SIWI WORLD WATER WEEK

Seminar: Investing in freshwater ecosystems and biodiversity: A key development challenge

ABSTRACT VOLUME

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Seminar: Investing in freshwater ecosystems and biodiversity: A key development challenge

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Balancing built and natural infrastructure investments in Kenya's Tana basin

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Keywords

ecosystem services, systems modelling, water infrastructure investment planning, climate change, decision making under uncertainty

Highlights

- A water system model of the Tana Basin and multiple performance metrics, including ecosystem services, were co-developed with stakeholders
- A multi-criteria search algorithm used the model to evaluate basin development interventions (assets/policies) and maximise system performance.
- Performance trade-offs implied by different infrastructure investments were interactively visualised for stakeholders to deliberate.

Introduction and objectives

Ecosystem service impacts of built water infrastructure can be significant, yet these rarely receive equal consideration in comparative technical or economic analysis of development options. The WISE-UP to Climate project spent four years developing and demonstrating a new approach to river basin planning in Kenya's Tana Basin. This uses the best available system-scale impact evaluation to better inform decision makers about the trade-offs inherent to their system's development. The objective was to show the advantage of a combined built and natural infrastructure design approach to address water-energy-food security, ecosystem service protection, and climate resilience.

Methodology approach

A system model was co-developed with diverse national and basin stakeholders. This involved mapping locations of key ecosystem service provision, and deriving benefit functions evaluating how services are impacted by varying river flow or reservoir storage. Stakeholder interactions took place through bi-annual Action Learning groups and bilateral meetings. Different plausible scenarios of hydrological inflows were generated by downscaling GCM data for the 2050s and passing the resulting precipitation and temperature data through a basin-wide hydrological model. The system model was coupled to a multi-criteria search algorithm to identify efficient and robust interventions based on several performance.

Analysis and results

The output of the search is a set of efficient and robust interventions and their performance over the range of scenarios tested. These outputs are interactively visualised to allow intuitive exploration of the complex relationships between competing interests. Understanding these relationships can help reduce unintended consequences of interventions and develop more balanced 'performance-based' development plans. We facilitated multiple interactive sessions during Action Learning meetings to explore user responses to different types of results and visualisations. Users interacted with results in small groups or in an open plenary forum. Stakeholder responses were used to narrow down a range of acceptable system performance trade-offs considering the various stakeholder objectives. The resilience of promising interventions identified by

the automated filtering were assessed with further stress testing simulation. Flooding is the driver of most ecosystem services in the lower Tana, and is projected to be increased by climate change. This means more benefits may become available overall, but decisions will need to be made about how best to balance benefits between different interests in the basin. Ecosystem services rival hydropower for monetary value and have distributional effects so the appropriate balance needs to be carefully considered.

Conclusions and recommendation

Taking a performance-based approach to basin intervention design showed how portfolios of combined built and natural infrastructure could better support water-energy-food security, biodiversity conservation, and climate resilience. An Action Learning process was used to align technical analysis with stakeholder needs and to provide regular feedback and iteration on model development and results. The work shows how decisions about balancing the multiple benefits from proposed water resources system interventions under future uncertainty, e.g. from climate change, could be effectively informed by the proposed approach.

Conserving the Lake Tana ecosystem for sustainable peace and livelihoods

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Keywords

Freshwater ecosystem, biodiversity conservation, peace, sustainable livelihoods, siltation

Highlights

Ethiopia's Lake Tana faces serious threats arising from encroachment, loss of wetlands; heavy deforestation in the upper catchment areas and consequent siltation from feeder-rivers; unsustainable investment patterns; and water hyacinth. Climate change added, the Lake would disappear in the very near future with catastrophic species, socioeconomic and political impacts.

Introduction and objectives

In 2007-2010, FESS launched an environmental security assessment study of Lake Tana, Ethiopia to determine threats and implications for socioeconomic, cultural, environmental and political wellbeing of the country and the Nile riparian countries. The study used a multiphase analytical tool that combines data gathering and field interviews. Serious degradation of wetlands around the Lake and its catchment have posed extensive threats, now, made worse by water hyacinth invasion. This paper reviews current situation; establishes a case for conservation of the Lake's water ecosystem as a critical tool for sustainable peace and development; and proposes holistic and actionable set of recommendations.

Methodology approach

The study involves literature review, analysis of primary and secondary data including household surveys and community focused group discussions guided by the Environmental Security Assessment Framework (ESAF) developed by FESS. ESAF analyzes multiple dimensions of stability and instability (social, economic, political) and links them to losses of environmental resources (water, land, forests) that may arise from overuse, abuse or misuse of them. These changes in resource conditions are treated as a continuum, with instability, heightened tensions, turmoil, and conflict. The ESAF proceeds through eight phases including generating scenarios that project potential environmental security trajectories over the years.

Analysis and results

Lake Tana, Ethiopia's largest water body, accounts for 50 percent of the total inland waters in the country, provides livelihoods to close to 5 million people and supports substantive fishing industry and significant hydropower energy. The Lake area and its 37 islands are home to 20 ancient Ethiopian Orthodox Church monasteries - a cultural heritage of national and global significance. Threats to the Lake include: (a) decrease in water levels owing to high population growth and unplanned investment; (b) unsustainable traditional and extensive cultivation practices at the backdrop of growing demand for food; (c) deforestation, soil and water erosion in the upper catchment and consequent siltation from feeder rivers; (d) water quality deterioration, prevalence of waterborne diseases, pollution from poor waste management and improper damping ; (e) destruction of wetlands that are natural breeding and feeding grounds for fish and bird species; (f) water hyacinth (Eichornia crassipes); and (g) deficient property rights and institutions. Diminished Lake Tana waters and biodiversity loss negatively impacts livelihoods and food security of surrounding communities and the

country at large, ecosystem services and functions provided by the Lake; unique cultural heritage and ancient monasteries and downstream riparian countries, Sudan and Egypt heightening tensions and conflicts.

Conclusions and recommendation

The paper highlights the urgent need for a holistic and coordinated local and global investment action to conserve the Lake's biodiversity and ecosystem based on best practices; greater cross-sectoral understanding of threats and impacts and the critical importance of conservation -that conservation enhances economic growth and societal wellbeing rather than derailing them. Investment in conservation combined with stronger policies and institutions would help build regional peace; ensure sustainable livelihoods; improve food security; save unique species from extinction; restore the country's cultural heritage - a major foreign exchange earner and help the country achieve its development goals of economic growth and transformation.

Integrating water and energy bills to construct the wastewater infrastructure

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Keywords
wastewater, finance, energy, tariff, cost

Highlights
Wastewater treatment in Tangier is a paramount objective for environmental protection and tourism reasons. However, only half of sanitation needs are covered by the rate payers, requiring local authorities to develop a specific tariff scheme to cover the remaining costs. This puts the ecosystems services at risk.

Introduction and objectives
In 2002, Tangier wastewater from over a million inhabitants was discharged into the natural environment without treatment and the sanitation service coverage rate was 79%, with unsustainable impacts on tourism and environment. At this time, Tangier entrusted the construction and operations for the distribution of drinking water, electricity and liquid sanitation services to Amendis (Veolia Morocco) for 25 years. The key requests of the contract are more widespread access to wastewater services and decreased pollution of the coastline. The contract objectives request the utility to be self-financing and to maintain a financial balance of the outsourced management.

Methodology approach
The master planning studies for liquid sanitation identified the sewage infrastructure needed to restore the natural environment and minimize the pressure on resources through reuse of treated wastewater. The contract provides that the tariff is set by the authorities, and that the investment program is covered by bills and self-financing generated by the operation of the services. Since the wastewater activity alone does not cover all its costs, the authorities decided to use the integration of the water and electricity activities under one contracting mechanism to cover this financing gap.

Analysis and results
The contract sales-revenue splits 78% from electricity, 18% from water, and 4% from wastewater management, whereas the latter represents 49% of the 640 million Euros investments program over the 25 years of the contract. However the wastewater management activity alone only generates 172 million Euros, including 42 million Euros in cash flow and 130 million Euros from customer bills, for investment.
The financing gap of 143 million Euros is covered by the surplus generated by the electricity activity (92%), and to a lesser extent, by the drinking water bill. This deliberate choice by local authorities, validated by regulators, to set an electricity tariff which allows this financial transfer, was paramount to clean the coastline.
The plan has attained its final phase with the completion of a pre-treatment station with outfall at sea, the extension of the treatment plant with tertiary treatment, 50 pumping stations and 1,700 km of infrastructure and distribution networks. The sanitation service rate reached 99% coverage at the end of 2017. Projects for the reuse of treated water for the watering of golf courses and green spaces are also operational, allowing an additional saving of drinking water.

Conclusions and recommendation

In Tangier, an affordable approach to the preservation of the aquatic environment and access to sanitation services is being achieved thanks to the integration of water and electricity services within the framework of a multi-service contract. This contract currently meets its objectives of greater access to liquid sanitation services and reduced discharges to the natural environment, thus enhancing local ecosystems. This solution may apply to other regions where sanitation infrastructure is not sufficiently developed and a lack of access to liquid sanitation is combined with insufficient revenues.

Investing in aquatic ecosystems and biodiversity: Beginning from schools

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Keywords
Investing in aquatic ecosystems, Biodiversity, Schools, Fresh water, Sustainable human development

Highlights
Study conducted in four schools showed that, on an average, 92%, 86% and 78% of the students, undergoing courses in aquatic-ecosystem management, gained very good knowledge of awareness, understanding and appreciation of the ecosystem management and, could become future preservers of ecosystem and biodiversity. Investment should begin from schools.

Introduction and objectives
Freshwater ecosystems are important for global biodiversity and provide essential ecosystem services. These ecosystems are vulnerable to the impacts of climate change, which may trigger irreversible regime shifts due to which biodiversity and ecosystem services may be lost. Freshwater ecosystems, including streams, rivers, lakes, riparian areas, and other wetlands, are highly vulnerable to stressors such as eutrophication, species invasion, land-use change, and increasing temperatures. Worst-case scenarios depict an erosion of resilience of freshwater ecosystems, affecting the ecosystem services in the future. I studied how schools can raise nurseries of future budding water-ecosystem-preservers and decision-makers in natural resources management.

Methodology approach
Four schools were selected for the study. Two batches, comprising 50 boys and 50 girls each, were selected from each school. Curriculum on water ecosystem management was introduced in two schools while the students from other two schools were not taught this syllabus. The curriculum included courses on aquatic ecosystem management, including fresh water with main emphasis on awareness, understanding, appreciation, evaluation and solution. Greater emphasis was placed on the improved management of blue (harvestable) and green (soil water, plant use) water, and this applied at all scales of water management. Environmental, economic, and social dimensions of sustainability were included.

Analysis and results
On an average, 92%, 86% and 78% of the students, undergoing courses in water ecosystem management, had very good knowledge of awareness, understanding and appreciation of the water ecosystem management compared to 14%, 16% and 18% of those students who did not undergo the course, respectively. Evaluation of the project showed that the water-use efficiency has increased in the area where curriculum on water ecosystem management was introduces by increased demand management, improved infrastructure, improved water productivity of agriculture, minimizing the water intensity (embodied water) of goods and services, concentrating food production in areas of high productivity, and planning for climate change. At the local level, people are becoming more self-sufficient by harvesting rainwater and reducing use of mains water. Human impact on ecosystem services was managed by approach is based largely on information gained and management of consumption of resources. Resource management was applied at many scales, from economic sectors like agriculture, to work organizations, the consumption patterns of households and

individuals and to the resource demands of individual services. The underlying driver of direct human impacts on the environment is human consumption which was reduced by making the full cycle of production, use and disposal more sustainable.

Conclusions and recommendation

For humans, sustainability is the long-term maintenance of wellbeing, which has environmental, economic, and social dimensions, and encompasses the concept of stewardship, the responsible management of resource use. One of the most promising methods of reaching such a state of sustainability is through technology, which provides the means for modifying the natural environment for human purposes and a wide range of consumer products and services. With human interventions, the ecosystems are under extreme pressure, resulting in deteriorated ecosystem services. It is high time that educating the people about the sustainable water ecosystem management, is started from their childhood in schools.

Investing in free-flowing rivers: Addressing the development challenge

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Keywords
river connectivity, infrastructure, basin planning, species migration, natural flows

Highlights

- River connectivity and free-flowing rivers have declined and will further decline with planned infrastructure
- Only 36% of long rivers (>1000 km) remain free-flowing and only 23% free-flowing and connected to the ocean
- Results of this study, including new connectivity metrics and methods, provide critical inputs for more sustainable river basin

Introduction and objectives

Rivers are 'arteries of the Earth', critical to sustaining aquatic ecosystems and many societal and economic services. However, many benefits, like sediment supply to deltas, fisheries and biodiversity, require free-flowing river networks, while others, like water supply and hydropower, require hard infrastructure that disrupts river connectivity and ecosystem processes. Loss of river connectivity has been associated with loss of freshwater species in the US and Europe where rates of species extinctions are particularly acute. Safeguarding and restoring river connectivity and free-flowing rivers (FFRs) is a grand management challenge, made urgent by accelerated hydropower development and unprecedented declines in freshwater biodiversity.

Methodology approach

We define FFRs as rivers where natural aquatic ecosystem functions and services are largely unaffected by changes to fluvial connectivity allowing an unobstructed exchange of material, species and energy. We analyzed five main pressures that affect river connectivity and for which global data were available: (a) river fragmentation; (b) flow regulation; (c) water consumption; (d) road construction; and (e) urbanization for all river reaches (8.5 million reaches, average 4.2 km long); combined these indicators into a connectivity status index (CSI); and evaluated FFRs to be rivers which maintained a CSI level of 95% along their length from source to outlet.

Analysis and results

Long (>1,000 km) rivers are the most threatened with only 36% remaining free-flowing and only 23% free-flowing and connected to the ocean. With buildout of planned large dams, these numbers drop further to only 24% of long rivers remaining free-flowing and 18% free-flowing and connected to the ocean. These results reinforce the urgent imperative for concerted global and national strategies to maintain and restore river connectivity and FFRs around the world if we are to sustain freshwater species, river ecosystems and the services that they provide. We recommend three concrete actions: the incorporation of river connectivity metrics in dam and energy planning with the aim to maintain or restore connected networks of FFRs; reoperation of infrastructure where it exists to mimic the natural flow regime; and strategic removal of aging infrastructure to reconnect rivers and floodplains. The global results are limited by the accuracy of global

data inputs; however, the methods and metrics can and are being applied in specific basins using better local data. Application at the basin scale and incorporation into ongoing planning processes are helping to elucidate trade-offs in development planning and finding more sustainable options that deliver across a range of SDGs.

Conclusions and recommendation

Concerted and coordinated action by a range of actors is required to deliver across the SDGs while simultaneously improving the state of freshwater biodiversity and meeting CBD targets. Economic and development planning agencies, environmental authorities, hydropower developers and engineering firms, civil society and academia, financial institutions and water resource managers each have a unique role and can contribute to ensuring that connected river networks and associated services are maintained or restored.

Making freshwater biodiversity in the Americas count: Safeguarding water security

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Keywords

water governance, watershed services, ecosystem protection and restoration, societal values, watershed conservation

Highlights

- Policy-relevant knowledge of the contribution of freshwater biodiversity and ecosystem services to the economy, water security and well-being of people in the Americas
- Identification of governance opportunities with high potential to guarantee water security and ecosystem's health
- Lessons learned from a science-policy assessment and its implications for freshwater systems conservation

Introduction and objectives

The American continent has the largest proportion of freshwater resources, extent of rainforest, extensive wilderness areas and is home to outstanding biodiversity. However, the contribution of such extraordinary biodiversity to human well-being has been largely unexplored, despite their accelerated loss and degradation. Our objective is to provide policy-relevant knowledge by evaluating the contribution of freshwater biodiversity and ecosystem services to the economy, water security and well-being of people in the Americas. We also aim to identify opportunities for improving environmental governance, addressing linkages between land and water resources, which are strongly connected to the achievement of Aichi targets and SDGs.

Methodology approach

The first regional assessment from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) evaluated the current state of knowledge about biodiversity and ecosystem services in the American continent. We made a literature-based synthesis to expand the major initial findings of this assessment related to freshwater biodiversity and the role of ecosystem services in supporting economies, livelihoods and water security. This synthesis focused on responding policy-relevant questions posed by decision makers, essential for unleashing opportunities that can guarantee water security and ecosystem's health, working towards improved governance and the protection and sustainable use of freshwater systems in the Americas

Analysis and results

Nature in the Americas underpins regulating functions highly relevant to environmental processes that are essential to human water security. Forests and wetlands are the ecosystems most recognized for their role in the regulation of freshwater supplies. Conserved areas are key for providing drinking water for several cities in the Americas, and wetlands deliver well-documented benefits in waste treatment, acting as natural

water purification plants. The flows emanating from freshwater ecosystems are also important for energy production. However, these benefits have been undervalued and severely threatened by extractive uses and exacerbated by climate change. Severe water scarcity is already experienced in several urban areas across the Americas. Furthermore, the importance of this region as commodity producer places additional pressure on freshwater resources for irrigation. Increasing agricultural production has resulted in high nutrient loading to rivers and streams, as well increased use of agrochemicals, both with negative consequences for ecosystem function and water quality.To address these water security challenges, policies such as protected areas, watershed protection initiatives, offset and compensation and ecosystem restoration, have been implemented and have provided several opportunities that benefit societies. However, prioritizing societal benefits to meet human water security can also bring environmental degradation and costly remediation.

Conclusions and recommendation

Fresh water resources in the Americas enable economic growth and sustain livelihoods of over a billion people, yet they are poorly recognized or quantified. A broader view of the importance of freshwater systems that account for societal challenges is required. Protected areas provide tangible benefits such as clean drinking water and associated watershed services, but if they are not designed carefully, these benefits may come at the cost of displacing local communities. Successful policies to protect freshwater systems need to account for how societies value nature, negotiate interests, prioritize problems and find solutions that respect social, institutional and environmental settings.

Private sector engagement with suppliers to improve water and ecosystems

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Keywords

Agriculture, Supply Chain, Water, Ecosystems, Tools

Highlights

- Case studies across a range of leading companies and sectors highlight best practice in collective action through supply chain engagement.
- User-friendly web-based tools provide practical and effective mechanisms for managing complex information and tracking progress.
- All parties benefit from improvements to ecosystems by reducing water-related risks.

Introduction and objectives

Expansion of agricultural water use is contributing to widespread impacts on ecosystems. Agricultural producers and companies with supply chains that rely on agricultural products are facing growing business risks. Response actions that companies can undertake to mitigate these risks range from economic hedging mechanisms to enhancing water supplies in the value chain (Larson, 2012). Key challenges for companies with large global supply chains include how to most effectively engage with suppliers, measure improvements and develop metrics to track progress. This paper describes case studies and tools that illustrate best practices to address these challenges across a range of business sectors.

Methodology approach

Over the past decade, the authors and colleagues have supported numerous global corporations and non-governmental organizations in developing and implementing water stewardship strategies. This study was designed to document current 'best practice' related to engagement in the agricultural supply chain, based on this work and related initiatives. The key research questions include: What practices are currently being implemented, what processes are followed, and how effective are they? How have information, communication and technology (ICT) developments been applied to help facilitate supply chain engagement? The research framework involved independent research and interviews with water leaders in the corporate and NGO communities.

Analysis and results

Corporate water stewardship to date has focused primarily on understanding and reducing water use in direct operations. Some companies are also 'balancing' water consumption through engagement with local stakeholders to support conservation projects in source watersheds (Bass and Larson, 2016). Leading companies understand the importance of going beyond direct operations to contribute to more sustainable management of shared freshwater resources in the supply chain, but they can be challenged by how to best engage where they do not have direct control. The complexity of global supply chains is a confounding factor. Sustainable-sourcing practices typically include procurement using supplier codes of conduct and third-party sustainability standards. Some businesses are engaging directly with producers to gather data and seek demonstration of continuous improvement based on various metrics. Recent years have seen an increasing

number of NGO-led platforms and collaborations focused on sustainability in agricultural supply chains, providing tools and resources and opportunity for commodity-specific collective action. These and other examples of supplier engagement will be highlighted through case studies.

Conclusions and recommendation

The scope and scale of supply chain engagement varies as much as companies vary in terms of products, geographic location, level in the supply chain, and corporate culture. The research conducted as part of this study does not represent a comprehensive review, rather it highlights notable examples of best practice in agricultural supply chain engagement. The study findings can help define appropriate approaches for engagement, and suggest opportunities for other companies to consider. Examining these successful case study examples is important because pre-competitive sharing of successes and lessons learned can help foster more widespread adoption of engagement practices.

Understanding freshwater biodiversity and aquatic systems threats for enhanced decision-making

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Keywords
industry, biodiversity, ecosystems, water management, stewardship

Highlights
Demonstrate the Integrated Biodiversity Assessment Tool (IBAT) freshwater functionality and explain how it can be used by industrial and development projects to evaluate site level freshwater biodiversity risks and understand species' threats at a watershed scale.
Share case studies that will show how IBAT application has improved conservation outcomes, protected ecosystems.

Introduction and objectives
This seminar will demonstrate application of the Integrated Biodiversity Assessment Tool (IBAT) fresh water functionality. This functionality enables users including industry, governments, conservation organizations, and academics, to screen for existing stressors to freshwater biodiversity and ecosystems in a watershed. This information is critical to making enhanced environmental management decisions to protect ecosystems and improving conservation outcomes through protection of sensitive ecological areas.
Additional objectives include:

- Promote broader uptake of the IBAT as a tool that helps better inform decision-making with respect to sensitive ecological resources management.
- Share best practices and learnings from collaborative industry and NGO engagement.

Methodology approach
Recently, the IUCN Red List of Threatened Species data was transferred to a new sub-basin system (HydroBASINS) allowing IBAT queries on freshwater species from upstream and downstream of a site of interest, providing better understanding of threats and impacts that radiate out from point sources over large distances.Pilot applications of the enhanced IBAT functionality were conducted at three global Chevron locations. The output was refined based on the pilots' lessons learned. This tool is the result of a Chevron and Conservation International collaboration, focused on advancing science, tools and practices for managing ecological and social risks in development projects.

Analysis and results
IBAT can be used to identify threats to freshwater ecosystems, informing management decisions by industry, governments, NGOs and others. The technical enhancements in the IBAT tool added functionality for users to be able to receive a report that:

- Has HydroBASINS as the data base layer
- Shows species upstream and downstream according to a project site
- Presents the IUCN Red List categories
- Allows users to select any distance from a site they chose

- Species results can be presented according to basin with the option to have results displayed either separately, by basin, cumulatively for the entire system.

Conclusions and recommendation

International Oil Companies (IOCs) including Chevron and BP have used this tool in early project assessments and will share learnings from pilots.

Key findings included:

- The collaboration between end users (IOCs), data providers (IUCN) and NGO's (CI) resulted in functional enhancement of the tool aiding in decision making for mitigation actions.
- Transparency of data origination, which enables users to determine the need for additional baseline studies
- The information from the list of threatened species from IUCN Red List, provided important insight on biodiversity and ecosystems risks at the watershed level
- Supplemental data (experts' opinion) is important to validate findings

Water community providers, ecosystems and adaptation in rural Central America

Presenting Author: Dr. Roger Madrigal-Ballestero, EfD/CATIE, Costa Rica
Co-Authors:

Keywords
Development, watersheds, ecosystem services, pricing, ecosystem-based adaptation

Highlights

- The performance of most water community providers in rural Central America is deficient and hinders development, particularly in drought prone areas
- Ecosystems services condition water delivery and adaptive capacity to climate change and variability
- Governance and financial aspects are critical to ecosystems restoration and improvement of performance of water providers

Introduction and objectives

Despite successful improvements in drinking water access, safe water is still not easily accessible to many households in poor and rural areas of Central America. Community-based drinking water organizations (CWO) are the most important providers in these regions. However, their performance do not contribute to foster development and adaptation to climate change. Degradation in ecosystems, poor governance and financial burdens limit the capacities of CWO to contribute to human well-being. We use primary data collected from CWO located in poor regions of Guatemala, Nicaragua and Costa Rica to assess these factors and discuss policy options for improvement.

Methodology approach

We carried out statistical analysis of survey-based and GIS data, collected from 160 water community organizations and 7,000 households located in the driest regions of Guatemala, Nicaragua and Costa Rica. We use primary data on the governance of CWO (e.g. rules, financial characteristics, human capital of the water board, relationship with external actors, performance indicators), water use at the household level and ecosystem variables (e.g. land uses, temperature, precipitation). We fully considered the effect of climatic and environmental variables on performance of CWO and the emergence of certain institutional features of CWO.

Analysis and results

The vast majority of literature on the performance of CWO largely ignores the effect of ecosystem services, coupled with governance, on performance. Our results constitutes a pioneer effort to bridge this gap. We found that differences in ecosystem attributes affect water treatment costs of CWO and coping strategies with droughts at the household level. On the other hand, controlling water demand is critical for preparedness against droughts. For this, one of the most important strategies a CWO should take is adopting volumetric pricing. Nevertheless, setting the incentives and overcoming obstacles that limit this critical change is necessary to scale up results. Promoting the financial health of CWO through improved cost-recovery practices is another important low-regret solution for building drought preparedness. Adaptation to drier conditions will need substantial modifications in physical infrastructure as well as green investments on watersheds, which requires large amounts of capital. Since most CWO are not capable of funding these

investments, governments and other key stakeholders should promote sounding financial policies to support these organizations but without undermining local incentives to contribute.

Conclusions and recommendation

The vulnerabilities of CWO to climatic and non-climatic threats are intrinsically associated to deterioration of critical ecosystems, poor governance structures and lack of financial resources. Under these conditions, millions of people in rural Central America suffer from unreliable water services affecting their quality of life and development opportunities. Hence, the implementation of low-regret adaptation measures could be an effective strategy to respond simultaneously to generic threats to water provision and to the longstanding development needs. These options include investments in restoration and conservation of essential functions of ecosystems as well as strengthening of local institutions.

Wetworking: A participatory network for wetland conservation

Presenting Author: Prof. Deepthi Wickramasinghe, University of Colombo, Sri Lanka
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Keywords
Networking for conservation, sustainable partnerships, wetlands

Highlights
This project addresses the vital need of networking and developing sustainable partnerships among diverse stakeholder groups in conservation of wetlands.

Introduction and objectives
Wetlands provide significant economic, social and cultural benefits. Despite all the services they provide wetlands worldwide continue to face many pressures from human activities, and Sri Lanka is no exception. The current programme focuses on the Bolgoda which is the largest natural freshwater lake in the country. Bolgoda wetland is tightly linked with the lives of the communities of the area and hence diverse community / ecosystem interactions exist. One key challenge in conservation management of this ecosystem is the essential need of multi stakeholder approach for collective decision making and action.

Methodology approach
Recognizing the urgent need for conserving this ecosystem and the importance of integrated actions, Sri Lanka Water Partnership initiated 'a network' and took a leading role in enhancing efforts to conserve the Bolgoda wetland in active collaboration with different

a) Government sector/ Central Regulators- relevant Divisional Secretariats and Central Environmental Authority, Sri Lanka Land Reclamation and Developmental Corporation
b) Local government (Decentralized regulatory function at local level)
c) School children and teachers
d) Community organizations- NGOs and CBOs in the Bolgoda catchment

All parties were provided a common platform to meet and discuss the issues, challenges and the way forward.

Analysis and results
Most significant outcomes of the 'wetwork' – networking for conserving the Bolgoda wetland include, but not limiting to the following:

a) Establishing the links between the regulators/ local government members and community organizations and facilitating discussion on several critical issues
b) Establishment of six new community environmental organizations at the grass root level to protect Bolgoda and getting them registered under the
c) Facilitating community reporting of environmental Issues relating to the wetland to the regulator with written reports on pollution and habitat degradation with photographs as evidence
d) Development of a newsletter with the articles, poems, news items etc submitted by the school children which was then distributed among the schools of the area
e) Development of booklets and posters in local languages for awareness raising
f) Initiation of a research group including university researchers and youth groups.

g) Initiation of links between the regulators and the private sector under their corporate social responsibility programmes targeting integrated conservation measures

Conclusions and recommendation

In this project have demonstrated some measurable benefits of 'wetwork' network which has established sustainable partnerships in conserving Bolgoda wetland ecosystem. The network served to bring together stakeholders across many disciplines and backgrounds to share views and ideas while learning from each other and forging new collaborations. The preset project could be a good example of working together of diverse groups towards common objectives of conservation and sustainable development.

Willingness to accept: Enticing landholders into environmental payments schemes

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Keywords
Choice Experiment, Payments for Ecosystem Services, Environmental Policy

Highlights
Willingness to accept ordered choice experiment
Multiple ecosystem service focus: Biodiversity, Carbon, Water and Soil
Policy scenarios for establishing Payments for Ecosystem Services markets in Australia

Introduction and objectives
Payments for ecosystem services (PES) are a phenomenon in natural resource management (NRM). By paying landholders to secure ecosystems, PES have been able to benefit human-wellbeing through 1) securing services, such as water purification and biodiversity, and 2) provide relief to embattled landholders with an additional source of income. Despite their advantage over other NRM approaches, with limited funding available, their success is dependent on identifying an appropriate price that maximises cost effectiveness and increases participation. The objective of this presentation is to identify PES scheme traits that maximise participation and bring additional environmental benefits to society.

Methodology approach
The approach to this experiment involved the implementation of a large-scale online landholder ordered choice experiment across New South Wales, Australia. Targeting landholders with properties greater than one hectare, this experiment asked its respondents to choose between different hypothetical PES schemes. These schemes were made up from the following attributes: ecosystem service focus, pre-scheme requirements, work intensity/inputs required, length of contract, payment mode, and payment amount.

Analysis and results
Returning 1055 responses, the results reveal that the longer/larger certain scheme attributes, such as length of contract and work intensity were, the lower probability of participation was. Whilst higher payments had a positive influence on participation, respondents also showed a preference for participating in carbon management schemes over biodiversity, water and soil schemes. Latent class modelling revealed three land holder segments. Each of these segments responded to the schemes and their attributes in varying ways--in particular payment mode and contract length. Analysis on landholder characteristics determined several elements which drive participation, such as: property ownership, land-use, income, and information seeking behaviours.

Conclusions and recommendation
From the results of this research, this presentation will showcase three policy scenarios appropriate for the cost-effective establishment of PES markets in regional Australia. This will assist public investment into biodiversity, carbon, water and soil protection schemes.