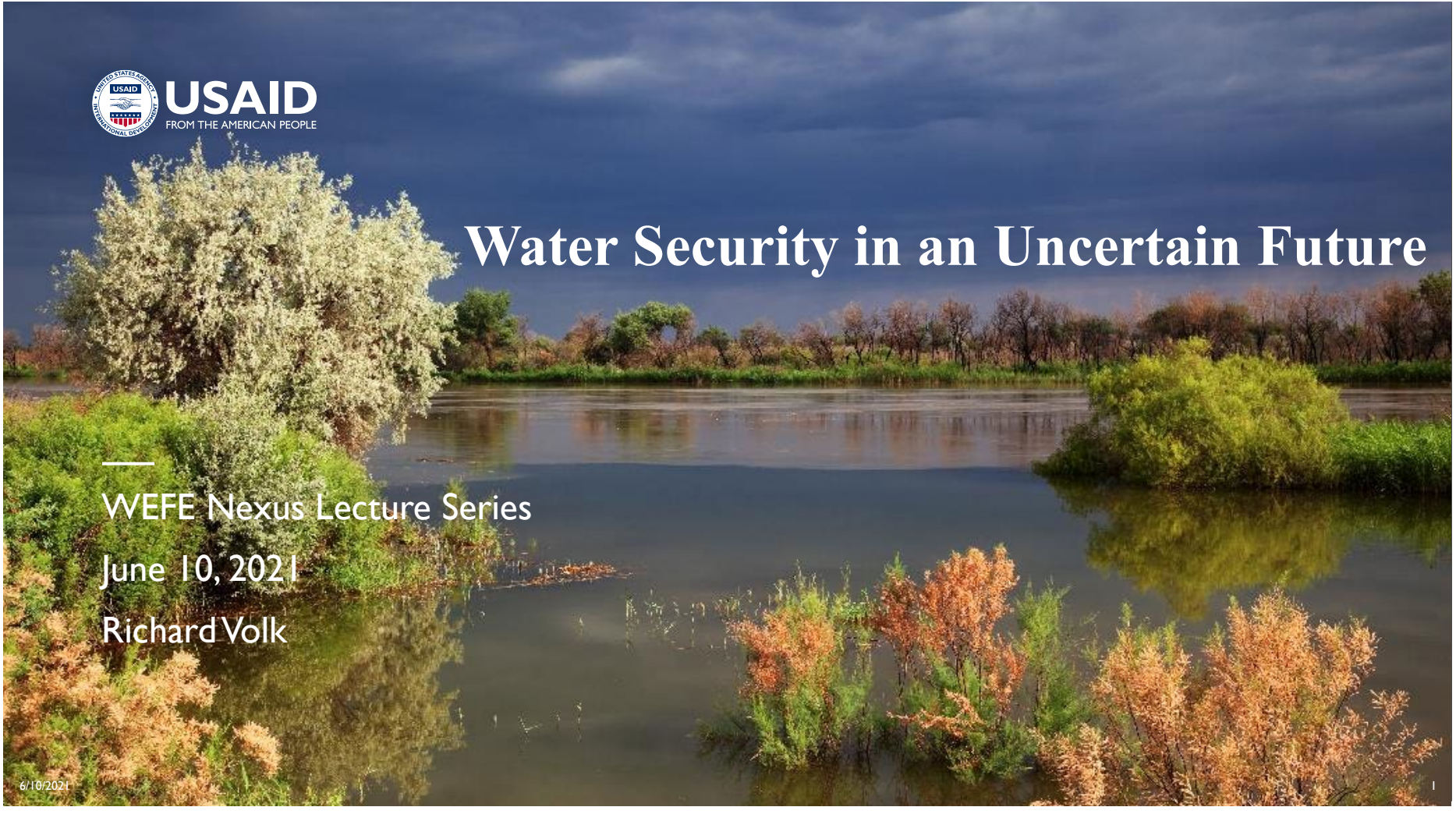
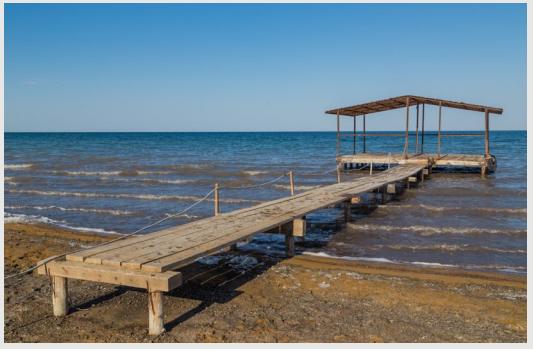

USAID
FROM THE AMERICAN PEOPLE
Water Security in an Uncertain Future
WEFE Nexus Lecture Series
June 10, 2021
Richard Volk

WHAT WE WILL COVER

- Central Asia's changing context
- An uncertain future
- Decision-making with uncertainty in-mind
- Next steps for our project

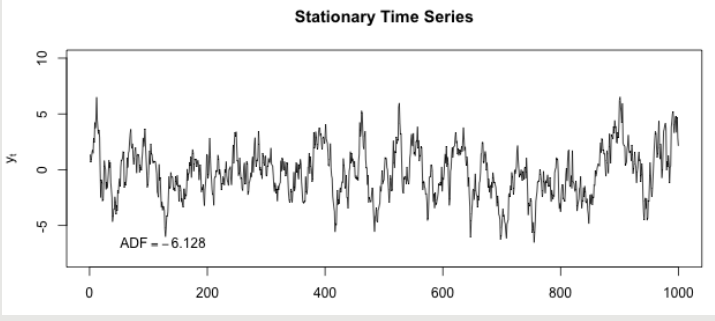
The region's changing context

- Demographics
- Growing demand for water, food, and energy
- Environment
- Climate change
- Hydrology



An Uncertain Future

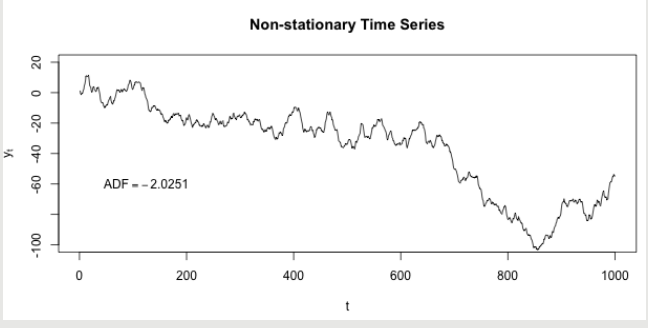
Stationarity – the idea that natural systems fluctuate within an unchanging range of variability



Annual stream flows, annual peak floods can be estimated from the historic record

An Uncertain Future

Non-stationarity – the idea that with climate and non-climate factors, natural systems are variable



CLIMATE CHANGE

Stationarity Is Dead: Whither Water Management?

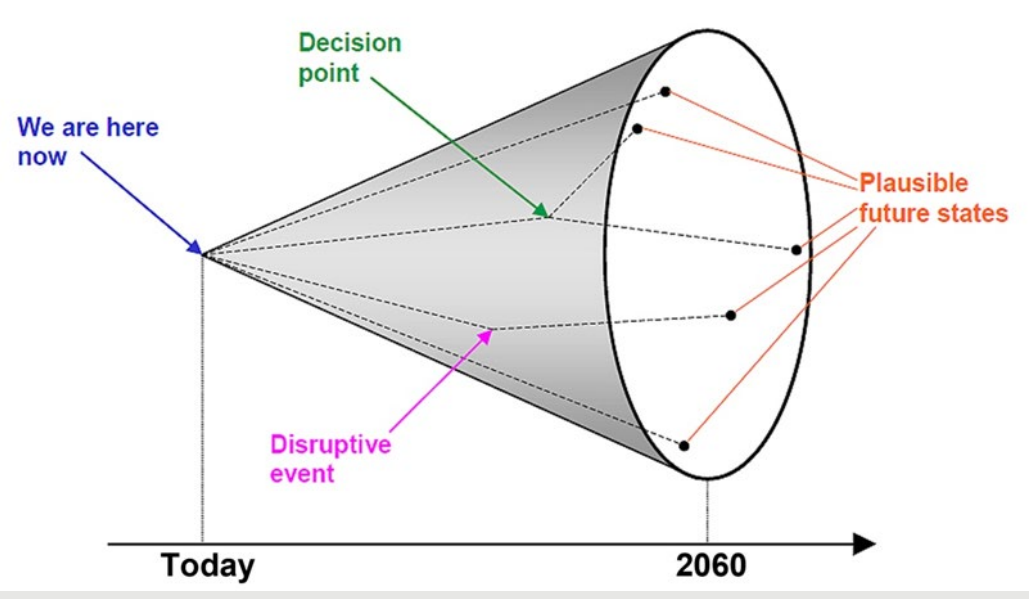
P. C. D. Milly,[1]* Julio Betancourt,[2] Malin Falkenmark,[3] Robert M. Hirsch,[4] Zbigniew W. Kundzewicz,[5] Dennis P. Lettenmaier,[6] Ronald J. Stouffer[7]

“ Stationarity is dead and should no longer serve as a central, default assumption in water-resource risk assessment and planning”

Lake Mead on the Lower Colorado River, USA (June 2021)

ADDRESSING AN UNCERTAIN FUTURE

The path of major influences in a changing climate can not be represented by a single view road range of futures.



UNCERTAINTY IS OUR NEW REALITY

- WRM has always relied on the historical record
- Many important decisions are based on a lack of data
- Climate models may be relatively good predictors of air temperature, but very poor predictors of precipitation or hydrology
- Hydrological changes related to location, timing, frequency, intensity are especially uncertain

Experience from the past is no longer

a reliable guide for the future

SOURCES OF UNCERTAINTY IN WRM

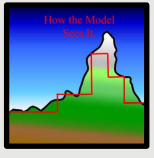
Related to the Analysis

Lack of information

Imprecise observations

Unmeasurable factors

Model structure assumptions



Others?

Related to the Future

Variable natural events

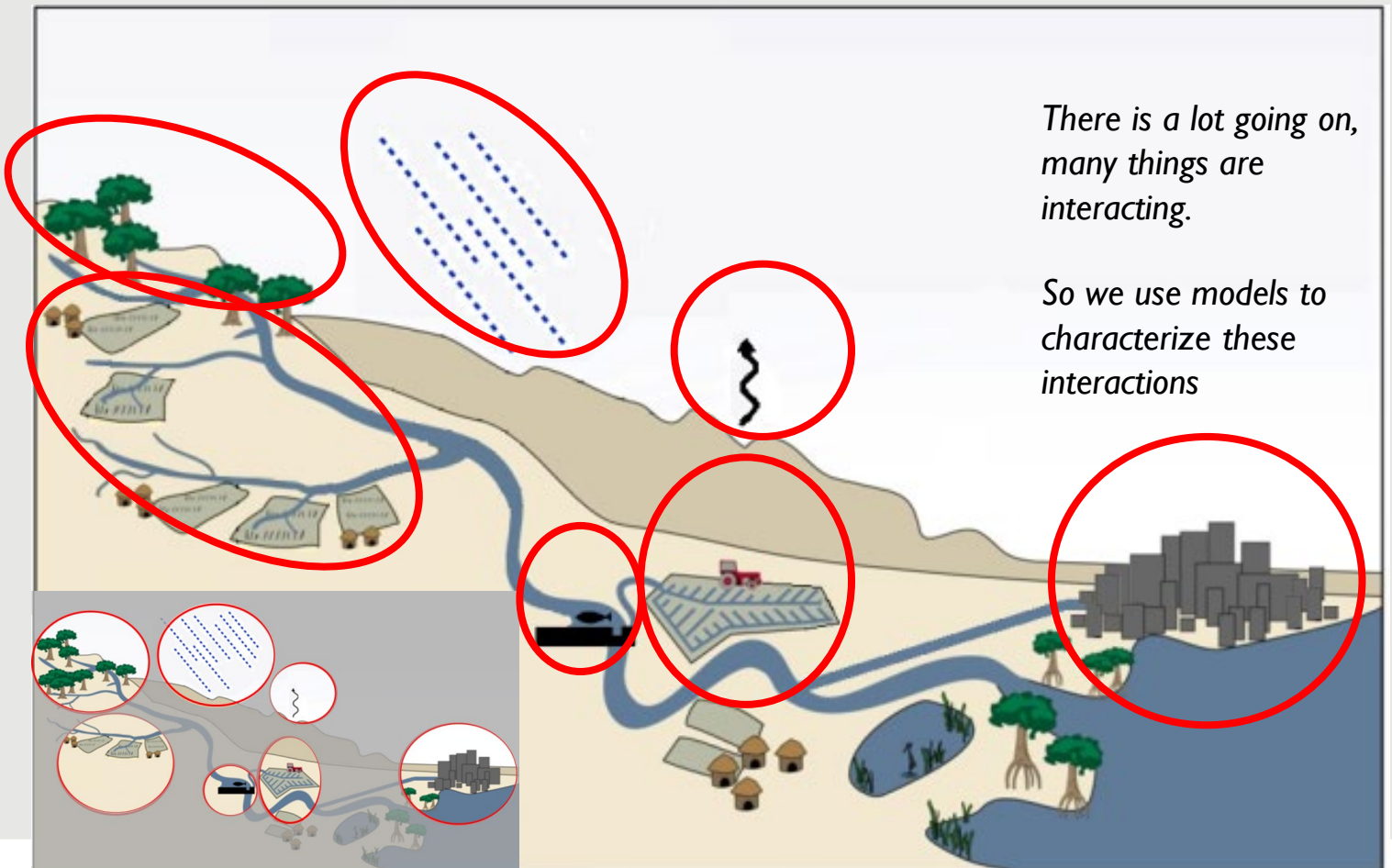
Different and shifting social values

Different and shifting individual behaviors

Social upheaval

Technological surprises

ASSESSING OUTCOMES IN A COMPLEX WATER SYSTEM



There is a lot going on, many things are interacting.

So we use models to characterize these interactions

MODELS AND DECISION SUPPORT

- In complex systems, and under significant uncertainty, models are important tools.
- Models can help us to quickly understand a range possible future scenarios.
- Scenarios help frame relevant "What if?" questions.
- The only perfect model of a system is the system itself.
- Models are only representations of reality.
- All models are wrong, some models are useful.
- A model will only be useful if those using it are looking for "insights" rather than "answers".

“PREDICT THEN ACT”

Collect Information → Conduct Analysis → Make Decision

“DELIBERATION WITH ANALYSIS”

- I definitely do not want to get wet.
- I don’t want to carry my umbrella, however, if it is not necessary.

- It seems like the chance of rain is pretty low.

- I have an important meeting today and I will be wearing a suit. It will be expensive to dry clean my suit if it were to get wet.

- But again, the chance of rain seems pretty low and I hate carrying that thing.

- Oh, I almost forgot, my boss will be there too.

DIFFERENT METRICS OF PERFORMANCE

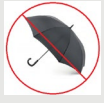
- Expected utility

- It seems like the chance of rain is pretty low.

- Personal finance

- I have an important meeting today and I will be wearing a suit. It will be expensive to dry clean my suit if it were to get wet.

- Personal convenience



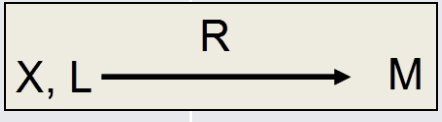
- But again, the chance of rain seems pretty low and I hate carrying that thing.

- Professional reputation

- Oh, I almost forgot, my boss will be there too.

XLRM AS THE BASIS OF ROBUST DECISION SUPPORT

Factors of Uncertainty (X)	**Management Options (L)**
Uncertain factors that are outside the control of managers and users of water resources, but which have the potential to impact outcomes – provide the basis for the creation of scenarios	Management options, or strategies, open to those who manage water resources: - The current system - Alternatives (e.g. infrastructure, behavioral change, regulatory reform)
Models or Relationships (R)	**Metrics of Performance (M)**
Models to estimate performance metrics (M) for an individual management option (L), or strategy, for a specific future set of uncertainties (X), or scenario	Evaluation criteria used to evaluate the performance of the proposed management options



A SIMPLE EXAMPLE OF SCENARIO ANALYSIS FROM EAST AFRICA

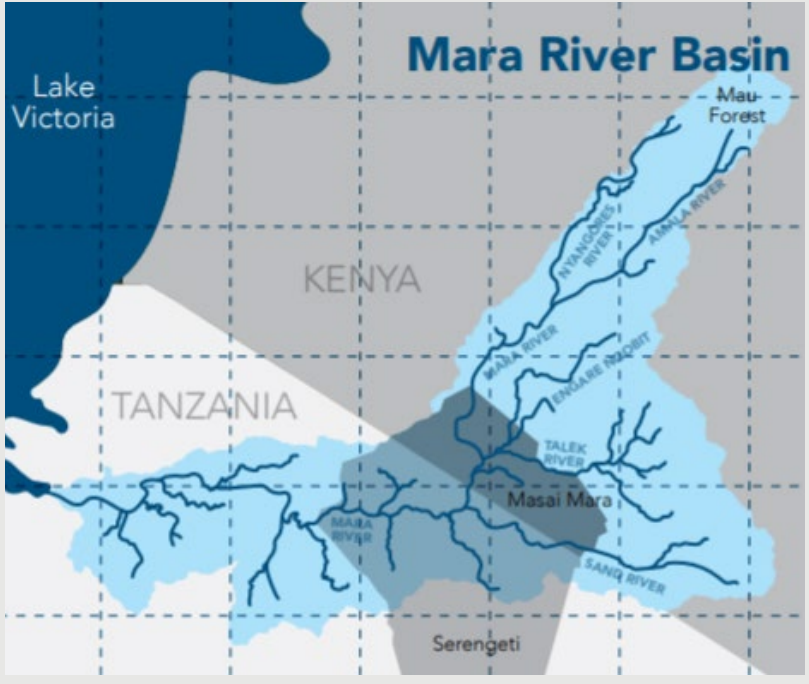
Global biodiversity hotspot

- **Maasai Mara National Reserve**
- **Serengeti National Reserve**

Can the ecosystem health of both basins be maintained while supporting the livelihoods of the people in both countries?

Stakeholder goals:

- Healthy ecosystems (both countries)
- Full potential for water-related development (both)
- Resilience to climate change and variability (both)
- Equitable water use across sectors/users (Tanzania)
- Sustainability of potable water supply (Kenya)



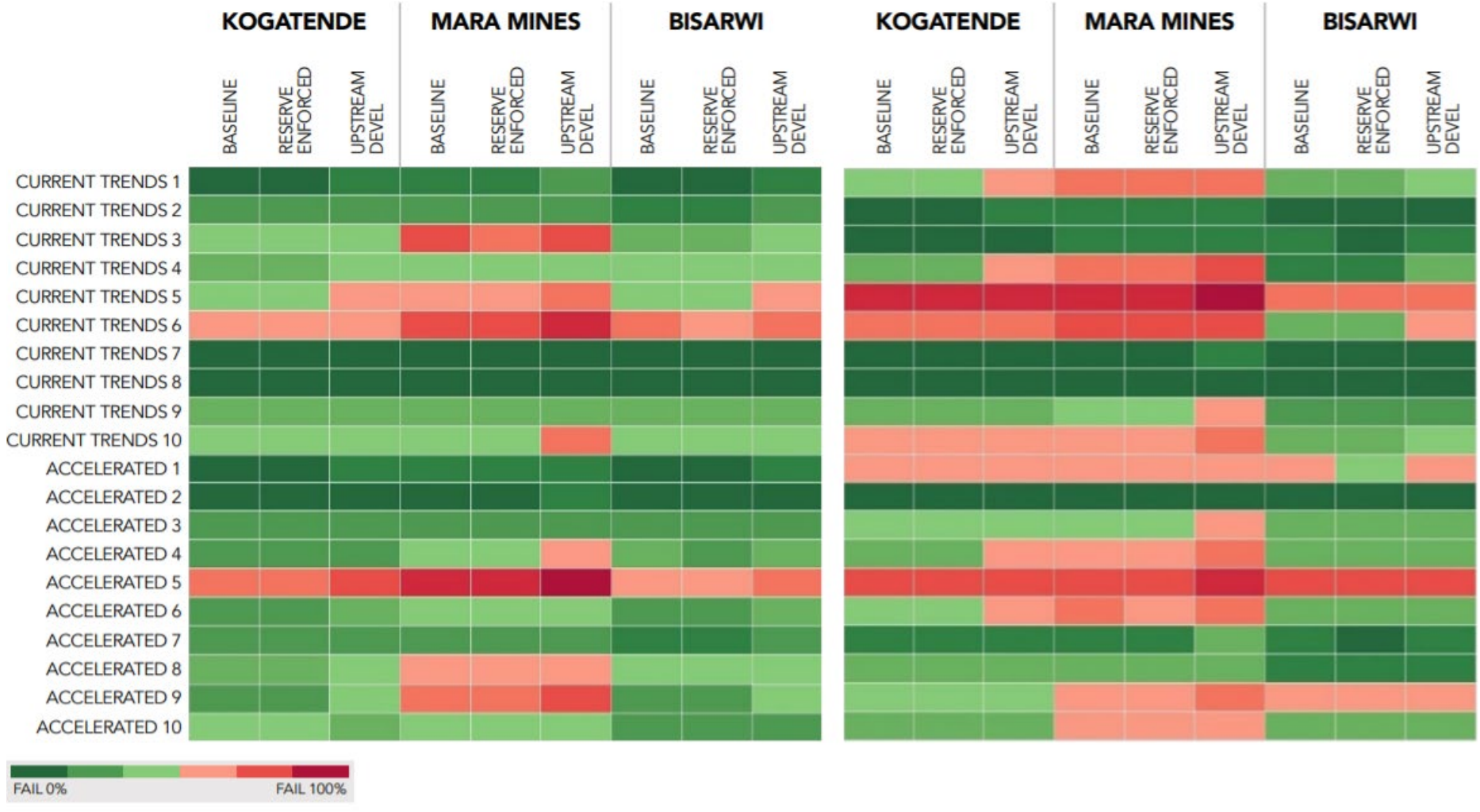
Water security challenges, goals, and uncertainties in the MRB

TABLE 1: STAKEHOLDER CHARACTERIZATION OF WATER SECURITY CHALLENGES, GOALS, AND UNCERTAINTIES IN THE MRB

CHALLENGES
• Climate change and variability creating uncertainty about water availability (Both countries) • Impacts of climate change on wildlife and tourism (Both countries) • Development objectives of Kenya may be in conflict with downstream development goals in Tanzania (Tanzania)
GOALS
• Healthy ecosystems (Both countries) • Achieve water-related development potential (Both countries) • Resilience to climate change and climate variability (Both countries) • Equitable water use across the basin (Tanzania) • Enhanced water governance (Kenya)
UNCERTAINTIES
• Climate change (Both countries) • Land use and ecological change (Tanzania) • Natural disasters and epidemics (Kenya)

SCENARIOS TO EXPLORE

- **Baseline** – represents the current state of water management in the basin
- **Reserve Enforced** – prioritizes the provision of sufficient river flows to support aquatic ecosystems and associated livelihoods
- **Upstream Development** – considers the impacts of potential projects in Kenya to expand irrigated areas and transfer water to an adjacent basin


KOGATENDE
MARA MINES
BISARWI
KOGATENDE
MARA MINES
BISARWI
BASELINE
RESERVE ENFORCED
UPSTREAM DEVEL
CURRENT TRENDS 1
CURRENT TRENDS 2
CURRENT TRENDS 3
CURRENT TRENDS 4
CURRENT TRENDS 5
CURRENT TRENDS 6
CURRENT TRENDS 7
CURRENT TRENDS 8
CURRENT TRENDS 9
CURRENT TRENDS 10
ACCELERATED 1
ACCELERATED 2
ACCELERATED 3
ACCELERATED 4
ACCELERATED 5
ACCELERATED 6
ACCELERATED 7
ACCELERATED 8
ACCELERATED 9
ACCELERATED 10
FAIL 0%
FAIL 100%

Results of the RDS process in the MRB

Reserve Enforced & Upstream Development

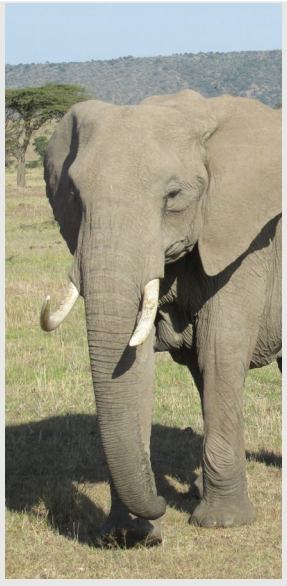
Near-term: Modest impacts on water availability

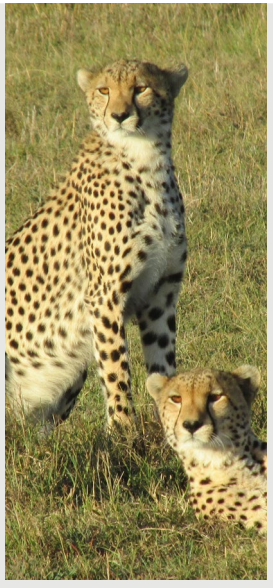
Beyond 10 years:

Upstream Development scenario has increasing probability that base flows will be reduced for longer periods each year, making it more challenging to meet flow targets at all three locations

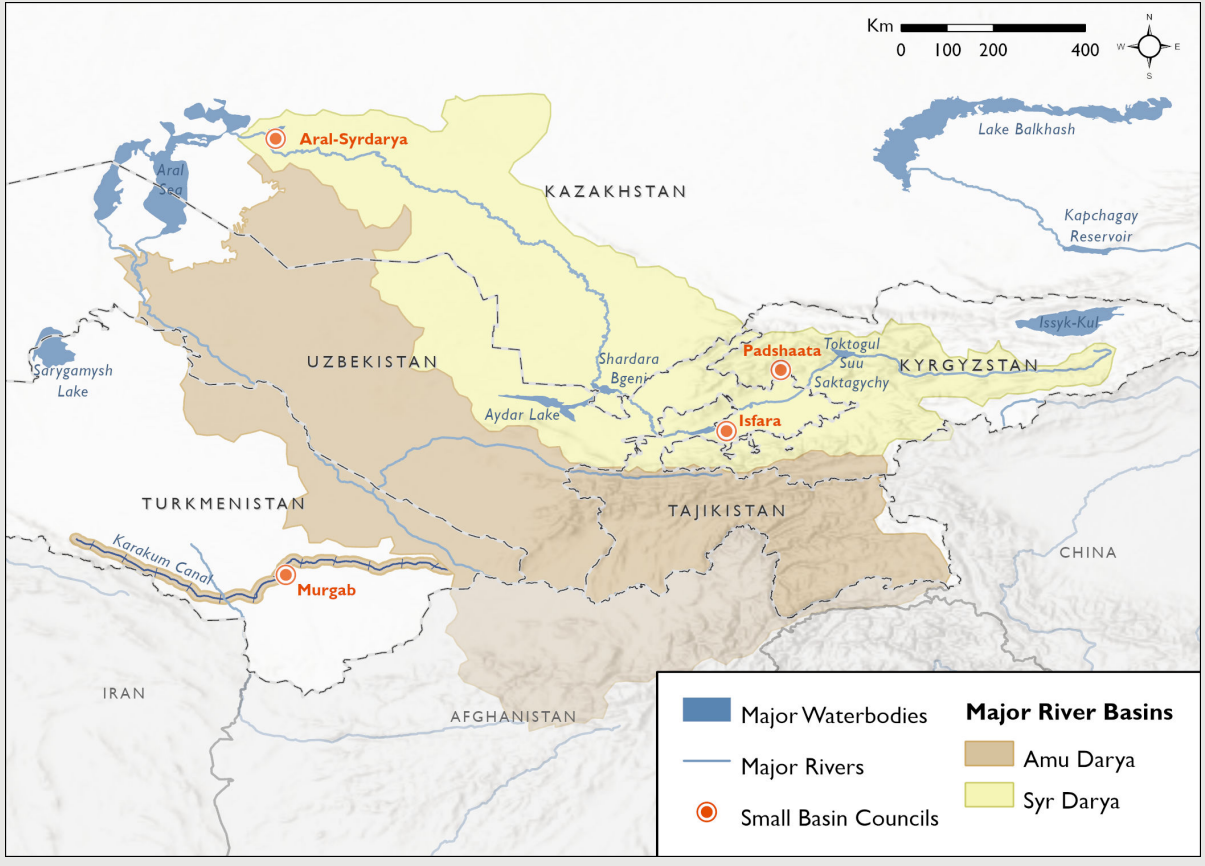
Stakeholders will therefore need to prioritize strategies that maximize water reliability for these vulnerable communities.

- Increase storage capacity
- More efficient irrigation and crop selection
- Alternative / additional sources of potable water
- Water reuse for agriculture
- Demand management strategies
- Drought contingency plan





USAID Regional Water and Vulnerable Environment Activity



End date: September 2025

Target basins: Syr Darya and Amu Darya

Target countries: Five CAS plus Afghanistan

Objectives:

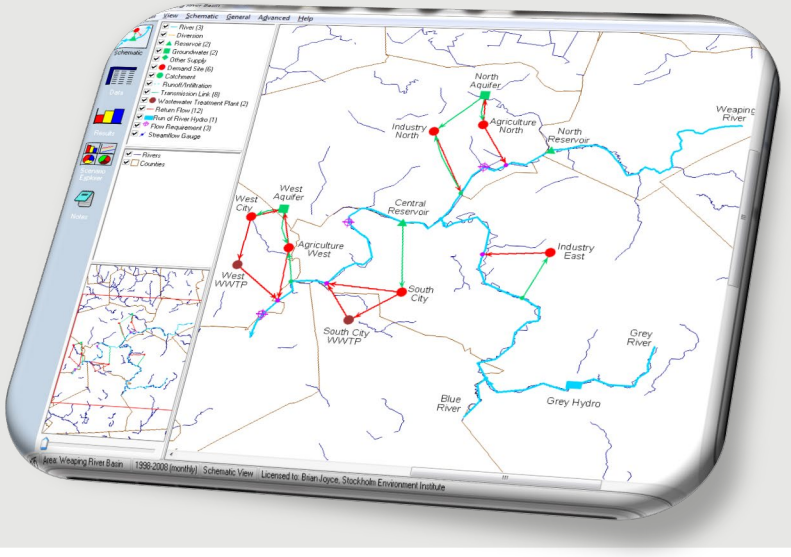
1) Education & training
2) Basin governance
3) Regional cooperation
4) Environmental management

RDS process for Syr Darya and Amu Darya

Modeling tools: Water Evaluation and Planning

- A tool for quantitative modeling featuring:
  - Integrated hydrology and water planning simulations
  - GIS-based, graphical drag & drop interface
  - Physical simulation of demands and supplies
  - Additional simulation modeling: user-created variables, modeling equations and links to spreadsheets & other models (e.g. water quality, environmental flows, agricultural production, groundwater, and economics)
  - Scenario management capabilities
- Created by SEI's Water Program to support sustainable development
  - Inform decision making
  - Empower stakeholders to perform their own analyses
- Well-suited to medium and long-term planning

https://weap21.org

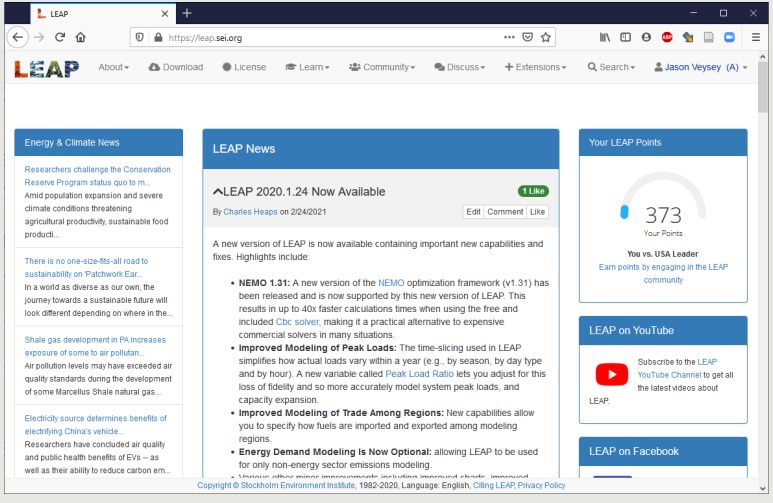


Modeling tools: Low Emissions Analysis Platform

- A tool for quantitative modeling of:
  - Energy systems
  - Pollutant emissions from energy and non-energy sources
  - Health impacts
  - Sustainable development indicators
  - Costs and benefits
  - Related externalities
- Created by SEI's Energy Modeling Program to support sustainable development
  - Inform decision making
  - Empower stakeholders to perform their own analyses
- Well-suited to medium and long-term planning

LEAP

https://leap.sei.org



RDS process for Syr Darya and Amu Darya

Integrated water and energy systems models
(WEAP and LEAP)

Stockholm Environment Institute

Used extensively worldwide

Four phase process in each basin
Preparation
Consultations
Preliminary results
Finalization of the models

Beginning July 2021

Examples of WEAP Scenario Analyses

- What if population growth and economic development patterns change?
- What if reservoir operating rules are altered?
- What if groundwater is more fully exploited?
- What if water conservation is introduced?
- What if ecosystem requirements are tightened?
- What if a conjunctive use program is established to store excess surface waters in aquifers?
- What if a water recycling program is implemented?
- What is a more efficient irrigation technique is implemented?
- What if the mix of agricultural crops changes?
- What if climate change alters water supply and demand?
- How does pollution upstream affect downstream water quality?
- How will land use changes affect runoff?

UNCERTAINTY IS MANAGEABLE

All development sectors face uncertainty,
but we need to approach
water security with more rigor.

USAID REGIONAL WATER AND VULNERABLE ENVIRONMENT ACTIVITY

Richard Volk, Chief of Party

Richard.Volk@centralasiawave.org

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FROM THE AMERICAN PEOPLE