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Submission of Work for the Consideration of the Nairobi Work Programme in the Area of Ecosystems, Interrelated Areas Such as Water Resources and Adaptation

Founded in 2010, the Alliance for Global Water Adaptation (AGWA) is an informal network for water resources adaptation to climate change, focused on supporting experts, decision makers, and institutions within the water and climate communities to find common solutions for sustainable water resources management. The AGWA network currently consists of more than 300 organizations from around the globe. AGWA is governed by a Steering Committee, which has two co-chairs: the World Bank and SIWI.

AGWA has several ongoing initiatives focused on mainstreaming climate adaptation in the areas of ecosystems and infrastructure as well as sustainable water resources management. These projects are cross-sectoral in nature and address a number of issues related to ecosystems, water resources, and adaptation.

AGWA is supportive of emerging bottom-up approaches to adaptive water resources management as a way to better work with uncertainty. Bottom-up approaches can be used within existing decision making processes to define problems more broadly and come up with more robust, flexible solutions. AGWA supports bottom-up approaches through three complementary methodologies: CRIDA, Eco-Engineering Decision Scaling (EEDS), and the World Bank's Decision Tree Framework (DTF).

CRIDA is an approach that implements decision scaling and bottom-up vulnerability approaches through collaborative stepwise planning procedures and adaptation pathways. To incorporate ecological considerations, CRIDA includes components of the recently published EEDS methodology. EEDS presents a novel way to negotiate simultaneous tradeoffs and risk exposure for ecological and human-centered water management objectives. CRIDA complements the World Bank's DTF, which was developed in 2015 and progressively directs the user through a series of queries to assess resilience or robustness to uncertain futures and does not prescribe any tool and/or planning process. CRIDA is similar and complementary to the DTF. Their strengths and applications are not exclusive. The application of the CRIDA processes and the application of DTF processes under similar conditions can lead to similar outcomes.

Below are highlights from relevant activities conducted by AGWA and collaborating organizations.

1. Incorporating Resilient Nature-Based Solutions for Water Services into Green Bonds

(Tools for assessing the benefits of mitigation and adaptation to enhancing resilience and emissions reductions that ecosystem-based adaptation provides.)

Description of the Tool

Investor demand for green bonds & climate bonds is strong, and will increase in line with the delivery of quality products into the market. Standards, assurance & certification will be essential to improved confidence and transparency, which in turn will enable further strong growth in the market.

The Climate Bonds Standard and Certification Scheme is an easy-to-use screening tool that allows investors and intermediaries to assess the climate integrity of bonds. It provides a set of transparent, verifiable compliance measures that all Certified Bonds must meet. A key part of the Standard is a set of sector-specific eligibility Criteria that can screen assets and capital projects for the purposes of identifying and certifying only that have climate integrity, either through their contribution to climate mitigation, and/ or to adaptation and resilience to climate change. AGWA has served as a leading member in the development of a Water Sector Criteria of green bond certification. Now, AGWA and partners are developing a second component of the Water Criteria focused on resilient nature-based solutions for water services.

This second phase of the Water Criteria extends the scope to incorporate nature-based solutions, which includes green and hybrid water infrastructure for such purposes as water collection, storage, treatment or distribution, flood protection, and drought resilience. This may include forests and wetlands that filter water, aquifers that store water for drinking or for flood control, and wetlands that attenuate storm surge or process wastewater effluent.

Partner Institutions

The Climate Bond Standard (of which this work is a part) is an effort of Climate Bonds Initiative, an investor-focused not-for-profit organization, promoting large-scale investments that will deliver a global low carbon and climate resilient economy. AGWA is the lead for the Technical Working Group (TWG) for the Water Criteria. Other organizations serving in the TWG for the Water Criteria and Resilient Nature-Based Solutions include CDP, Ceres, and World Resources Institute.

Key Results and Challenges

Phase 1 of the Water Criteria was completed in 2016. Its focus is on engineered water infrastructure for the purposes of water collection, storage, treatment or

distribution, or for flood protection or drought resilience. In May 2016 the San Francisco Public Utilities Commission (SFPUC) became the first organization to issue a green bond certified using the Climate Bonds Water Criteria. The certified bond was issued for USD 240 million. In December 2016 SFPUC announced their second Climate Bonds Certified water issuance with a USD 256 million offering as part of their USD 4.8 billion Water System Improvement Program.

Phase 2, which focuses on Resilient Nature-Based Solutions for water services, is still in the process of developing a draft version of the Criteria.

The key challenge for both components of the Water Criteria is making a tool that is usable by the market yet firmly grounded in eco-hydrological science. The Criteria must be simple to understand, implement, and measure. To accomplish this goal, the Criteria relies predominantly on information that already exists within potential issuers' organizations (e.g., Environmental Impact Assessments, etc.). This helps to minimize time and costs associated with undergoing certification and therefore increases the likelihood of uptake and utilization.

Planned Next Steps
Once a draft version of the Resilient Nature-Based Solutions Criteria has been completed, it will be circulated to members of an Industry Working Group (IWG) for review. Revisions will be made based on comments of the IWG. Then, the final proposed Criteria will be submitted to CBI's Climate Bond Standards Advisory Board for review and final approval. This is expected to take place in 2017.

2. Reducing Climate Risk for the Insurance Sector Through Natural Infrastructure (NAIAD)

(Tools for assessing the benefits of mitigation and adaptation to enhancing resilience and emissions reductions that ecosystem-based adaptation provides.)

Description of the Tool
AGWA is a member of a consortium for a new multi-year project called **NA**ture **I**nsurance Value: **A**ssessment and **D**emonstration (NAIAD). The NAIAD project is an effort to operationalize the insurance value of ecosystems to reduce the human and economic cost of risks associated with water (floods and drought) by developing and testing – with key insurers and municipalities – the concepts, tools, applications and instruments (business models) necessary for its mainstreaming. The project will do this in detail for eight demonstration sites (DEMOs) throughout Europe and develop tools and methods applicable and transferable across all of Europe.

The assumption is that Natural Assurance Schemes can reduce risk, especially to drought and flooding, and this risk reduction can be assessed and incorporated within insurance schemes.

Partner Institutions

The NAIAD project is being hosted by Confederación Hidrográfica del Duero in Spain. AGWA is a member of a consortium that includes individuals from the following organizations: CH Duero, Geological and Mining Research Office (France), King's College London, ICATALIST, European Regional Center for Hydrology, REVIVO, L'Istituto di Ricerca sulle Acque, Geological and Mining Institute of Spain, Stockholm International Water Institute (SIWI), GeoEcoMar, Geological Survey of Denmark and Greenland (GEUS), Business Development Group (Romania), CCR (France), Universidad Politécnica de Cartagena, ISKRIVA Institute, National Research Institute of Science and Technology for Environment and Agriculture (France), Institut Méditerranéen du Risque, de l'Environnement et du Développement (IMREDD), UNESCO-IHE, Københavns Kommune, Field Factors, and Deltares.

Key Results and Challenges
NAIAD is still in its initial stages. AGWA and consortium members are working to finalize project scope and identify DEMO sites.

Planned Next Steps
The team has submitted a paper to *Environmental Research* for review and possible inclusion in a special issue on Nature-based Solutions. At the end of January, consortium members will attend a series of kick-off meetings in Valladolid, Spain.

3. **Using Natural Infrastructure within a Decision Support System Through CRIDA: A Bottom-Up Approach to Adaptive Water Resources Management**
   (Adaptation planning processes addressing ecosystems and interrelated areas such as water resources)

Description of Relevant Activities and Partner Institutions
Now under development for publication in the first quarter of 2017, Collaborative Risk Informed Decision Analysis (CRIDA) provides stepwise planning guidance for water resources planners, managers, and engineers to implement robust water management as promoted by the AGWA network — particularly for water managers working in the developing world. CRIDA will initially launch as a publication, and support a community of practice to rapidly scale up implementation.

Through CRIDA and the other supported bottom-up approaches, AGWA addresses the urgent need to better tailor decision making under uncertainty to the practice of water management and to improve the capacity of stakeholders, decision makers, and technical water staff together while simultaneously focusing on using natural infrastructure within a decision support system for adaptation.

Within AGWA, CRIDA is led by the US Army Corps of Engineers and the Rijkswaterstaat (Dutch Water & Environment Ministry), with strong support from Deltares, the World Bank, the University of Massachusetts at Amherst, and the Pegasys Foundation.

Key Results
At this stage it is too early to state key results as the publication is still forthcoming and the community of practice is in early development. However, CRIDA is beginning to be applied to some real world scenarios which will provide feedback on implementation of the process.

Description of Lessons Learned and Good Practices
CRIDA will address a number of critical water resources priority areas, including the assessment of existing and future water-related infrastructure (including natural infrastructure) to climate risks and the relative importance of climate risks to other challenges (e.g., demographic, economic, and urbanization shifts). It is a framework that helps water managers to address extreme weather events as well as shifts in mean climate characteristics, as well as associated socio-economic and environmental impacts. CRIDA provides a way of estimating climatic and eco-hydrological interactions with water availability, water quality, and water seasonality, including groundwater management and its interaction with shifting surface conditions. Throughout all CRIDA steps, there is an emphasis on wise use, adaptive management, and effective water conservation approaches.

Description of Key Challenges
CRIDA steps align well with other planning and design processes. Therefore, it will be a challenge to distinguish where CRIDA aligns with the status quo versus areas where it may supplement or diverge from existing planning processes. Also, due to the general novelty of CRIDA, it will initially be challenging to translate the process into practice for the first cases as the capacity for implementation is evolving.

Planned Next Steps
The CRIDA publication will come out in the first quarter of 2017. Efforts are already underway incorporate CRIDA into a community of practice along with other bottom-up methodologies to risk assessment and addressing uncertainty (i.e., EEDS, DTF, adaptation pathways). One component of the community of practice will be developing a "knowledge platform" that can serve as a means for showcasing, curating, and fostering a global practitioner's network centered on bottom-up climate adaptation methodologies through information technologies (IT). This will include descriptions of emerging tool sets, a global forum, and showcasing new applications of these bottom-up methodologies in programs and case studies.

Another component of the community of practice will be a technical methods meeting with key SIWI, World Bank, and other partners (e.g., Rijkswaterstaat, US Army Corps of Engineers, etc.) in May or June 2017 to explore how these methodologies have been progressing and how best to advance these programs of work for the future, how this issues are being implemented, what gaps are emerging in terms of practice, governance, finance, and capacity, how to integrate existing and new tools within this framework, and how best to activate and serve the potential and actual members of this community.

In addition to the development of the community of practice, AGWA and partners will have recently received approval to pilot CRIDA at a city scale in Thailand. This project will begin sometime in 2017.

4. Developing National Adaptation Policy Guidelines Around River Management for the Mexican Government Using EEDS

(Tools for assessing the benefits of mitigation and adaptation to enhancing resilience and emissions reductions that ecosystem-based adaptation provides.)

Description of the Tool

AGWA is leading a project to develop national adaptation policy guidelines for river/water management in Mexico using Eco-Engineering Decision Scaling (EEDS). The project is designed to analyze the effects of climate change on e-flows as they relate to the CONAGUA-WWF water reserves program in Mexico.

The water reserves program currently specifies a volume or percentage of water that is "reserved" for freshwater ecosystems as an environmental flow program. This project will assess and quantify the adaptation benefits of this water reserves program using the EEDS approach to analyzing freshwater ecosystems and infrastructure.

EEDS is an approach that explicitly and quantitatively explores trade-offs in stakeholder defined engineering and ecological performance metrics across a range of possible management actions under unknown future hydrological and climate states. The EEDS framework significantly contrasts with approaches typically used to assess the environmental impacts of water infrastructure projects, and it follows an iterative five-step process that includes defining system performance criteria, building a systems model, conducting a vulnerability analysis, evaluating options, and identifying a preferred decision (and, if necessary, reevaluating management options and/or criteria). EEDS is one of multiple bottom-up methodologies promoted by AGWA. It can work with other water resources management decision making frameworks such as CRIDA and the World Bank Decision Tree Framework mentioned earlier.

Partner Institutions

For this project, AGWA is collaborating with the Mexican Water Commission (CONAGUA), World Wildlife Fund, and the Inter-American Development Bank.

Key Results and Challenges

The goal of this project is to quantify the climate adaptation benefits of the CONAGUA-WWF water reserves program in Mexico so that the team can document how environmental flows contribute to ecological and social resilience. In particular, AGWA aims to make clear the volume and timing of the environmental flows necessary to ensure resilience for these systems, with particular attention paid to drought and flood risks. The project is well underway and currently in the scenario testing and vulnerability analysis phase.

Planned Next Steps
Based on the outcomes of the EEDS process, the project team will hold a workshop in Mexico to present outcomes and discuss results. The workshop is set to take place in March or April 2017. The ultimate goal will be the development of a protocol that CONAGUA and other water managers can implement for other national management contexts.

5. Assessing and Managing Climate Change and Other Risks in Water Projects Through the Decision Tree Framework (DTF)

(Tools for assessing the benefits of mitigation and adaptation to enhancing resilience and emissions reductions that ecosystem-based adaptation provides.)

Description of the Tool
Planning, design and operation of water resources projects is a decision-making process under uncertainty. In this scenario, the first uncertainty relates to the methodology to be used. Are traditional methods obsolete? Which of the methods developed for making decisions under uncertainty is the most appropriate in each case? Will the many approaches proposed to simplify the task be adequate? Do we need, on the contrary, to resort to the most complex models in all cases? What effect does technology, the need for specialized assistance, limited information, time and cost, have on our methodology decisions? Which of the many climate-related and unrelated uncertainties is dominant and deserving most attention under existing constraints especially in developing countries?

The Decision Tree is a framework of analysis that allows finding answers to these and other questions in a logical, sequential and scientifically supported way, in four successive phases, from the simple to the complex. It allows therefore to apply the most appropriate methodologies according to the case and the causative factor of the dominant uncertainty, being efficient in the use of available resources and time. It is not based on assuming in advance scenarios that in the long run are fundamentally uncertain, but in analyzing the behavior of the Projects in a plausible range of values of the variables to discover their vulnerability and then propose corrective measures in terms of planning, design, and/or operation to achieve robustness.

Partner Institutions
The Decision Tree Framework (DTF) was developed by the World Bank with financing of the Water Partnership Program (WPP), a longstanding partnership among the World Bank and the governments of the Netherlands, the United Kingdom, Denmark and Austria, and the collaboration of the University of Massachusetts at Amherst and the input of several other institutions belonging to the Alliance for Global Water Adaptation (AGWA) such as the United States Army Corps of Engineers (USACE), the Stockholm International Water Institute (SIWI), and others. During its application phase since 2015 it has received the collaboration and input from WPP, the Korean Green Growth Trust Fund, the Ministry of Energy, Government of Nepal; the Nepal Electricity Authority (NEA), the Kenya Ministry of Environment and Natural Resources, the National Water

Commission of Mexico (CONAGUA), the Valley of Mexico Water Basin Organization (OCAVM) and the Mexico City Water System (SACMEX), among others.

Key Results

The DTF has been and is actually being applied to real world projects such as the Upper Arun hydroelectric project in Nepal, the Mwache water supply and irrigation project in Kenya, the multi-reservoir Cutzamala water supply and irrigation system in Mexico, the Poko project and the pumped storage Matenggeng hydropower projects in Indonesia. As a result, the risks and potential benefits of investment in the Upper Arun project and robust adaptation options for the Mwache project were identified. Likewise, the vulnerabilities of the Cutzamala system and options for adaptation are being assessed. The Poko and Matenggeng projects are still under study. Discussion workshops have been held in Nepal and Kenya and DTF application training courses were held in Nepal and Mexico City.

Description of Lessons Learned and Good Practices

In each case of DTF application inception and validation workshops with representatives from key government organizations, academic institutions and other relevant stakeholders demonstrated the importance of local inputs to define performance metrics and selection of relevant adaptation options. At its best, the DTF approach is expected to provide a common framework that can be generally applied to infrastructure development. It will also be useful to assess other risks in addition to climate and thus position climate risks within a broader and realistic context. The articulation of a programmatic approach to assessing and managing climate risks in the context of other risks for water project investments is expected to lead to more robust and resilient projects that perform well over their lifetime.

Description of Key Challenges

The DTF aligns well with the status quo of general water resources practice enhanced by a practical way to account for the climate change uncertainty. It is more effective in the early stages of planning and design, where decisions can still be made about options for adaptation. In fact, brings out again the importance of decision making under uncertainty in the planning and design of water projects. The main challenges relate to the mainstreaming of this analysis not as a separate assessment but as an integral part of the regular planning and pre-feasibility studies. These challenges can be faced by wide diffusion and dissemination among practitioners, which in itself is also an important challenge.

Planned Next Steps

Looking at the first semester of 2017, the application to the Cutzamala system is about completed and the application to the Poko and Matenggeng projects in Indonesia is also under way. An initial evaluation of the urban water systems of Mexico City is about to start. A report synthetizing the experiences and lessons learned is planned after closing of Fiscal Year 2017. Regional training courses are planned for Marrakech, Beijing, Korea and Amherst MA. Additional operational applications and training courses are envisaged for the two following fiscal years.

6. Assessing Water Infrastructure Solutions from Ecosystem Services underpinning Climate Resilient Policies and Programmes (WISE-UP)

(Adaptation planning processes addressing ecosystems and interrelated areas such as water resources)

Description of relevant activities and collaborating partner institutions

Project led by *The International Union for Conservation of Nature (IUCN)*
Partners: *The Ghana Water Research Institute – Council for Scientific and Industrial Research (WRI-CSIR), The African Collaborative Centre for Earth System Sciences (ACCESS) – University of Nairobi, the International Water Management Institute (IWMI), the Overseas Development Institute (ODI), the University of Manchester, the Basque Centre for Climate Change (BC3).*

'WISE-UP to climate'[1] sets out to demonstrate natural infrastructure as a 'nature-based solution' for climate change adaptation and sustainable development. The project develops knowledge on how to use mixed portfolios of built water infrastructure (e.g. dams, levees, irrigation channels) and 'natural infrastructure' (e.g. wetlands, floodplains, watersheds) for poverty reduction, water-energy-food security, biodiversity conservation, and climate resilience. WISE-UP aims to show the application of optimal portfolios of built and natural infrastructure using dialogue with decision-makers to identify and agree trade-offs. The project also seeks to link ecosystem services more directly into water infrastructure development in the Volta River Basin (Ghana principally, but also Burkina Faso) as well as the Tana River Basin in Kenya.

Inter-disciplinary by design, the success of the project lies in its ability to bridge the social and natural sciences. Using the Tana and Volta as demonstration basins, IWMI is exploring the eco-hydrological functions of built and natural infrastructure in the context of climate adaptation through a range of techniques, including modelling, ecosystem service mapping and the development of "benefit functions" linked to hydrological functions. BC3's economic valuation work is assigning monetary value to different system impacts and natural infrastructure investments. This information facilitates analysis of the economic costs and benefits associated with infrastructure, management and climate shifts. The University of Manchester's river basin impact modelling and trade-off analysis integrates IWMI and BC3's outputs to generate the set of best available (i.e. most efficient and robust) combined built and natural infrastructure investment options for an uncertain climate future. Each combination of built and natural infrastructure provides a different balance of benefits which is then represented graphically for stakeholders to discuss.

The political economy research on decision logics and political drivers, complements the ecosystem infrastructure investment analysis by bringing a deeper understanding of why and how basin stakeholders make the investments decisions they do and how climate change is understood. The basin leads, WRI-CSIR and ACCESS, work alongside the other partners to help ground truth the research. They develop in-country skills and

[1] WISE-UP is a four and a half year project which started in August 2013.

capacities for sharing results, aiming to strengthen understanding and ownership of data and tools under WISE-UP.

Weaving a joint project narrative through iterative learning is the Action Learning process under WISE-UP. Led by IUCN, this engages basin stakeholders directly from the start putting them in the driver's seat to actively guide project research and direction. The process is designed to operate at the interface between the development of new scientific evidence and the identification of the political dynamics and economic drivers shaping decision making and policy. This is critical to better understand how to make information and innovative tools practical, useful and trusted – how to take science into policy circles and decision making processes. It helps us shape the future stages of research and field work, and allows WISE-UP to continually evaluate the relevance of its work.

Key results

WISE-UP is generating preliminary results concerning infrastructure choices and options, and how these relate to climate futures using the latest climate and hydrological information and predictions. This is set in context using political-economy research and sensitive information concerning decision making. The project has been engaging with basin stakeholders to ensure that it builds products/outputs that are accessible, relevant and directly applicable.

- **Eco-hydrology functions of infrastructure in the context of sustainable adaptation (IWMI):**
    - Baseline reports publisehd for the Volta and Tana river basins.
    - Climate change scenarios anaylsis (including sedimentation and remote sensing work) for Tana and Volta basins.
    - Ecosystem services mapping at community level and basin level ecosystem service benefit functions developed for integration of natural infrastructure processes into system modelling for trade-off analysis.

- **Ecosystem valuation and benefits of natural infrastructure (BC3):**
    - Economic valuation results have been produced at household level in the sub-catchment of the Kimakia, in the Tana River Basin (Kenya) and from the Pwalugu area in the Volta River Basin (Ghana).

- **Systems modelling and trade-off analysis (University of Manchester):**
    - Systems models built and trade-off analysis results produced for the Tana and Volta River Basins through engagement with basin stakeholders. The final results will be able to include 10 decision options.

- **Political economy analysis of water infrastructure decisions and governance (ODI)**:
    - The results have examined the underlying drivers, incentives and constraints to understand how stakeholders interact in pursuit of their interests, promoting some policy objectives or isolating others, towards making certain investment choices. The aim is to identify opportunities to introduce innovation to policy-making and river basin planning, with a

view to promoting equitable, sustainable and climate-compatible solutions.

- **Action learning process with stakeholders to strengthen applications of evidence and tools in policy making, infrastructure decisions and consensus building (IUCN):**
    - 4 sets of Action Learning meetings (over 2015-2016) with both a wider stakeholder group and decision-makers delivered in both the Tana and Volta basins, to verify and provide guidance into the research under WISE-UP.

- **Capacity building for integrating built and natural water infrastructure and sharing results (CSIR/ACCESS):**
    - Series of workshops to build in-country understanding of WISE-UP's approach and the tools and results produced have been delivered in-country to a range of stakeholders including decision-makers, NGOs, academics. This included: IRAS modelling training, participatory scenarios visioning wokshop, economic valuation tools, participatory ecosystems mapping at local level and systems modelling training.

Description of lessons learned and good practices

Joint learning occurs at two levels, at one level between the project and basin stakeholders to understand the political, social, economic and environmental landscapes in the Volta and Tana River basins and then within the project research team itself between social and natural scientists. Some key points include:

- The range of interpretations of the term 'ecosystem services' has created delays in learning and sharing of results/experiences. It also has implications on discussions around climate change adaptation and nature based solutions. WISE-UP has attempted to tackle this by working on a new conceptualisation (visualised through an infographic and developed in a journal article) of 'ecosystem services' and how they relate to built infrastructure to ensure clarity and agreement.
- To reach real integration of multi-disciplinary research, continuous and active facilitation between partners/scientists is needed. Even when agreements are reached and research aligns, it cannot be assumed that it will continue in that way.

Description of key challenges

Challenges with first the recognition and then the implementation of natural infrastructure approaches are complex. A dominance in conventional approaches and weakness in institutional capacities leaves natural infrastructure absent from many discussions. 'Ecosystem based Adaptation' tends to be small scale, sporadic, and cause confusion with institutions as to the benefit, the overlap, and the complementarity of this work. In the Volta particularly, questions are raised on the economics of adaptation, to better understand the possible savings from mobilising adaptation actions. Natural infrastructure management also sits with communities, so coordination with built infrastructure becomes complex and sporadic, when ideally large scale coordination is required with institutions.

Planned next steps (as appropriate)
The project will end in Dec 2017 but currently working to solidify relationships with key institutions for a continued use of outputs, tools and data beyond the project.