# Planning with EFlows – Cubango-Okavango Basin

Mainstreaming of Environmental Flows into Integrated Water Resources Management

Cape Town 25-27 Nov 2019

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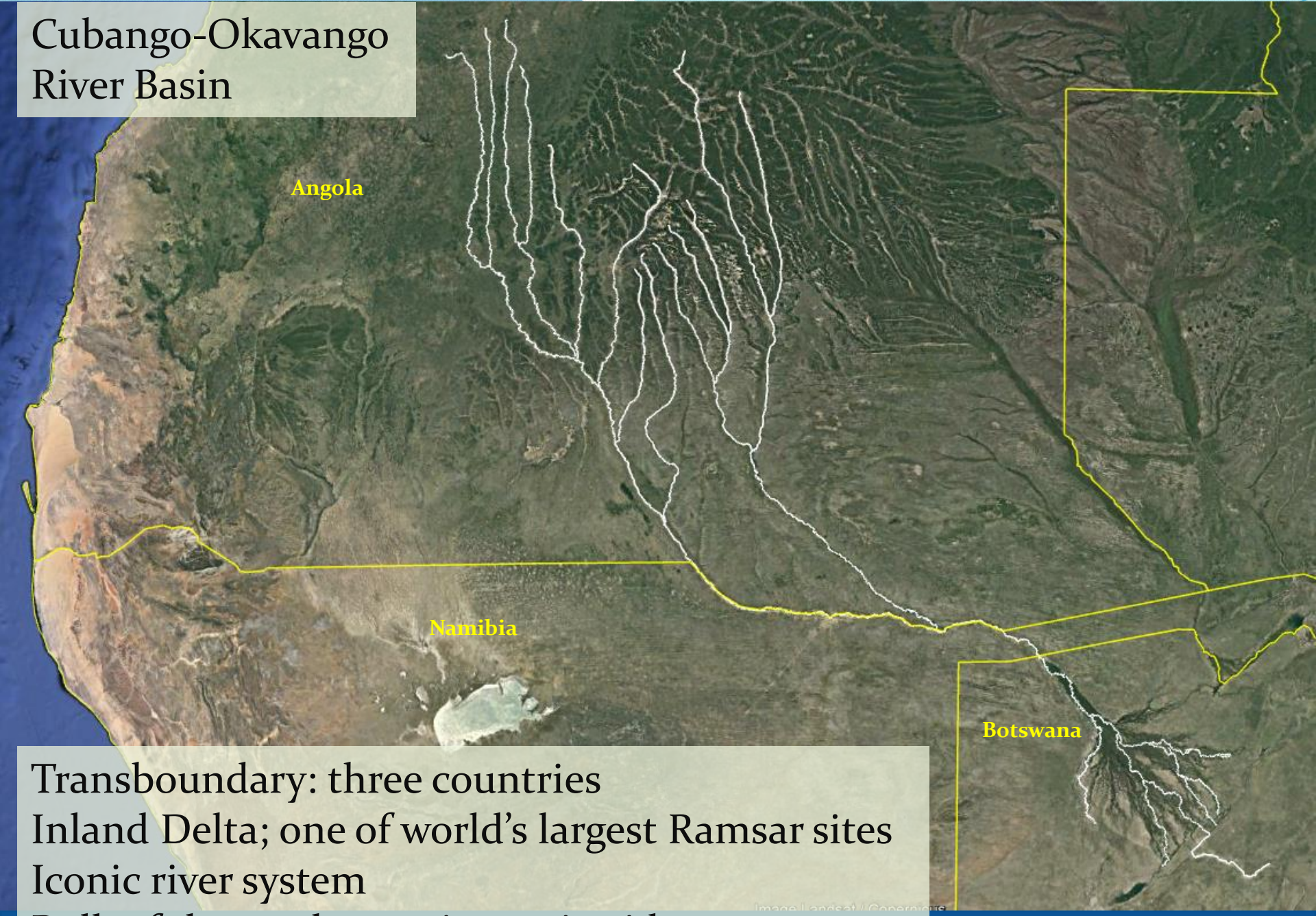
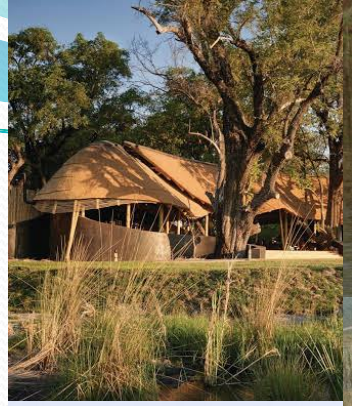
# Cubango-Okavango River Basin




Transboundary: three countries
Inland Delta; one of world's largest Ramsar sites
Iconic river system
Bulk of the catchment in semi-arid areas

# Background

- In relatively good condition from source to Delta
- Many are reliant on the natural resources provided by the riverine ecosystem
- … Improve livelihoods without degrading the river






# Background


- Angola, Botswana and Namibia signed the OKACOM Agreement in 1994: Guided by the spirit of managing Cubango-Okavango River Basin as a single entity.
  - "…commits … member states to … coordinated and environmentally sustainable regional water resources development, while addressing the … social and economic needs … of the riparian states"
  - The three countries recognize that developments upstream can influence the resources downstream.

# EFlows in the Okavango

- From 2008 - ongoing:
- Use of the DRIFT eco-social (EFlows) model to compare scenarios of different levels of development and use
- Part of the decision support systems for OKACOM and governments to examine future scenarios

# EFlows in the Okavango

- Three phases of DRIFT EFlows in Okavango:
- 2008-2010 : TDA
- 2016 : MSIOA
- 2018-2020 : EU and USAID projects

# EFlows in the Okavango: TDA

- 2009:
  - Environmental Protection and Sustainable Management of the Okavango (EPSMO)
  - Transboundary Diagnostic Analysis (TDA)
  - Strategic Action Programme (SAP)

- TDA - to predict the positive and negative implications of possible future water resource developments; address them pro-actively with a SAP for the basin

# 2009 TDA EFlows process, model and analysis(1)

1. Daily hydrology time-series
2. Scenarios of different flow patterns representing different levels of water use:
   - Current
   - Low
   - Medium
   - High

# 2009 TDA EFlows process, model and analysis(2)

3. Specialists from each of the countries formed "discipline" teams for field work; to select indicators and the relevant driving indicators; and to develop response curves

- Disciplines were:
  - Hydrology
  - Geomorphology
  - Water quality
  - Macro-invertebrates
  - Fish
  - Birds
  - Wildlife, and
  - Socio-economics

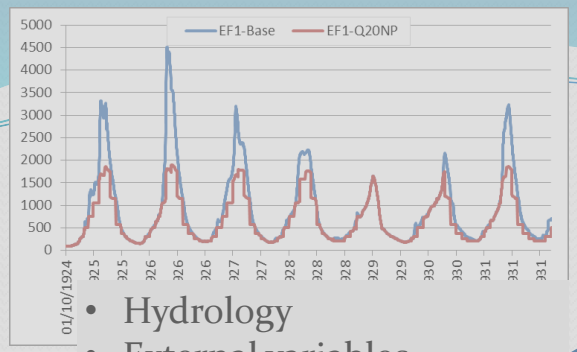
DRIFT

# 2009 TDA EFlows process, model and analysis(1)

- Time series of ecologically relevant flow indicators:
  - Dry season duration, wet season peak flows, etc.
- Several disciplines representing the ecosystem and the people depending on it
  - Indicators within disciplines to represent changes in abundance and condition
- Each indicator linked to a set of "driver" indicators which change with different flow scenarios
  - For each link a response curve defined to describe how the responder reacts to changes in the driver

DRIFT

# 2009 TDA DRIFT model and analysis(4)




- Hydrology
- External variables

Time series per scenario

## DRIFT

Flow and external indicators
Per scenario
Per site

Geomorphology indicators

Vegetation indicators

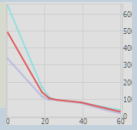
Fish indicators

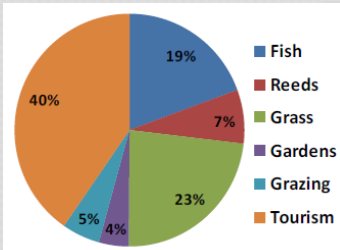
Social
Fish catch
Recreational

Links

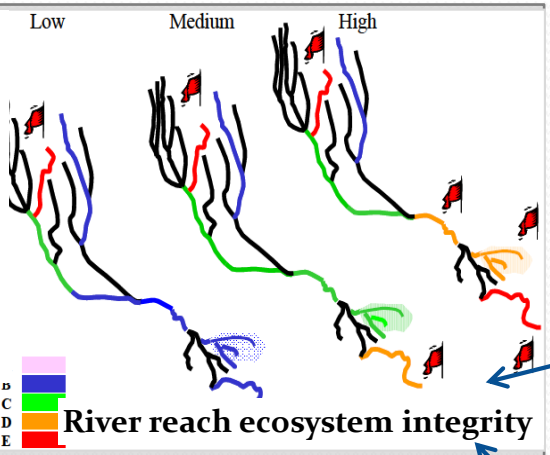
Time-series of relative abundance per indicator per scenario

Response curves

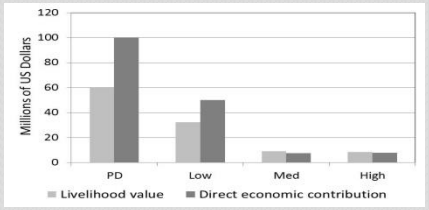




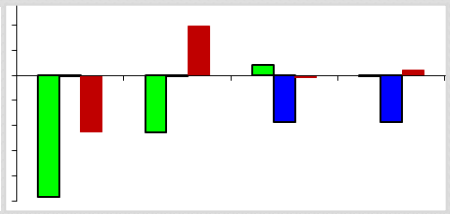

**IUA8(Kapako)-Hh income from river US$7.3 mill**




**River reach ecosystem integrity**

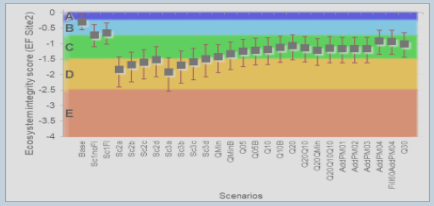



**Socio- and broader economic consequences**



**"Three pillars": ecological, social, economic**

Integrity results for discipline and site per scenario



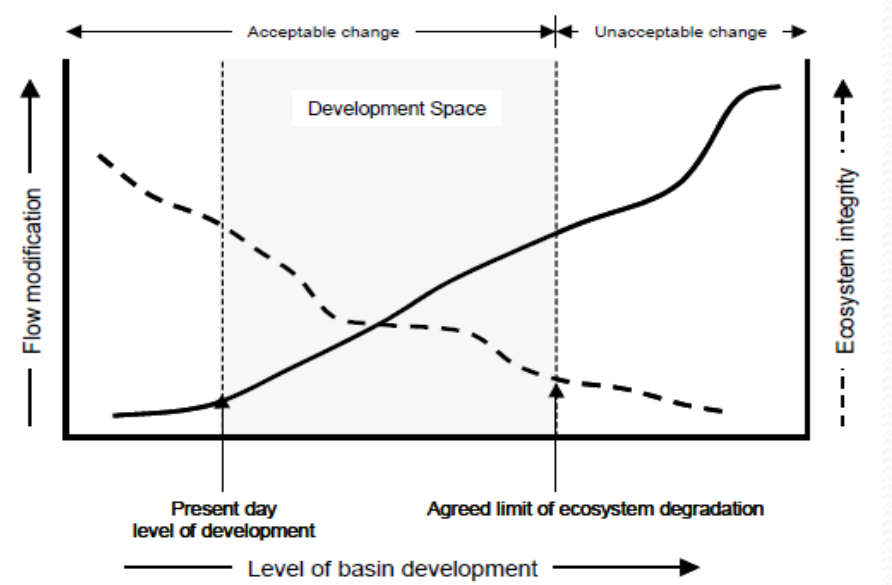

Baseline ecological condition

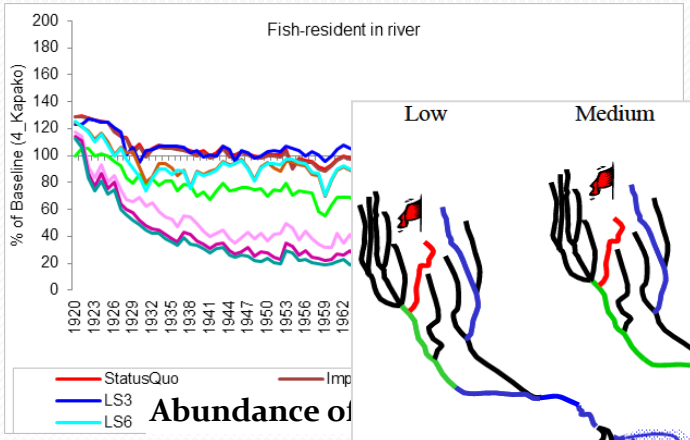
| Discipline | EF Site1 | EF Site2 |
|---|---|---|
| Geomorph | A | A |
| RipVeg | A/B | B |
| MacroInverts | A/B | A/B |
| Fish | A/B | A/B |

Weights for aggregation up to discipline and site condition

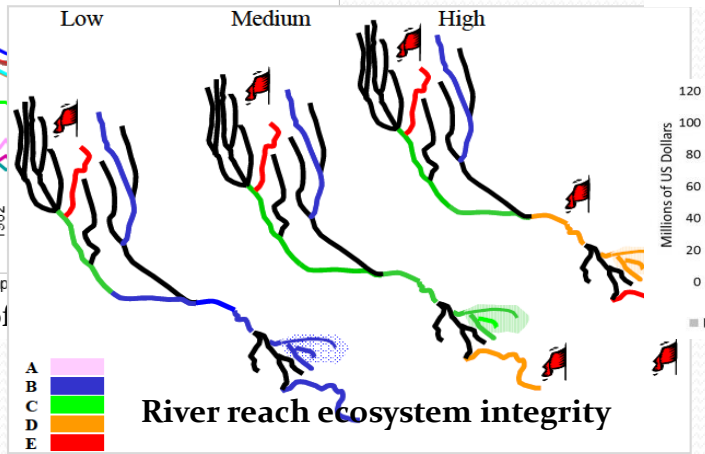
# 2009 TDA DRIFT model and analysis(5)

- Integrative, structured process and decision support system
- Different disciplines, environmental, social , socio-economic can be compared within the same structured system
- Broad level summaries & detailed indicator results
- Co-learning among countries, OKACOM, etc.

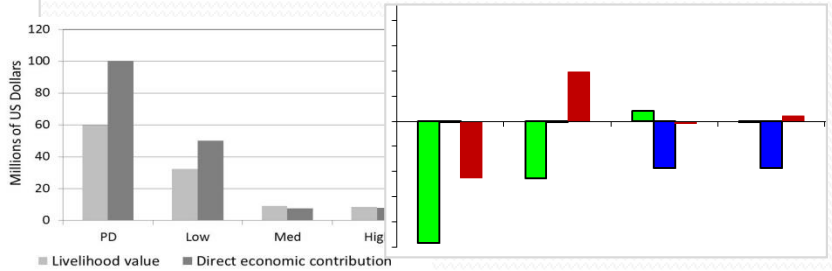



Abundance of




River reach ecosystem integrity



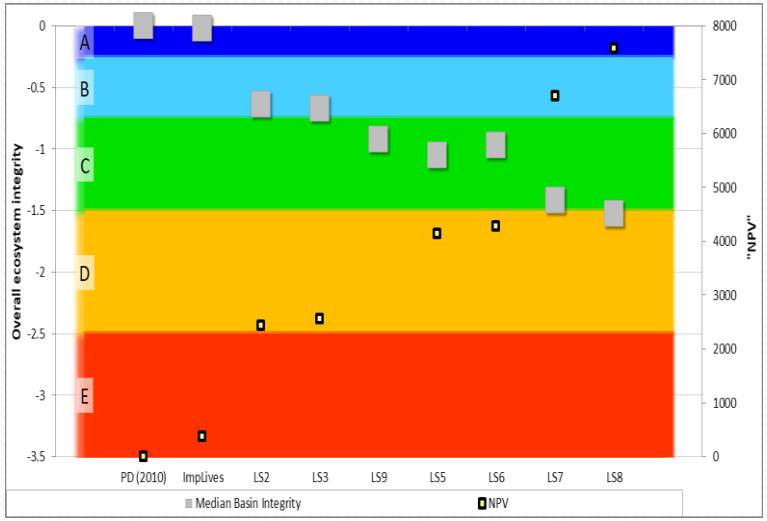

**Socio- and broader economic consequences**

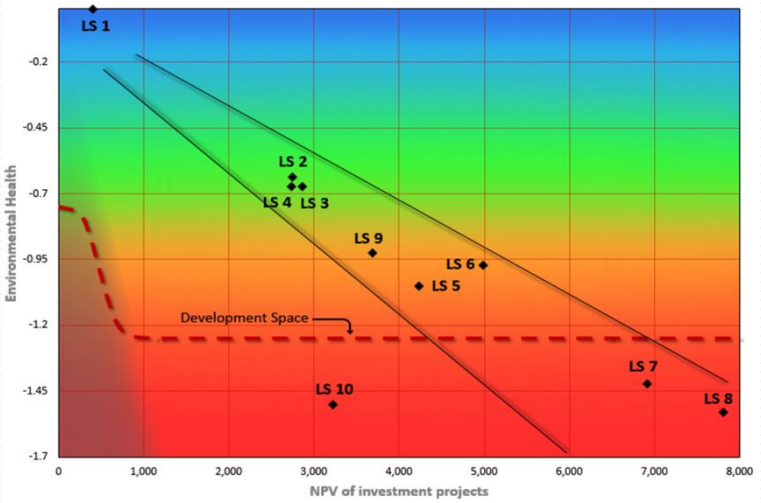
**"Three pillars": ecological, social, economic**

# SAP, NAP

- Main transboundary concerns

| **Areas of Concern** | **Driving Factors** |
|---|---|
| Variation and reduction of hydrological flow | Population dynamics |
| Changes in sediment dynamics | Land use change |
| Changes in water quality | Poverty |
| Changes in the abundance and distribution of biota | Climate change |



# 2016 MSIOA DRIFT model and analysis(1)

- Expanded set of more detailed, specific scenarios of irrigation schemes, dam building, etc.
- Refined indicators and response curves
- Addition of sediment as a driver
- Addition of hydraulics (one site)

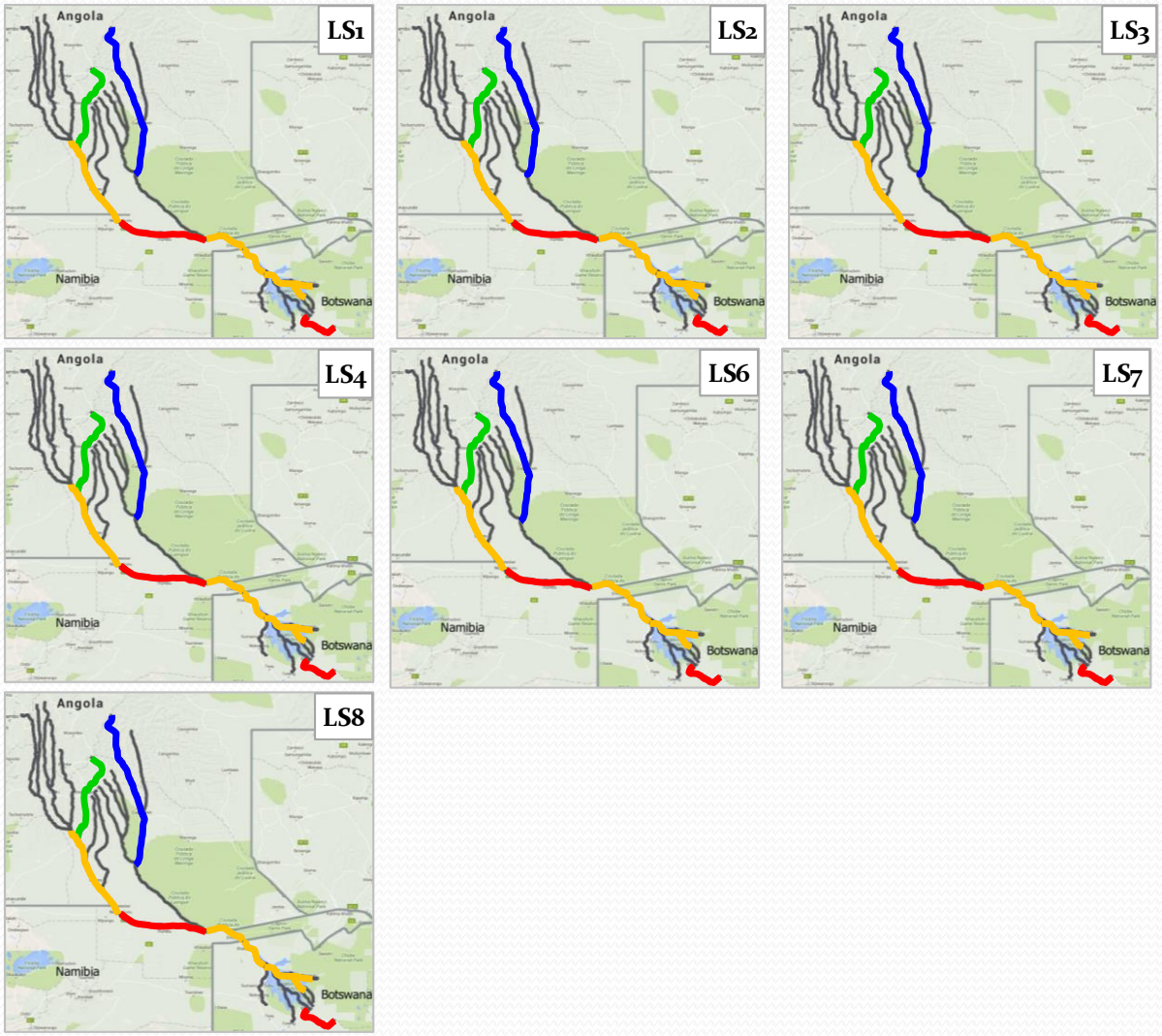
- Model already set up; did not require specialists to gather again

- Separate (not in DRIFT socio-economics)

| | Option 1 (BDS3) | Unit |
|---|---|---|
| Angola irrigation | 55,060 | ha |
| Namibia irrigation | 11,660 | ha |
| **Total irrigation** | **66,720** | ha |
| Irrigation abstraction | 604 | $Mm^3/yr$ |
| Urban abstraction | 27 | $Mm^3/yr$ |
| Windhoek & CAN | 67 | $Mm^3/yr$ |
| **Total abstraction** | **698** | $Mm^3/yr$ |
| Dams built | Mucundi | |
| Installed hydroelectric power | 105 | MW |
| **Total investment for HEC** | **$ 3.112** | $ billion |
| Direct jobs created | 40,000 | |
| Total jobs created | 160,000 | |
| GDP direct impact | $2.9 | $ billion |
| **GDP total impact** | **$5.9** | $ billion |

# 2016 MSIOA DRIFT model and analysis(1)

## Basin view per scenario




Unsustainable Working river "Conservation" river

A

B

C

D

E

# 2019-ongoing

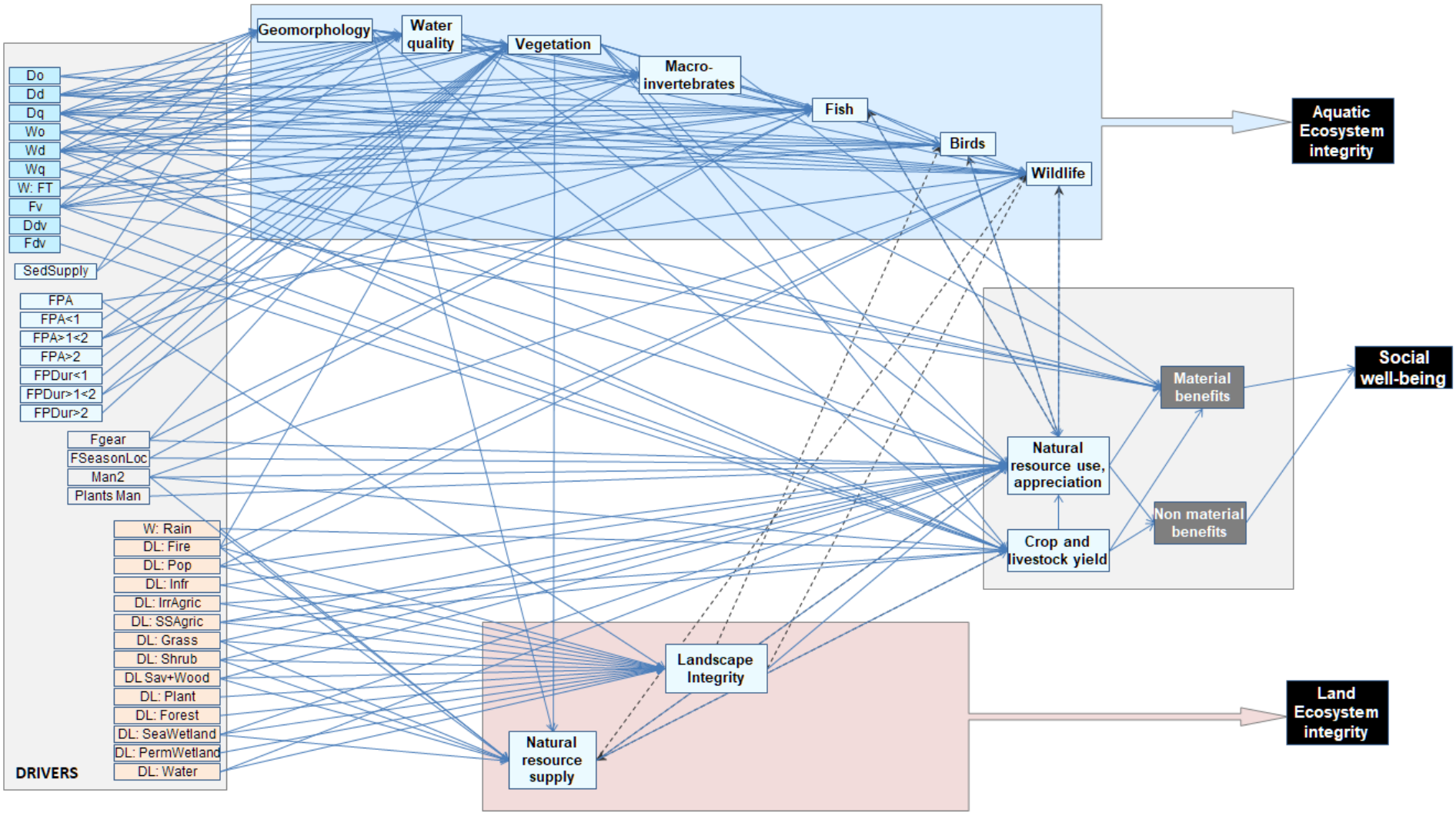
- **EU and USAID**
  - Programme for Transboundary Water Management in the Cubango – Okavango River Basin;
  - Resilient Waters Programme: Cubango-Okavango Basin DRIFT update

- DRIFT EFlows model:
  - More explicit inclusion of land-cover / land-use
  - Expansion of ecosystem services, livelihoods, social component
  - Further refinement of indicators, ecosystem links and response curves
  - Addition of five sites

# 2019-ongoing

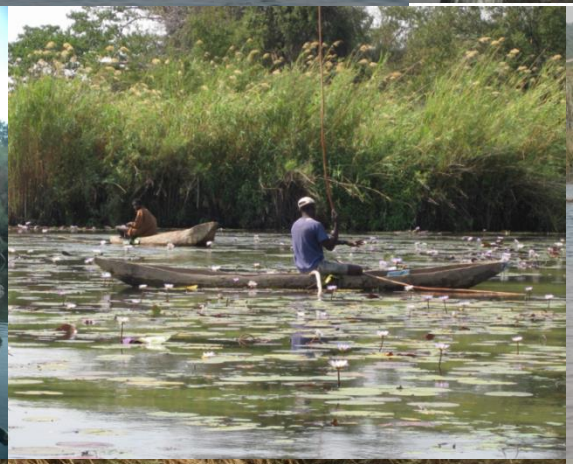
- DRIFT EFlows model:
  - Additional specialist input for:
    - Additional ecosystem services integration
    - Geomorphology
    - Vegetation
    - Fish
- More formal integration into broader OKACOM DSS
- Integration with monitoring
- OKACOM personnel to run DRIFT-DSS in future

# 2019-ongoing










Thank you