



Towards transboundary basin cooperation: Development and agreement of “Objective Flows” for the Pungwe Basin

The Pungwe Water - Sharing Agreement

Cooperation between countries that share rivers, estuaries, lakes and aquifers is essential to achieve sustainable utilization of water and sanitation for all. Recognizing that a legal and institutional framework was needed for sustainable water-resources management and development, and to build resilience to climate change in the Pungwe Basin, the Governments of Mozambique and Zimbabwe signed the Pungwe Basin Water - Sharing Agreement in 2016 and established the Buzi, Pungwe, and Save Watercourse Commission (BUPUSACOM) in 2023. In the same year, an Environmental Flows (EFlows) assessment was commissioned by the two countries, to develop a shared understanding of the ecosystems, to inform local solutions for managing competing water uses, and to define ' objective flows' for key sites in the shared basin.

EFlows Assessment using the DRIFT-PUNGWE ECO-SOCIAL MODEL

The complexity and interconnectivity of the Pungwe rivers, estuary and near-shore ecosystems were modelled to:

EFlows are “the quantity, timing and quality of the flow of water, sediment and biota necessary to sustain freshwater and estuarine ecosystems, and the human livelihoods, and well-being that depend on these ecosystems”.

World Bank Group (2018)



IDENTIFY the driving processes and functioning of the ecosystems



UNDERSTAND their implications for the rivers, estuary and near-shore ecosystems - their condition, ecological tipping points, and the services they provide to people



ASSESS how management approaches and water-resource development scenarios might help deliver on the spirit and specifics of the Pungwe Water - Sharing Agreement

DRIFT-Pungwe uses scientific reasoning and logic to model ecosystem responses to natural and human interventions, such as abstractions, discharges, instream infrastructures and natural resource management.

DRIFT (www.drift-eflows.com) is the acronym for the Downstream Response to Imposed Flow Transformation model.

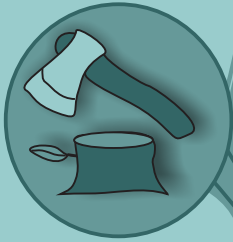
2023 Water-Resource Developments and Social Uses

Zimbabwe

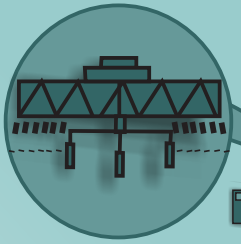
Recession Farming

Mozambique

Deforestation



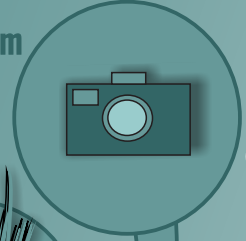
Zimbabwe Irrigation
2229 ha (36.9 mm³/ year)



Nyanga National Park

Wamba Dam

Tourism



Plant Harvesting



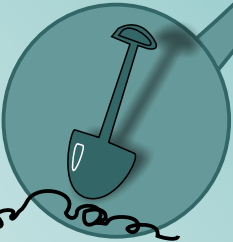
Gorongosa National Park

Salt Marsh

#1 carbon sequestrators

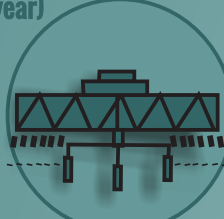


Artisinal Gold Mining

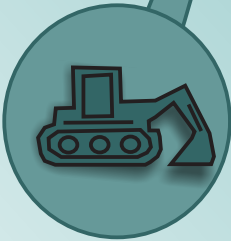


Mozambique Irrigation
6853 ha (92.2 mm³/ year)

Muda Dam



Commercial Gold Mining

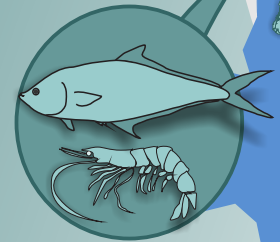


Mangroves



Fishing

Estuary and Marine
- 175000 tons/annum



The 2023 level of water use is well below the annual average yield of the basin. However, some there are several other human pressures on the aquatic ecosystems that are affecting their condition adversely.

Water-Resource Developments included in the Pungwe Water Sharing Agreement



Implications for Aquatic Ecosystem Health

Ecosystem health with 2023 water-resource developments and impacts related to social use ONLY



Ecosystem health with water-resource developments in Pungwe Water Sharing Agreement ONLY



COMBINED: 2023 social use AND water-resource developments in the Pungwe Basin



Key to River Health

- A** Unmodified, natural
- A/B**
- B** Largely natural
- B/C**
- C** Moderately modified
- C/D**
- D** Largely modified
- D/E**
- E** Completely modified
- E/F**

Social



Fishing yield reduced



Gender equality reduced



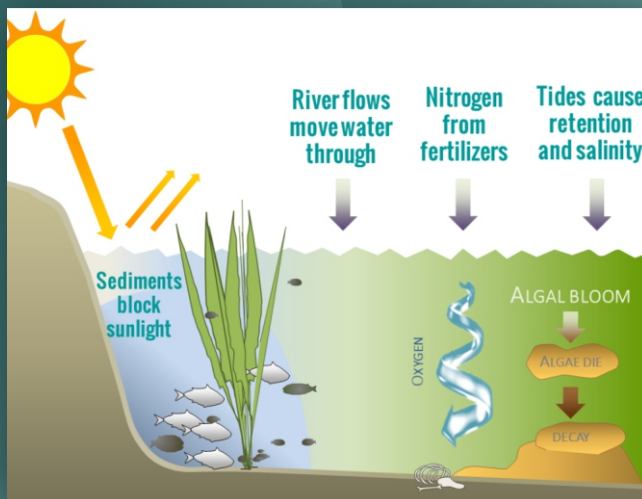
Carbon retention reduced

Executing the water-resources developments in the Pungwe Water Sharing Agreement without mitigating 2023 social-use impacts compromises the aquatic ecosystems and the people who use them. For example, fishing yield and carbon retention are reduced and gender equality is negatively impacted.

Major Threats to Ecosystem Health

of executing the water-resources developments in the Pungwe Water Sharing Agreement without mitigating 2023 social-use impacts

- Heightened risk of eutrophication
- Reduced aquatic biodiversity
- Diminished defenses against climate change
- Collapsed fisheries



Eutrophication begins with an excessive influx of nutrients into estuaries and coastal waters combined with low river inflows and leads to detrimental consequences such as harmful algal blooms, dead zones, and fish fatalities.

The risk of eutrophication can be mitigated by maintaining $>6.5 \text{ m}^3/\text{s}$ dry season inflows to the estuary and reducing nutrient inputs to the river.



Small mesh mono-filament nets catch fish before they are big enough to breed - sustainable fisheries are more productive

Mangroves defend against climate change by sequestering carbon, preventing erosion, and generating oxygen



Recommendations

Combine water-resource development in Pungwe Water Sharing Agreement with investments in environmental protection and sustainable utilization of natural resources, comprising:

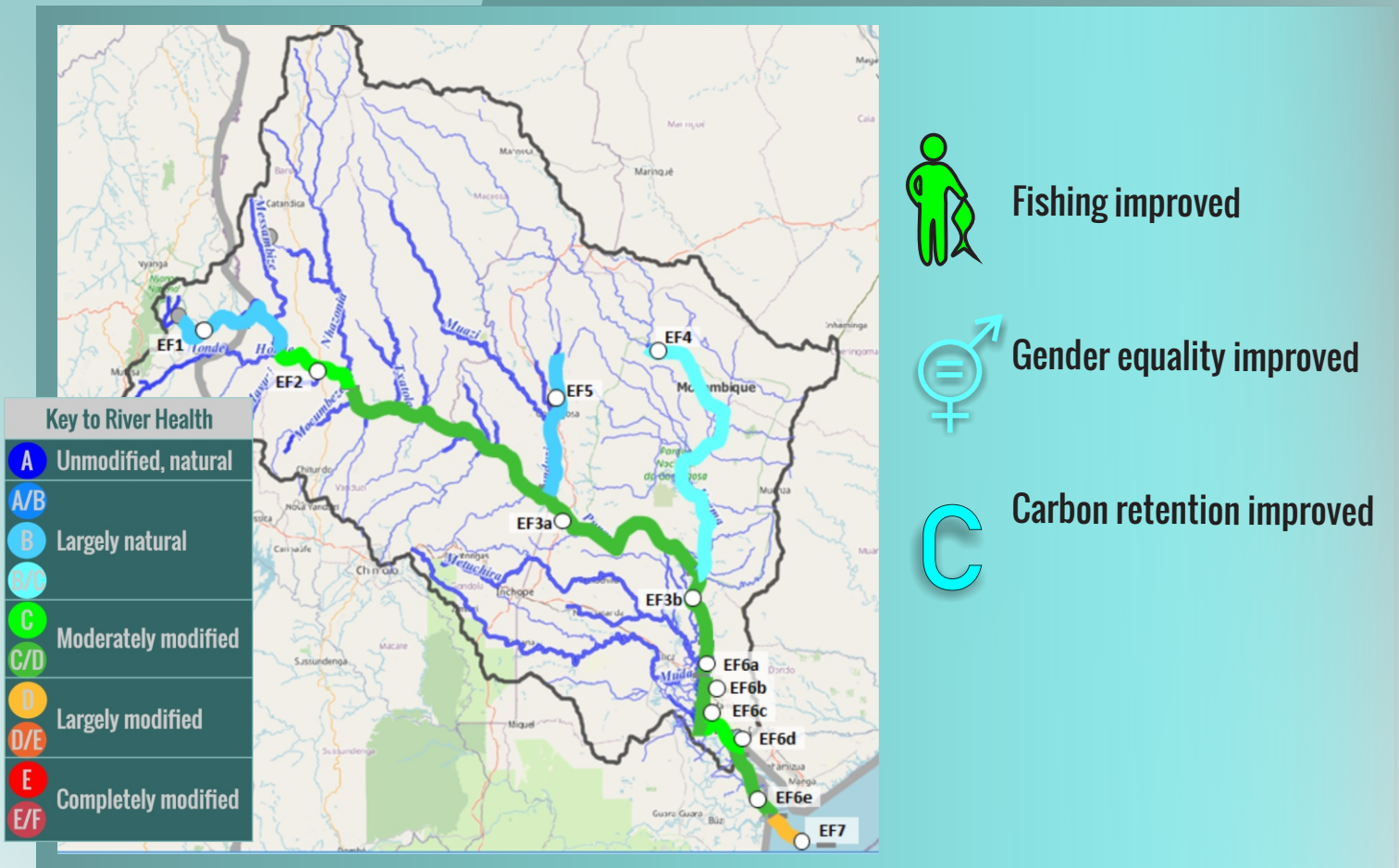
- EFlows (see below), including:
 - maintain the Nhandugue River, the Nhandare River and the Urema catchment in near-natural condition, including a cessation of deforestation activities, to support migratory species and other ecosystem processes
 - ensure dry season river inflows to estuary >6.5 m³/s to offset risk of eutrophication, and other risks
 - maintain flood flows in the river and estuary to support fishery
- sustainable management plans, linked with:
 - employment-intensive activities
 - rural health, quality education, rural infrastructure and services.

‘EFlows’ linked with Pungwe Agreement water-resource developments plus recommendations*												
Locations	O	N	D	J	F	M	A	M	J	J	A	S
	Minimum volume (million m ³)											
E64	16.0	20.4	63.3	130.2	140.8	112.9	70.8	42.3	32.1	28.1	26.5	19.2
E73	6.5	9.6	44.0	94.1	101.1	79.8	47.3	22.4	15.6	13.7	13.3	8.6
E65	28.6	35.7	141.2	302.0	324.6	256.7	155.6	82.0	59.9	52.9	51.0	36.2
E80	4.5	8.7	21.6	69.7	174.7	147.9	47.9	11.4	6.6	8.0	6.6	7.9
Estuary	16.8	40.6	257.8	731.0	1150.4	1054.9	552.9	132.7	65.1	50.2	36.6	16.8

* These are the volumes that remain in the river after the water resources in the Pungwe Water - Sharing Agreement have been fully implemented, plus 6.5 m³/s minimum flows into the estuary. These flows support the predictions of the aquatic ecosystem condition with recommendations (on next page).

Aquatic ecosystem condition with recommendations

Applying the recommended management actions will result in a largely natural to moderately modified river basin. The fishery will still provide for livelihoods, water quality will remain at acceptable levels and mangrove stands will provide some protection from climate extremes. Aquatic ecosystem condition will provide a more enabling environment for gender equity and social inclusion as healthier ecosystems provide more valued goods and services and fewer health risks for men, women, youth, the disabled, and the socially disadvantaged.



The final decision on “Objective Flows”, which include EFlows and other transboundary flows of water in the Pungwe Basin, rests with the Governments of Zimbabwe and Mozambique as per the Pungwe Water-Sharing Agreement.

References

World Bank. 2018. Good Practice Handbook. Environmental Flows for Hydropower Projects. Guidance for the Private Sector in Emerging Markets. 136 pp.

This work was supported through the " Management of competing water uses and associated ecosystems in Pungwe, Buzi, and Save Basins" project funded by the Global Environment Facility, implemented by the International Union for the Conservation of Nature (IUCN), and executed by Global Water Partnership Southern Africa (GWPSA).



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