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Coping with Water Scarcity in River Basins  
Worldwide: Lessons Learned from Shared  
Experiences (Martz Summer Conference, June  
9-10)

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2016

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### SLIDES: Environmental Flow Case Studies: Southern and Eastern Africa

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# Environmental Flow Case Studies Southern and Eastern Africa

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**UNESCO-IHE**  
Institute for Water Education



**USAID**  
FROM THE AMERICAN PEOPLE

Martz Summer Conference, Boulder, CO, USA 9-10 June 2016

# Water Management in Tanzania and Kenya

## Tanzania

### National Water Policy 2002

“water for basic human needs will receive highest priority, water for the environment to protect the ecosystems that underpin our water resources will attain second priority and will be reserved”

### Water Resources Management Act (WRMA) No. 11 of 2009

“take into account and give effect to the requirements of the reserve”

## Kenya

### Water Resources Management Rules 2007

“establish the reserve based on water resource records and reserve water demand or ecological vulnerability, human vulnerability, local observations of historic drought flows, maintenance of perennial flows and consultations with WUAs”

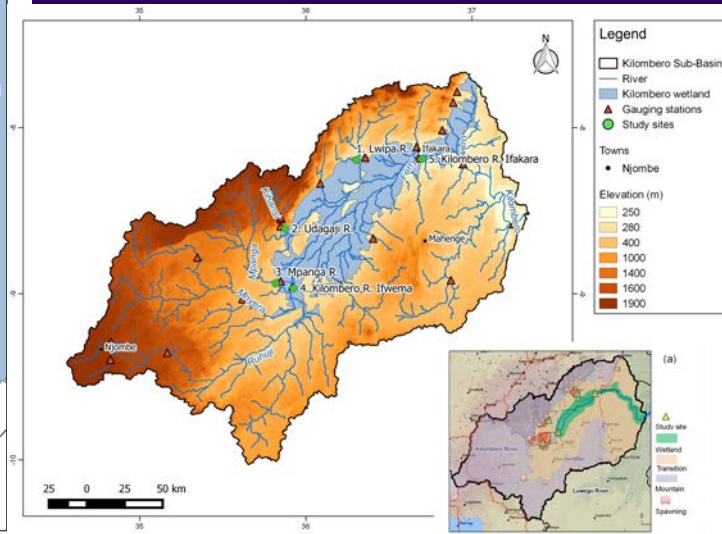
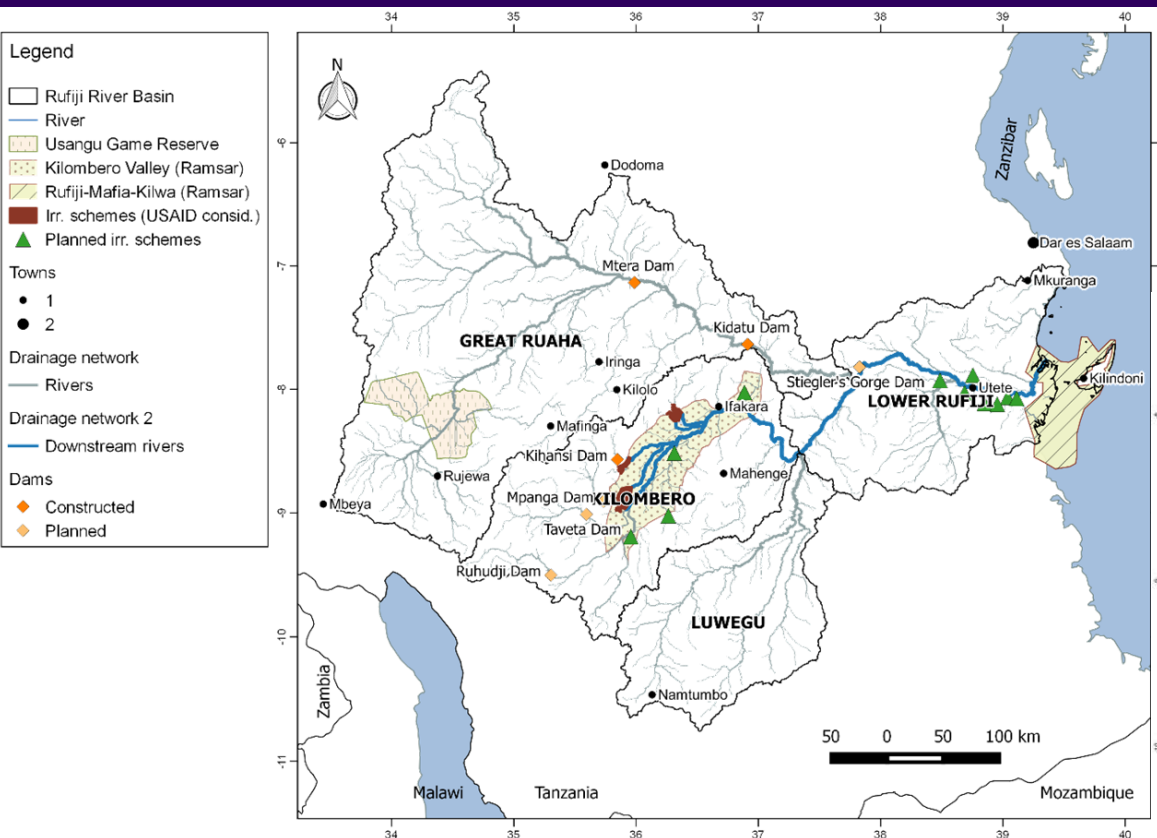
### The Water Bill 2014

"reserve, in relation to a water resource, means that quantity and quality of water required (a) to satisfy basic human needs for all people who are or may be supplied from the water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource ”

# Tanzania

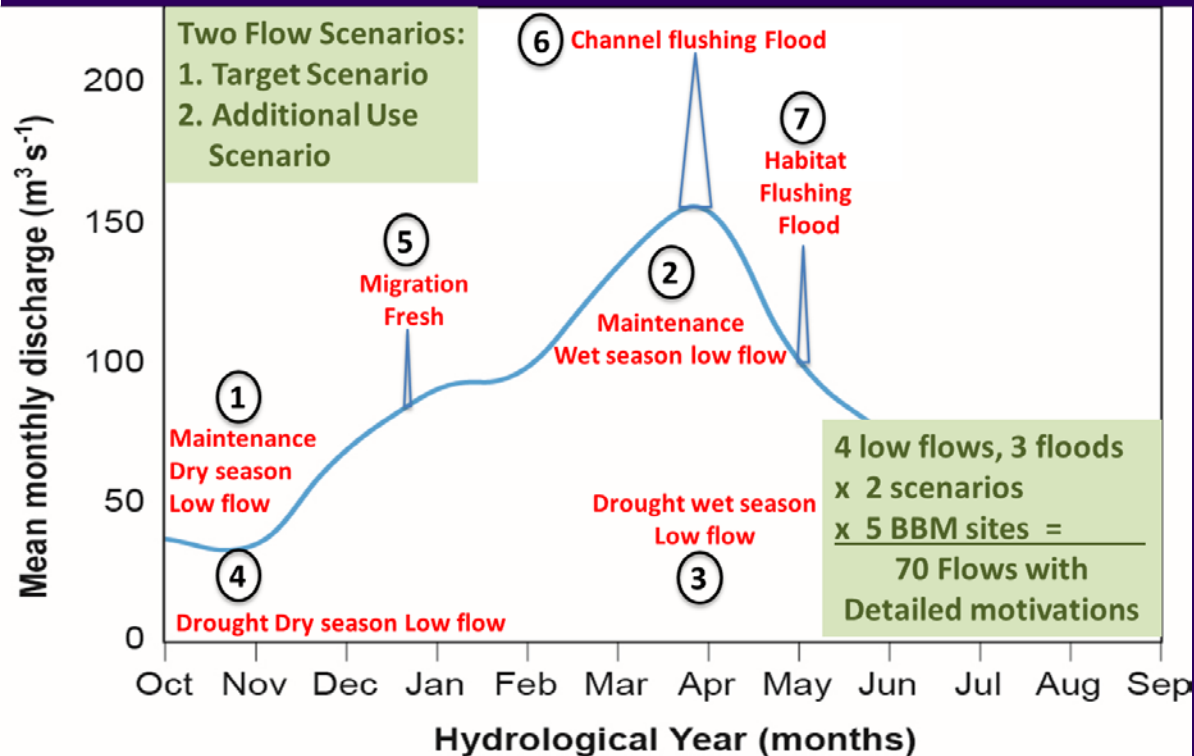
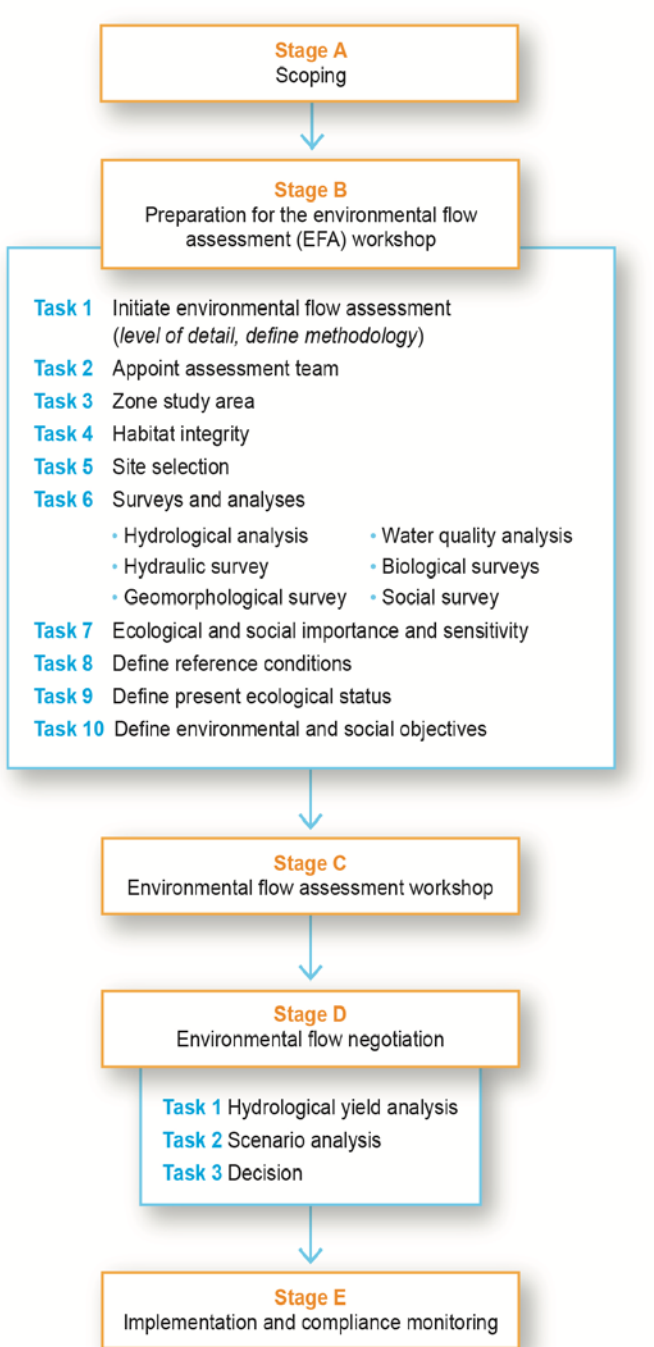
## Rufiji Basin Environmental Flow Assessment

To provide support for balanced use and protection of water resources by determining recommendations for the Reserve, *with special attention devoted to protecting ecological functions that also provide services to neighboring human communities*



# Main stages and tasks in holistic e-flows assessment for Kilombero to build flow regime for 5 sites and 2 flow scenarios

## Stakeholders engaged at each stage of process



# Kilombero Socioeconomic Surveys

To assess dependencies of communities on ecosystem services and the suitable flows to sustain them

Two-phase method to collect socio-economic information

1. Participatory Rural Appraisal (PRA) supported with key informants interviews (village extension officers, traditional healers, school children, fishermen)
2. Questionnaire survey for quantification of Phase 1 results

16 villages

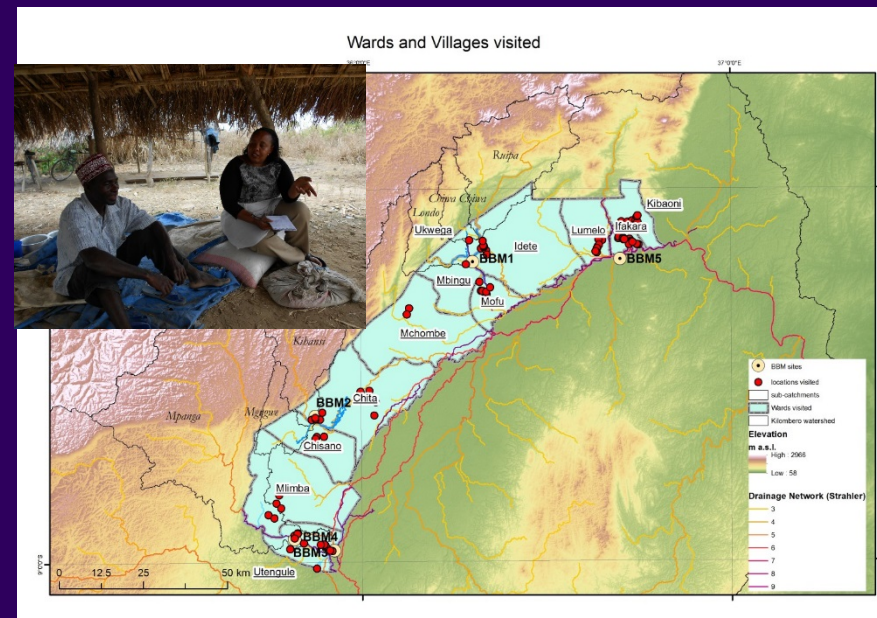
436 households

*45% female - 55% male*

*59% young - 31% middle - 10% elderly*

*82% primary education*

\* Ecohydrological surveys also conducted



# Kilombero Riverine Resource Services

<b>Rivers</b>	<b>Supply of domestic water</b> <b>Fishing</b> <b>Recession agriculture</b> <b>Navigation</b> <b>Rituals (floodplains)</b>
<b>Oxbow lakes/ponds</b>	<ul style="list-style-type: none"><li>● Fish spawning areas</li><li>● Fishing</li><li>● Cultivated and wild vegetables</li></ul>
<b>Valleys</b>	<ul style="list-style-type: none"><li>● Rice farming during rainy seasons</li><li>● Maize and cultivated vegetables during dry seasons</li><li>● Grazing livestock during dry seasons</li></ul>
<b>Fish</b>	<ul style="list-style-type: none"><li>● Important food source</li><li>● Cash generation for subsistence</li><li>● Culturally important for rituals</li></ul>



# Ecological and Social Importance and Sensitivity

## Present Ecological State

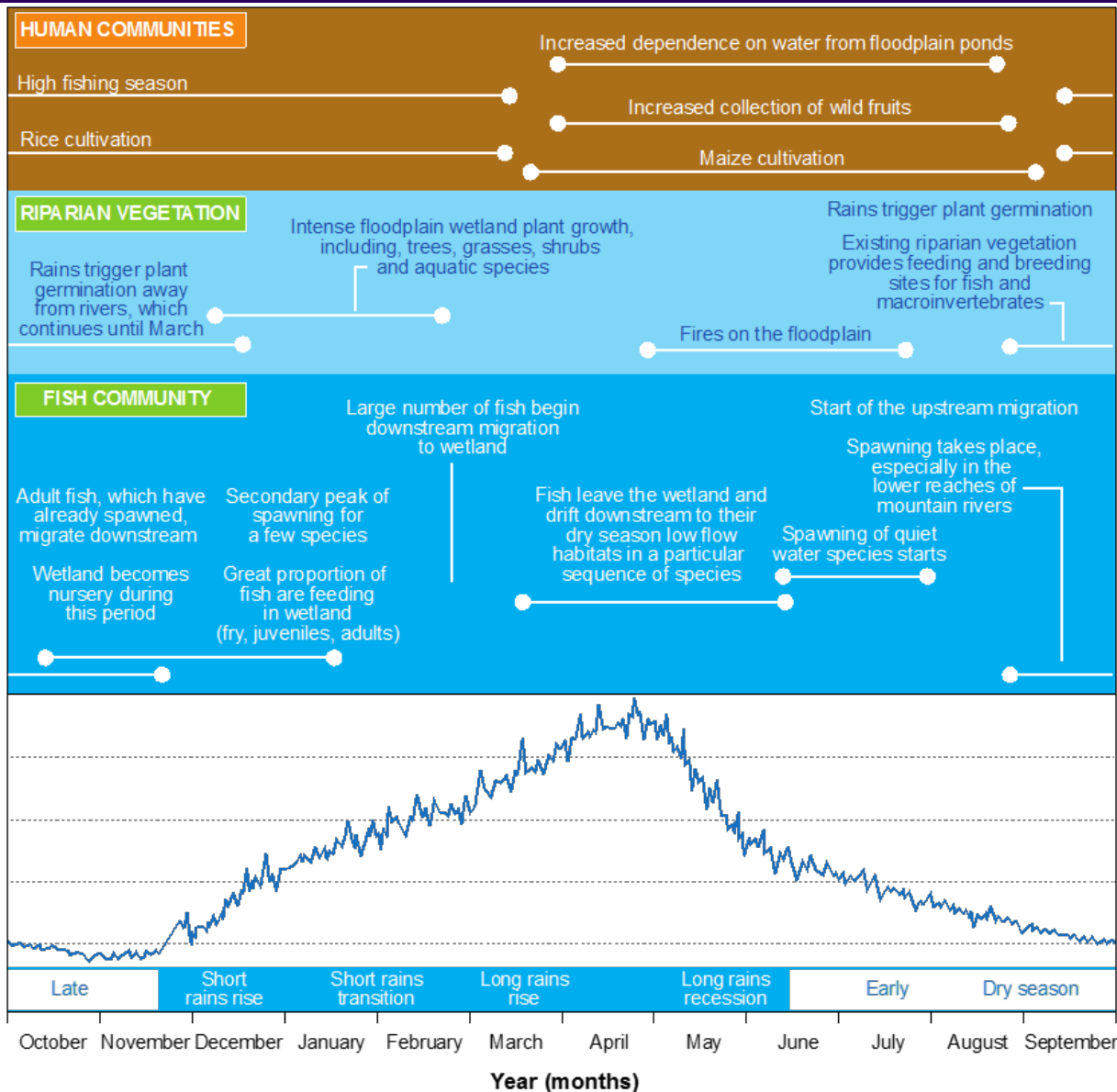
### Environmental Management Class

#### Lwipa River (site 1)

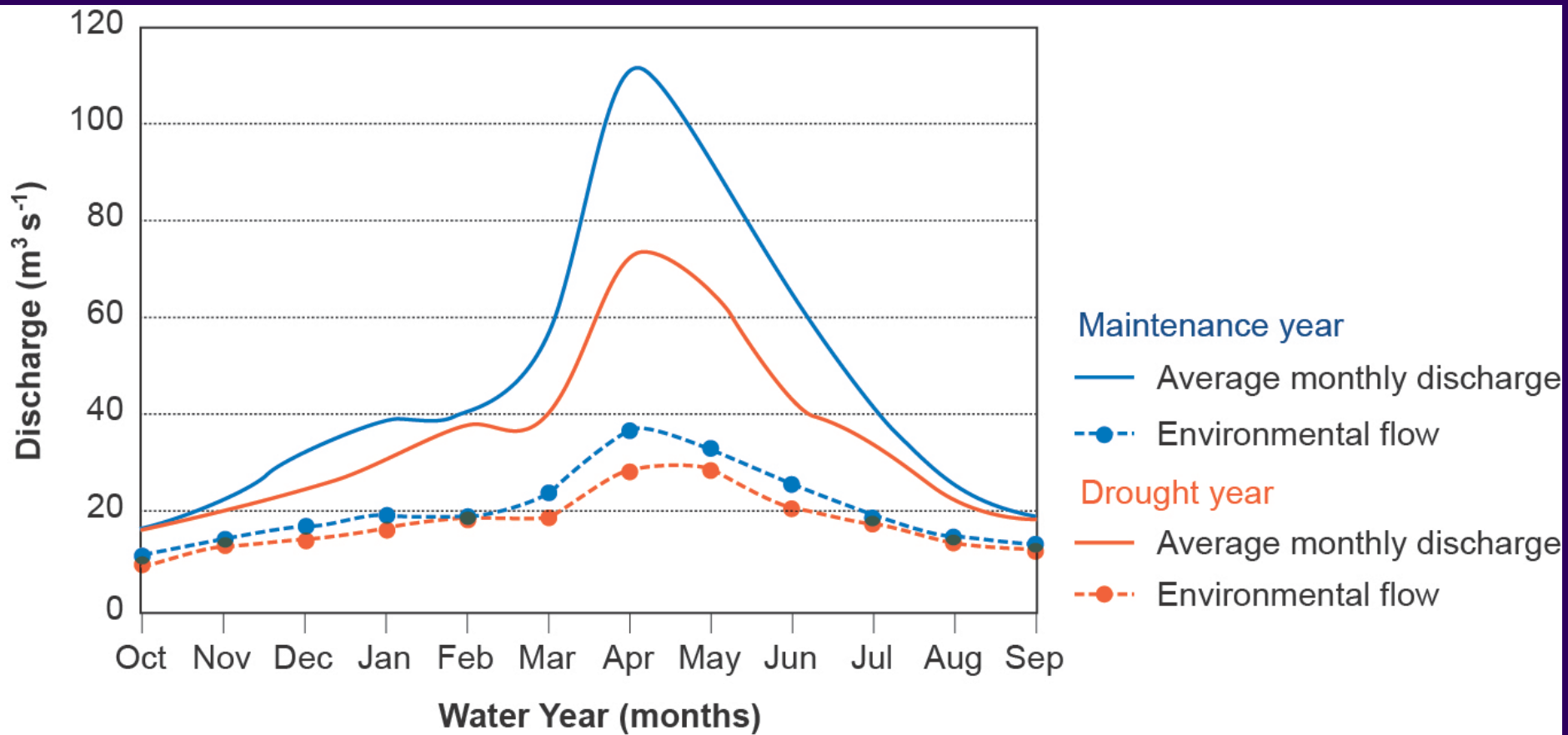
Component	EIS	SIS	PES	Trajectory	EMC
Hydrology	Medium	N/A	A/B	Negative	B
Geomorphology	N/A	N/A	B/C	Negative	B
Water Quality	High	High	A/B	Negative	A/B
Vegetation	Moderate	High	B	Negative	B
Fish	High	High	B	Negative	B
Macroinvertebrates	High	High	C	Negative	B
Social	N/A	Very High	C	Negative	B
<b>Overall</b>	<b>Moderate</b>	<b>High</b>	<b>B</b>	<b>Negative</b>	<b>B</b>

# Kilombero River-floodplain System

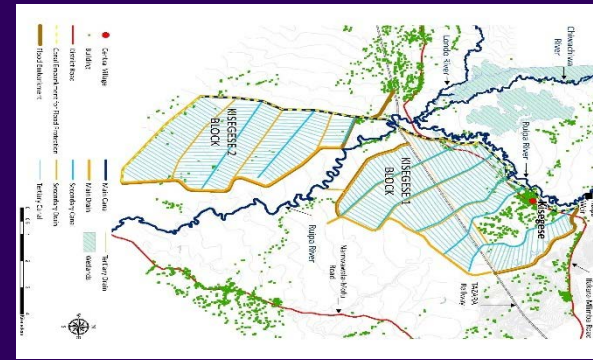
## Conceptual model of social and ecological relationships with flow regime



# Recommended Environmental Flow Regime Lwipa River, Kilombero Sub-basin



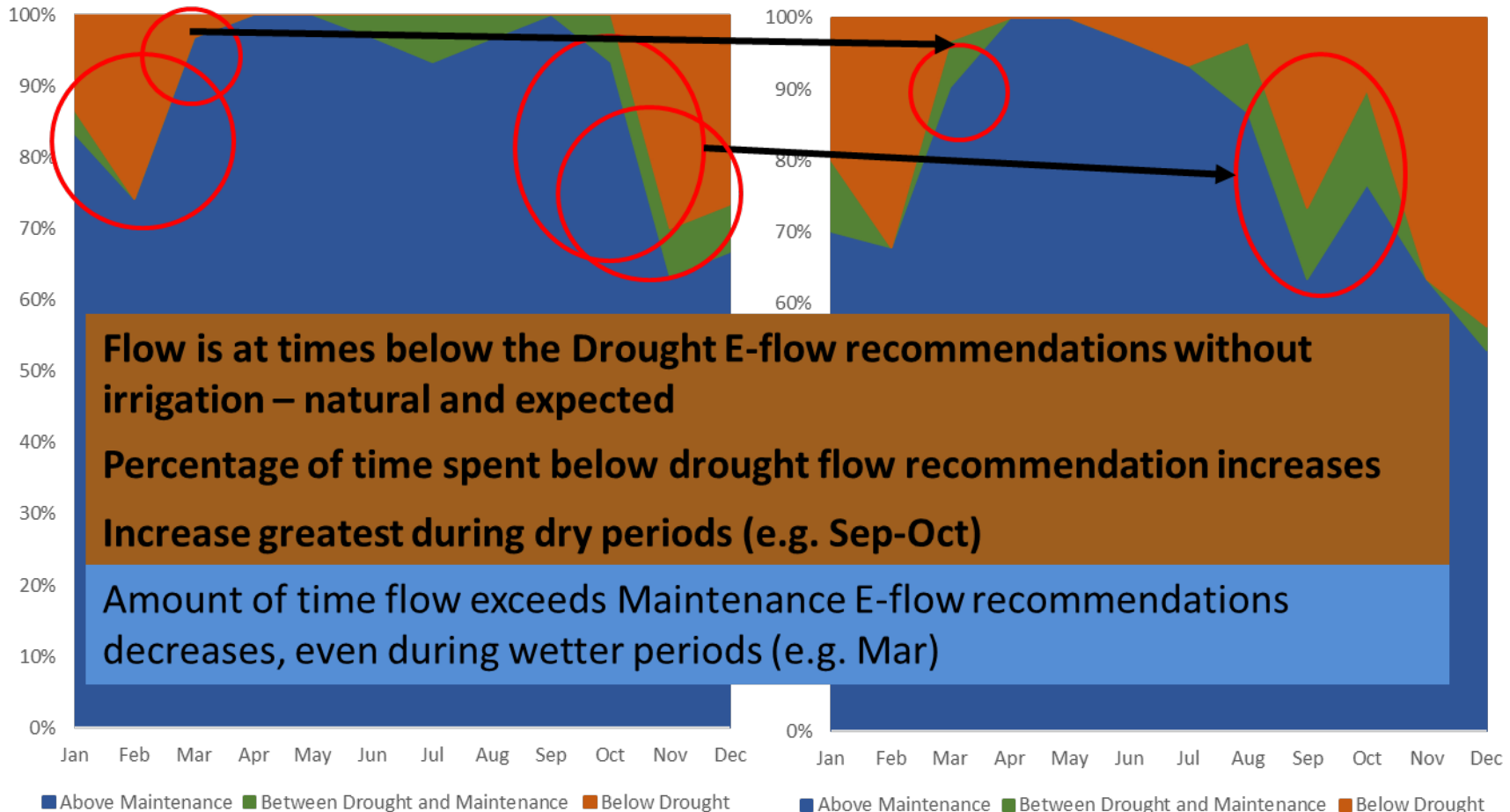
# Scenarios of E-flow results for Lwipa River with Irrigation Demand Kisegeese Blocks 1 & 2



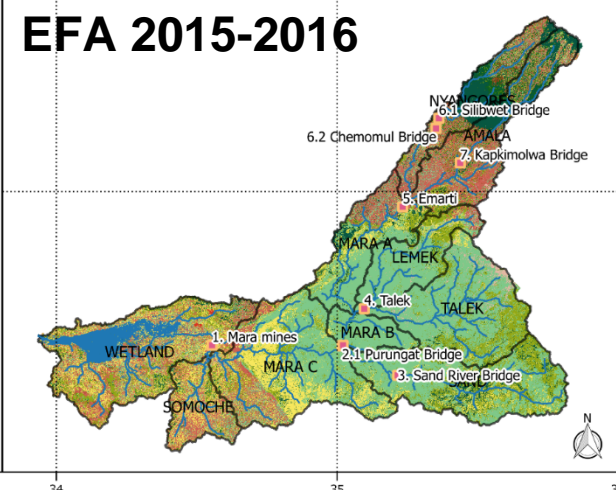
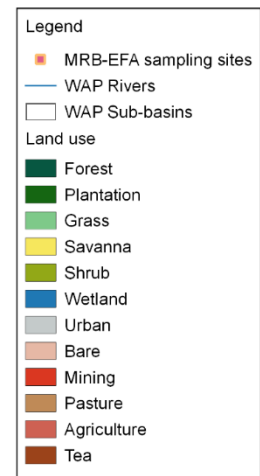
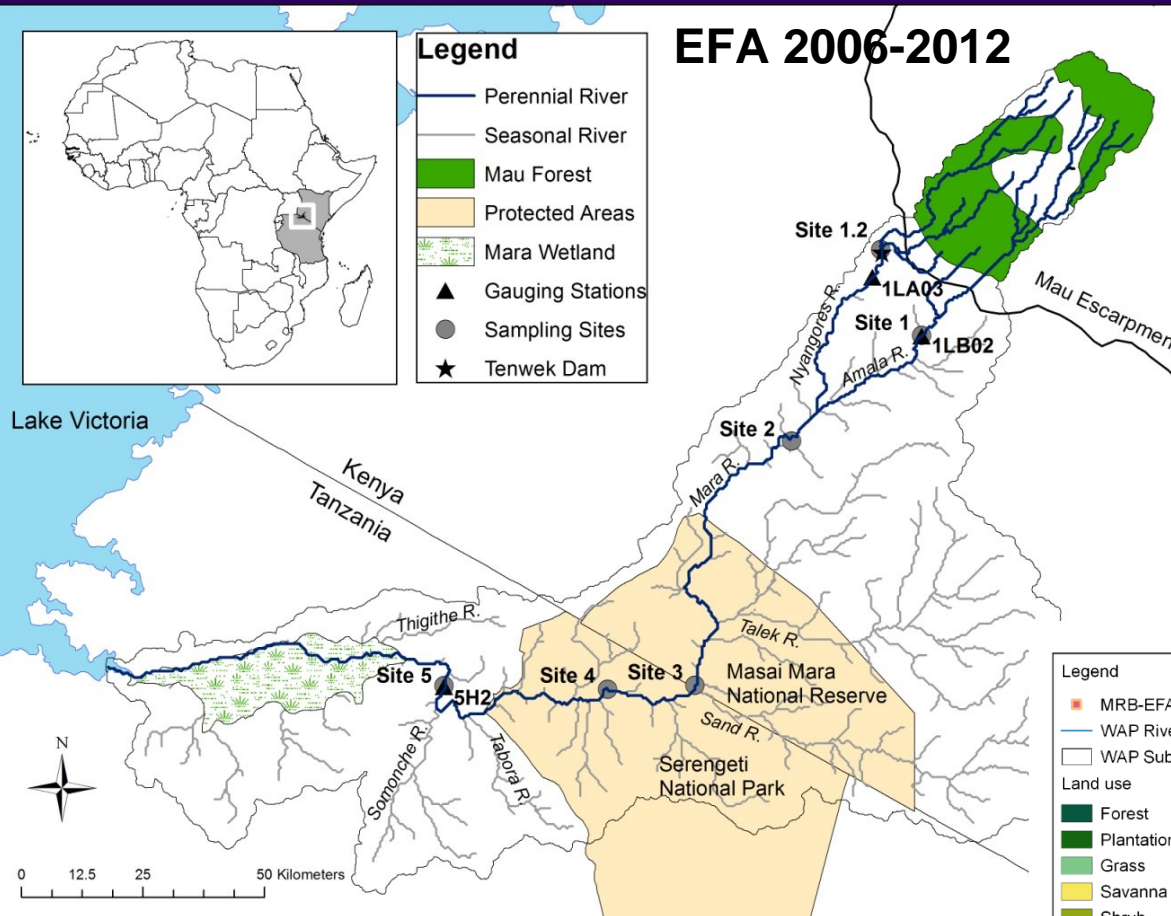
Percentage of Time Flow is Within Range

## No Irrigation

## With Irrigation



# Mara River Basin Environmental Flows Kenya and Tanzania



# Mara River Basin Environmental Flow Timeline

**2006** Project Transboundary Water for Biodiversity and Human Health in the Mara River Basin (TWB-MRB)

**2008** NBI Legal and Institutional Cooperative Framework for water management in the MRB

**2010** LVBC and WWF-ESARPO Biodiversity Strategy and Action Plan for Sustainable Management of the MRB

**2010-2012** Mara River Basin Management Initiative (MRBMI) Environmental Flow

**2007-2012** Assessment using Building Block Methodology (BBM)

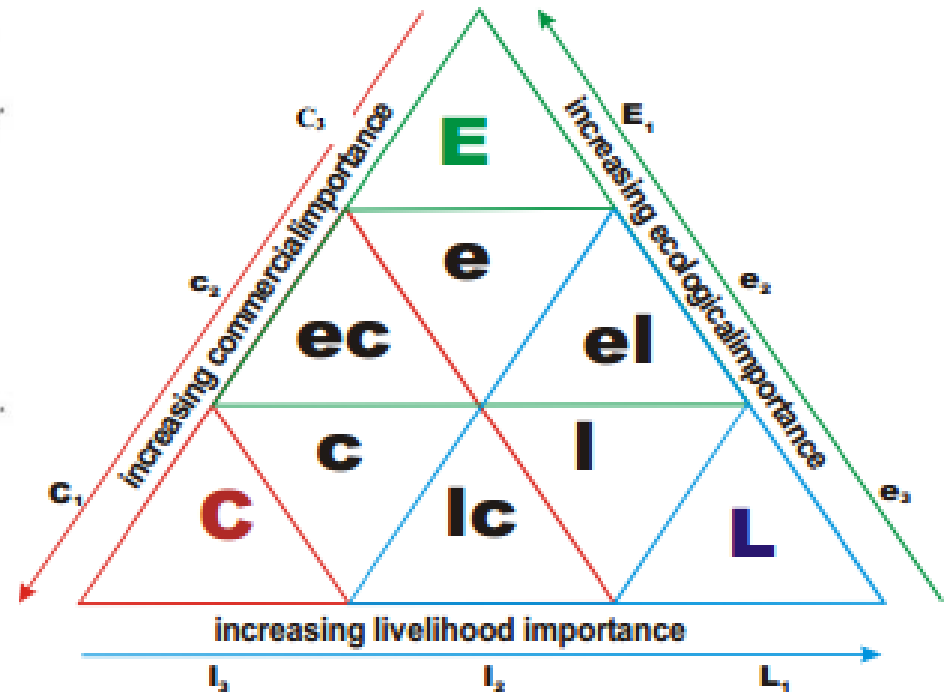
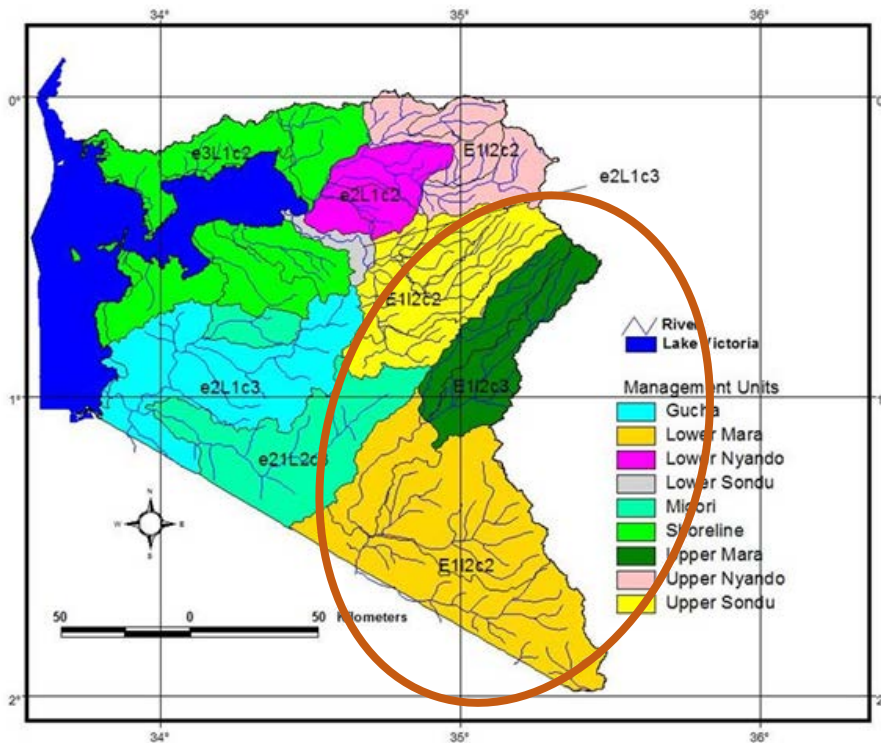
**2013** LVBC Initiation of Mara River basin-wide Water Allocation Plan

**2015** Signature of MoU between Kenya and Tanzania as agreement for transboundary water management in MRB

**2015-2016** E-flow Assessment using PROBFLO and BBM (ongoing)



# Water Resource Classification Mara Basin, Kenya



**Water Resource Classification**  
(Source: Republic of Kenya, 2006b)

## Water Resource Classification System Lake Victoria South Catchment Management Units, Kenya

**Upper Mara:** high ecological importance (E1), high livelihoods value (L1) low commercial (C3) value

**Lower Mara:** high ecological importance (E1), livelihoods value reduces to medium (L2) and commercial (C2) value increases from a low to medium importance

(WRMA 2014)

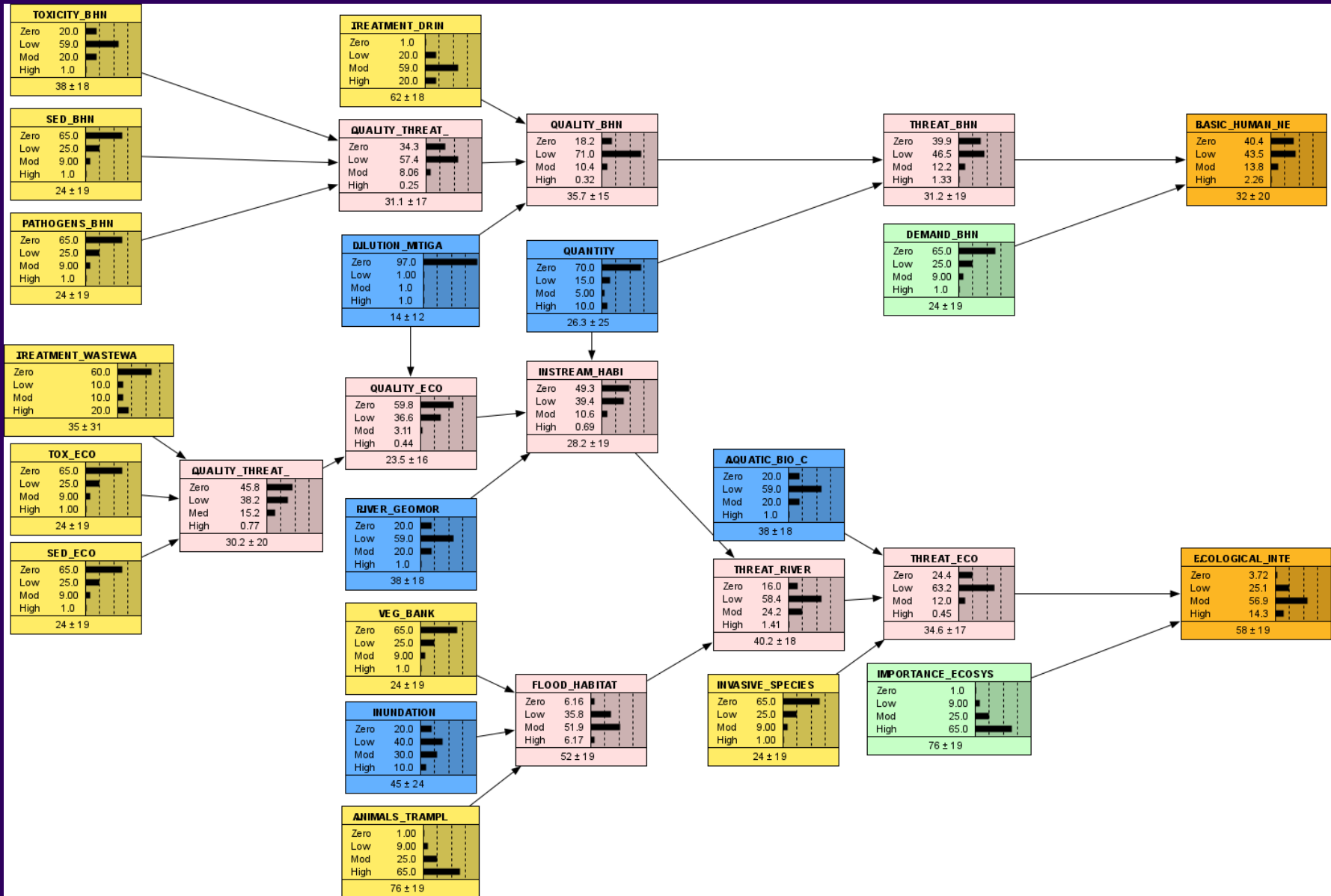
# Resource Use and Flow-related Social Impacts at Low and High Flows

Based on separate studies for Mara River Basin  
Kenya and Tanzania

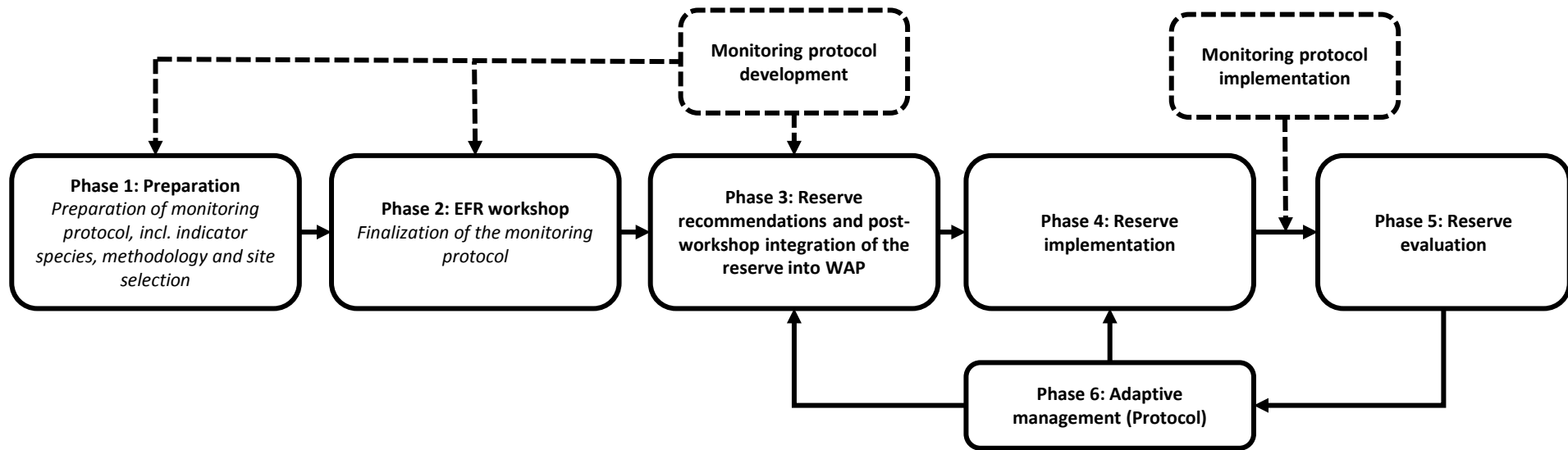
Resource	Use	Flow-related impact on livelihoods	
		Low flow (dry season)	High flow (wet season)
Water	Domestic consumption	Increased proximity with wildlife	Water in the tributaries
	Livestock consumption	Bank degradation	Risk of drowning
	Irrigation	Risk of availability < demand	-
	Recreation	-	Swimming (except if current is too strong)
	Industrial use, e.g. water mills, mines	-	Maintain industry practices*
	Generation of hydroelectric power	-	Sufficient water levels for hydroelectric power generation*
	Cultural/religious practices, e.g. baptism	-	Supports vegetation and deep pools of water to meet cultural needs of the community
	Transportation	River crossing, harvest of opposite banks	Transportation by boat
Fish	Consumption and sale	Easier catch	Trigger for fish migration and spawning
Reeds	Habitats for wildlife	-	Riparian zone provides habitat and camouflage for wildlife
	Making mats and baskets	-	Blooming season, collection
Trees	Construction material, furnitures and utensils, medicine, charcoal, fuel wood	Harvest and drying of the wood	Growth of shrubs and large trees
	Water retention	Less water infiltration	Groundwater recharge
Herbs	Medicine	-	Flood regimes that foster growth of medicinal herbs that are only found in the riparian zone
	Cultural/traditional artifacts	Riparian zones under pressure if levels are too low	Submerged during high floods
Soil sediments	Construction, sale and art work	Sediments more accessible	Allows flushing/mobilisation of sediments
Land	Cultivation	More land to harvest	Natural watering of crops
Wildlife	Tourist attraction	Wildlife watering points and habitat under pressure	Risk of drowning



# Probflo Bayesian Network for E-flows Recommendations for Mara River



# Proposed Adaptive Management Process and Monitoring Protocol



Indicators \ Groups	Trigger points (TPCs)	Frequency	# Sites
Fish species (Rheophilic)	Enough fish to eat or sell Both adults and juveniles present Each sample > 3 adults, > 5 juveniles	seasonal 6 months Yearly	All 7 Sites All 7 sites Key sites; 3/7
Macroinvertebrates	High abundance Sensitive taxa present Index Score < value X	Yearly 3,5 years 3,5 years	All 7 sites All 7 sites All 7 sites

# Thanks



Photo credits: Geemi Paul