number of selected pioneer transactions – ideally one per concept, in locations that maximize support and opportunities for successful implementation, and starting with measures at small scale – that a) create the evidence (data on the effects of the different interventions), b) generate buy in of communities, public and private sectors and c) gradually creates the capacity of public authorities to procure these projects successfully and of private sector to deliver professionally the works or services each of these concepts involve.

Creating an Enabling Environment – required support from MDB's

<p>1. Tax base and behavioural change</p> <ul style="list-style-type: none"> - Increasing tax base / DRM - Spatial planning & value capturing strategy - Revision of water tariffs: cost reflective incl. ecosystem protection - Water fund or other earmarked tax collections for DRR/CCA - Risk base insurance premiums 	<ul style="list-style-type: none"> • IFI's (e.g. WB Credit worthiness program) • Public-Private Infrastructure Advisory Facility (Trustfund) • GCF Readiness grant
<p>2. Monitoring smart water management systems</p> <ul style="list-style-type: none"> - Collect the data necessary to build the development / water security and Climate Business case for public and private investments - Monitoring for PBC and PES 	<ul style="list-style-type: none"> • GCF - Project preparation grant • TNC - experiences with design of water funds LAC • IFI's
<p>3. Blended finance: develop new markets</p> <ul style="list-style-type: none"> - Derisking suitable investments - Slowly reducing risk perception of private sector = service providers - Creating demand for different real state and urbanization models - Focus on SME's and creation of green jobs 	<ul style="list-style-type: none"> • Public-Private Infrastructure Advisory Facility (Trustfund) • GFC Private Sector Facility: Guarantees & Loans • IFI's & OECD & 100RC - to increase replicability

Secondly, work together with different government layers and with the support of the MDB's, Climate Funds and key donors to reconsider existing incentives created by the way risk, rewards and responsibilities are allocated between different government layers as well as between public and private players in the urban development, water management and disaster risk management sectors. Once this diagnosis has been done,

they can together set in motion the changes required to create an enabling environment that would allow the adoption of several innovative business models for efficient and effective provision of water services and the use of innovative financial instruments.

In table 1 are presented the three key elements of this last and transversal component, as well as an indication of which parties and funds or Technical Assistance grants seem a good match to support each of these lines of work.

Strategy to improve the bankability of Cascading Semarang

The Implementation Strategy developed making use of the Financing Framework for Water Security aims to improve the bankability of each of the concepts as well as the overall program by:

- Enabling multi-sectoral investments, making possible the financing and procurement of multifunctional projects
- Making use of a blended finance strategy: each concept and project will combine multiple SDG's, public and private goals, allowing of the use of different concessional and commercial funds: such as
 - Official Development Assistance for SDG6 and SDG8
 - Climate Finance – for the Climate Change Adaptation components
 - Generation of municipality local revenue sources
 - Efficiency gains driven by an increase in private sector participation in service delivery and the use of performance -based contracts
 - Introducing a new valuing of water and water related climate risks; which would lead to new trade-offs, improving the economic and financial viability of water security investments

Last but not least; a blended finance approach would also allow the use of concessional finance to stimulate the creation of frontier markets, by a) utilizing concessional finance to de-risk suitable investments, b) allow the introduction of new private players to the sector first as service providers and consequently – once they risk perception has been lowered- as possible financiers, and c) creating demand for different real state and urbanization models.

Implementation arrangements per cluster

As explained above, following the Financing Framework for Water Security methodology we proposed several alternative implementation arrangements and Public-Private engagement models for each of the concepts. The viability and details of these models will be further tested and worked out in close cooperation with SDG Indonesia one blended finance facility managed by PTSMI.

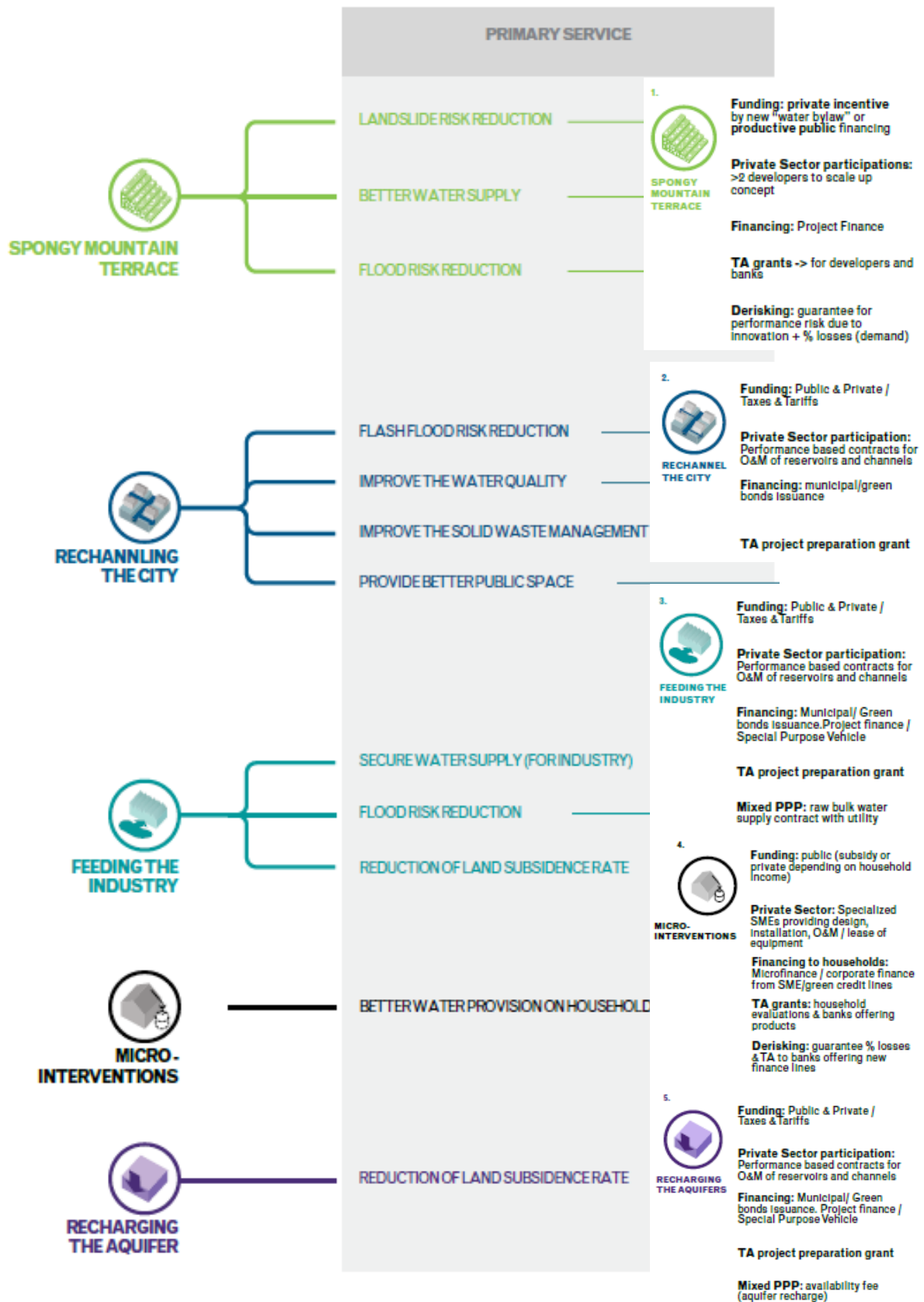


Diagram: primary services per cluster and proposed implementation arrangement.