SIWI WORLD WATER WEEK

Seminar: Ecosystem based water management: From innovation to practice

ABSTRACT VOLUME

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Water, ecosystems and human development

Seminar: Ecosystem based water management: From innovation to practice

Contents

Changing water management practice in Canterbury to address sustainability limits

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Co-Authors:

Keywords
integrated water resource management, nested adaptive systems, collaborative governance, sustainability limits, outcomes-based management

Highlights

- Regulating development within environmental limits was ineffective in managing water at sustainability limits of availability and cumulative effects of use.
- A paradigm based on nested-adaptive-systems and collaborative governance led to improvements in water management.
- Strategy shifted from storages on major rivers to integrated management to achieve ten community-defined targets.

Introduction and objectives

Irrigation expansion in Canterbury led to sustainability limits being reached for water availability and cumulative effects of land use intensification. Increasing water availability through storage was proposed. There was strong community opposition to impacts of storage and further intensification.

Legislative arrangements give regional councils a regulatory role in environmental assessment of development proposals. Effects-based institutional arrangements proved inadequate to manage resource extraction and cumulative effects of use at sustainability limits.

To address these issues, the regional council introduced a non-statutory strategic approach based on nested adaptive systems and collaborative governance. This paper describes this real-world experiment in water resource management.

Methodology approach

The regional council considered water management at four spatial scales: regional level for water availability and land use intensification, catchment level for supply reliability and cumulative effects, tributary level for environmental flow requirements and riparian management, and property level for irrigation and land-use practices.

A regional water strategy was developed through a multi-stakeholder steering group under the Canterbury Mayoral Forum and with extensive community engagement. Zone Committees were established to develop Zone Implementation Programmes. Farmer collectives are being established for operational delivery of water management targets. Farmers can develop farm management plans to meet property-level outcomes which are independently audit.

Analysis and results

The shift from applicant-driven development to a community-based strategy led to a shift from a focus on storage on alpine rivers to integrated management for not only increased irrigated area and economic development, but also biodiversity, natural character, kaitiakitanga (Māori stewardship), drinking water, recreation and water use efficiency.

The regional strategy investigations demonstrated that a focus on new development would not achieve sustainable development, rather existing users had to improve if there was to be headroom for new users. Water use efficiency improvements were found to be more cost effective than new storage. Also, different forms of storage, such as managed aquifer recharge and off-river storage, were identified that avoided the adverse effects of storage on the mainstems of alpine rivers. There was a need identified for proactive measures to address such issues as water quality degradation, biodiversity loss, Māori involvement, and ecological restoration.

The development of implementation programmes to achieve community outcomes is leading to improved water management. However, it also identified issues relating to the affordability of proactive measures, equity in allocation, and the need for a public infrastructure agency. Uneven implementation of measures has led to some groups withdrawing from the collaborative process.

Conclusions and recommendation

A systems perspective and a change in governance from a regulatory to a collaborative approach has led to improved water management. The change to delivery of multiple community outcomes rather than effects assessment of applicants' proposals has the potential to achieve sustainable management.

Legislative change is needed to reflect an outcomes-based approach rather than an effects-based approach. Legislation also needs to incorporate a proactive role for government rather than just a regulatory role. An investment framework is needed to address funding of proactive measures. Mechanisms for equity in allocation of scarce resources and within contaminant caps is also needed.

Decision structure in Brazilian water management a 2030 agenda perspective

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Keywords

SDG 6, Water Policies, Ecosystem, Stakeholders

Highlights

- Water policies evaluation in Brazil in an integrated perspective
- Challenges and measures proposal for SDG 6 implementation
- Division of power and information systems of water

Introduction and objectives

Although Brazil is considered to have the largest hydrographic system on Earth with 12% of world's freshwater, the country is facing difficult times in its water management system due to the occurrence of critical events, main water scarcity and inter-agents conflicts. At the same time, despite the ample knowledge of specialists and studies, persist the difficulties of response and the challenges to scale up good practices and lessons learnt from different water uses and also from integrated water and environment management. The present work shows actions launched by Brazilian stakeholders due to develop a strategy to implant and monitor water.

Methodology approach

The study counts on three pillars that groups contents and delineates the methodology based in documental review, exploratory data analysis, and interaction with stakeholders:

1) Analysis of successful and hindrances elements in water management experiences, using survey and a semi-structured questionnaire applied to stakeholders;

2) Recognition of the level of divergence among the pathways to management water systems in a selected group of seminars in Brazil in 2017;

3) Identification of challenges on databases and information systems in water resources.

Analysis and results

The main result of the present research is a structured and critical analysis about the level of power division and social participation on water resources management system. Other result is a review of the challenges on water management databases including possibilities and constraints to collect, organize and share information in supporting decision making process on water management, sanitation and ecosystems. A proposal to improve state measures inside WASH management instruments was also launched to support a conception of a model to implementation and monitoring structure for SDG 6, enhancing political-institutional, financial and technical-operational elements.

Conclusions and recommendation

The main result of the present research is a structured and critical analysis about the level of power division and social participation on water resources management system. Other result is a review of the challenges on water management databases including possibilities and constraints to collect, organize and share information in supporting decision making process on water management, sanitation and ecosystems. A proposal to improve state measures inside WASH management instruments was also launched to support a conception of a model to implementation and monitoring structure for SDG 6, enhancing political-institutional, financial and technical-operational elements.

Development of a curated global compendium of hydro-ecological data

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Keywords
Aquatic ecosystem descriptors, conservation, biogeographic data, water management, wetlands

Highlights
Global freshwater conservation efforts frequently are hampered by coarse, low-quality, patchy, or inconsistent data sources. We will discuss progress and present an updated roadmap towards a comprehensive, high-resolution hydrographic database of global freshwater ecosystem characteristics, represented by a catalogue of biotic and abiotic attributes as well as social data.

Introduction and objectives
The importance of the world's freshwater systems as providers of biodiversity and other ecosystem services is undisputed. While computational power has increased exponentially and many planning tools are now freely accessible, data availability is still a key issue. To make informed conservation decisions, data on environmental, biotic, social and economic attributes will have to be collected and analysed. Globally, environmental datasets are increasingly collated, but they differ in their spatial or temporal consistencies, accuracy and technical formats. A consortium of researchers, NGOs and intergovernmental organisations are currently working towards a global compendium of standardized stream and catchment attributes, termed HydroATLAS.

Methodology approach
To create a map repository based on abiotic variables we collated over 250 variables in >40 classes using established datasets from either free, publicly available sources or from collaborators who provided their data for this project. Based on the watershed and stream network templates of the HydroSHEDS family of products, data were aggregated and propagated to nested sub-basins at multiple scales, as well as to individual river reaches, both extracted from the underpinning hydrography at 15 arc-second (~500 m) resolution.

Analysis and results
The first version of HydroATLAS has the following attribute themes (with examples):
Hydrology (discharge, runoff, wetland inundation, groundwater table depth)
Climate (temperature, precipitation, evapotranspiration, snow, aridity)
Physiography (elevation, slope, landform)
Land cover (vegetation classes, ecoregions, forests, wetland classes, habitat types)
Soils/geology (percent clay, silt, sand, organic carbon, geology classes)
Human influence (cropland, pasture, irrigation, population, human footprint)
These attributes have been mapped to approximately 1 million sub-basin units worldwide (average size 130 km2) and 8 million river reach units (average length 4 km). Attributes that have an expected influence on downstream catchments have been accumulated along the river network and/or are summarized as upstream averages. Subsequent analyses can thus readily include both local habitat conditions as well as upstream influences.

In collaboration with NGOs, scientists, and intergovernmental bodies such as the Group for Earth Observation, we will discuss next steps (e.g.,integration of existing global biodiversity data from IUCN; improving socio-economic indicators) and develop a roadmap for continued database curation. We conclude that for success in uptake and legacy, the next generation of hydroecological data need to be seamless and globally comprehensive; free and accessible; easy to operate; and dynamic - trading off data quality and updateability.

Conclusions and recommendation

Global data can provide baseline information in remote areas where little monitoring is available yet stakeholders need to address urgent issues in a timely manner. Especially in developing countries, both government entities and NGOs will have access to a new data source that is free, reliable and globally comparable. We will present an example from Bhutan where the database has been used for a conservation assessment. Issues of governance and community involvement are an important consideration. Our vision is not to produce a proprietary database, but to create an evolving data repository built for and by the freshwater community.

Drivers for ecosystem-based flood management: Insights from three deltas

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Keywords
Ecosystem-based flood management, water governance, deltas, eco-DRR

Highlights

- in several world deltas, flood dynamics are being restored for various purposes
- ecosystem-based flood management measures can be stimulated from both top-down policy-making directions, but also from the perspective of social movements
- a better understanding and appreciation of environmental dynamics contributes to more sustainable social-ecological (delta) systems

Introduction and objectives
Well in line with the theme of the World Water Week 2018, this contribution highlights findings from a comparative, multi-annual (2012-17) research project on ecosystem-based flood management measures. These measures consisted of the restoration of (seasonal) flooding, for the benefit of both environment (biodiversity, restored land-water dynamics) and human society (improved regional flood safety by spreading out flood peaks). This contribution argues that ecosystem-based flood management measures can be an outcome of top-down policy-making as well as of bottom-up social movements.

Methodology approach
Comparative case study analysis, based on a number of case studies from different parts of the world (Netherlands, Bangladesh, Vietnam). Grey literature review of policy studies and case study material, complemented by series of data collection at case study level (2013-2016).

Analysis and results
The case studies delivered the following key results:
In the Netherlands controlled flooding is heavily steered from a top-down, central governmental perspective. Near flooding caused the initiation of a Room for the River programme which called for restored flooding to reduce overall flood risks in the wider region, and to facilitate natural dynamics. These interventions caused disputes and surprisingly local farmer communities brought forward innovative plans to continue living on mounds in the areas that were appointed for occasional flooding.
Moving towards Asia, in Bangladesh it were local communities who enforced the restoration of controlled tidal flooding. This was done to address severe water logging on lands in the coastal zone. Tidal flooding would scour silted river beds and deposit sediment on the lands. Facilitating ecosystem dynamics (tidal flooding, twice daily) by means of Tidal River Management, as the practice is called, resembles ancient overflow irrigation techniques and is seen as a learning-by-doing measure.
In the Vietnamese Mekong delta, seasonal flooding has been halted by high embankments. Both government authorities and farmers, each from their own point of interest, have been calling for the restoration of seasonal flooding in some designated areas. The intake of fresh nutrients is coupled with increased flood frequencies.

Conclusions and recommendation

Two main points are brought forward here:

1) Ecosystem-based flood management can be stimulated from both a top-down perspective (central policy makers implementing new flood management policies and projects) but also from a bottom-up direction (local communities who suggested to restore seasonal flooding). This insight calls for a mode of interaction, or governance of flooding, in which different stakeholders (governmental actors, policy makers, local communities, NGOs) are involved in ecosystem-based flood management.

2) An appreciation of flood dynamics, beyond its association with catastrophes alone, is helpful to consider the positive aspects of controlled (seasonal) flooding for long-term management of dynamic social-ecological systems

Enabling smart collaboration for the sustainable use of water

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Keywords
collaborative and participative monitoring, open data, water monitoring

Highlights

- We designed a unique cloud-based technology platform that integrates multiple historic water records incorporating public and private sources.
- We consolidated 1.5 million geo-referenced data entries with physical, chemical, biological and organoleptic parameters, linked to mining discharges.
- We incorporate community monitoring, helping communities upload, store and process their data online.

Introduction and objectives

Peru´s water monitoring infrastructure linked to extractive activities is scattered, piecemeal and of limited access to the wider public, resulting in the emergence of social-environmental conflicts. We are piloting an open and online water data management system, using tailored algorithms, and participative monitoring technologies that integrate complementary health data that are providing comprehensive insights as to the quality of water resources in mining regions of Peru. The research will share with participants the mechanisms to process and generate data and the findings generated by the database.

Methodology approach

The research combines quantitative and qualitative methodological approaches. Information has been compiled from primary and secondary sources, with a strong focus on data systematization and codification; while generating interviews with different stakeholders related to environmental monitoring of mining activities in Peru. Our research questions where: 1. how can we propitiate an all-encompassing data monitoring system to capture, systematize and measure the quality of water, building on collaborative processes? 2. how can we support real-time qualitative water monitoring; 3. how can we scale up the process and promote its use for other productive sectors? The data will support informed policy making.

Analysis and results

We have systematized 1.5 million geo-referenced data entries on water discharges covering physical, chemical, biological and organoleptic parameters (focused on the mining sector). We have identified over 73,000 parameters that exceed maximum permissible levels for the period 1993-2016. The parameters with the highest recurrence are PH, Lead, Total Suspended Solids, Iron, Zinc, Copper, and Dissolved Oxygen. Furthermore, we have also identified that the 73,000 parameters that exceed limits also impact river body readings. Currently, over 100,000 parameters of river bodies near discharge points exceed national environmental quality standards. These numbers should be approached with caution: we are currently running tests using tailor made algorithms to help us identify and prevent data anomalies, considering that available water data lack input-quality filters. Furthermore, we are also in the process of interpreting results in 382 different districts that co-exist with mining activities.

Another important result of our research points out to the importance of enhancing the scope and type of information required to build a comprehensive database on the quality of water, and its impact over social-environmental conflicts. Developing new sources of data, including participative and community water monitoring inputs, as well as qualitative information is helping us address the gaps found in official data sources.

Conclusions and recommendation

Lack of access to data and coherent sources on the quality of water linked to mining discharges, together with the absence of verifiable official data require the use of alternative sources and technologies to support the appropriate monitoring of water discharges. Our results show that technology contributes to filing the data gaps of water monitoring while supporting collaboration for the sustainability of water resources.

Environmental report-cards support ecosystem based water management incorporating indigenous values

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Keywords
indigenous knowledge, river restoration, New Zealand, science communication

Highlights

- Environmental report cards provide clear messages about environmental state across values and spatial scales.
- The Waikato River Report Card extended the concept to include biophysical, cultural and economic aspects based on bicultural values of indigenous Maori and Pakeha New Zealanders.
- It is contributing to restoration of the Waikato River.

Introduction and objectives

Water management to achieve measurable positive outcomes rests on a shared understanding of the current state of key values in relation to community expectations and having tools to measure progress in response to management and communicate findings clearly to a wide range of stakeholders. Environmental report cards can assist here by using the familiar format of a school report card (RC) to produce combined scores for key values derived from monitoring data to indicate whether the values correspond to a healthy state. We describe development and initial uses of a RC for the Waikato, New Zealand's longest river, based on bicultural values.

Methodology approach

The indigenous Waikato River Maori and NZ government have embraced co-management to secure the river's longer-term health and wellbeing, including a $220M Clean-up Fund and co-management framework to deliver on a Vision and Strategy. Waikato River Authority commissioned us to develop a novel RC founded on Maori cultural values, and including the economy, along with conventional biophysical data of existing international RCs. Our bi-cultural team built on earlier research and cultural knowledge to identify key themes, develop 'knowledge network' diagrams linking monitored indicators to drivers and values and the process for choosing indicators and calculating RC scores.

Analysis and results

The RC set the baseline for measuring restoration and provides a framework for focusing restoration efforts. Key components include:

- a framework that links environmental indicators to the aspirations of the Vision and Strategy via the 8 Taura (Maori for 'strands of a rope'), namely kai (indigenous foods), water security, ecological integrity, experience, sites of significance, economy, water quality, sites of significance that, if restored, will provide for a healthy and well river and people;
- an A to D system for grading the 8 Taura and 64 indicators they are calculated from using existing council monitoring data and best professional judgement, and

- conceptual linkage models of pressure-state-response relationships that identify potential restoration actions for key indicators (e.g., healthy eel and whitebait populations) and environments (e.g., hill farm streams, mainstem river reaches with hydrodams).

The taura and indicator grades for 5 RC spatial units, and their component mainstem, tributaries and lakes, http://versite.co.nz/~2016/19099/files/assets/basic-html/page-1.html highlight where and what aspects require focus for restoration. The linkage models synthesise existing knowledge on ecological interactions, multiple stressors and the direct and flow-on effects of potential restoration actions. The RC framework has been used to identify priority restoration actions that can be taken by individuals, organisations and industries.

Conclusions and recommendation

We contend that framing RCs around indigenous cultural values, and including economic indicators, overcomes barriers to bicultural understanding and co-management of freshwater. This enhanced public engagement. The RC summarises catchment information in tiers that provide multiple levels of information summary; from high-level messages, picked up by national and regional newspapers and TV and radio news programmes, to more detailed sub-catchment taura and indicator gradings, that have informed restoration priorities and key actions. Identified gaps in quantitative data around important values had to be addressed by professional judgement. This is initiating new monitoring, including by Maori groups, to augment council data.

Floods for food: Water spreading weirs turning the tide

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Keywords
Landscape, Pastoralism, Natural-Resource-Management, Innovation, Food Security

Highlights

- Reversing degradation in dry river valleys through floods for the creation of development nuclei – contrary to current dispersed large-scale interventions
- Holistic and integrated approach within a fragile ecosystem respecting socio-cultural patterns
- Rapid prototyping of interventions together with communities and integration into governmental systems

Introduction and objectives

The current paper discusses the findings and experience of an innovative landscape approach that takes the highland-lowland continuum in Ethiopia into account and works with seasonal river systems, turning destructive floods from the highlands into productive fields for the provision of food, fodder and water.
The Ethiopian Lowlands only receive minimal rainfall and are thus poorly suited for rainfed crop production. Pastoralism is the predominant form of livelihood and is severely affected by increasing natural resources degradation, putting traditional livelihood patterns under threat that were previously sustainable. Prevalent interventions often target rangeland management systems or work around groundwater utilisation.

Methodology approach

Since 2013 GIZ prototypes a new approach to the sloping ranges between the highlands and lowlands of Ethiopia. Soil and water harvesting methods based on water-spreading weirs are part of a holistic approach. They reverse the effects of strong runoff of rain water and recurring flash floods in the fertile but degraded dry river valley areas, leaving enough discharge for downstream communities. Appropriate locations and equitable future use concepts of the newly created resources are sought together with all involved stakeholders. Construction and maintenance, as well as utilisation are constantly reviewed and improved in joint learning loops.

Analysis and results

In Ethiopia, terracing is known from highland natural resource management. Using an integrated water-spreading weir approach in degraded dry river valleys allowing to work with floods is new to Ethiopia. This intervention leads to deposition of sediments carried with the flood water, which in turn levels the ground, allows vegetation growth and even farming on an increased acreage, and supports the infiltration of flood water into the soil. It is creating large fertile terraces in the former degraded dry river valleys. This allows the local population to farm three cycles per year (rainfed, dryland and irrigated). Moreover, river bank protection is ensured by providing water to trees that stop erosion and by filling up the eroded river bed to its original level. This water and soil conservation approach combined with intensive training strengthens the resilience of the pastoralist and agro-pastoralist population to the impacts of climate change providing economic opportunities and reducing conflicts. Further downstream, the groundwater levels are recharging rapidly, providing water for other users in the same ecosystem. Testing of the interventions was

accompanied by feeding the harvested knowledge into research and technical and vocational training plus providing the necessary skills development within the communities.

Conclusions and recommendation

Current interventions for (agro-)pastoral communities on rangeland management or groundwater based development often do not consider the semi-mobile livelihood of the targeted communities enough. Societal change takes time and thus an initial strengthening of traditional livelihood patterns is paramount to foster a sustainable transition. Anchoring the required skills and knowledge on multiple levels and stakeholders to move from a passive to an active management systems provides the basis for a successful upscaling. Still, further prototyping in other comparable ecosystems is necessary to develop this emerging into a good practice, which can easily be picked up and replicated by other actors.

How much groundwater can we pump and protect environmental services?

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Keywords
environmental flows, groundwater, ecosystem services, water management

Highlights
By applying the groundwater presumptive standard for the first time in a project actively involving scientists, policy makers and practitioners, this project is a compelling case study of integrating ecosystem approaches into water management practice.

Introduction and objectives
Groundwater is a critically important source of water for river, wetland, lake and terrestrial ecosystems, yet most frameworks for assessing environmental flows and environmental services have ignored or not explicitly included the potential impacts of groundwater pumping on environmental flows.

Methodology approach
Recently we proposed a new groundwater presumptive standard as is critical as a placeholder to protect environmental flows in rivers lacking detailed assessments. This presumptive standard has been applied for the first time in British Columbia, Canada by scientists, policy makers and practitioners assessing aquifer stress across over 1000 aquifers in the province. British Columbia recently passed the progressive Water Sustainability Act which regulates groundwater use and protects environmental flow, both for the first time.

Analysis and results
The presumptive standard suggests that 'high levels of ecological protection will be provided if groundwater pumping decreases monthly natural baseflow by less than 10% through time'. The final product is a new interactive online decision support tool for water managers that make decisions under the new Act. The decision support tool is based on new modeling and mapping of groundwater recharge, use and the groundwater contribution to environmental flows. Results indicate that high levels of aquifer stress are common in a number of regions, and that this could potentially be impacting ecosystem services.

Conclusions and recommendation
By applying the groundwater presumptive standard for the first time in a project actively involving scientists, policy makers and practitioners, this project is a compelling case study of integrating ecosystem approaches into water management practice.

Industry in action: Case studies of ecosystem-based water management

Presenting Author: Ms. Cate Lamb, CDP, United Kingdom
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Keywords
industry, collective action, private sector, ecosystem-based water management

Highlights
Companies increasingly realise that the health of their business is fundamentally tied to the health of the basin. This research analyzes three years of CDP's corporate water dataset to provide insights into industry uptake of ecosystems-based water management. Case studies of action will be presented along with recommendations for improvement

Introduction and objectives
Rivers, forests, wetlands and numerous other ecosystems underpin modern economies, with many corporations depending on these systems to deliver their products and services. As such, there is a strong business case for protecting and enhancing these ecosystems. But is the private sector investing in these approaches? If so, are they working collaboratively with others in the basin? This presentation will use CDP's dataset to provide a state of play of corporate action in ecosystems-based water management. By articulating the business case for action and taking stock of successes to date, we can propose future directions for the private sector.

Methodology approach
To assess industry action on ecosystem management, this research combines quantitative and qualitative analysis of CDP's corporate dataset for the years 2015, 2016 and 2017. Due to the cross-cutting nature of the issues, both CDP's water and forests datasets were analyzed. Corporate case studies were developed by analysing the following areas of CDP's questionnaire: companies facing risks driven by ecosystem vulnerability, and how they respond to these risks; companies factoring the current and future status of ecosystems and habitats into their water risk assessments; and companies that have set goals around watershed remediation, habitat restoration, and/or ecosystem preservation.

Analysis and results
The analysis reveals several positive stories: companies are increasingly building ecosystems into their business models. Over 60% factor the status of ecosystems and habitats into their water risk assessments, up from 49% in 2015.
The business case for action is clear: CDP data shows that companies are financially impacted by disruptions to ecosystem services. Danone reported losing €740,000 in finished goods when polluted river water contaminated their lines in certain facilities in Brazil.
The number of companies setting goals around watershed remediation, habitat restoration, and/or ecosystem preservation has steadily increased year on year, becoming the most common goal reported in 2017. For example, Vina Concha y Toro has committed to the protection and conservation of 100% of its 3,200 hectares of native forest in Chile, and Suntory Beverage & Food has set a target to expand the area of their Natural Water Sanctuaries to 12,000 hectares by 2020.

There are also some excellent examples of collaborative action to protect ecosystems, including from South African brewer Distell Group, who set up a river collaborative in Stellenbosch; and APS, the largest electricity utility in Arizona, which participates in environmental flow workshops for the San Juan river basin in New

Conclusions and recommendation

Although companies increasingly understand and apply the ecosystems approach, barriers to action still exist: for example, when concepts like 'environmental flows' have not yet been locally defined. Furthermore, it can be difficult for companies to the see the business case for collective action at the ecosystem level. One response to this is to ecourage companies to engage their supply chains as a first step towards collaborative action. It is hoped that by promoting and discussing these case studies, policymakers and other corporates will be inspired to accelerate the ecosystems approach to water management

Moving ecosystems from 'stakeholder' to 'foundation' of water resource management

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Keywords
ecosystem services, indicators, decision support, governance, IWRM

Highlights

- Freshwater ecosystems are chronically undervalued and poorly understood
- Spatial and power asymmetries exist between points of ecosystem service supply and demand, and among administrative jurisdictions and ecosystem boundaries
- The Freshwater Health Index offers a tool, and an approach, to synthesizing information about ecosystem integrity, services, and water governance

Introduction and objectives

While it is now commonly recognized that freshwater ecology, watershed hydrology and dependent human systems should be understood and managed under a holistic framework, one of the initial stumbling blocks is the breadth of information involved in integrated water resource management. We develop a social-ecological framework and corresponding indicators-- the Freshwater Health Index-- to help the various stakeholders in a given basin understand and link ecosystem health to delivery of services. Eleven indicators are measured and mapped at sub-basin scale, including biophysical measures as well as assessments of the water governance system.

Methodology approach

We applied this system of indicators in two case studies-- the Dongjiang basin in southern China and the Sesan, Srepok, and Sekong (3S) tributary sub-basins in the Lower Mekong. Over a period of approximately 12 months we worked with local and national institutions in both basins to apply the framework and calculate the indicators each on a 0-100 unitless scale, based on a combination of remotely sensed, monitored, and modeled data. Additionally, we convened stakeholder workshops where stakeholders weighted the relative importance of indicators and thereby revealed differing preferences and priorities for the basin.

Analysis and results

The initial applications raised interesting perspectives from the stakeholders, such as their perception of weak governance. It also highlighted key data and knowledge gaps, such as groundwater usage, sediment regulation and mining, and the role of biodiversity in underpinning services. In both basins, Ecosystem Vitality-- the health of underlying ecosystems-- scored lower than Ecosystem Services, suggesting that basins were presently meeting human needs, albeit at the expense of the ecosystems. This is emblematic of the tradeoffs that occur when, for example, the connectivity of streams are reduced in order to provide hydropower, flood protection, and a stable water supply to the Pearl River Delta. However, a single assessment does not illuminate these tradeoffs or help stakeholders understand where improvements could be made in the future. Thus we have begun working with stakeholders to model some of these ecosystem dynamics to help head off conflicts. To start, we assessed a phasing in of over 100 dams in the 3S basin and modeled the effects to our indicators of Freshwater Health. A next step in both basins is to expand scenario

modeling to consider future pressure from land use and climate change, and to evaluate options for ecosystem protection and restoration.

Conclusions and recommendation

The Freshwater Health Index framework and its accompanying indicators are oriented toward management and stakeholder engagement, and they make a significant contribution by providing a systematic, evidence-based quantitative tool that supports the integrative social and ecological nature of fresh waters at the basin level. We demonstrated that it is flexible and can be adapted to a range of contexts and user needs, providing a much needed implementation tool for operationalizing IWRM. The Index also highlights the vital, yet much neglected, role of governance in safeguarding the delivery of ecosystem services in an equitable and sustainable manner.

Policies to scale up ecosystem-based water management

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Keywords

natural capital, payment for ecosystem services, collaborative approach, policy, water management

Highlights

A range of tools can be harnessed to promote ecosystem-based water management, in particular to manage diffuse pollution. Their diffusion requires conducive institutional and policy frameworks. The paper draws lessons from practical experience with policies that facilitate scaling up ecosystem-based water management, drawing on in-depth case from various contexts.

Introduction and objectives

While control of point-source water pollution is improving globally, water pollution from unregulated diffuse sources of pollution continues to rise in both developed and developing countries. The relative lack of progress with reducing diffuse pollution reflects the complexities of controlling multiple pollutants from multiple sources, their high spatial and temporal variability, associated transactions costs, and limited political acceptability of regulatory measures.

The objective of the paper is to take stock of innovative options based on ecosystems, identify the obstacles that hinder their dissemination at scale, and recommend policies that can facilitate their further diffusion in a variety of contexts.

Methodology approach

The paper analyses the water quality challenges facing developed and developing countries. It presents policy instruments that support ecosystems-based approaches, and details several case studies of such approaches to control diffuse pollution. The case studies investigate:

- The policy and institutional context;·
- Rationale for the introduction of the policy instrument;·
- Instrument design (how the instrument was selected; how it works, who pays and who benefits; how it combines with other instruments);·
- Outcomes;·
- Challenges with implementation.The project benefited from expert discussions at a dedicated workshop and in OECD Working Party on Biodiversity, Water, and Ecosystems.

Analysis and results

Prevailing policies to abate diffuse water pollution have limited impact because they do not reach major polluters, or lack finance or supportive environmental regulations.

The greatest challenge of regulating outputs of diffuse pollution is to allocate a pollution 'cap' to individual land owners in a way that is equitable and cost-efficient. A promising ecosystem-based approach identified is the natural capital based approach. This allocates diffuse pollution limits based on the underlying capacity of the soil to filter and retain water and nutrients. Shifting to a natural capital based approach offers a basis for assessing the capability of wider landscapes to provide multiple ecosystem services for a range of desired outcomes beyond just economic growth and water quality. Advances in computer modelling offer an

opportunity to design policy instruments directly proportional to the amount of estimated pollution generated or reduced from individual properties in the catchment. Payments for ecosystem services is another option, but must be underpinned by enforced environmental regulations so as to achieve additionality. Stakeholder engagement through inclusive water governance is increasingly recognised as critical to secure support for reforms, raise awareness about water risks and costs, increase users' willingness to pay, and to handle conflicts.

Conclusions and recommendation

The paper highlights emerging policy solutions, such as a natural capital based approach to allocating diffuse pollution limits to individual property owners, water quality trading, collaborative governance, and outcome-oriented contributions to policy design. It provides a risk-based framework for intervening and policy principles to guide policymakers and stakeholders through the myriad decisions required to establish new or alter existing water quality management regimes. It identifies key elements to successful reform of policies, which can inspire and promote ecosystem based water management.

System-wide tools for managing water and ecosystems

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Keywords

Ecosystems, fish, hydrology, operations, modeling

Highlights

Responding to declines in aquatic habitat availability and species viability, water managers need tools to consider ecosystem needs. Working in California rivers, SEI developed and deployed a generic simulation platform to evaluate options in terms for habitat supply potential and its capacity to meet other more water supply objectives.

Introduction and objectives

Water managers chiefly consider human development objectives paramount, including urban, industrial, energy and agricultural water demand satisfaction. A crucial element is often missing: ecosystems. Policy-makers, recognizing the impacts of water development on aquatic ecosystems, are asking water managers to identify the best water management strategies to maintain species' habitats in rivers where the watershed is highly intervened through infrastructure development, land use change, and urbanization. New tools are required to respond to this imperative. We present an approach that gives ecosystems a seat at the table, providing water managers the information needed to weigh trade-offs that include ecosystem needs.

Methodology approach

A complete understanding amongst water managers of how operations connect to aquatic ecosystem health is lacking. This gap is particularly important in urban settings where the design and operation of the infrastructure targets human needs. Working in water systems in California, this paper presents a simulation modeling platform that integrates hydro-ecological processes within an water operations model developed by a water district, with which the district evaluated the implications of various management scenarios on both water supply and fish species viability.

Analysis and results

This work focused on building and piloting a new tool that streamlines the inclusion of ecosystem needs in water planning. In the process of identifying the right tool, a team of scientists and practitioners came up with an innovative solution by incorporating different sources of data into a single platform. The model, originally constructed with the WEAP (Water Evaluation and Planning) system to inform water allocation and planning, was adapted to generate a complete aquatic habitat assessment at ecologically relevant points and creek reaches. This habitat analysis models daily hydraulic, substrate, and temperature conditions, weighs habitat conditions against life-stage suitability curves and thresholds, and composites the suitability of each criteria to answer questions like: how many acres of suitable habitat are available for spawning salmonids at any given moment? How frequently can juveniles successfully out migrate? How many cohorts of embryos will survive to hatching? What is the most upstream passage extent of migrating salmon? The model was linked to visualization tools that show that changes in reservoir releases can affect fish habitat for each lifestage. These visualizations were designed to help water managers and stakeholders evaluate potential modifications to existing reservoir operating rules.

Conclusions and recommendation

The existence of habitat analysis within a water management model has the potential to simulate complex operations and competing allocations so water managers can explore the tradeoffs between water supply goals like municipal demand coverage or groundwater recharge and ecological goals like adequate habitat for anadromous fish. Working with local partners to identify the key ecosystem challenges, gather data, and generate estimates of available habitat is crucial to identify options to safeguard ecosystems. The presentation will focus on presenting the tool integration and recommendations for its applicability in a wide variety of settings.

Upscaling agricultural water management indigenous knowledge practices through agro-ecological zones

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Keywords

Indigenous Knowledge Practices, Agriculture Water Management, Agroecological zones, Resilience, Food Security

Highlights

A study has documented various agricultural water management Indigenous Knowledge Practices (IKP) across the African continent and beyond. It demonstrates that IKP can be upscaled to areas of similar agro ecological characteristics. This can enhance resilience and food security while preserving the natural resource base that sustains rural communities.

Introduction and objectives

Rural African communities sustain their livelihoods mostly through agriculture. Consequently, they are largely dependent on natural resources, particularly water and land. Their interaction with the environment has evolved, over centuries and through generations, into indigenous knowledge practices (IKP). The objectives of this seminar are:

- To highlight the role of IKPs in the sustainable management of land, water and other natural resources
- To demonstrate the opportunity for upscaling IKPs to agroecological zones of similar characteristics
- To contribute to food security, resilience and the preservation of the natural resources
- To share cases from Africa and elsewhere, as collected through a consultative e-forum.

Methodology approach

The following methodology has been used:

- Field visits to selected countries to identify relevant IKPs
- Literature review of similar IKP across the African continent
- Analysis of the information received using GIS and spatial data on agro-ecological zones to establish linkages and identify options for upscaling
- Consultative- e forum facilitated with four Technical Networks of the FAO , the Global Framework for Water Scarcity in Agriculture (WASAG) and other targeted stakeholders
- Analysis of additional case studies from across the world, with special contributions
- Validation of the findings through a webinar with the participants in the-forum.

Analysis and results

The results based on the analysis of the data collected prior to the e-consultation demonstrate that linking IKPs to their agro-ecological zones increases the potential for their upscaling to locations of similar agro-ecological characteristics.

Such linkages were facilitated by the use of Geographic Information Systems (GIS) and spatial data on agro-ecological zones in Africa with the following results:

- A high diversity of IKP for land and water conservation was identified in sub-humid and semi-arid agro-ecologies, respectively accounting for 34% and 23.4% of the total number of identified practices.
- Fewer IKP were identified in arid (17%), coastal and wetlands (14.9%), humid (6.4%), and highland (4.3%) zones.

Additional results are expected from the e-forum consultation that will take place in February and March 2018 and the case studies that will be solicited from the participants, to expand these findings beyond the African continent.

Expected special contributions to the compendium:

- IKP related to water and soil conservation by the Global Soils Partnership (GSP)
- Innovative financing mechanisms that can facilitated the upscaling of IKPs; this will be provided by the working group on Financing Mechanisms of the WASAG partnership.

Thus, an updated version of this analysis and results will be presented during the session.

Conclusions and recommendation

This abstract will demonstrate and/or recommend that in the context of water scarcity, increasing world population, food security, climate change and the ensuing pressure on natural resources:

- Indigenous Knowledge Practices can significantly contribute to alleviating the pressure on natural resources by providing innovative options for their preservation while exploiting them for food production
- Indigenous Knowledge Practices from one agroecological zone can be used in a zone with similar characteristics, thus upscaling their wider adoption
- Opportunities for financing IKPs exist and should be explored innovatively
- The overall benefits of upscaling IKPs include food security, resilience and sustainable natural resources management.