WISE UP to Climate

Participatory Scenario Building Workshop Report

"Learning from the Future: Alternative Scenarios for Adaptive Basin Management of Natural and Built Infrastructure Mix under Chaining Climate"

Tana River Basin



Nairobi 16th – 18th November 2015, Nairobi

Executive Summary

WISE-UP to climate' is a project that demonstrates natural infrastructure as a 'nature-based solution' for climate change adaptation and sustainable development. This report presents a summary of the proceedings of the stakeholder Participatory Scenarios workshop on the WISE-UP to Climate project that took place in Nairobi Kenya from 17th to 19th November 2015. The workshop was hosted by the African Collaborative Center for Earth System Sciences (ACCESS) and attended by stakeholder groups working the Tana River basin. The workshop served both as a capacity building and a technical project implementation activity where partners and WISE-UP users were meant to gain skills on anticipatory planning while expanding a range of future basin water infrastructure alternatives.

The overall aim of the scenario-building workshop was to develop skills and competencies among participants in the design and use of basin scenarios by stakeholders to inform decision-making and planning for alternative future water infrastructure options under changing climate scenarios. The workshop was participatory and hands-on integrating lessons, available data and trajectories from other work-packages as inputs into qualitative and quantitative storylines. Basin management tipping points (infrastructural mix) were used to set thresholds for sensitivity analysis and design/practice/behavior/investment/decision/policy trade-offs based on lessons from emerging futures.

The main content/elements of the workshop were:

- Contribution of Scenario Development Process to WISE-UP Project
- Setting the scene and Scoping for Participatory Scenario Building
- Understanding natural and Built-infrastructure mix and ecosystem services approach to basin water systems management
- The Basin Context
- Defining a Common Vision for the basin
- Future images in terms of selected drivers of ecosystems change in Tanna Basin
- Framing and Characterizing the Scenarios
- Elaborating Scenarios and Sequencing New Developments
- Plausible Future Trends in Selected Drivers and Ecosystems Services Outcomes
- Sequencing of Natura; Infrastructure developments
- Strategy for Scenario Communication
- The workshop technical sessions were concluded by a group activity to develop a

The workshop was concluded by closing remarks from facilitators, participants' representation and ACCESS team. The workshop was evaluated using both formative (continuous – daily and by session) as well as summative (final last day evaluation. A variety of participatory tools were used to assess change in participant's knowledge base and received their feedback on key workshop technical and operational processes.



Participatory Scenario Workshop participants

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List of Abbreviations and Acronyms

ACCESS	-	African Collaborative Center for Earth System Science
BC3	-	Basque Centre for Climate Change
CASELAP	-	Centre for Advanced Studies in Environmental Law & Policy
CBO	-	Community Based organization
CC	-	Climate Change
CCA	-	Climate Change and Adaptation
CDA	-	Coast Development Authority
CEC	-	County Executive Committee
CGIAR	-	Consultative Group of International Agricultural Research
CIAT	-	International Centre for Tropical Agriculture
CIDP	-	County Integrated Development Plan
ES	-	Ecosystems Services
HGF	-	High Grand Falls
ICPAC	-	IGAD Climate Predictions and Applications Centre
IEA	-	Integrated Environmental Assessment
IUCN	-	International Union for the Conservation of Nature
IWMI	-	International Water Management Institute
IWRM	-	Integrated Water Resources Management
KALRO	-	Kenya Agriculture and Livestock Research Organization
KENGEN	-	Kenya Electricity Generating Company
KEWI	-	Kenya Water Institute
KIPPRA	-	Kenya Institute for Public Policy Research and Analysis
KMD	-	Kenya Meteorology Department
KVDA	-	Kerio Valley development Authority
LBDA	-	Lake Basin Development Authority
NCF	-	Nordic Climate Fund
NDMA	-	National Drought Management Authority
NEMA	-	National Environment Management Authority
NGO	-	Non-Governmental Organization
NIB	-	National Irrigation Board
ODI	-	Overseas Development Institutes
PDNK	-	Pastoralist Development Network of Kenya
PPG	-	Pastoralists Parliamentary Group
RDA	-	Regional Development Authorities
SCMP	-	Sub-Catchment Management Plan
SDG	-	Sustainable Development Goals
SLM	-	Sustainable Land Management
TARDA	-	Tana and Athi River Development Authority
TARDA	-	Tana River Development Authority
TEEB	-	**The Economics of Ecosystems and Biodiversity**
UoM	-	University of Manchester
UoN	-	University of Nairobi
WASREB	-	Water Services Regulatory Board
WISE-UP to Climate	-	Water Infrastructure Solutions from Ecosystem Services Underpinning Climate Resilient Policies and Programmes
WRI-CSIR	-	Water Resources Institute – Center for Scientific and Industrial Research
WRMA	-	Water Resources Management Authority
WRUA	-	Water Resource Users Association

About Wise-Up to Climate

Project Summary‘

WISE-UP to climate’ is a project that demonstrates natural infrastructure as a ‘nature-based solution’ for climate change adaptation and sustainable development. The project will develop knowledge on how to use combinations of built water infrastructure (e.g. dams, levees, irrigation channels) together with natural infrastructure (e.g. wetlands, floodplains, watersheds) for poverty reduction, water-energy-food security, biodiversity conservation, and climate resilience. WISE-UP will demonstrate the advantages of combined built and natural infrastructure approaches using dialogue with decision-makers to agree acceptable trade-offs. WISE-UP will run over a four-year period and link ecosystem services more directly into water infrastructure development in the Tana (Kenya) and Volta (Ghana-Burkina Faso) river basins.

Project Components

Project Coordination – led by IUCN & Basin leads – ACCESS in the Tana Basin (Kenya) / Water Research Institute (WRI-CSIR) in the Volta Basin (Ghana/Burkina Faso), working with the Volta Basin Authority

- **Ecosystem infrastructure** investment analysis – led by IWMI, BC3 and University of Manchester
    - Eco-hydrological functions of infrastructure in the context of sustainable adaptation (IWMI)
    - Economic valuation and benefits of natural infrastructure (BC3)
    - System impact modelling and trade-off analysis (University of Manchester)
- **Political economy** of water infrastructure decisions and governance – led by ODI
- **Action learning** with stakeholders to strengthen applications of evidence and tools in policy making, infrastructure decisions and consensus building – led by IUCN
- **Capacity Building & Communications** for integrating built and natural water infrastructure and sharing results – led by ACCESS/CSIR/IUCN

Introduction

This report presents a summary of the proceedings of the stakeholder Participatory Scenarios workshop on the WISE-UP to Climate project that took place in Nairobi Kenya from 17th to 19th November 2015. The workshop was hosted by the African Collaborative Center for Earth System Sciences (ACCESS) and attended by stakeholder groups working the Tana River basin.

Background to the Participatory Scenarios Workshop

- An action –oriented scenarios building workshop planned for November 2015 in Tana basin based on emerging data and lessons drawn from the *WISE-UP to Climate* project implementation.
- In the workshop, participants explore the essentials of shared vision planning, basin developmental trajectories, scenario development (business as usual, worst case and best case scenarios) and propose best practices for infrastructure optimization under changing climate and other socio-economic and ecological drivers.
- This workshop addresses the need for climate compatible development within the basin.
- The workshop aims to make research resonate with policy makers/stakeholders who are the consumers of the project outputs and thus will provide a platform to gather information on possible futures and present ideas/perceptions of climate

The workshop served both as a capacity building and a technical project implementation activity where partners and WISE-UP users were meant to gain skills on anticipatory planning while expanding a range of future basin water infrastructure alternatives. The workshop was premised on the basic assumption that ***scenarios are not predictions or linear projections but rather a coherent description of how the future of the basin might unfold***. With this the participants explored the plausible, not just the probable basin futures and challenged users (decision makers, policy makers, experts) from stakeholder organizations to think beyond emerging trajectories and design water use options under mutually exclusive "worlds" that take into account uncertainty of major drivers of ecosystems change.

Workshop aims and objectives

Aim of Workshop

The overall aim of the scenario-building workshop was to ***develop skills and competencies among participants in the design and use of basin scenarios by stakeholders to inform decision-making and planning for alternative future water infrastructure options under changing climate***.

Expected Outcomes

It was expected that after effectively participating in the workshop, participants should be able to:

1. Explain basic concepts and principles for scenario development for basin water infrastructure management;
2. Apply different approaches and tools for scenario generation; and
3. Use participatory scenario development relevant protocols to engage stakeholders in joint ecosystems services and basin infrastructural development planning and decision-making.
4. Influence decision making/policy using information and lessons from alternative futures exploration on basin infrastructure mix, investment and decision outcomes
5. Make informed decisions on basin level water infrastructure planning and action

The workshop was designed to prepare participants to embark on a scenario development process of their own that supports basin/sub-basin/organizational ecosystem service assessment and informs decision-making. Participants learnt how to develop scenarios for basin water infrastructure planning and overall ecosystem service assessment, including challenges and skills relating to resource and tool decisions, framing, stakeholder engagement, and designing and interpreting scenarios with field-tested scenario development tools and approaches.

General approach to the workshop

The workshop was purely participatory and hands-on. Lessons, data and trajectories from other work-packages were used as input into qualitative and quantitative storylines. Basin management tipping points (infrastructural mix) were used to set thresholds for sensitivity analysis and design/practice/behavior/investment/decision/policy trade-offs based on lessons from emerging futures.

A combination of presentations, discussion, games, and hands-on activities to build knowledge and skills related to scoping, framing, stakeholder engagement, and designing and interpreting map-based scenarios will be adopted. An intuitive logics approach was adopted to cover the overall scenario building process of scoping, assessing drivers, generating qualitative and quantitative storylines and performing sensitivity analysis with different basin futures focusing on infrastructural portfolio mix.

Contribution of Workshop to WISE-UP to Climate Implementation

The topics and process of the workshop were intentionally designed to contribute to implementation of WISE-UP to Climate project as indicated in the table below.

Table 1: Contribution of Scenario Development Process to WISE-UP Project

Participatory Scenario Workshop Component	General Use	Input from Other Work Packages	Outputs for use in Other Work Packages
Setting the scene	Awareness creation among stakeholders within the WISE-UP project (project scope, progress and emerging results) Understanding Natural and Build-infrastructure mix and ecosystems services approach to basin water systems management	Current results and status of work-packages including possible future use by stakeholders of the results	Ideas and issues to be explored in stakeholder workshops and action learning events
Introduction to Scenarios: Understanding goals, scoping and reviewing drivers of change	Capacity for scenario	Dialogue output from Action Learning /Stakeholder forums Outputs of data and innovative tools Political economy results	Further capacity building needs for trade analysis/co-benefit decisions Decision parameters, performance metrics and assumptions to explore in further modeling and ES valuation
Scenario exploration process	Deepening common understanding and interaction between Drivers of Ecosystems Change	Land use change projections (concept and potential applications in anticipatory basin planning) Output from action learning events and political economy study	The critical uncertainties for further quantitative scenario modeling The scenario Framework to be used for boundary analysis in models Issues to explore in future action learning/stakeholder forums
Sequencing of built infrastructure	Time-phasing of physical perturbations	Socio-economic trends and investments ES values for comparison of different investments Climate compatible development in the Tana basin	Options for trade-offs for use in future workshops of benefit sharing and trade off analysis Parameters for model sensitivity analysis and refine of quantitative trends under different scenarios
Scenario application and future use	Communication and dissemination Raising profile of WISE-UP project Technical and population publications Project exit strategy	Project management lessons Issues/challenges for project integration and stakeholder engagement emanating from action learning meetings and partner interactions	Input into work packages for final data, tools, result refinement Strategy to hold similar workshop in Volta

Summary of Daily Proceedings

Day 1: Setting the scene and Scoping for Participatory Scenario Building

Welcome and Official Opening

Dr. Bell Okello, the facilitator, opened the workshop by welcoming the participants to the workshop and led them in introducing themselves. Following the introductions, Dr. Okello requested Ms. Omuombo from ACCESS to give her opening remarks.

Ms. Omuombo recognized and appreciated the presence of all the stakeholders present at this meeting that have been able to support the project from time to time. She gave apologies from Prof. Eric Odada who was not present at the meeting due to the other commitments in New York for a global meeting on Sustainable Development Goals (SDG) where water has now been accepted as a stand-alone agenda.

She recognized the participation of the various stakeholders present in the room who have attended several of the project events and was glad that their institutions are willing to engage with the project at different capacities including the provision of the data that is informing the project. She reiterated that the WISE UP to Climate project will continually engage the stakeholders and pointed to the importance of the participatory scenarios workshop, a forum to dialogue on issues in the Tana and elaboration of shared vision for the basin as a means of exploring the possible futures alongside climate change. The workshop was designed to foster climate compatible developments on the backdrop of the fact that climate change is in the forefront of global discussions including the upcoming COP21. She noted that Kenya has mainstreamed climate change in the National Water Master Plan. Sustainable land management, IWRM, droughts, water security and climate adaptation are also being considered for integration in the current framework of basin management. She called upon the participants to take note of these and other developments even as the workshop develops the participatory scenarios over the 3-day period. She acknowledged the many challenges within the basin and further thanked the stakeholders present for sparing some time off their busy schedules to come to this important meeting that will inform the project results moving forward and help the project adjust or deliver useable results including building capacity of basin stakeholder to use emerging information, tools and knowledge for basin infrastructure decision making and practice.

Ms. Omuombo, invited the keynote speaker Prof. Daniel Olago, Professor of in the Department of Geology and Institute for Climate Change and Adaptation, University of Nairobi and one of the Directors of ACCESS to give his keynote presentation on "***International policy on climate change adaptation and mainstreaming adaptation in development planning"***. In his address, Prof. Olago made the following key points:

- Climate change is inevitable with the current analysis displaying regional impacts of the estimated magnitude of change. There is a possibility of disastrous impacts of the anticipated change that would require reliable monitoring technological options. With the anticipated change, there are limits to sustainable development that would require monitoring and collaboration between scientists, institutions and civil society to effectively communicate results and findings.
- His presentation highlighted the impacts of climate change on agriculture, forestry, natural terrestrial ecosystems, water resources, freshwater fisheries, human settlements and human health.
- He noted the current state of the science of assessment is in its infancy, limited in scope, narrow in terms of discipline and seldom considers adaptation. These issues can be remedies by through assembling relevant inventories, integrated monitoring to quantify sensitivities, multidisciplinary impact research programmes and national and regional action.
- In mainstreaming adaptation, there is need to bring climate change adaptation to the forefront of the national policy agenda and mobilize political goodwill. Climate change adaptation needs to be integrated in the national and sub-national (county/regional levels) development strategies and plans. He further emphasized the need to create fiscal and policy incentives to increase climate financing for equitable climate change adaptation.
- There is need to improve institutional capacities for the formulation and implementation of laws, and this can be well done through participatory approaches thus enabling the elimination of barriers that limit poor's access and economic benefits of climate change.
- He concluded that the governments and NGO'S need to work together in assessing the local adaptation needs, environmental governance and capacity development, have local delivery platforms, support local and indigenous SMEs and community based adaptation to climate change initiatives.

Understanding natural and Built-infrastructure mix and ecosystem services approach to basin water systems management

- Ms. Omuombo shared a brief of the WISE UP project and focused on the ecosystems as being infrastructure within a water management system.
- From the presentation it was apparent that the project is looking at basin wide management that looks at multiple objects that would meet the economic development as well as foster sustainable natural resources that in this case are important infrastructures in satisfying human needs within the basin.
- She highlighted some of the expected outcomes of WISE UP as being the development of built and natural infrastructure investment portfolios; the sharing of knowledge and tools that meet the needs of the stakeholders within the basin; the improvement of the capacities of the stakeholders in accessing and applying evidence generated by the project thus ensuring there is adaptive capacity.

The Basin Context

In order to lay the foundation for the Tana basin scenarios, a discussion and brief presentations were made/facilitated on prevailing situation with respect to stakeholder portfolio, WISE-UP project agenda, basin ecosystems services and emerging trends that might influence the basin water infrastructure and ecosystems service trajectories.

- *Stakeholder portfolio*: Different agencies/stakeholders are working on several initiatives in the basin. These including state and non-state actors. Representatives from some of the organizations present at the workshop made presentations, namely: KENGEN, TARDA, CDA, County Governments. The presentations covered organizations goals and mandate, current activities, information and data holdings on ecosystems services and water infrastructures, need for WISE-UP tools/knowledge base and how the participatory scenarios outcomes will enhance their work.
- *Video clip on WISE-UP project*: DW video about WISE-UP project showing Dr. Lydia Olaka interacting with some of the stakeholders in the Tana basin.
- *Emerging trends*: A discussion was held on the emerging trends in Tana basin socio-economic and biophysical processes with implication on water infrastructure designs and ecosystems services. The trends reflected the following:
    - Climate change and variability
    - Industrialization
    - Resilience of ecosystems
    - Social – cultural milieu
    - Basin management including downstream-midstream-upstream relations
    - Hydropower energy
    - Policy development, implementation and tracking
    - Energy (demand for hydropower electricity)
    - Land use change
    - Population and demography including settlements and movements
    - Governance (national and county level)
    - Basin biophysical processes (erosion, flooding, hydrology)

The session concluded that there is a general trend in complications with respect to basin water resources management due the need to balance various ecosystems services as key drivers like climate change, land use change, energy requirements demand increasing integration of water governance, natural infrastructure and built infrastructure mix as well as conflict between benefits especially agriculture vs pastoralism. There is need for approaches, tools and data to support integrated as well as forward looking assessments and management.

Common Vision for the basin

The participants discussed in groups, the future image of the basin under specified drivers of change. The results were presented on cards and are summarized in the table below.



Table 2: Future images in terms of selected drivers of ecosystems change in Tana Basin

Driver	Future Image
CLIMATE CHANGE	• Well functioning ES • Bridging the gap in terms of climate change knowledge between technocrats and the laymen this could also include simplifying the jargons • Adaptation and adoption of coping mechanisms in addressing WR issues in relation to CCA
INDUSTRIALIZATION	• Industrialized economy
RESILIENT ECOSYSTEM	• Adequate food • No waste • Continuous flow of water all the year round • Resilient economy • Resilient wetland ecosystems • Resilient ecosystems/ A conserved environment • A water secured basin • Benefit sharing among water users

Driver	Future Image
	• Recognition of ecosystems and biodiversity values (including intrinsic values)
SOCIAL SPACE	• Mutual respect of livelihoods • A food secured community • An informed community making informed decisions and choices thereby enhancing their resilience to climate change and manage resources sustainably • Stop conflicts along the belts • Good quality water for everyone • Gender mainstreaming in the development od policies and plans as well as budgetary process (women are impacted most by climate change due to their societal roles) • Effective and efficient water allocation to different intended uses • Healthy people • Minimal Water use conflicts • Clean water • Consultative society • Easy access to water • 1st rate transport infrastructure
BASIN MANAGEMENT	• Collaboration among all the stakeholders in the management of the basin/stronger partnership between institutions dealing with the management of the basin thereby complementing each other as opposed to competing with each other • Regulation of river flow through dam construction • Conserving vegetation cover – upstream and along the river • A policy in place on land management within the basin (integrated land use policy) • Protection of assets and lives (disaster risk reduction in cases of floods and droughts) • A basin that provides some water to all users within the basin every time/everywhere • A well managed conserved basin to provide adequate water for irrigation • A basin with improved vegetation cover (forested basin) • A basin with more consultative management approach/ efficient water use • Active multi-stakeholder dialogues and forums • Well catchment management of protection

Driver	Future Image
	• Stakeholder involvement in IWRM activities • More empowered communities in IWRM through WRUA's
HYDROPOWER ENERGY	• Stable supply of electricity • Construction of dams for power • A well conserved basin catchment to increase hydropower generation
POLICY	• WR data collection, management and use • New and existing policies on NRM should not only be put in place and enforced. • Good governance
ENERGY (demand for hydropower electricity)	• Increase in industrialization • Rural electrification • Changing lifestyles leading to increase in energy demand • Construction of more dams upstream • Rural electrification programs and policies • Capacity of existing – hydro dams • Alternative renewable energy • Impact – downstream ES and hydrology and people • Options for dam technology esp. mitigation downstream impacts
LAND USE	• Land use change, land use practices, over abstraction upstream, human encroachment, competition for resources • Grazing • Afforestation/deforestation • Irrigation • Land use • Infrastructure – roads, buildings • Mining • Farming • Tourism- game parks • Fishing
Population and demography	• Population growth: utilization of resources, pollution, depletion • Urbanization: Utilizaton of natural infrastructure, increase in built infrastructure, destruction of built infrastructure • Income: increase in income for utilization, lifestyle affects demand for resource • Education: education infrastructure increase needs for water resources

Driver	Future Image
	• Change in diet – tubers to water intensive crops thus need for irrigation
Social change	• Urbanization, externalities, lack of education, poverty level, education and awareness, lack of • Urbanization: increased demand for water, water quality, catchment reduction • Cultural issues: conflicts, competition • Tourism: forest preservation • Education: Awareness, soil and water conservation • Political will: political regime, policy framework
Industrialization	• Growth in industrialization, technology and technological advancements, research and development • WR pollution, • Over abstraction of G/W • Obstruction of natural water infrastructure • Water politics (trans-basin transfers) • High density population in urban areas. • Water use conflicts • Environmental degradation.
Agriculture:	• Demand for water intensive foods, conflicting policies • Overstocking • Poor agricultural practices • Increase in demand for agricultural produce leading to degradation • Overfishing • Irrigation
Climate change	• Elements of climate change and variability-land use • Resources conflict • Rise in sea levels • Relative importance of climate change variability • Floods • Rainfall patterns • Change in vegetation • Recurrent droughts • Eviction of wildlife • Increase in temperature – global warming
Governance	• Geopolitics, hydropolitics, laws and policies, governance • Gender inclusivity • Prioritization of catchment conservation programmes by central government

Driver	Future Image
	• Poor legislation and enforcement • Lack of awareness at local levels • Devolution – different plans and policies • Inequitable distribution of water resources • Institutional frameworks • Hydropolitics • Corruption: misappropriation, water permits licenses, charcoal permits

Day 2: Characterizing the Scenarios

Dr. Lucy Emerton on behalf of BC3 research team made a presentation on valuing of ecosystem services. She pointed out the ecosystem services have in the past been undervalued yet they count as natural infrastructure as an economic part of water infrastructure that need to be factors in water planning and investment decisions. Her presentation highlighted some of the work carried out in Cameroon, Uganda, Malawi and in the Kenya where ecosystem services valuation has been used to demonstrate to donors and government the options that may be profitable in planning and management of water resources. She further concluded her presentation with the mention of the ongoing WISE-UP work that looks at establishing economic linkages across the landscape on a smaller sub catchment in the Kimakia in Upper Tana.

Dr. Richard Mulwa from the University of Nairobi, CASELAP highlighted the economics of ecosystems and biodiversity (TEEB) project in the Tana River. The presentation highlighted the TEEB framework, the impact of drivers on ecosystem service provision with emphasis on dose response functions of flood recession farming, pastoralism, health and fish catch. He further presented some of the work that has been carried out in valuation of the mangrove ecosystems where extensive was carried out in quantifying the economic values.

Question and Answer session

Question	Answer
Emmanuel – How sensitive are the ES goods and services are due to the river level?	It's possible but what was done was static optimization but to achieve this, dynamic optimization needs to done to detect this sensitivity.
Future changing conditions that might change the relationships in the basin. CC impacts within the basin? Land use in relation to stream flows?	One of the indirect drivers in the TEEB is CC but the impact of CC itself will affect the flows.
Issues of uncertainty – uncertainty analysis a range of values instead of a	Assumption that the value gotten was representative of the population.

single value. How certain is the one number?	Changes in price margins can present the range.

Tana Basin Stakeholder Impressions: Water Infrastructure for Climate Change Adaptation

TARDA presentation by Eng. Peter Muli

TARDA is currently under the ministry of Environment and is responsible for 138, 000 sq km total development area within the Tana and Athi basins. The current flagship project under vision 2030 is the HGF dam that covers the Tharaka Nithi, Mwingi and Kitui counties. Currently there are loan negotiations with the Exim bank of China that is one of the milestones of the project. The feasibility study of the project has been carried out and there will soon be a groundbreaking ceremony. The current project cost is projected at 1.54Bn USD and it will take 6 yrs to implement. The HGF dam is a 5.4bn cubic meters multipurpose dam projected to provide the following benefits: 200ha of irrigation, 500 – 700 MW hydropower production, Tourism, Flood protection, Water supply and Job creation. There is an ongoing ESIA that should be completed soon for the project to go ahead.

Question	Answer
Has the project had community consultation to pave way for such a project? At what stage was the community consulted? Is there a displacement of the local community	There is a resettlement action plan from 2009 that is currently under revision. The ESIA will include this. A partial environmental impact assessment. The process has been Participatory
How willing is TARDA to uptake results of studies in the Tana or is the information cast in stone already?	They are willing to accept any information availed to them from the project and are willing to borrow from the wider stakeholder group and value the outcome of the various projects in the Tana.
There is an irrigation development proposal on the upper Tana (Upper Murang'a being developed) can you let us know more about this?	Murang'a irrigation scheme- there is a underway feasibility study for 5000ha. Currently its in the prefeasibility stage and the detailed design of the project should be out by early March
Constitutional issue – is the project within the RDA not in contravening the current constitution?	
Do you think that you could be parastatalizing county functions?	19 milestones, the project were designed a few years back before devolution and TARDA understands this project better than the counties. RDAs Undertake integrated regional

	planning, the counties can approach TARDA in the implementation especially if the counties have the capacity.
Irrigation schemes within the upper Tana. Level of stakeholder involvement now that the prefeasibility study is underway; How far are social aspects done? Are WRUAs in consultation? Legality in terms of water resource management?	• The counties are now being involved and all the stakeholders are to be involved.
Are the RDA's still relevant	Yes they are relevant since devolution is being implemented; they are the institutions with relevant regional integration.
How much are you involving the Tana river county in Gamba – rice irrigation, and Mumias scheme in the delta? Have there been consultative meetings with the counties?	The Mumias scheme has stalled. TARDA is trying to integrate the counties in the projects.
To what extent have the counties aligned their sectoral plans to accommodate new developments? Will there be the revision of plans or how the plans and projects from TARDA fit in it.	The counties have now started to develop with the integrated plans so that they can seek county partnership on the projects.
COMMENTS:	
TARDA started the process and are the best to implement this. The counties are a new constitution and this is in schedule 4 of the constitution. Intergovernmental relations act provides provisions of the cooperation. There are legalities under the constitution and now the counties are mandated to carry out development projects as well.	
Comment by CDA – RDA's deal with integrated projects and transboundary of river basins and such projects e.g. Mwache dam in Kwale and supply water to Mombasa and Kwale – counties Kwale – Irrigation, Mombasa – Supply of water. Contribution from Kwale and Mombasa counties. Implementation of the projects from the RDA's and counties will be included in the process.	
The conflicts arising from the discussions are healthy, looking at the different project developments – counties need to appreciate that there is work that has been on going, but there is need for dialogue. There is need for realignment of the projects from RDA's and counties spatial plans.	

Water Resources Management Authority (WRMA) – Ms. Jacqueline Mboroki

WRMA is a government parastatal charged with regulating water resources, as well as analyzing supply and demand for water. WRMA faces challenges in addressing these demands, management of catchments, silting and sedimentation of dams that store water. WRMA through ORGUT Kenya, Nordic Climate Facility (NCF), and Rural Focus carried out an adaptive capacity training in selected WRUAs. This followed the downscaling of the climate simulations (generated by UK Met office) that provided simulations of near future (2049 - 2070) and distant future (2070 - 2099) scenarios. The key outputs of this work are being implemented in the pilot WRUAs (one of which is in the Tana) of which they would like to upscale to other sub-catchments. Currently, WRMA is the custodian of the generated produces and for the dissemination of work linked to the products.

Scenario Development Process

An interactive presentation was made on the scenario building processes with an emphasis on participatory scenarios. The key steps discussed and practiced are highlighted in Figure 1:

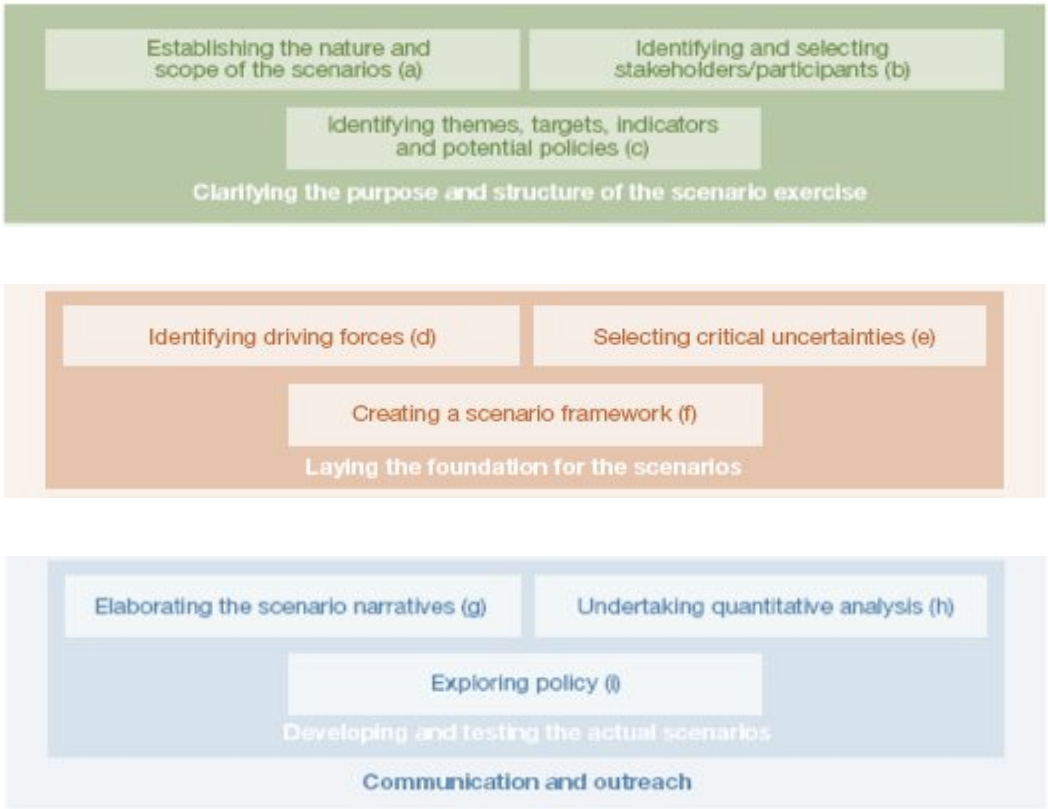


Figure 1: Participatory scenario building process – an Introduction

Scenario Framing

After clarification of the overall purpose and process of participatory scenario building, the participants defined the specific objectives of the Tana Basin Water

Infrastructure/Ecosystems Services participatory scenario development exercise. The following were highlighted as the main objectives:

- Capacity building and training to provide information to Tana basin stakeholder on visioning and foresighting as well as raising awareness of policy makers on forward planning
- WISE-UP Project work package integration of information from different processes and actors into a dialogue plat from planning and exploring future possible developments
- To endear strategic planning through basin management decision support by gathering different views and to identify issues that will determine future trends and support evidence-based planning for preparedness for future alternative trends in drivers, outcomes, ecosystems benefits and optimal mix to support policy measure development

In summary, the plenary discussion concluded that the process should allow for the stakeholders to participate, enable the representation of conflicting opinions and views. It was acknowledged that challenges such as climate change, land use change, biodiversity loss and natural resource use inefficiencies have long-term implications and so require long-term policy solutions that participatory scenario building processes help address ahead of time. By anticipating, jointly what lies ahead and grasping ongoing, emerging and latent developments, we are more able to collectively address adaptive basin management needs.

Plotting of the Critical Uncertainty

The plenary discussed the procedure and plotted the identified drivers to determine the critical uncertainties. *A critical uncertainty is a driver that is most important for the future basin ecosystems changes but is also most uncertain.*

Procedure for Determining Critical Uncertainties

- Consider each driver in turn, and recall the range of possible ways it could evolve.
- Consider the degree of uncertainty in each of these drivers. How much variation is there in the range of possible ways it could evolve? Is there a great deal of uncertainty, or relatively little?
- Consider the relative impact/importance of each of these drivers into the future. Does the way that it evolves make a major difference in the overall vision for the future, or does it make a relatively minor difference?
- Plot each the **driver** on the chart of impact/importance versus uncertainty. (In Figure 8, each circle represents a particular driver.) The farther to the right, the greater the uncertainty in how that driver could develop. The farther upward, the more significant is the impact of that driver.
- Identify the two or three drivers that are highest impact and highest uncertainty. (The two drivers that have the combination of the highest importance and highest uncertainty are labeled CU1 and CU2.)

The Tana Basin Scenario Critical Uncertainties and 4 Futures

For Tana the two critical uncertainties were identified as:

1. Climate change and variability
2. Land use change

Image of the plenary plotting of drivers' relative importance against future uncertainty. The exercise was used to determine the critical uncertainties (climate change and land use change) which was then used to draft the scenario framework.

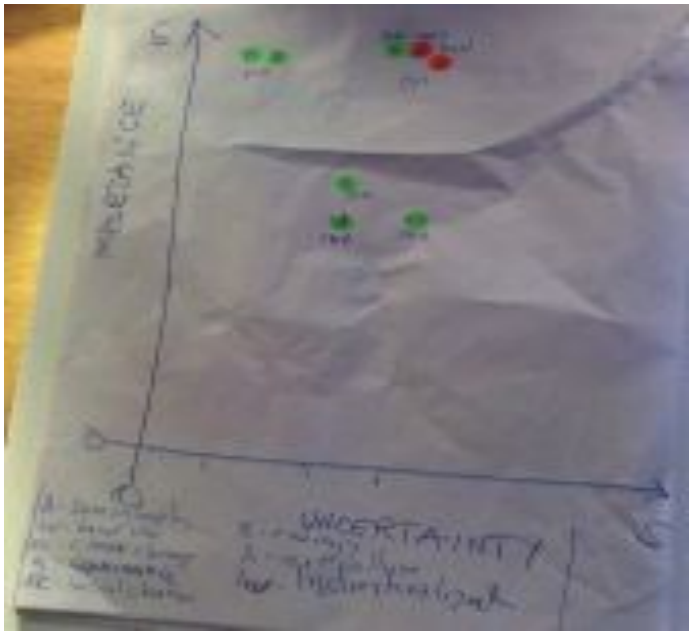


Figure 2: Determining the critical uncertainties



The four quadrants that reflect the four mutually exclusive futures of Tana basin ecosystems services as plausibly dictated by climate change and land use change dimensions.

- Scenario 1:
- Scenario 4:
- Scenario 2:
- Scenario 4:

Future participatory work in the workshop was based on the four scenarios.

Figure 3: The scenario framework depicting the four quadrants (Tana futures)

QUESTION	RESPONSE
Will certificates be issued at the end of the workshop?	No there will not be any certificates issued although ACCESS will take this into account in future workshops
Comments	
• The National Lands commission needs to be included in these discussions, as the land use change seems to be a recurring issue.	
• The project needs to figure out a mechanism to distribute the results to the ASAL counties as these regions would greatly benefit from the outcomes of such projects	
• Duplication of mandates of NDMA, NLC, Min of Lands- land use issues should be clearly looked at in the project	
• Lack of awareness on climate change in by local communities, how will information dissemination occur from the project to these communities?	
• The scenario development is a policy guiding process to select certain plausible futures/actions that can help in the harmonization of the basin development strategies.	
• What role do counties spatial plans play in the decision making process and how will these be taken up by the project?	
• There is need to engage NEMA and county environmental committees in the project demonstration and dissemination of results.	
• There are several upcoming laws and bills concerning Land use and water that need to be considered especially when looking at future scenarios.	

Scenario Definition Exercise

The four emerging future "worlds" were described with respect to the major features of the critical uncertainties (climate change and land use change). Participants were divided into four groups to characterize the scenarios and give each a unique name.

GROUP A – JUDAS (Negative land use change, positive Climate Change)

LAND USE SCENARIOS

1. Deforestation
2. Poor farming practices
3. Over stocking
4. Unsustainable quarrying practices
5. Unsustainable exploitation of resource e.g. sand
6. Siltation of rivers
7. Water pollution
8. Land degradation
9. Soil infertility
10. Dysfunctional economy
11. Poor policies, regulations and enforcement
12. Encroachment
13. Increased and unresolved resource conflict
14. Depletion of biodiversity
15. Unplanned settlement
16. Land disasters
17. Increased flooding incidences

CLIMATE CHANGE SCENARIOS

1. More water
    - Replenish the natural infrastructure thus ensure more water
    - Food security (irrigation during the dry season)
    - More energy to the national grid
    - Eco-tourism, water games
2. Increase level of awareness in climate change this enhance preparedness in built infrastructure
3. Climate change mainstreaming in planning and budgetary allocation in all sectors to finance adaptive measures for infrastructure mix
4. Gender mainstreaming n climate change adaptation to ensure gender sensitive adaptation
5. Alternative livelihoods in place
6. Stakeholder involvement in planning and implementing projects
7. Coherent climate change policies in place
8. Proper M&E tools for tracking climate finance
9. Sustainable resource utilization and management in place
10. Mandatory life cycle assessment for most of industries in place
11. Policies to conserve biodiversity in place

12. Carbon credit trade opportunity.

GROUP B – TANA POA (Positive Land Use Change, Positive Climate Change)

1. Mainstreaming of CC into development plans (CIDPs, sector plans and county spatial planning)
2. Disaster preparedness in Tana basin (floods, droughts, diseases)
3. Secure livelihoods
4. Soil conservation measures in place
5. Resilient biodiversity (entire basin and marine areas)
6. CC adaptation plans
7. Awareness on CC
8. Food security (availability)
9. Sufficient water of good quality for all everywhere and every time
10. Soil and water conservation plans developed and implemented
11. Climate compatible development
12. Good governance – policies, political goodwill
13. Increase in forest cover
14. Investments (financing)
15. Awareness on land use
16. Secure land tenure
17. Resource conflicts managed and reduced
18. Functional early warning systems
19. SCMPs incorporate climate issues – Sub Catchment Management Plans
20. Harmonized policies and institutional frameworks
21. Governance on land use
22. Resilient wetland ecosystems
23. Participatory development (gender, youth, disabled)
24. Land use plans developed and implemented
25. Capacity building on CC and land use
26. Dissemination and information sharing
27. Adequate data for CC and land use

GROUP C – Ardhi bora (Positive Land Use Change, Negative Climate Change)

1. Catchment conservation programs e.g. terracing and check dams
2. Adequate reliable up to date and used data to support LU management
3. Research – geological and ecosystem with linkages to research institutions
4. Land use tenure system
5. Industrialization
6. Population growth
7. Recreational tourism
8. Cultural sites
9. Participatory approach in land use
10. Industrialization / urbanization
11. Limited capacity (financial, technical and skills)
12. Migration

13. A lot of conflicts over resources
14. Predictability and application of laws to policies (e.g. in Israel, California, Mauritania)
15. Enforce policies/laws
16. Strengthen institutions
17. Change of livelihoods (drop out by pastoralist to farmers)
18. Land use – afforestation, appropriate zoning, land use planning
19. Climate change (negative)
    - Flooding increased
    - Displacement
    - Destruction of property
20. Recurrent droughts
21. Policies – Weak institutions/political interference

GROUP D – Okoa Tana (Negative Land Use Change, Negative Climate Change)

1. Climate change
    a. Floods
        - Displacement of people
        - Inundation
        - Loss of livestock or properties
        - Destruction of infrastructure
        - Water borne diseases
        - Poor water quality
        - Mudslide and landslide
        - Loss of biodiversity
        - Legal and institutional framework weak
    b. Droughts
        - Loos of livestock, crops, disease outbreak
        - Degradation of land
        - Diseases outbreak
        - Reduced flow in rivers
        - Rise in water use conflicts
        - Displacement of people
        - Human, livestock, wildlife conflicts
        - Famine
        - Disruption of education, health, social fabric,
        - Heat stress
    c. Land use
        - Poor drainage
        - Erosion in catchment areas
        - Poor farming practices
        - Misuse of legal framework (selective use of legal framework)
        - Inefficient use of financial and economic resources
        - Loss of land fertility

- Catchment degradation
- Deforestation
- Degradation
- Land use policy and tenure system
- Inadequate awareness (Capacity building)

Day 3: Elaborating Scenarios and Sequencing New Developments

After a recap of the previous day's activities, participants continued with scenario building focusing on qualitative and quantitative elaboration to create draft storylines under each scenario. The day was also dedicated to discussions on impacts (spatial, socio-economic, ecosystems service based) future trends and impacts of alternative water installations. The investment categories that were sequenced included:

- Proposed dams
- Existing dams
- Agriculture
- Population
- Water transfers



Table 4: Plausible Future Trends in Selected Drivers and Ecosystems Services Outcomes

Year	Group A	Group B	Group C	Group D
2050		• Mushrooming urban center/sprawls		• Land degradation • Social change - major conflict among human/livestock/wildlife on resource is leading to migration, displacements, deaths
2045	• Full population growth • Growth in industrialization	• Alternative energy source development by 2040	• Population surge in the basin • Development of other alternative sources of energy • Leaching of soil	• De-industrialization • New technological advancement in energy production and climate change • Continuous capacity building • Over abstractions of water from the basin • Lack of water and food security policies in place leading to increased and unresolved water related conflicts among the competing users

Year	Group A	Group B	Group C	Group D
2035	• Influx in population in Tana	• Increased income levels in Tana • Technological advancement • Social change - cultural issues erosion of cultural values and increase in immorality • Social change: tourism boom resulting to more employment/rise in living standards, • Growth in tourist resorts	• Urban sprawls in Tana basin • Technological advancement • Effective laws and policies on climate change and efficient energy production by 2025 • Policy and awareness in place within the basin to enhance and promote water conservation measures e.g. dams by 2030 • Agriculture act and other land use policies are being effectively enforces by 2035 • Research and development • Water and environmental pollution • Social change - managed conflicts on resource use	• Population perturbation in Tana basin by 2025 • Urbanization shocks in Tana basin by 2025 • Land and water use conflicts • Social change - poverty level - major food shortage leading to dependency on relief supply leading to rise of slums and deaths • Nile basin IWRM treaty has not been ratified by Kenya so no national IWRM policy and no IWRM principles being applied to the Tana basin

Year	Group A	Group B	Group C	Group D
			• Social change - displacement of population to extreme floods and droughts	
2025	• Adequate water supply for irrigated agriculture • Zonation of basin for irrigation • Inadequate water for livestock • Inadequate pasture for livestock • Harmonized agricultural policy (by 2020) • Social change - weak policy framework with lack of enforcement and weak institutions • Urbanization: massive urban development • Urbanization: reclaiming wetlands and creating planned	• High water demand • Allocate land for livestock keeping for pastoralists (2020) • Development of hydropower infrastructure (2025) • Adequate water for livestock • Multi-stakeholder sectoral forums in place for knowledge/information sharing and management for sustainable management of the basin and incorporated into county decision making • Integrated land use policy for Tana Basin in place and being implemented by 2020	• Interference with ES	• Environmental degradation and over-abstraction of resources
			• Social change - awareness - increased awareness on land use practices	

Year	Group A	Group B	Group C	Group D
	and unplanned settlement • Effective energy policy • Change in land use policy • Capacity building on energy • Environmental degradation • CCA regulations elaborated and concrete plan of action is in place for implementation in the Tana basin 2020			

Sequencing of built infrastructure in the basin informed by the National Water Master Plan – presentation by Christine Omuombo. Ms. Omuombo highlighted some of the activities within the national water masterplan provided a holistic outlook at some of the developmental agenda of the Tana displaying changes in projected infrastructural development associated with water storage, water transfers, irrigation, agriculture, population and energy that need to be given consideration in the basin from the stakeholders.

Table 5: Sequencing of Natural; Infrastructure developments

	Group A	Group B	Group C	Group D
PROPOSED DAMS	• Reduced water storage by 20% by 2035 • Reduced supply by 20% by 2035 • Escalation of competition of resources by 40% by 2035 leading to conflicts • Increased demand for land to build more dams by 25% by 2035	• Increased water storage by 20% by 2030 • Increased water supply by 20% by 2035 • Increased power supply by 20% by 2035		• No investment on proposed dams by 2040 • Negative impact on society, ES and economy by 2040

	Group A	Group B	Group C	Group D
EXISTING DAMS	• Siltation of dams leading to filling up 100% by 2050 • Reduced power generation leading to power rationing and use of expensive fossil fuel (diesel) by 30% by 2050 • Reduced water supply leading to water rationing by 50% and drying up of rivers downstream by 40% due to siltation by 2030 • Regeneration of vegetation by 30% by 2050 • Increased soil fertility by 40% due to deposition downstream by 2030 • Reduced soil fertility by 40% due to erosion upstream by 2030	• Increased power generation by 20% by 2035 • Increased water supply by 2035	• Floods - increased power generation and water supply by 20% by 2030 • Droughts decrease power generation and water supply by 30% by 2030	• Siltation of dams by 50% by 2040 • Increased power rationing by 50% by 2030 • Reduced water supply by 50% by 2030

	Group A	Group B	Group C	Group D
AGRICULTURE	• Decrease in livestock production by 2025 • Flooding disasters affecting livestock by 2025	• By 2015, existing institutional ranches in lower Tana • Meat processing plants by 2035 • Increased livestock productivity by 2025 • **Location** • Mostly the middle Tana basin especially (large scale) with small/private also in upper/lower in the riparian zone • **On site impacts** • Equitable allocation/siting of schemes to allow livestock access to river and grazing zones • Allow for continued traditional floodplain agriculture • SLM techniques adopted by farmers, maintaining and improving soil/water quality • **Downstream impacts** • Water abstraction managed to allow sufficient social, economic	• Reduced pasture by 2035 • Reduced livestock production by 2035 • Climate smart technology for pasture by 2035	• **Location** • Most of the irrigation will be in the middle Tana (especially Large-scale irrigation) with small/private also in upper/ lower Tana but in Riparian zone • Status by 2025 - large scale irrigation will have increased by 75%, small scale declined by 30% and private increased by 25% but land will be badly managed (soil exhaustion, no wastewater treatment, inefficient water use) • 2035 - due to land exhaustion all type of irrigation will decline • 2050 - very little irrigable land left • **On site impacts** • Large irrigation schemes will be located along floodplain in middle Tana (conflicting with dry season pasture and traditional floodplain agriculture • On site land

	Group A	Group B	Group C	Group D
POPULATION	• Development of water storage facilities (across the board 100%) by 2030 • Deforestation by 5% across the basin by 2030 • Siltation in rivers by 2030 by 30% in middle and lower Tana • Air and water pollution by 15% across the basin by 2025 • Erosion across the basin by 20% by 2030 • Destruction of wetlands in the middle and lower Tana by 20% by 2025 • Flooding in urban areas in upper and lower Tana by 25% by 2025 • Pastoralists - conflicts for water competition lower by 20% by 2030 • Destruction of floodplains lower by	• Increased land use resources by 25% across the basin by 2020 • Increased water storage by 100% across the basin by 2030 • Equity in water allocation	• Conflicts across the basin by 2020 • Increased water storage by 100% by 2030 • Water pollution across board by 15% by 2030	• Conflict by 2020 • Flooding by 2030 - 20% lower • Wetland depletion - across board 15% by 2025 • Water pollution - across board by 15% by 2030 • Loss of biodiversity lower by 25% • Deforestation - upper 20% by 2030 • Erosion - across basin by 20% by 2025 • Waterborne diseases - increase by 50% across board by 2030

	Group A	Group B	Group C	Group D
Water transfers	• Masinga-- Kitui extension - delayed implementation due to the CC there's more water but this is not harvested due to poor land use practice though there is still pressure for this by 2030 • Kiambere to Mwingi extension - No extension- its already in the red, subsidies not available anymore this deepening the operational costs • HGF to Lamu - delayed, there is water but affordability is a challenge by 2035 • TCA to ACA for Nairobi - immediately (2020) increased demand for water in the city	• Masinga – Kitui extension - There is adequate rainfall since CC is positive with positive land use practices this water is harvested • Kiambere to Mwingi extension - Shouldn't continue there's increased rainfall and water harvesting • HGF – Lamu - Delayed/not necessary with good land use there is harvesting from sand dunes and Lake Kenyatta. Increased rainfall - increased infiltration more water will happen at some point due to pollution influx, over extraction may lead to intrusion • TCA to ACA for Nairobi - will be done by 2025 increased demand from industries and domestic use	• Masinga – Kitui extension - This will happen immediately, there is a lot/increased demand for water. Water harvesting and good irrigation in place • Kiambere to Mwingi extension - Could start earlier- affordability with positive land use practices by 2025, there is increase in demand • HGF – Lamu - Take place immediately and operational by 2025 its demand driven • TCA to ACA Done immediately due to increased demand by 2020 there will be a further increase in demand for urban water	• Masinga Kitui extension - this will be a white elephant as it will be a very expensive project which will require expensive infrastructure. The project can't sustain itself. There is pressure to rescue the situation though by 2035 • Kiambere - Mwingi extension - No extension - No money to run/ operate it as a result of high operational costs • HGF to Lamu - Delayed to 2035 due to demand for water.

Communication Needs

The workshop technical sessions were concluded by a group activity to develop a scenario communication strategy. The activity involved, identifying and characterizing the target groups, listing their respecting scenario and WISE-UP information needs, determining best communication channels, expected behavior/decision making changes and means of receiving feedback. The results of the discussions are summarized in the table below.

Table 6: Broad target group based scenario communication strategy.

Target Group	Categories of Stakeholders in this Group (Clusters)	Information Needs	Channel or Media	Expected Action (Decision, Behavior, Action)
WISE UP PARTNERS	• IUCN • IWMI • ACCESS • CSIR • ODI • BC3 • UNIVERSITIES AND RESEARCH INSTITUTIONS	• Socio-economic scenarios • Population trend and projections • Land use scenarios - land use changes • Water demands - irrigation, domestic, industry • Current and planned water infrastructure • Policy information/strategic plans for agriculture, energy, water etc.	• Reports/publication • Workshops/presentations • Emails • Videos/documentary on scenario development with stakeholders	• Refine or adjust the research objectives and project outcomes/outputs modify research methodology • Refine model input data to incorporate better data • Refine strategy for communicating project outputs

Regional Development Authorities (RDA's)	• CDA • TARDA • LBDA • KVDA • Community • County government • Ewaso Nyiro North • Ewaso Nyiro South • Development partners • CBO's • Institutions of higher learning • NGO's	• Land use planning • Strategic environmental Assessment • Early warning systems/info • CC adaptation • Climate compatible development • Natural resource management • Valuation of ES goods and services • Environmental awareness Spatial planning	• Newspaper • Local Radio • Newsletters • Barazas • Internet • Mobile phone (sms platform) • Pamphlets • TV • Briefs • Booklets • Brochures • Magazines • Roadshows • Theatre • Artwork/Exhibitions • Competitions/sports Letters	• Include participatory approaches in development • Mainstreaming CC in policies, programs and projects • Ensure environmental conservation • Ensure sustainability Design and implementation of sustainable projects • Monitoring and evaluation of projects to ensure sustainability • Mitigation of negative environmental impacts
Development partners	• Cooperate sector (CESR program, water investors) • Bilateral donors (GIZ, DFID, etc.) • Multilateral (UNDP, FAO etc.) • Development banks (AfDB, WB) • International NGO's (Oxfam, wetlands	• They need to know: How the scenarios relate to development agendas what the implications of different development futures are • How different stakeholder groups stand to be affected (especially the poor/vulnerable) • How the natural	• Via donor working groups • Round table discussions • Policy briefs • Presentations at their offices • Meetings, workshops and conferences • Representations/presentations at global fora	• Reorient their programs and projects to target these realities and drivers • Increase funding to sustainable/equitable natural and built infrastructure in the Tana basin • Factor natural infrastructure

	international) National NGO's (Nature Kenya, KFWG)	environment might be affected and how it needs to be conserved what difference CC will make to development in the Tana basin	(e.g. WWW) • Technical working papers	solutions in their investment portfolios • Lobby and advocate other national/ international agencies and processes
Parastatals	• KENGEN • WSPS • Kenya power • Tana water Services board • NEMA • WRMA • Athi Water services board	• Data on ecological flows of the Tana basin • Population patterns • New technologies • Socio-economic data existing and proposed projects	• Seminars and workshops • Publication and reports collaborative • Information exchange	• Climate smart investment • Integration of CCA into planning and operations • Create awareness on CC initiatives to other stakeholders • Harmonize existing policies and consultation with relevant ministries Enforce the existing laws
Research and Academia	• CGIAR • KALRO • KIPPRA • IEA • ACCESS • Universities • ICPAC • KMD • CC Sec	• Methodology • Case studies • Induction and training • Funding	• Seminars and conferences • Workshops • Involvement in research teams • List serve	• Further dissemination and training • Further analysis and development of tools • Develop case studies

WRUAs	• Community Based organization • Common interest group • WRMA • Water abstractors • Chief • County government • Irrigation group	• Communication capacity • Awareness creation • Workshops • Training • Education tools	• Chief barazas • Group meetings • Community farmer group • Mobile phones • Radio • Seminars • Farmer field day • WRUA members meeting group	• Implement what has been passed on • Inform other stakeholders • Develop action plans • Form some committee to monitor
Communities	• Pastoralists • Farmers • Business men and women • Clergy • Community administration – chiefs, council of elders, opinion leaders, • Women reps • Women, men, youths and children	• Information sharing • Consultation in all development projects • Lobbying and advocacy skills • Sensitization on environmental management and conservation • Alternative livelihood options/ policies and legislations in place • Creation of a platform to engage policy makers at national, county and community levels	• Mass media - vernacular radio stations • Print media - development of simplified training manuals translated into local languages • More community forums considering their calendar i.e. barazas, workshops, multi-cultural days • Organize national forums to meet the opinion leaders such as the PPG and CPG • Use media personnel for specific issues.	• Active participation in policy making process • Alternative livelihood uptake to ease pressure on resource • Sustainable management of environment and resources • Make informed choices in decision making • Reduce conflict over resources • Food and water security • Change in behaviors and preferences • Community views are articulated in national

				and county developments therefore ownership in land use and management • Increase the forest cover
National Water and irrigation institutions	• WRMA • WSBS • National Water • Pipeline cooperation • KEWI • Water Appeals Board • NIB • WASREB • Research institutions • County government	• Proposed catchment management implementation activities in the basin • Cases of water arbitration • Proposed dam sites Water demand for different uses in the basin • Area in acreage available for irrigation • Data on water resources in the basin • Managing conflict that will arise • Likely water conflicts on the proposed scenarios and their impacts • Data on WR • Data on unresolved conflicts and cases • Projects project	• Media, • Brochures, • Fliers • TV shows, • Print media, • Public barazas • local radio stations, • Internet (twitter,facebook) • Reports through email workshops • Official mail delivery • Booklets • Electronic media • Youtube • Roundtable meetings • Consultative forums • Documentaries	• Implementation of best case scenario • Ensure equity in allocation of water resource • Implementation policies influencing different scenarios in the catchment area • Manage conflicts in resource use • Provide sustainable and logical irrigation development • Engaging other stakeholders • Respond to issues raised • Review policies and come up with new ones where necessary • Address the issues highlighted

		implementation and where to be implemented • How the various developments will affect the basin • Recommendation on sustainable scenarios for the basin data		• Pass on information throughout the institution • Implement sustainable irrigation schemes
County Government	• County government (CEC, CO, governor) • County assembly County Public Service Board • County Lands Commission • Water and Natural Resource Department Council of Governors	• Data on water and weather • Communication and planning tools • Research and development tools • Case studies for research conducted in similar basin • Information on policies and legislation affecting resource planning and development	• Seminars and workshops • Brochures and newspaper • County magazines • County radio stations • TV talk shows • Social media - FB, twitter, instagram Meeting and barazas	• Give feedback • Integrate research finding into their development agenda and planning • Enforcement of research findings through legislation and policies • Integration of feedback into management structure

Stakeholder Concluding Remarks

The workshop was concluded by closing remarks from facilitators, participants' representation and Ms. Omuombo. Key points mentioned by the speakers included:

- Lively discussion – other institutions presenting their activities was a learning experience
- CC modeling and life span of the project – meteorology department UoN involved in this – climate evolution and
- Recommendation on operational hydrology refresher course at UoN met postgraduate course – to build capacity of the participants – climate and hydrology issues, masters course in CC
- Pastoralists – need to be given a due consideration
- Rights based approach
- Water supply and food is important, water is finite – water consumption for the population and the virtual water, water food print for the production of crops? How do we minimize the water consumption and consider virtual water content
- What alternatives do we need, water conservation, water use
- Water use and the need for Gibe 3 to provide resources for the communities

Workshop Evaluation

The workshop was evaluated using both formative (continuous – daily and by session) as well as summative (final last day evaluation. A variety of participatory tools were used to assed change in participant's knowledge base and received their feedback on key workshop technical and operational processes. Annex 4 shows the final workshop evaluation form used.

Annexes

Annex 1: Workshop Agenda

Day 1

Morning

- Welcome and Introductions
- Keynote on Water –Food– Energy nexus *(Prof. E. Odada)*
- Understanding Natural and Build-infrastructure mix and ecosystems services approach to basin water systems management
- Tana Basin Context: Stakeholder realities and WISE-UP Project emerging findings
- Reflections on Basin (Ecosystems Services, Stakeholder Portfolio and Objectives)
- About WISE-UP Project (including a video clip)

Afternoon

- Introduction to Scenarios: Clarifying the concept, purpose and structure of WISE-UP to Climate scenario capacity exercises/workshops
- Scenario Scoping (temporal and spatial)
- Scenario building Objectives/Purpose and Stakeholder Scenario Information/policy and decision making Needs
- The Drivers of Basin Ecosystems Changes

Day 2

Morning

- Keynote on ES Valuation *(Lucy Emerton)*
- Land use change projections *(CIAT/ACCESS- concept and potential applications in anticipatory basin planning)*
- Deepening understanding and interaction between Drivers of Ecosystems Change
- The critical uncertainties
- The scenario Framework
- The End-picture

Afternoon

- Expanding the plausible scenario narratives:
  - Qualitative
  - Quantitative
- Tracking alternative pathways and decisions and looping the ES benefit outcomes.

Day 3

Morning

- Sequencing of built infrastructure in the basin (Informed by the UoM schematic)
- Using the scenarios:
  - Policy and decision making (basin governance, combination of built/natural infrastructure, natural infrastructure benefits)
  - Stakeholder work including basin management/use planning
  - Conflict resolution and ES trade-offs

    - Further WISE-UP to Climate scenario and social learning work
- Sensitivity analysis – tracking uncertainties and policy decisions

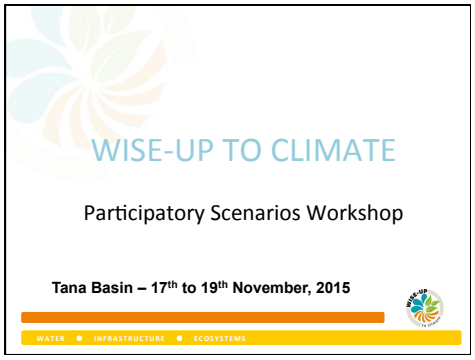
Afternoon
- Scenario Application Action Planning and Follow-up/Commitment
- Scenario Communication Strategy
- Workshop Closure

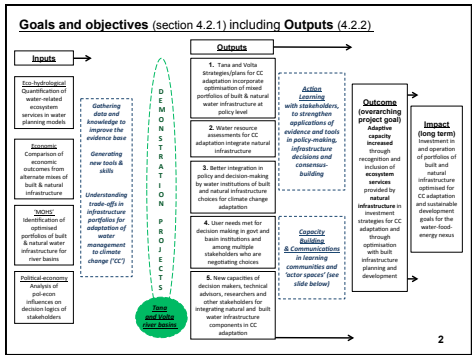
Annex 2: List of Participants

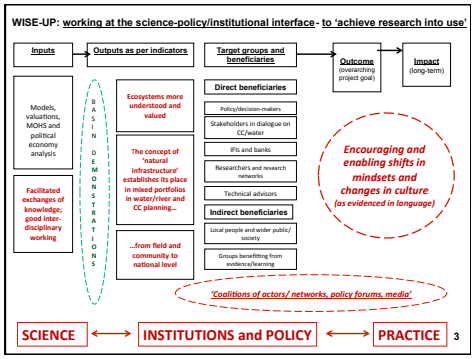
No.	Name of Participants	Institution
1	Julie Mulonga	Wetlands International
2	Peter Muli	TARDA (Environmentalist)
3	Eng. Henry Maina	TARDA
4	Leonard Muchiri	TARDA (Forester)
5	Elizabeth Diego - Lusimba	WRMA – Community Projects coordinator
6	Jacqueline Mboroki	WRMA - Sub regional Manager - Murang'a subcatchment
7	Lawrence Thooko	WRMA - Regional manager Tana Catchment
8	Daniel Gichuki	WRUA - Upper Tana
9	Gilbert Maigacho	CDA
10	Nelson Mutanda	NDMA
11	Monica Yator	PDNK
12	Sammy Boit	NIB
13	Nesline Ogwe	NIB
14	Engineer Ginalius Njiraini	KENGEN
15	Matthews Murgor	KENGEN – NRM
16	Eunice Jemutai	Athi water services Board
17	Damaris Wairimu	Chief officer - Water, energy, forestry, environment, natural resources and cooperative development Murang'a County
18	David Gitonga	Chief officer - water, environment and Sanitation - Meru County
19	Nasra Hanshi	Chief Officer - Environment, Wildlife and Natural resources - Garissa county
20	Elizabeth Wanja	Kenya Climate Change Working Group
21	Mr. Samuel Mutisya	Council of Governors representative
22	Richard Rop	Council of Governors representative
23	Lucy Emerton	BC3
24	Emmanuel Obuobie	CSIR
25	Richard Mulwa	CASELAP, UoN
26	Simon Thuo	Maji na Ufanisi
27	Dr Rwigi Stephen	Meteorology Department, UoN
28	Bell Okello	ETC East Africa
29	Washington Ochola	ACCESS
30	Christine Omuombo	ACCESS
31	Daniel Olago	ACCESS

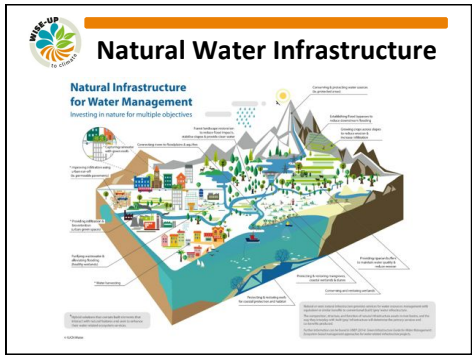
Annex 3: Presentation Slides

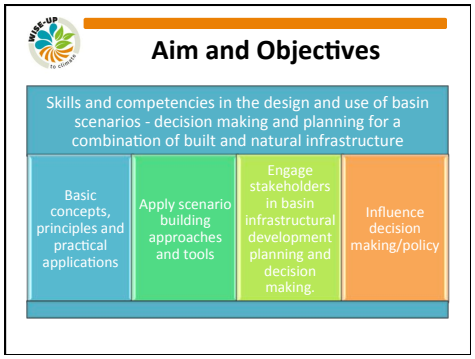
Annex 3a: Objectives and Workshop Context

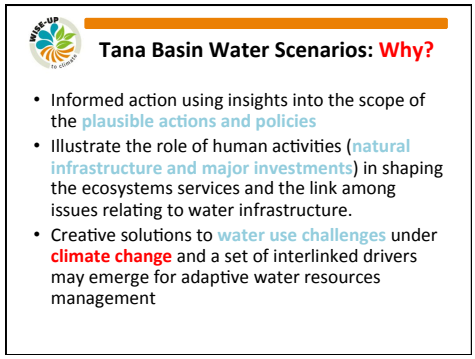


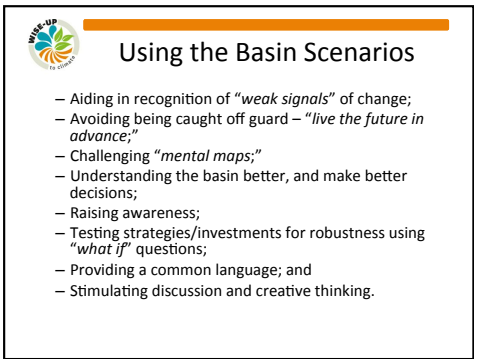








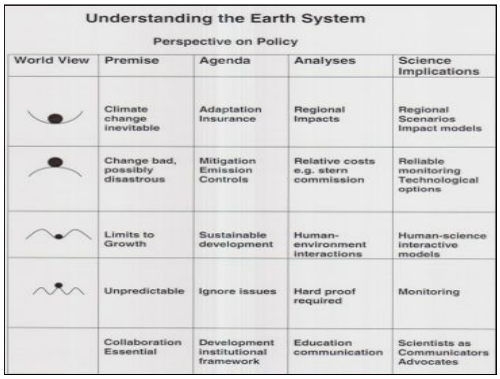


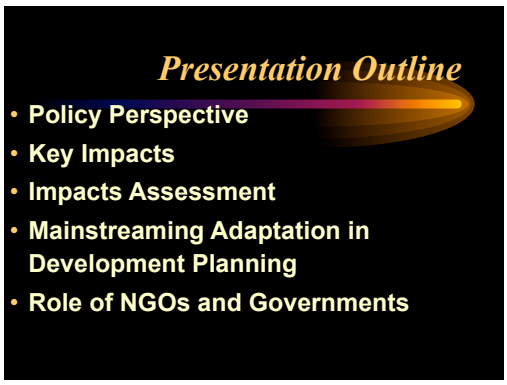




Annex 3b: International Policy on Climate Change Adaptation and Mainstreaming Adaptation in Development Planning.









Most Important Changes for Agriculture

- Increased drought incidence associated with temperature rise and increased moisture loss.
- Aggravated weed problem and changes in crop quality due to CO_2 effect.
- Increased pest depredation due to high C:N ratio and temperature.
- Changes in suitability of regions for particular crops.

Impacts on Natural Terrestrial Ecosystems

- Aggravation due to land-use change and anthropogenic disturbance.

- Need to consider socioeconomic and aesthetic benefits of biodiversity, e.g food, fuel, medicine, material and income.

Most Important Changes for Agriculture

- Impact on crop calendar
- Heat stress
- Increase in agricultural diseases
- Higher order effects including altered costs, risks, profitability leading to changes in rural employment, food security, exports and imports.

Impacts on Water Resources

- Need to consider domestic water supply, irrigation, hydropower, navigation, industrial cooling, purification and amenity; and also different types of water bodies:
  * Rivers and water courses
  * Lakes and reservoirs
  * Aquifers and shallow ground waters
  * Wetlands



Impacts on Forestry

- Impact dependent on details of climate change, physiological adaptability of species, disease and pest susceptibility, and wildlife loss.
- Long lived so abrupt changes (0.1^0C per decade) reduce survival rate.
- Balance between stress changes and climate where changes are favourable.
- Managed forests demand high levels of investment but have potential to mitigate undesirable impacts.

Impacts on Water Resources

- Most water resource schemes are designed to cope with particular extreme events e.g floods or droughts, so are sensitive to changes in their magnitude and frequency.
- Hydrological structures represent large investments with lengthy construction cycles and lifetimes which may span significant change.



Impacts on Natural Terrestrial Ecosystems

- Rate of change may exceed capacity of most species and systems to change.
- Particularly sensitive species include:
  * Those at edge or beyond optimal range
  * Geographically localized
  * Genetically localized
  * Poor dispersers

Impacts on Freshwater Fisheries

- Impact dependent on attributes of species and specific regional factors
- Most sensitive species will be those near their thermal limit.
- Wind is a key climatic variable through its influence on stratification and the nutrient-phytoplankton-zooplankton chain.



Impact on Human Settlements

- Most vulnerable are those exposed to natural hazards, e.g low lying coastal or flood plains, in drought-prone regions, subject to landslides, severe wind storms and tropical cyclones.



How Healthy is the Science of Impact Assessment?

- In its infancy
- Limited sectoral scope
- Narrow single discipline perspective
- Adaptations seldom considered

What Actions are Needed to remedy the Situation?

- Assembly of relevant inventories
- Integrated monitoring to quantify sensitivities
- Multidisciplinary impact research programmes
- National and regional action

Impact on Human Settlements

- Most vulnerable populations are in developing countries, in lower income groups, residents of coastal lowlands and islands, populations in semi-arid grasslands, and the urban poor.
- Climate change and sea level rise have the capability of causing large population movements; e.g those in coastal lowlands and small island nations.

Mainstreaming Adaptation in Development Planning

- Raise the profile of climate change adaptation in the national policy agenda and mobilize political commitment to mainstreaming climate change adaptation in national development processes;
- Integrate the climate change adaptation into national and sub-national development strategies and plans, and key sectoral plans and their implementation;
- Create fiscal and other policy incentives, and increase public budgetary allocations, for sound and equitable climate change adaptation.

Impacts on Energy, Transport and Industry

- Global warming is expected to affect the availability of water resources and biomass, both major sources of energy in many developing countries.
- Loss of these elements may also jeapordise the supply of materials essential for human habitation and sustenance.
- Many industries in developing countries may find their competitive position eroded by climate-related changes in the availability of production resources: energy, water, food, timber, fibre and minerals.

Mainstreaming Adaptation in Development Planning

- Improve institutional capacities to mainstream climate change adaptation in development planning and implementation, using participatory approaches where appropriate;
- Develop and strengthen capacities for the formulation and implementation of laws and regulations that curb activities that could lead to climate change;
- Remove barriers that limit the poor's access to and economic benefits of climate change e.g ecosystem services and equitable access to water and land resources, particularly among the rural poor and women.

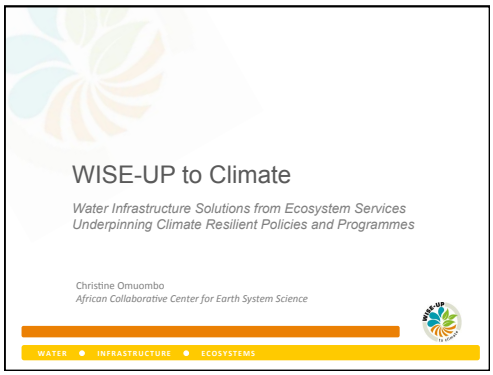
Impacts on Human Health

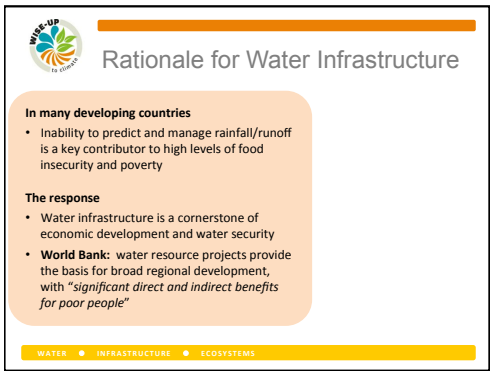
- Major health consequences are possible, especially in large urban areas, due to changes in water and food availability, and problems due to spreading of infections and heat stress.
- Radically altered patterns of vector-borne and viral diseases due to climate changes may lead to range shifts towards higher latitudes, thus putting large populations at risk.
- Such changes could cause large migrations of people leading to disruption of settlement pattern and social instability.

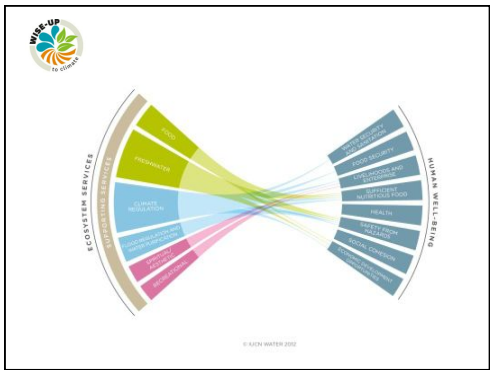
Roles of NGOs and Governments

- Assessing local adaptation needs and services;
- Environmental governance and capacity development;
- Local delivery platforms for climate change adaptation;
- Supporting local and indigenous SMEs for climate change adaptation;
- Local and community-based adaptation to climate change.

Annex 3c: Understanding Natural and Build-infrastructure mix and ecosystems services approach



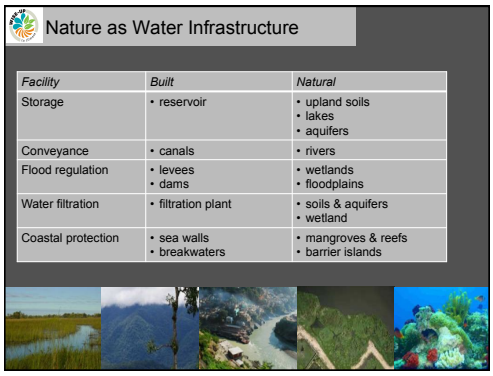




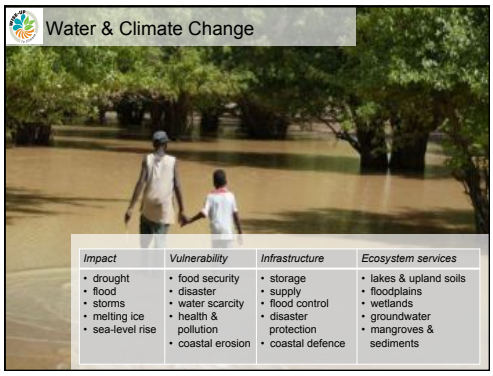
Ecosystems are infrastructure –

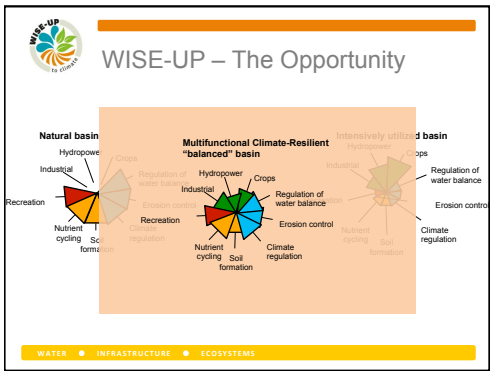
part of the *"stock of facilities, services and installations needed for the functioning of a society and economy."*

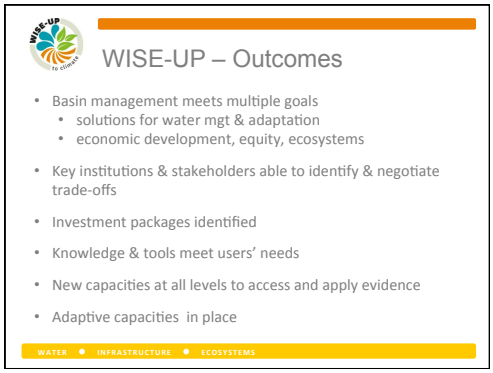




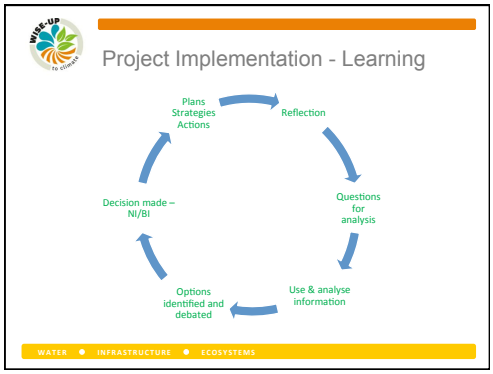
Facility	*Built*	*Natural*
Storage	• reservoir	• upland soils • lakes • aquifers
Conveyance	• canals	• rivers
Flood regulation	• levees • dams	• wetlands • floodplains
Water filtration	• filtration plant	• soils & aquifers • wetland
Coastal protection	• sea walls • breakwaters	• mangroves & reefs • barrier islands


Water & Climate Change
Impact
• drought
• flood
• storms
• melting ice
• sea-level rise
Vulnerability
• food security
• disaster
• water scarcity
• health & pollution
• coastal erosion
Infrastructure
• storage
• supply
• flood control
• disaster protection
• coastal defence
Ecosystem services
• lakes & upland soils
• floodplains
• wetlands
• groundwater
• mangroves & sediments

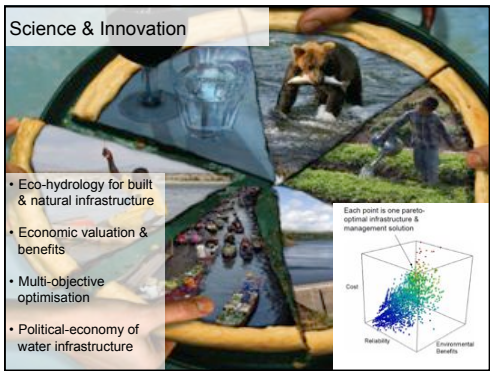

WISE-UP – The Opportunity
Natural basin
Multifunctional Climate-Resilient "balanced" basin
Intensively utilized basin
Hydropower
Crops
Industrial
Recreation
Regulation of water balance
Erosion control
Nutrient cycling
Soil formation
Climate regulation
WATER INFRASTRUCTURE ECOSYSTEMS

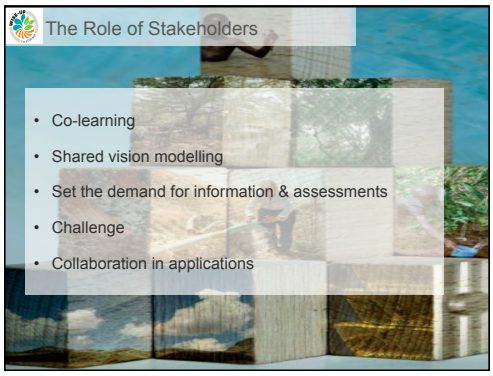

WISE-UP – Outcomes
• Basin management meets multiple goals
• solutions for water mgt & adaptation
• economic development, equity, ecosystems
• Key institutions & stakeholders able to identify & negotiate trade-offs
• Investment packages identified
• Knowledge & tools meet users' needs
• New capacities at all levels to access and apply evidence
• Adaptive capacities in place
WATER INFRASTRUCTURE ECOSYSTEMS

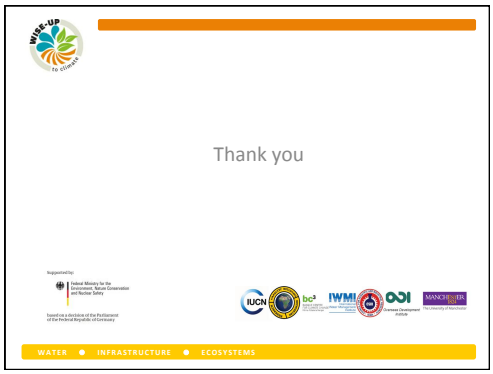

Project Implementation - Demonstrations
Tana & Volta Basins
• data, tools & skills
• co-learning
• trialling tools for mixing built & natural infrastructure in planning & decisions
• applications to investment choices
• multi-stakeholder dialogues
• adaptation actions
WATER INFRASTRUCTURE ECOSYSTEMS


Project Implementation - Learning
Plans Strategies Actions
Reflection
Questions for analysis
Use & analyse information
Options identified and debated
Decision made – NI/BI
WATER INFRASTRUCTURE ECOSYSTEMS

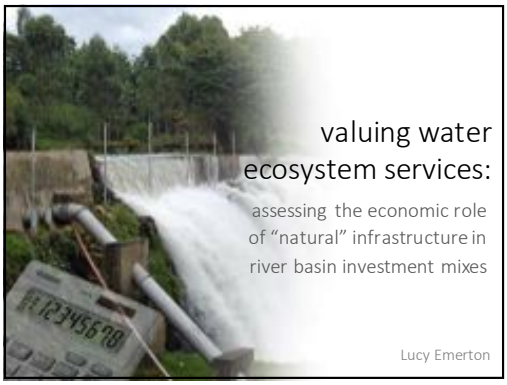

Project Implementation – Capacity Building
• decision-makers
• development agents
• local actors
WATER INFRASTRUCTURE ECOSYSTEMS


Science & Innovation
• Eco-hydrology for built & natural infrastructure
• Economic valuation & benefits
• Multi-objective optimisation
• Political-economy of water infrastructure
Each point is one pareto-optimal infrastructure & management solution
Cost
Reliability
Environmental Benefits

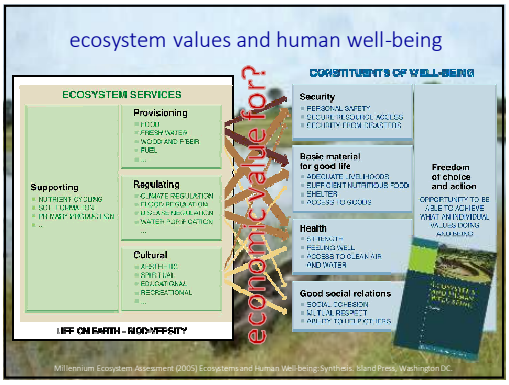

The Role of Stakeholders
• Co-learning
• Shared vision modelling
• Set the demand for information & assessments
• Challenge
• Collaboration in applications

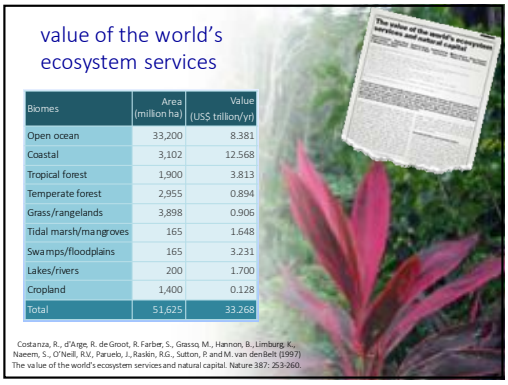

Thank you
WATER ● INFRASTRUCTURE ● ECOSYSTEMS

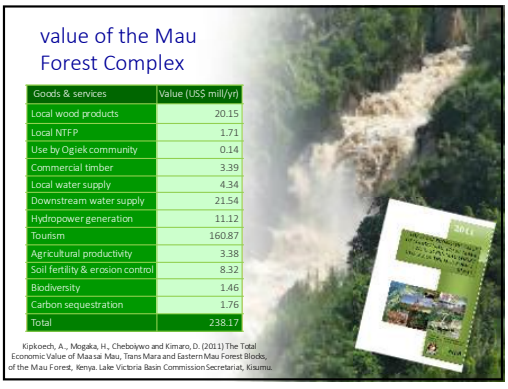
Annex 3d: Ecosystems Service Valuation

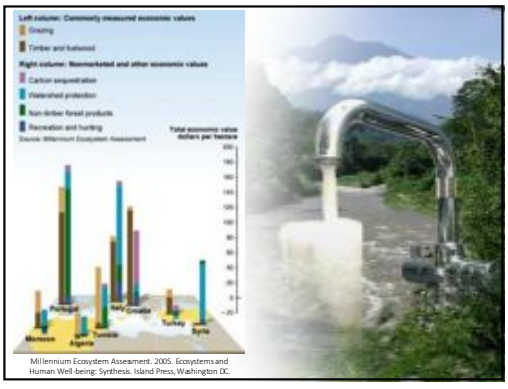


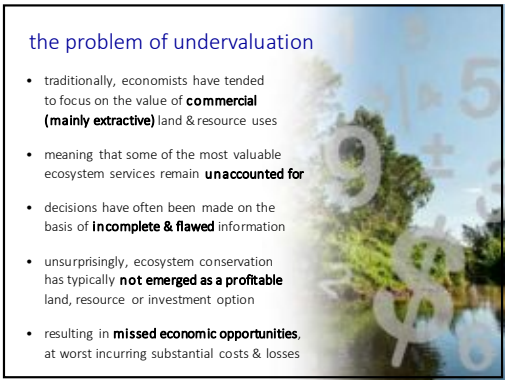








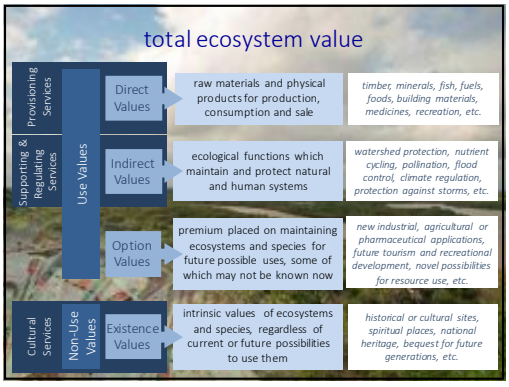


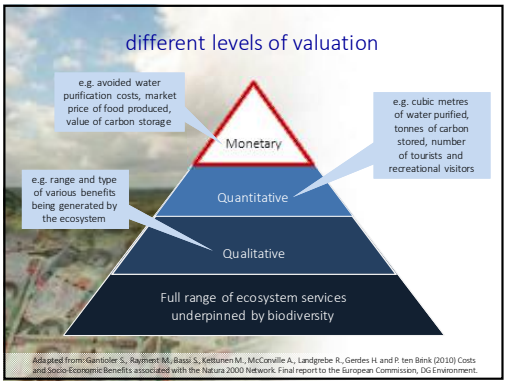

the problem of undervaluation
• traditionally, economists have tended to focus on the value of commercial (mainly extractive) land & resource uses
• meaning that some of the most valuable ecosystem services remain unaccounted for
• decisions have often been made on the basis of incomplete & flawed information
• unsurprisingly, ecosystem conservation has typically not emerged as a profitable land, resource or investment option
• resulting in missed economic opportunities, at worst incurring substantial costs & losses


failure to count natural ecosystems as an economic part of water infrastructure


ecosystems as water infrastructure
water supply
water quality
agricultural production
energy production
fisheries production
tourism industry
disaster risk reduction
co-benefits for livelihoods & wellbeing – fuel, food, health, shelter, earnings, etc. ...

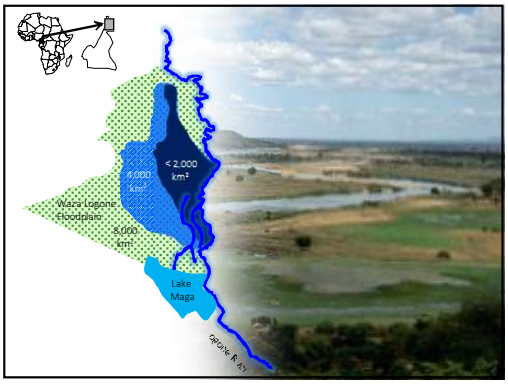

factoring natural infrastructure values into water planning & investment decisions


total ecosystem value
Provisioning Services
Supporting & Regulating Services
Cultural Services
Use Values
Non-Use Values
Direct Values
Indirect Values
Option Values
Existence Values
raw materials and physical products for production, consumption and sale
timber, minerals, fish, fuels, foods, building materials, medicines, recreation, etc.
ecological functions which maintain and protect natural and human systems
watershed protection, nutrient cycling, pollination, flood control, climate regulation, protection against storms, etc.
premium placed on maintaining ecosystems and species for future possible uses, some of which may not be known now
new industrial, agricultural or pharmaceutical applications, future tourism and recreational development, novel possibilities for resource use, etc.
intrinsic values of ecosystems and species, regardless of current or future possibilities to use them
historical or cultural sites, spiritual places, national heritage, bequest for future generations, etc.

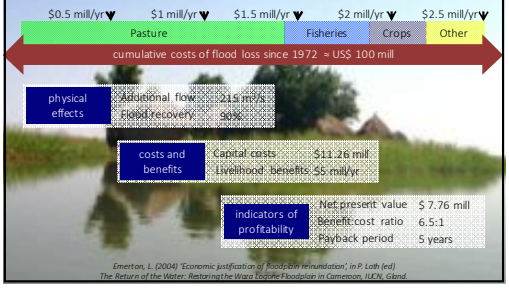

different levels of valuation
e.g. avoided water purification costs, market price of food produced, value of carbon storage
e.g. cubic metres of water purified, tonnes of carbon stored, number of tourists and recreational visitors
e.g. range and type of various benefits being generated by the ecosystem
Monetary
Quantitative
Qualitative
Full range of ecosystem services underpinned by biodiversity
Adapted from: Gantioler S., Rayment M., Bassi S., Kettunen M., McConville A., Landgrebe R., Gerdes H. and P. ten Brink (2010) Costs and Socio-Economic Benefits associated with the Natura 2000 Network. Final report to the European Commission, DG Environment.

investing in floodplain restoration as poverty reduction infrastructure (Waza Logone, Cameroon)

- 1970s large-scale rice irrigation scheme diverted water from floodplain
- severely weakened already-vulnerable dryland livelihoods of 150,000 fisherfolk, pastoralists and farmers
- ongoing climate change poses further threats to local wellbeing and resilience
- how to show Ministry of Finance and Development Banks that investing in civil engineering works to restore hydrological processes would qualify for HIPC poverty reduction loan?



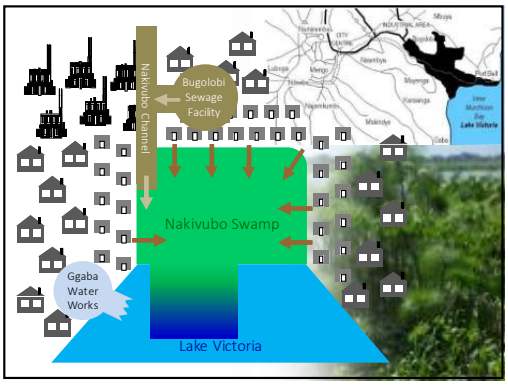
small modifications to the irrigation scheme would permit the restoration of floodplain-based livelihoods: *> US$ 5 million/year value-added to local economy, and a positive investment return*

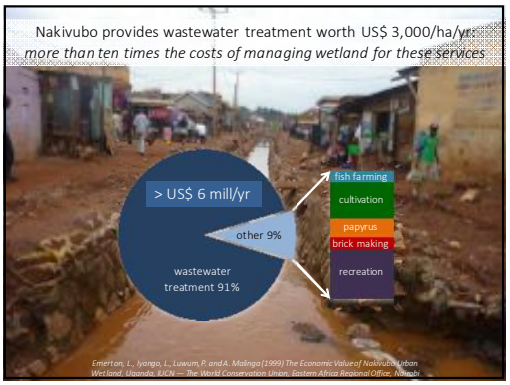


Emerton, L. (2004) 'Economic justification of floodplain reinundation', in P. Loth (ed) The Return of the Water: Restoring the Waza Logone Floodplain in Cameroon, IUCN, Gland.

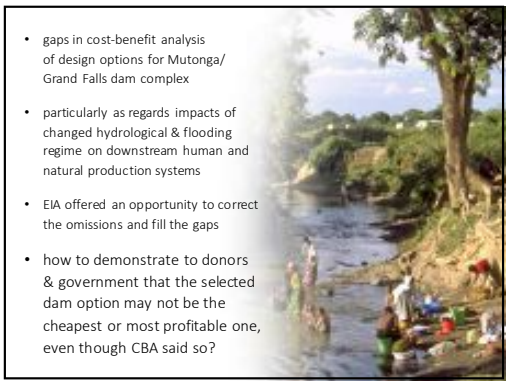
counting wetlands as core urban sewerage & sanitation infrastructure (Nakivubo, Uganda)

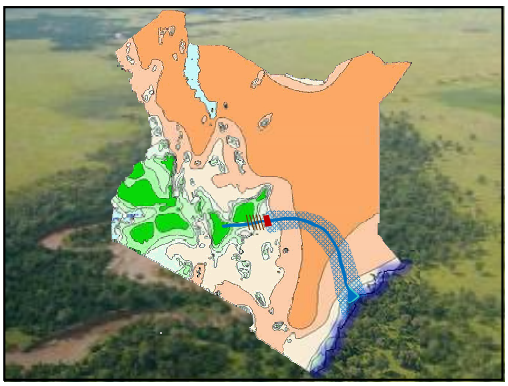
- Nakivubo Swamp highly threatened by drainage & reclamation for urban expansion
- but plays critical role in providing sewerage & sanitation services to Kampala City residents and businesses
- wetland retains, treats and purifies wastes: biologically, physically and chemically
- how to influence urban planning and zoning designations to designate Nakivubo as a protected "green zone" rather than a housing and industrial development zone?

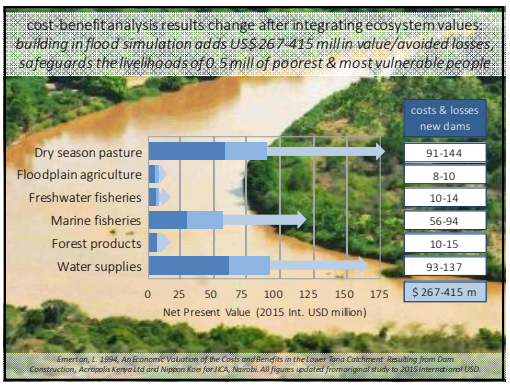

Nakivubo Channel
Bugolobi Sewage Facility
Nakivubo Swamp
Ggaba Water Works
Lake Victoria


Nakivubo provides wastewater treatment worth US$ 3,000/ha/yr:
more than ten times the costs of managing wetland for these services
> US$ 6 mill/yr
other 9%
wastewater treatment 91%
fish farming
cultivation
papyrus
brick making
recreation
Emerton, L., Iyango, L., Luwum, P. and A. Malinga (1999) The Economic Value of Nakivubo Urban Wetland, Uganda. IUCN — The World Conservation Union, Eastern Africa Regional Office, Nairobi


factoring downstream ecosystem impacts into calculations of hydropower profitability (Tana River, Kenya)

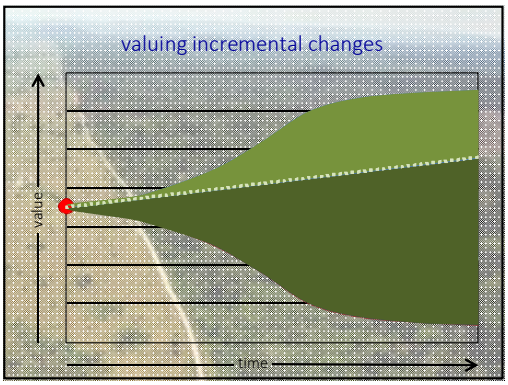

gaps in cost-benefit analysis of design options for Mutonga/ Grand Falls dam complex
particularly as regards impacts of changed hydrological & flooding regime on downstream human and natural production systems
EIA offered an opportunity to correct the omissions and fill the gaps
how to demonstrate to donors & government that the selected dam option may not be the cheapest or most profitable one, even though CBA said so?

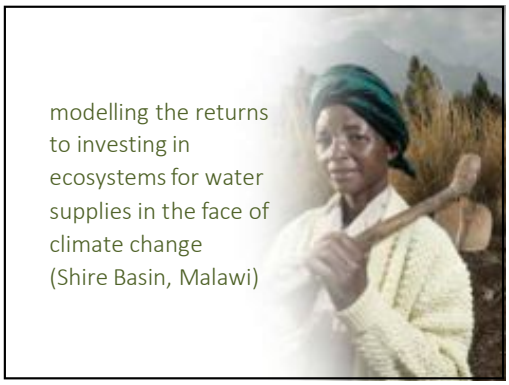



cost-benefit analysis results change after integrating ecosystem values:
building in flood simulation adds US$ 267-415 mill in value/avoided losses,
safeguards the livelihoods of 0.5 mill of poorest & most vulnerable people
costs & losses new dams
Dry season pasture
Floodplain agriculture
Freshwater fisheries
Marine fisheries
Forest products
Water supplies
91-144
8-10
10-14
56-94
10-15
93-137
$ 267-415 m
0 25 50 75 100 125 150 175
Net Present Value (2015 Int. USD million)
Emerton, L. 1994. An Economic Valuation of the Costs and Benefits in the Lower Tana Catchment Resulting from Dam Construction, Acrópolis Kenya Ltd and Nippon Koei for IUCN, Nairobi. All figures updated from original study to 2015 International USD.

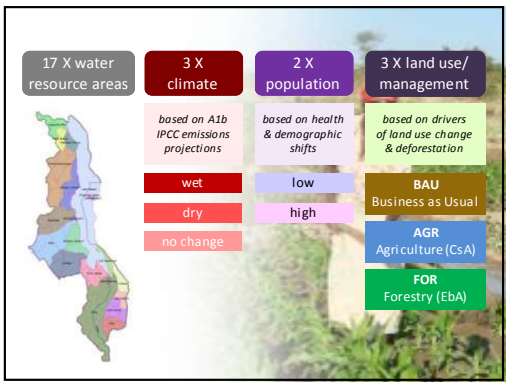

valuing economic
impacts & trade-offs
for water infrastructure
planning in the Tana Basin

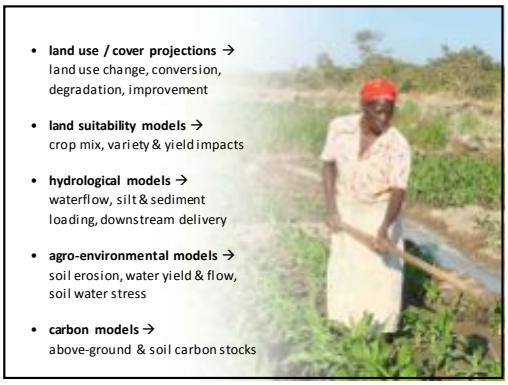

coming up with a single, snapshot figure of the economic value of ecosystem services has little meaning
it is the change in value that arises from different infrastructure mixes, management regimes, or other shifts in river basin context that is of interest
... in terms of particular goods & services
... to a particular person, group or sector
... over a specific time frame

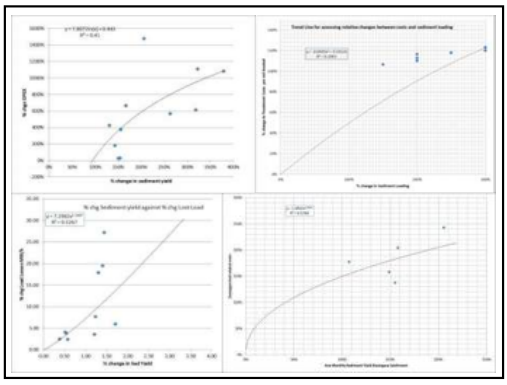

valuing incremental changes
value
time

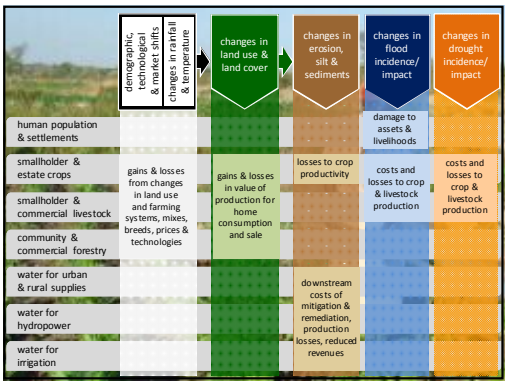

modelling the returns to investing in ecosystems for water supplies in the face of climate change (Shire Basin, Malawi)

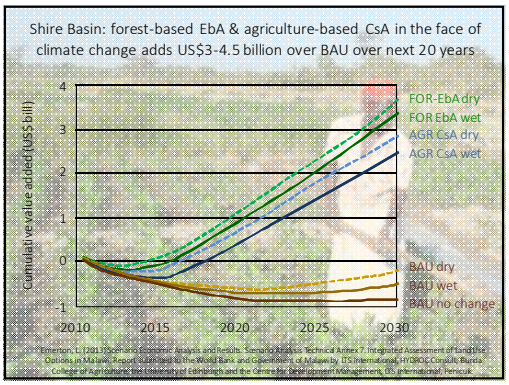

national economy, industries & poor rural communities are all highly vulnerable to the effects of climate variability and change
ecosystem degradation is severely undermining adaptation capacity and resilience, with particular impacts on agriculture water & energy sectors
ClimateSmart Agriculture (CsA)/ Ecosystem Based Adaptation (EbA) offer cost-effective, equitable & sustainable strategies for adaptation (and mitigation)
how to articulate the economic imperative to invest in climate-compatible land use options in watersheds?

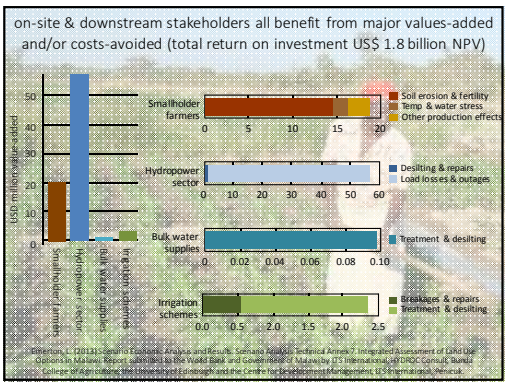

17 X water resource areas
3 X climate
based on A1b IPCC emissions projections
wet
dry
no change
2 X population
based on health & demographic shifts
low
high
3 X land use/ management
based on drivers of land use change & deforestation
BAU
Business as Usual
AGR
Agriculture (CsA)
FOR
Forestry (EbA)


• **land use / cover projections →** land use change, conversion, degradation, improvement
• **land suitability models →** crop mix, variety & yield impacts
• **hydrological models →** waterflow, silt & sediment loading, downstream delivery
• **agro-environmental models →** soil erosion, water yield & flow, soil water stress
• **carbon models →** above-ground & soil carbon stocks



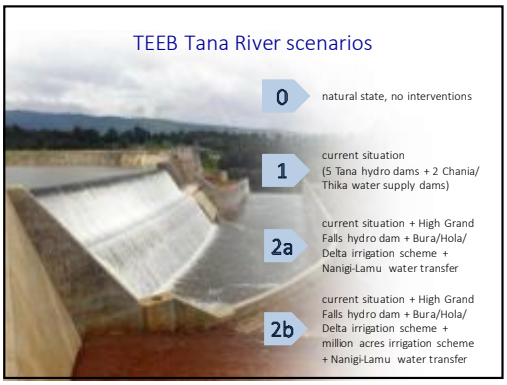

demographic, technological & market shifts
changes in rainfall & temperature
changes in land use & land cover
changes in erosion, silt & sediments
changes in flood incidence/ impact
changes in drought incidence/ impact
human population & settlements
damage to assets & livelihoods
smallholder & estate crops
gains & losses from changes in land use and farming systems, mixes, breeds, prices & technologies
gains & losses in value of production for home consumption and sale
losses to crop productivity
costs and losses to crop & livestock production
costs and losses to crop & livestock production
smallholder & commercial livestock
community & commercial forestry
water for urban & rural supplies
downstream costs of mitigation & remediation, production losses, reduced revenues
water for hydropower
water for irrigation


Shire Basin: forest-based EbA & agriculture-based CsA in the face of climate change adds US$3-4.5 billion over BAU over next 20 years
Cumulative value added (US$ bill)
4
3
2
1
0
-1
2010
2015
2020
2025
2030
FOR-EbA dry
FOR EbA wet
AGR CsA dry
AGR CsA wet
BAU dry
BAU wet
BAU no change


on-site & downstream stakeholders all benefit from major values-added and/or costs-avoided (total return on investment US$ 1.8 billion NPV)
USD million value added
Smallholder farmers
Hydropower sector
Bulk water supplies
Irrigation schemes
Soil erosion & fertility
Temp & water stress
Other production effects
Desilting & repairs
Load losses & outages
Treatment & desilting
Breakages & repairs
Treatment & desilting


Mutonga/High Grand Falls EIA scenarios
0
current hydropower dams (Kindaruma, Kamburu, Gitaru, Masinga, Kiambere)
A
current + Mutonga
B
current + Low Grand Falls
C
current + Mutonga + Low Grand Falls
D
current + Mutonga + High Grand Falls

TEEB Tana River scenarios



- **0** natural state, no interventions
- **1** current situation (5 Tana hydro dams + 2 Chania/ Thika water supply dams)
- **2a** current situation + High Grand Falls hydro dam + Bura/Hola/ Delta irrigation scheme + Nanigi-Lamu water transfer
- **2b** current situation + High Grand Falls hydro dam + Bura/Hola/ Delta irrigation scheme + million acres irrigation scheme + Nanigi-Lamu water transfer

WISE-UP: economic linkages across the landscape



- valuing **water services (and associated co-benefits)** from alternative mixes of built & natural water infrastructure in Tana Basin
- assessing costs & value-added of **including "natural" infrastructure** in investment options
- accounting for **(opportunity) costs** of degrading "natural" water infrastructure in the course of expanding built facilities
- **distributional** elements: who gains and who loses from the changes, how & when?
- **risk**: what risks do shifts in infrastructure & management pose for different groups?

Kimakia case study

- what are the costs and benefits of managing forests and agroecosystems in the upper Kimakia catchment as 'natural water infrastructure'?
- what are the water infrastructure mix options?
- what do upstream farmers gain or lose from a shift to SLM practices for watershed conservation?
- what do downstream water beneficiaries gain?
- what are the gaps and imbalances in benefits and costs arising between water ecosystem service providers and beneficiaries?
- what are needs, niches & opportunities for incentives/financing mechanisms to sustain Kimakia's valuable natural water infrastructure?



economic aspects of WISE-UP scenarios: key elements and assumptions of change

- status and mix of built & natural water infrastructure
- land use & land cover at farm and landscape scales
- quantity, quality, flow & reach of water services
- water infrastructure construction & maintenance costs
- demand & prices for water-dependent sectors: water supply, irrigation, energy, fisheries, etc.
- human population & demography
- market access & conditions
- economic livelihoods, occupations & aspirations
- farm management techniques & technologies: crop mixes & prices; livestock ownership, breeds, management & prices
- dependence on natural products & ecosystem provisioning services
- on-site and off-site reliance & value of ecosystem regulating services

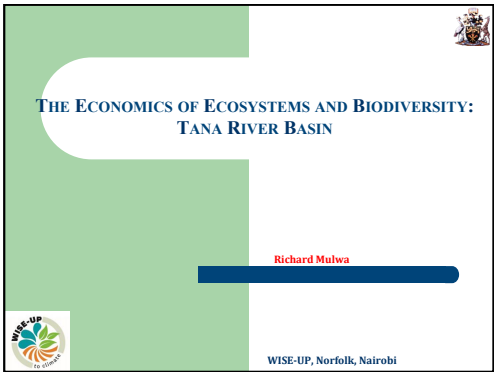


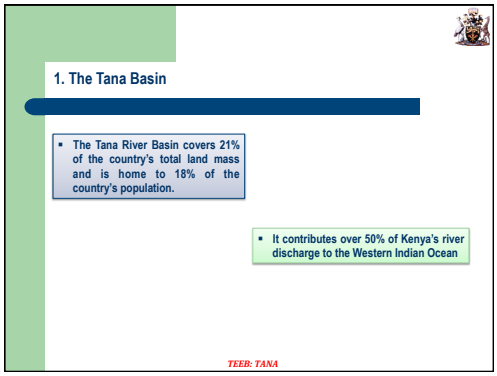


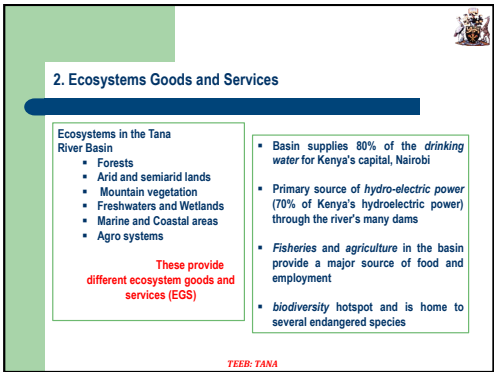
Thank You

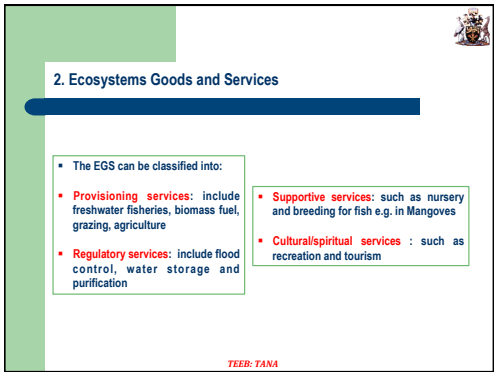
for your attention

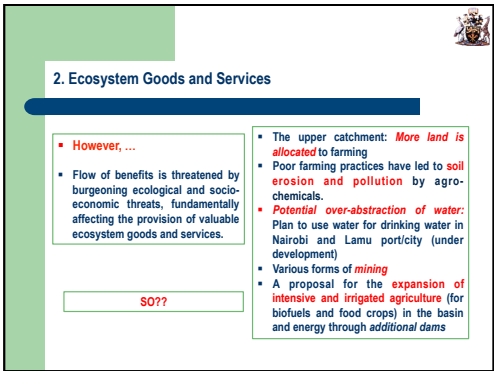
Annex 3e: Tana TEEB presentation

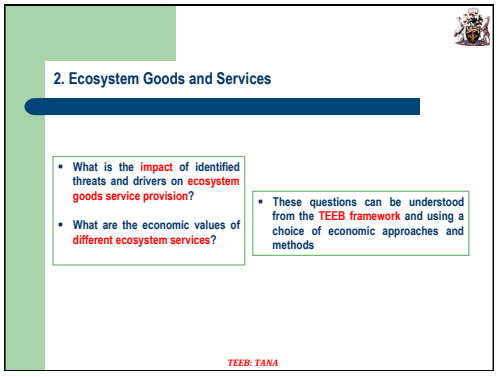












3. Analysis Framework

TEEB framework



TEEB: TANA

Source: Daily, (1997; 2009)

3. Analysis Framework

- Decisions: The decisions we make e.g. increased farming, over abstraction of water
- These in turn influence the hydrological regime of the river
- This in turn affects the ecosystems and the provision of EGS identified earlier, either positively or negatively

- Quantification of these benefits and values should inform policies and interventions for Swamp management
- These will in turn inform decisions to be taken such as conservation, which in turn influence the ecosystem processes

TEEB: TANA

4. Impact of Drivers on Ecosystem Service Provision

- The 5 hydropower stations and the planned construction of the High Grand Falls (HGF) provide various valuable functions for the people in and around the Tana River Basin

- Benefits of these infrastructural works include flood regulation, hydropower, irrigation and supply of potable water.
- However, the reduced availability of water downstream (reduced flooding) is expected to have negative effects on local ecosystem service provision

4. Impact of Drivers on Ecosystem Service Provision

- There is need to link benefits provided by ecosystem services to the Tana river regime

- Benefits of these infrastructural works include flood regulation, hydropower, irrigation and supply of potable water.
- However, the reduced availability of water downstream (reduced flooding) is expected to have negative effects on local ecosystem service provision

- There link is created using a dose response functions

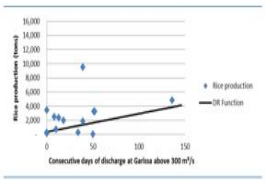
4. Impact of Drivers on Ecosystem Service Provision

- There link is created using a dose response functions

- *They are used to assess the effects of changes in quality/quantity of ecosystem services on the profitability/size of related productions/output*

4. Impact of Drivers on Ecosystem Service Provision

- Dose-response function flood recession farming



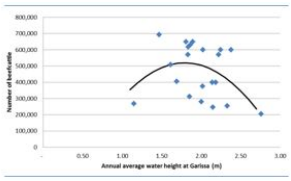
- The hydrological parameter is the number of days above the flooding threshold at Garissa. The threshold is a consecutive discharge of over 300 m³/s for at least seven days.

- *y* represents the rice production in tons
- *x* is the cultivated area in hectares
- *z* is the amount of days above the flooding threshold.

$$y = 363.9 + 1.855x + 25.73z$$

4. Impact of Drivers on Ecosystem Service Provision

- Dose-response function Pastrolism: Beef Cattle

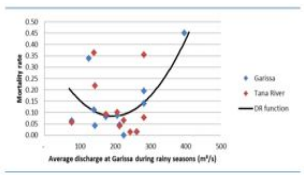


- *y* represents the current number of beef cattle
- yt-1 represents number of livestock last year
- *x* is average water height in Garissa
- *x2* is the square of x.

$y = -225347 + 0.842y_{t-1} + 312644x - 80994x^2$

4. Impact of Drivers on Ecosystem Service Provision

- Dose-response function of health: Mortality Rates

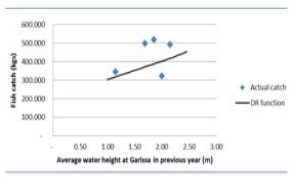


- *y* represents the mortality rate
- x average rainy season discharge at Garissa
- *x2* is the square of x.

$y = 0.382 - 3.07 * 10^{-3}x + 7.93 * 10^{-6}x^2$

4. Impact of Drivers on Ecosystem Service Provision

- Dose-response function of fish: Catches



- *y* Fish catch
- x Average water height Garissa in previous year (*x*)

$y = 204.6 + 98.91x$

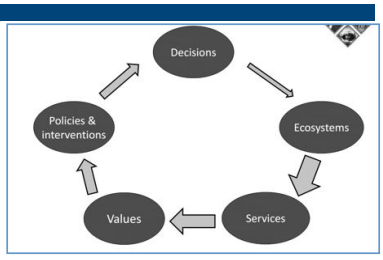
5. Economic values of the mangrove Ecosystem G&S

- The Mangrove at the study site covers a total of 2,350ha
- Main socio economic activities include; pastoralism, livestock keeping, farming, business, and fishing



The state of Mangrove Forest in Kipini

5. Economic values of the Mangrove Ecosystem G&S



5. Economic values of the Mangrove Ecosystem G&S

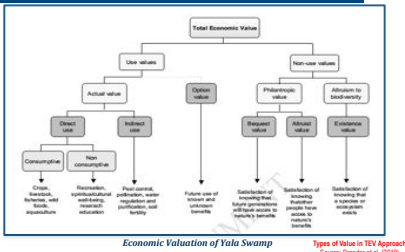
- Decisions: The decisions we make e.g. wetland reclamation influence ecological structures and processes of the Swamp
- This in turn affects the provision of EGS identified earlier, either positively or negatively
- These EGS have benefits and values

- Quantification of these benefits and values should inform policies and interventions for Swamp management
- These will in turn inform decisions to be taken such as conservation, which in turn influence the ecosystem processes

- The different EGS have to be identified and their values estimated?

Economic Valuation of Yala Swamp

6. Methods: Quantifying Economic Values



Economic Valuation of Yala Swamp

Types of Value in TEV Approach
Source: Brander et al. (2010)

6. Methods: Identification of EGS

The study identified 4 EGS with Direct use values and 4 with Indirect use values

EGS with Direct Use Values	Mangrove Area	EGS with Indirect Use Values	Mangrove Area
Fisheries production	1645	Flood Protection	2350
Building material	400	Water quality regulation	2350
Firewood	400	Tourism and Recreation	2350
Honey production	235	Nursery and Breeding for Fish	2350

Economic Valuation of Yala Swamp

6. Methods: Quantifying Economic Values

EGS with Direct Use Values

- Market based Approach:
- Methods:
  - Market price method

EGS with Indirect Use Values

- Stated preference Approach:
- Method
  - Choice experiment

7. Data

Primary data: Quota sampling of 405 respondents from 6 villages the using the Mangroves

Secondary data

- These were used for Estimating direct and indirect use values of the Mangroves

8a. Direct Use Value of the Mangroves

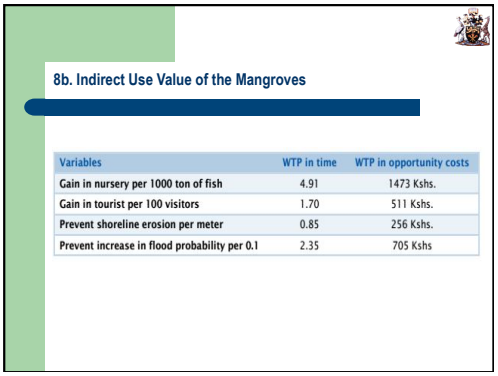
		Percentage (%)	Area (ha)
	Total Mangrove forest Area		2,350
1	Mangrove area contributing to fisheries production.	70	1,645
2	Mangrove area contributing building materials	17	400
3	Mangrove area contributing to firewood.	17	400
4	Mangrove area contributing honey.	10	235

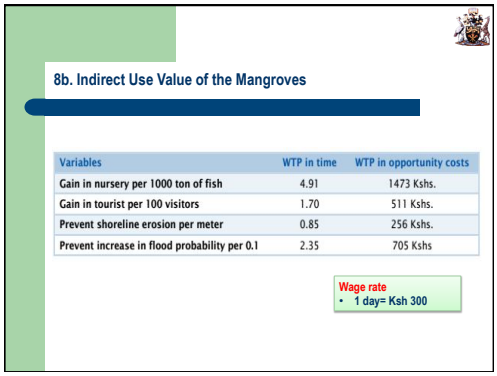
8a. Direct Use Value of the Mangroves

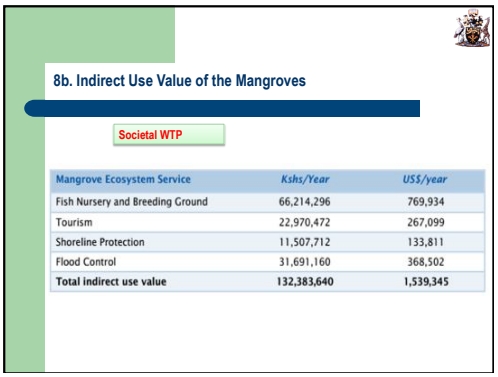
Ecosystem Goods	Amount Harvested/Year	Price (Ksh/ unit)	Annual Value (Ksh.)	Value (Ksh/ ha)	Value (USD/ ha)
Fisheries	791,338 Kg	100	79,133,800	48,105	559
Building Material	5,131 poles	100	513,100	1284	15
Firewood	9,149 bundles	100	914900	2,287	27
Honey	178 litres	300	53,400	227	2.60

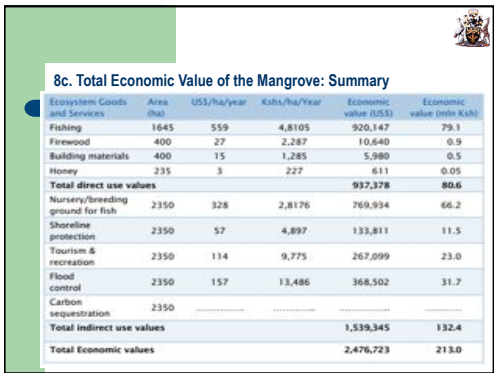
Exchange rate

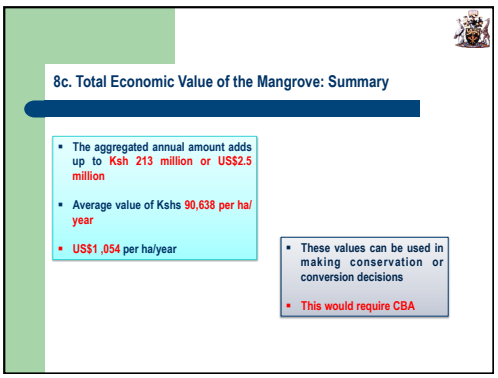
- 1USD= 85.6 Ksh


8b. Indirect Use Value of the Mangroves
Variables
WTP in time
WTP in opportunity costs
Gain in nursery per 1000 ton of fish
4.91
1473 Kshs.
Gain in tourist per 100 visitors
1.70
511 Kshs.
Prevent shoreline erosion per meter
0.85
256 Kshs.
Prevent increase in flood probability per 0.1
2.35
705 Kshs


8b. Indirect Use Value of the Mangroves
Variables
WTP in time
WTP in opportunity costs
Gain in nursery per 1000 ton of fish
4.91
1473 Kshs.
Gain in tourist per 100 visitors
1.70
511 Kshs.
Prevent shoreline erosion per meter
0.85
256 Kshs.
Prevent increase in flood probability per 0.1
2.35
705 Kshs
Wage rate
1 day= Ksh 300


8b. Indirect Use Value of the Mangroves
Societal WTP
Mangrove Ecosystem Service
Kshs/Year
US$/year
Fish Nursery and Breeding Ground
66,214,296
769,934
Tourism
22,970,472
267,099
Shoreline Protection
11,507,712
133,811
Flood Control
31,691,160
368,502
Total indirect use value
132,383,640
1,539,345


8c. Total Economic Value of the Mangrove: Summary
Ecosystem Goods and Services
Area (ha)
US$/ha/year
Kshs/ha/Year
Economic value (US$)
Economic value (mln Ksh)
Fishing
1645
559
4,8105
920,147
79.1
Firewood
400
27
2,287
10,640
0.9
Building materials
400
15
1,285
5,980
0.5
Honey
235
3
227
611
0.05
Total direct use values
937,378
80.6
Nursery/breeding ground for fish
2350
328
2,8176
769,934
66.2
Shoreline protection
2350
57
4,897
133,811
11.5
Tourism & recreation
2350
114
9,775
267,099
23.0
Flood control
2350
157
13,486
368,502
31.7
Carbon sequestration
2350
Total indirect use values
1,539,345
132.4
Total Economic values
2,476,723
213.0


8c. Total Economic Value of the Mangrove: Summary
The aggregated annual amount adds up to Ksh 213 million or US$2.5 million
Average value of Kshs 90,638 per ha/ year
US$1 ,054 per ha/year
These values can be used in making conservation or conversion decisions
This would require CBA

Annex 3f: Sequencing of infrastructure in the Tana basin

Sequencing water infrastructure in the Tana Basin: What does the National Water Master Plan say?

'WISE-UP to Climate' Participatory Scenarios workshop
17-19th November 2015, Norfolk, Nairobi

WATER ● INFRASTRUCTURE ● ECOSYSTEMS

Projected Population (TCA)

(Unit: million persons)

Year	Urban population	Rural Population	Total
2010	1.04	4.69	5.73
2030	6.34	4.03	10.37

Source: JICA Study Team, based on the data of Census 2009

Proposed Irrigation Areas in 2030 (TCA)

(Unit: ha)

Category	Existing Irrigation Area in 2010	New Irrigation Area in 2030					Total Irrigation Area in 2030
		Surface Water Irrigation			Ground-water Irrigation (Borehole)	Water Harvesting Irrigation (Small Dam/ Water Pan)	Total New Irrigation Area
		Weir	Dam	Total			
Large-scale	11,200	4,961	131,000	135,961	0	0	135,961	147,161
Small-scale	14,823	0	0	0	10,054	5,730	15,784	30,607
Private	38,402	0	0	0	10,054	0	10,054	48,456
Total	64,425	4,961	131,000	135,961	20,108	5,730	161,799	226,224

Source: JICA Study Team (Ref. Sectoral Report (E), Section 3.4)

Existing Water Resources Structures and Facilities (TCA)

Existing Structures/ Facilities	Name of Structures/ Facilities	Purposes	Notes
Dam	SasumuaDam	Domestic water supply to Nairobi	Storage volume of 16 MCM
Dam	Thika Dam	Domestic water supply to Nairobi	Storage volume of 69 MCM
Dam	Masinga Dam	Hydropower (40 MW), domestic water supply	Storage volume of 1,402 MCM
Dam	Kamburu Dam	Hydropower (94 MW)	Storage volume of 110 MCM
Dam	Gitaru Dam	Hydropower (225 MW)	Storage volume of 20 MCM
Dam	Kindaruma Dam	Hydropower (44 MW)	Storage volume of 16 MCM
Dam	Kiambere Dam	Hydropower (168 MW), domestic water supply	Storage volume of 585 MCM
Intra-basin Water Transfer	From Kiambere Dam	Domestic water supply to Mwingi	0.5 MCM/year
Intra-basin Water Transfer	From Masinga Dam	Domestic water supply to Kitui	3 MCM/year
Inter-basin Water Transfer	From Sasumua Dam	Domestic water supply to Nairobi	21 MCM/year
Inter-basin Water Transfer	From Thika Dam	Domestic water supply to Nairobi	161 MCM/year
Small Dam/Water Pan	Total No. = 622	Domestic and livestock water supply mainly, partly for irrigation	Total storage volume of 26.9 MCM, average volume per facility of 43,000 m^3
Borehole	Total No. = 1,587	Domestic water supply mainly	Total abstraction volume of 68 MCM/year

Source: JICA Study Team based on NWMP (1992) and data from MWI, WRMA, NWCPC, KenGen, TARDA, and AWSB

Proposed Dams (TCA)

(Unit: MCM)

Name of Dams	Storage Volume for Domestic/ Industrial	Storage Volume for Irrigation	Storage Volume for Hydropower	Flood Control Space	Total Storage Volume	Remarks
Maragua 4 Dam	33.0	0.0	0.0	0.0	33.0 *	F/S and M/P ongoing (AWSB)
Ndiara Dam	12.0	0.0	0.0	0.0	12.0	
Chania-II Dam	49.0	0.0	0.0	0.0	49.0	
Karimenu 2 Dam	14.0	0.0	0.0	0.0	14.0 *	F/S and M/P ongoing (AWSB)
Thika 3A Dam	13.0	0.0	0.0	0.0	13.0 *	F/S and M/P ongoing (AWSB)
Yatta Dam	35.0	0.0	0.0	0.0	35.0 *	D/D completed (NWCPC)
Thiba Dam	0.0	11.2	0.0	0.0	11.2 *	Flagship Project, D/D completed (NIB)
High Grand Falls Dam	(291.0)	(3,251.0)	3,542.0	1,458.0	5,000.0 *	Flagship Project, D/D completed (MORDA)
Kora Dam	0.0	537.0	0.0	0.0	537.0	Flagship Project
Mutuni Dam	17.0	0.0	0.0	0.0	17.0	
Kitimui Dam	8.0	0.0	0.0	0.0	8.0	
Total	181.0	548.2	3,542.0	1,458.0	5,729.2	

Note: * Total storage volumes planned or designed by the government.
D/D=Detailed design
Source: JICA Study Team, based on information from relevant government agencies

Proposed Water/Transfers (TCA)

(Unit: MCM/year)

Structures	Amount for Domestic	Total Water Transfer Amount	Remarks
Intra-basin Water Transfer from Masinga Dam to Kitui (Extension)	23	23	
Intra-basin Waer Transfer from Kiambere Dam to Mwingi (Extension)	2	2	
Intra-basin Water Transfer from High Grand Falls Dam to Lamu	69	69	(equivalent to 189,000 m^3/day), MORDA
Inter-basin Water Transfer from TCA to Nairobi in ACA (Extension)	168	168	(AWSB)

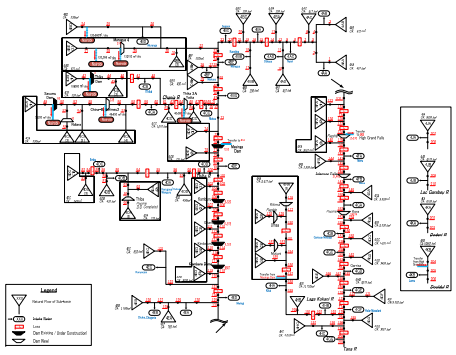
Source: JICA Study Team based on M/P and F/S by AWSB (2012) and MORDA

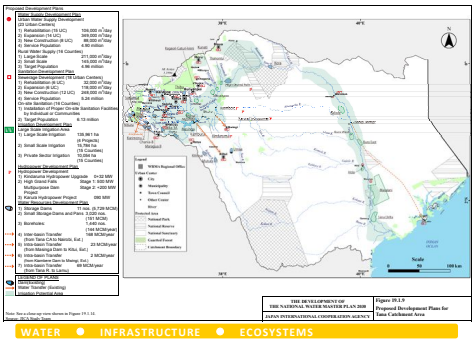
Proposed Small Dams/Water Pans (TCA)

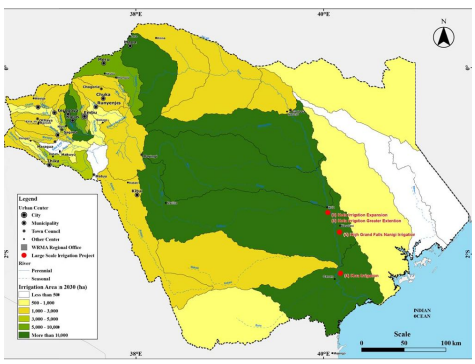
(Unit: MCM)

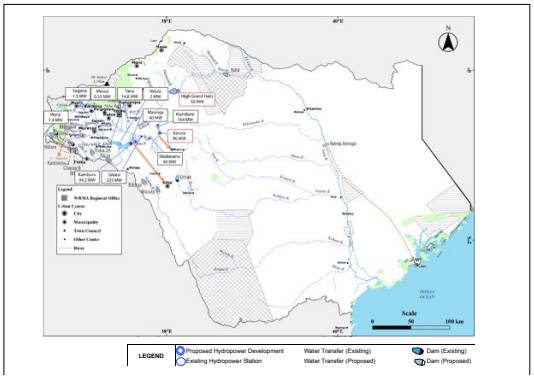
Structures	Volume for Domestic	Volume for Irrigation	Volume for Livestock	Volume for Wildlife/ Fisheries	Total Storage Volume	Remarks
Small Dam/Water Pan	26	39	69	17	151	Total No. of small dams/ water pans = 3,020

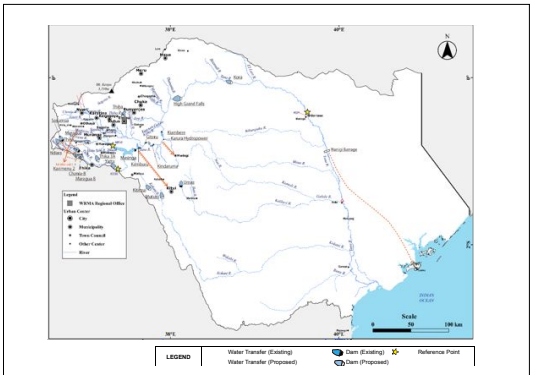
Note: Excluding the storage volume of the existing small dams and water pans of 27 MCM.
Source: JICA Study Team








LEGEND
Proposed Hydropower Development
Existing Hydropower Station
Water Transfer (Existing)
Water Transfer (Proposed)
Dam (Existing)
Dam (Proposed)


LEGEND
Water Transfer (Existing)
Water Transfer (Proposed)
Dam (Existing)
Dam (Proposed)
Reference Point

Annex 4: Workshop Evaluation Form

This questionnaire seeks your feed on the planning, processes and outputs of the WISE-UP to Climate Participatory Scenario Building Workshop. Your cooperation in completing this questionnaire will be greatly appreciated. The information you provide will be useful in evaluating the output of the workshop and improving future WISE-UP workshops.

A Background Information	Gender	Organization	Sector (e.g. water, forestry, agriculture, environment)
	☐ Female ☐ Male		

B Workshop Objectives and Outputs	In general, I would rate the workshop activities as being	On balance would you consider the workshop objectives to have been achieved?
	☐ Excellent ☐ Good ☐ Average ☐ Fair ☐ Poor	☐ Yes, Fully ☐ Yes, Partially ☐ No

The following are the main workshop objectives, please rate their level of achievement in your opinion

WORKSHOP OBJECT	Not Achieved at All	Partially Achieved	Fully Achieved
1. Explain basic concepts and principles for scenario development for basin water infrastructure management			
2. Apply different approaches and tools for scenario generation			
3. Use participatory scenario development approach to engage stakeholders in joint ecosystems services and basin infrastructural development planning and decision making (Shared vision planning).			
4. Influence decision making/policy using information and lessons from alternative futures exploration on basin infrastructure management			
5. Make informed decisions on basin water infrastructure planning and action using selected WISE-UP to Climate data and tools			

C. Strengths of the Participatory Workshop

List what you consider as the three main strengths of the meeting

1.
2.
3.

F. Weaknesses of the workshop

List what you consider as the three main areas to consider for improvement in the workshop

1.
2.
3.

G Workshop Features Features *(Please rate the level of your happiness with these meeting aspects)*		Poor	Fair	Good	Very Good
	Time Management	☐	☐	☐	☐
	Workshop Facilitation	☐	☐	☐	☐
	Hotel/Venue & Accommodation	☐	☐	☐	☐
	House Keeping & Logistics	☐	☐	☐	☐
	Stakeholder Participation	☐	☐	☐	☐
	Pre-workshop Planning & Organization	☐	☐	☐	☐
	Workshop Background Materials	☐	☐	☐	☐
	Other (Specify _____)	☐	☐	☐	☐
	Other (Specify_____)	☐	☐	☐	☐
	Other (Specify _____)	☐	☐	☐	☐
	Other (Specify _____)	☐	☐	☐	☐

H How do you rate the level change in your skill/ competency with respect to the following aspects of scenario building covered in the workshop		Non-Improved	Uncertain	Improved fairly	Improved Greatly
	Scenario exercise planning and scoping	☐	☐	☐	☐
	Drivers of water infrastructure change	☐	☐	☐	☐
	Determining critical uncertainties	☐	☐	☐	☐
	Developing scenario framework	☐	☐	☐	☐
	Developing scenario narratives	☐	☐	☐	☐
	Exploring policies, trade-offs and water use decisions	☐	☐	☐	☐
	Engaging stakeholders	☐	☐	☐	☐
	Communicating scenarios for basin water infrastructure planning	☐	☐	☐	☐

H **Other General Comments about the Workshop** *(Please comment freely about the meeting)*	

I **How can the Skills learnt be widely shared** *(Please suggest ways to ensure the further capacity is built)*	