

TANZANIA HYDROPOWER SUSTAINABILITY ASSESSMENT

Hydropower Sustainability Forum

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Outline

- Background and objective
- Team
- Case study
- National study
- Results
- Recommendations



Background and objective

The power sector in Tanzania has a huge impact on the country's economy as power security is essential for economic growth. Hydropower is a renewable energy source, and with storage gives ancillary benefits such as frequency control to the transmission system, flood control and guaranteed water supply for domestic users.

However, despite the potential, large hydropower schemes in Tanzania have failed to deliver power during a number of low rainfall years, which has caused a strong perception that climate change has made conditions drier in catchment areas and that additional hydropower development is risky because of current climate variability and future climate change.

Assess the sustainability of existing and identified hydropower schemes in Tanzania

- Assess the impacts of climate change on the future generation of power from hydropower plants
- Assess the impacts of upstream and downstream anthropogenic activities on the future generation of power from hydropower plants
- Case study – Analyse historic production to get a better understanding of the system and reasons for reduced generation

Team

- Sweco Norway
- Sweco Sweden
- Deltares, the Netherlands
- Local partners in Tanzania



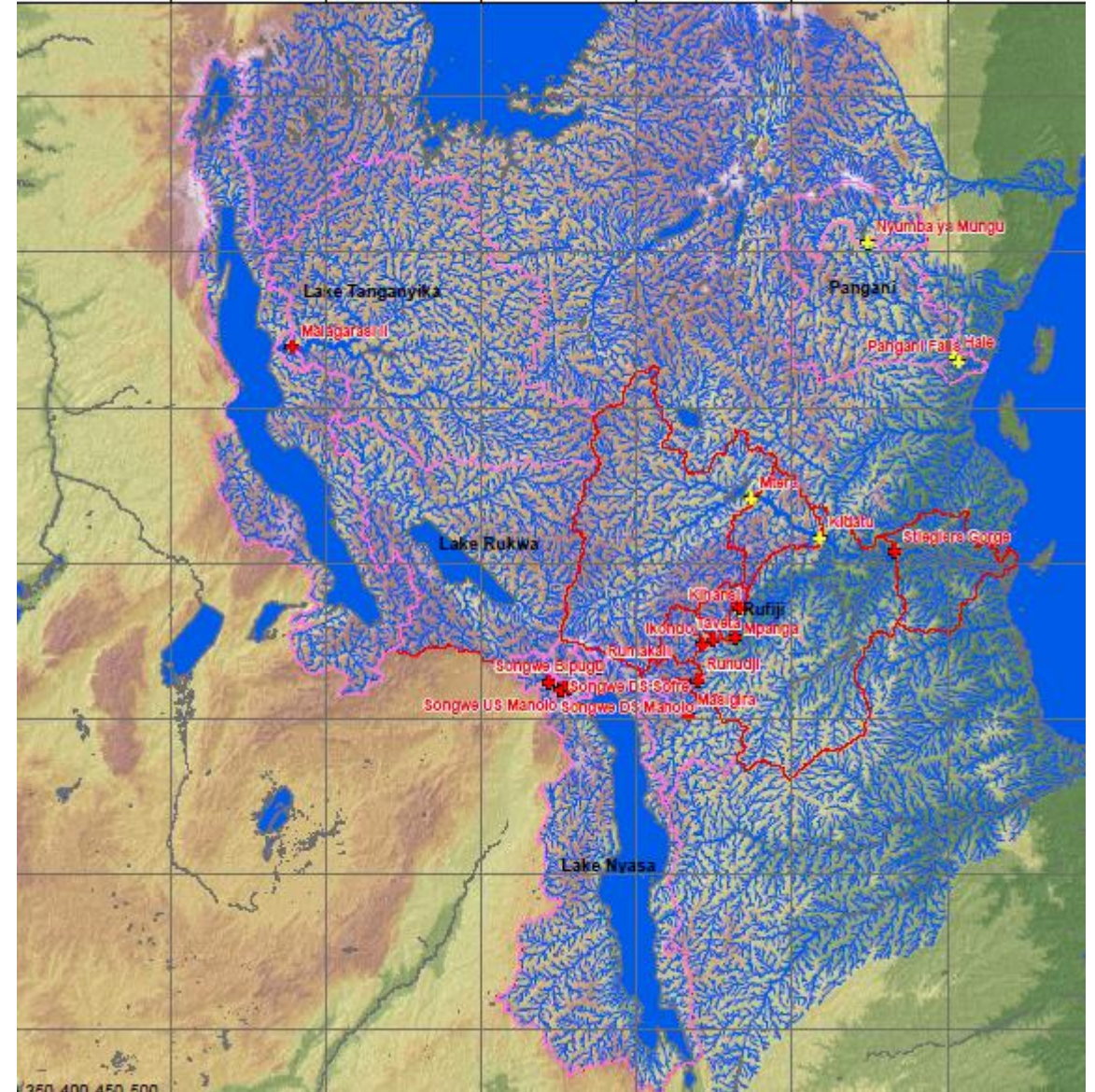
Today's situation

- Energy sources
 - Hydro 39%
 - Thermal 61%
- 6 existing hydropower plants on the national grid

Name of HPP	River Basin	Age	% of Total Hydro Installed Capacity	Total Generating Capacity (MW)
Kidatu	Rufiji	35	35.9%	204
Kihansi	Rufiji	10	32.3%	180
Mtera	Rufiji	22	14.4%	80
Pangani Falls	Pangani	15	12.2%	68
Nyumba ya Mungu	Pangani	42	1.4%	8
Hale	Pangani	43	3.8%	21
Total Generating Capacity (MW)				561

Source: URT 2009, Noel, S. 2011

- 12 planned new hydropower plants (PSMP), in four basins



Case study – the Mtera and Kidatu system

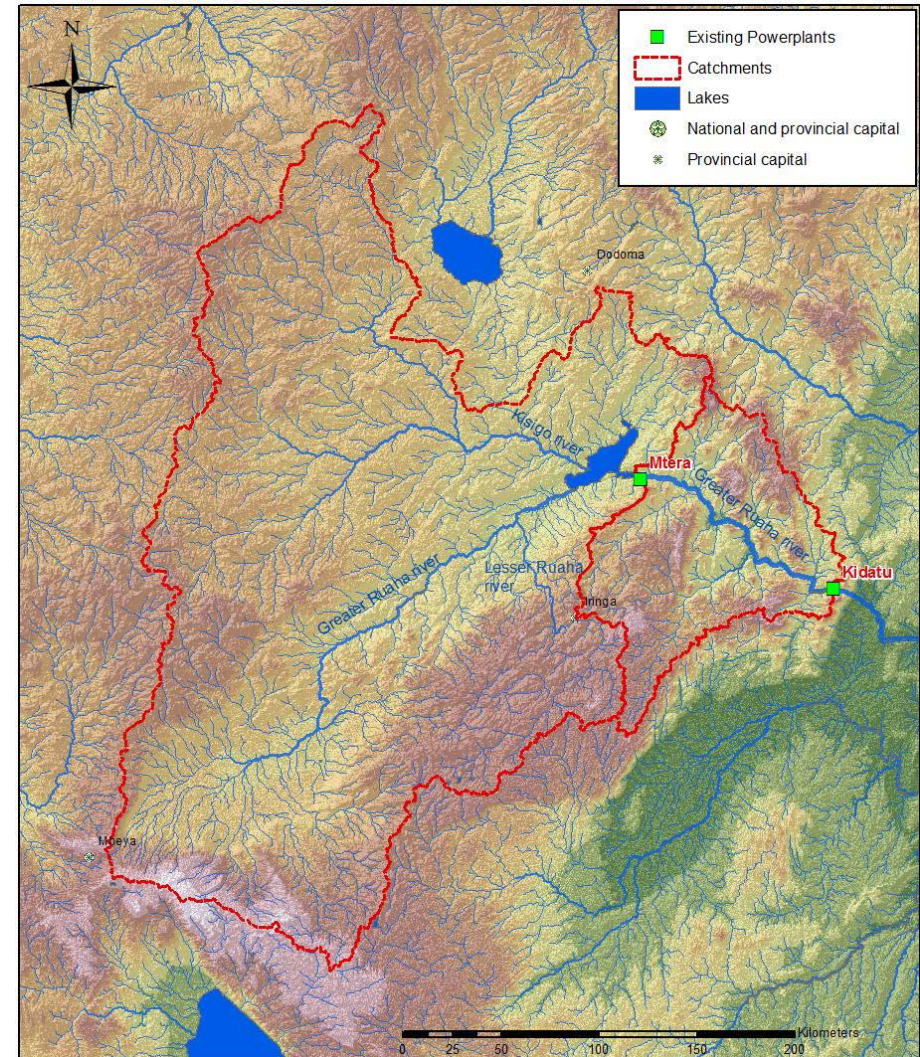
Great Ruaha River

Mtera

- Reservoir 3187 mill.m³
- HPP 80 MW

Kidatu

- Reservoir 127 mill.m³
- HPP 204 MW



Annual energy generation

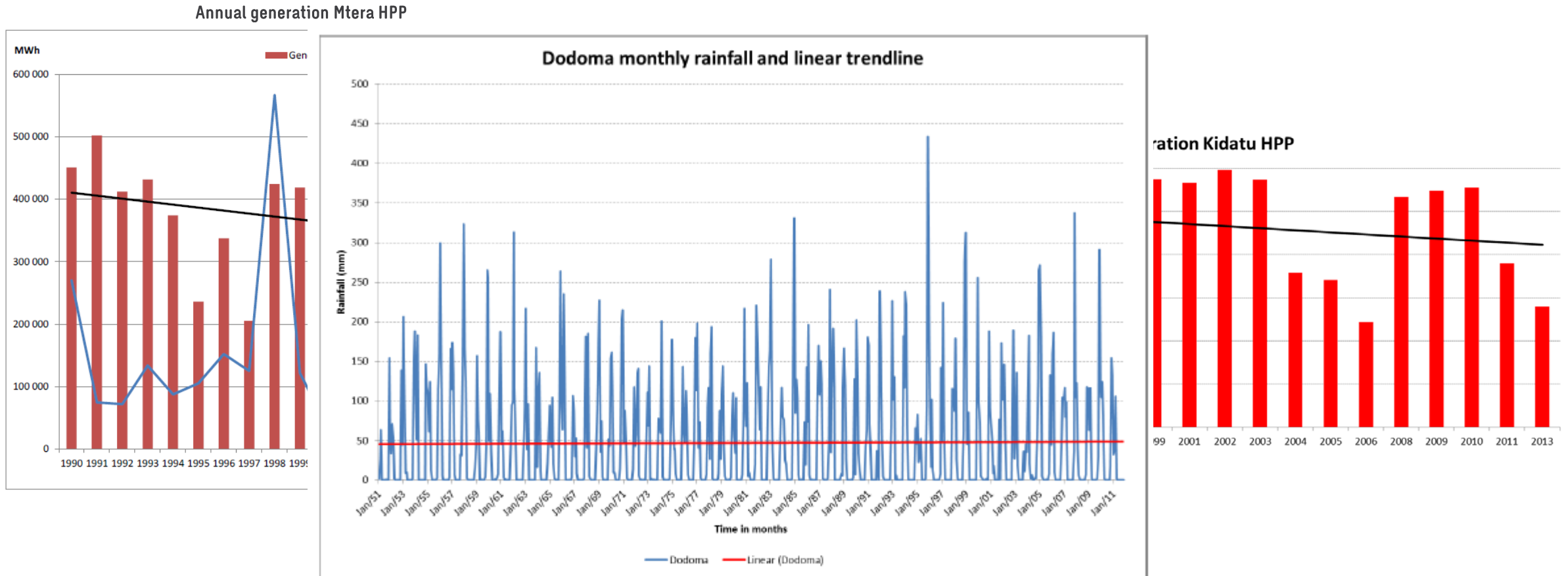
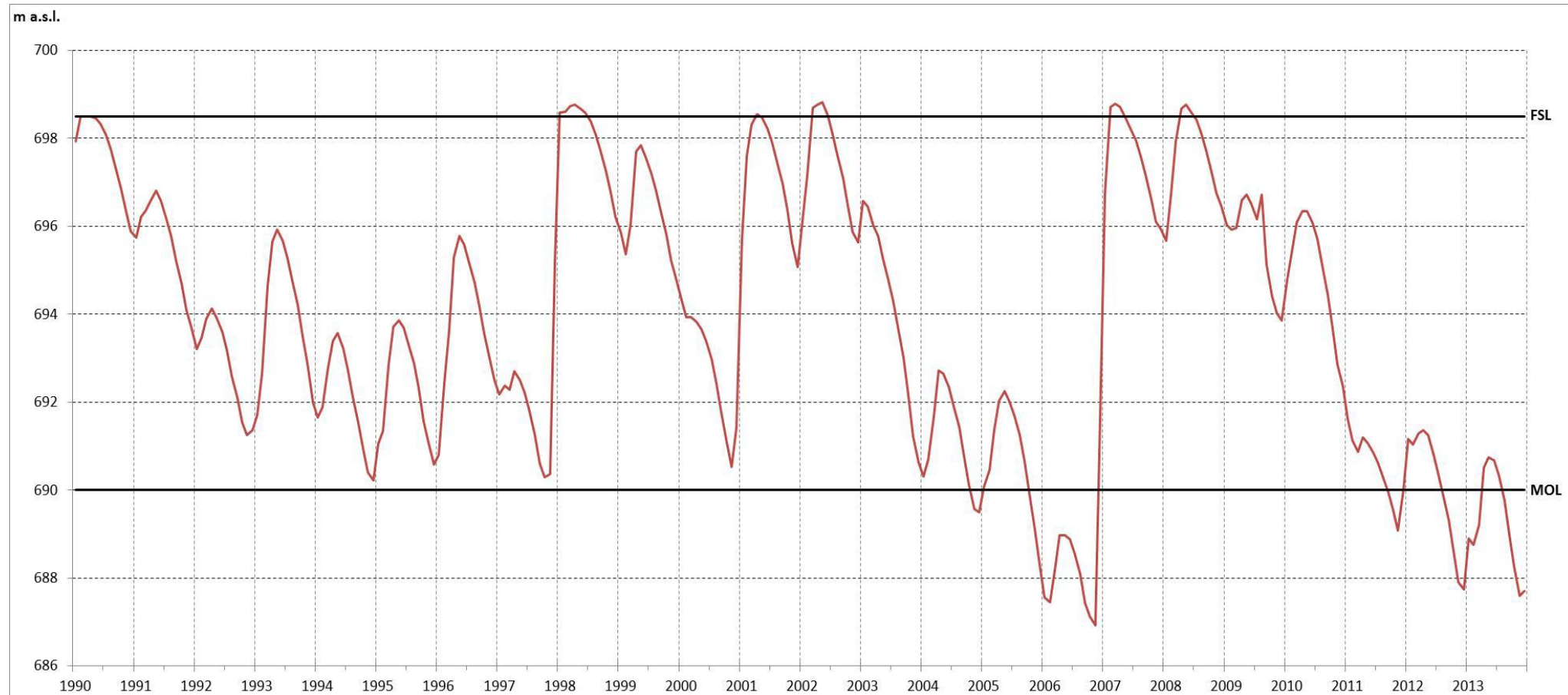


Figure 4 Dodoma monthly precipitation series with linear trend line

Reservoir levels Mtera 1990-2014



Conclusions case study

Three possible reasons for reduced inflow to the reservoir and the failures:

- Changes in inflow due to climate change

The trend analysis on rainfall data did not reveal any downward trends

- Changes in inflow due to upstream water abstractions

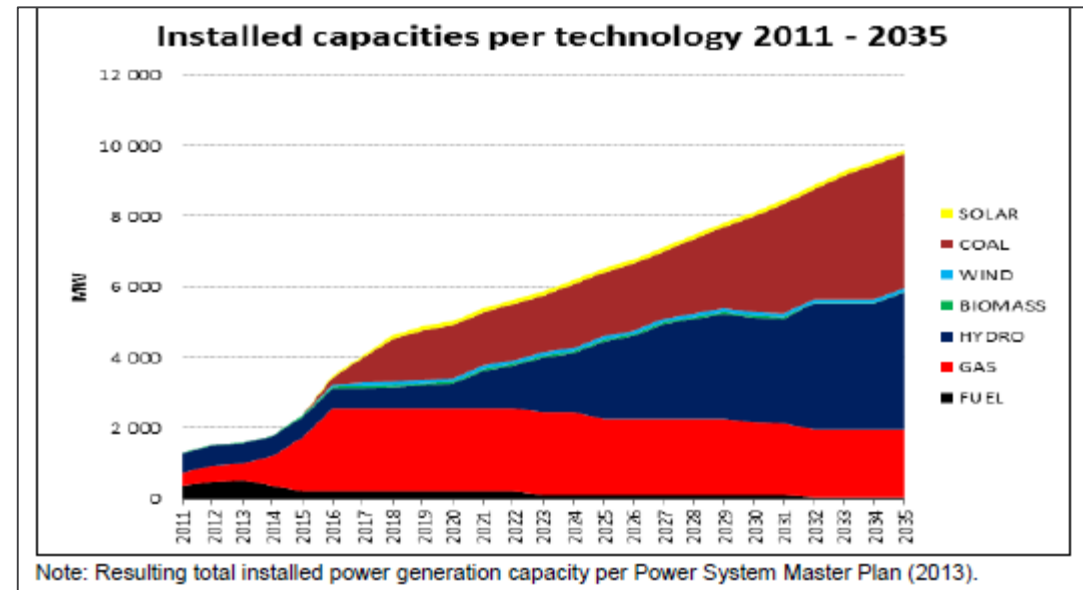
Increased irrigation upstream seems to be the main reason for reduced inflow to the reservoir, and hence the reduced power generation, but not the most important reason for the reservoir failures

- Operation of the power plants

The failures in the reservoir is to a large extent a result of the operation, but the reduced power generation is not a result of the chosen operation

National study

- The study simulated different future scenarios using modelling tools on global climate change, hydrology, water balance and the power market
- The scenarios were based on:
 - Climate scenarios from IPCC
 - Anthropogenic – future human use of water, most important irrigation (scenarios from Ministry of Agriculture)
 - Future demand and generation towards 2035 (PSMP)



Scenarios

		Anthropogenic influence		
		Current	Probable 2035	Worst 2035
Climate	Current	Base Case 2035	Anthropogenic 2035	Anthropogenic_worst 2035
	Probable 2035	Climate 2035	Probable 2035	
	Worst 2035	Climate_worst 2035	 	Worst 2035
Base Case 2035		Power market in 2035, with current climate and current anthropogenic water use. The scenario is the reference scenario in the analyses.		
Climate 2035		Probable climate change scenario for 2035 with current anthropogenic water use.		
Climate_worst 2035		Worst climate change scenario for 2035 with current anthropogenic water use.		
Anthropogenic 2035		Current climate and probable anthropogenic water use scenario for 2035.		
Probable 2035		Probable climate change scenario for 2035 and probable anthropogenic water use scenario for 2035.		
Anthropogenic_worst 2035		Current climate and worst anthropogenic water use scenario for 2035.		
Worst 2035		Worst climate change scenario for 2035 and worst anthropogenic water use scenario for 2035.		

Results national study

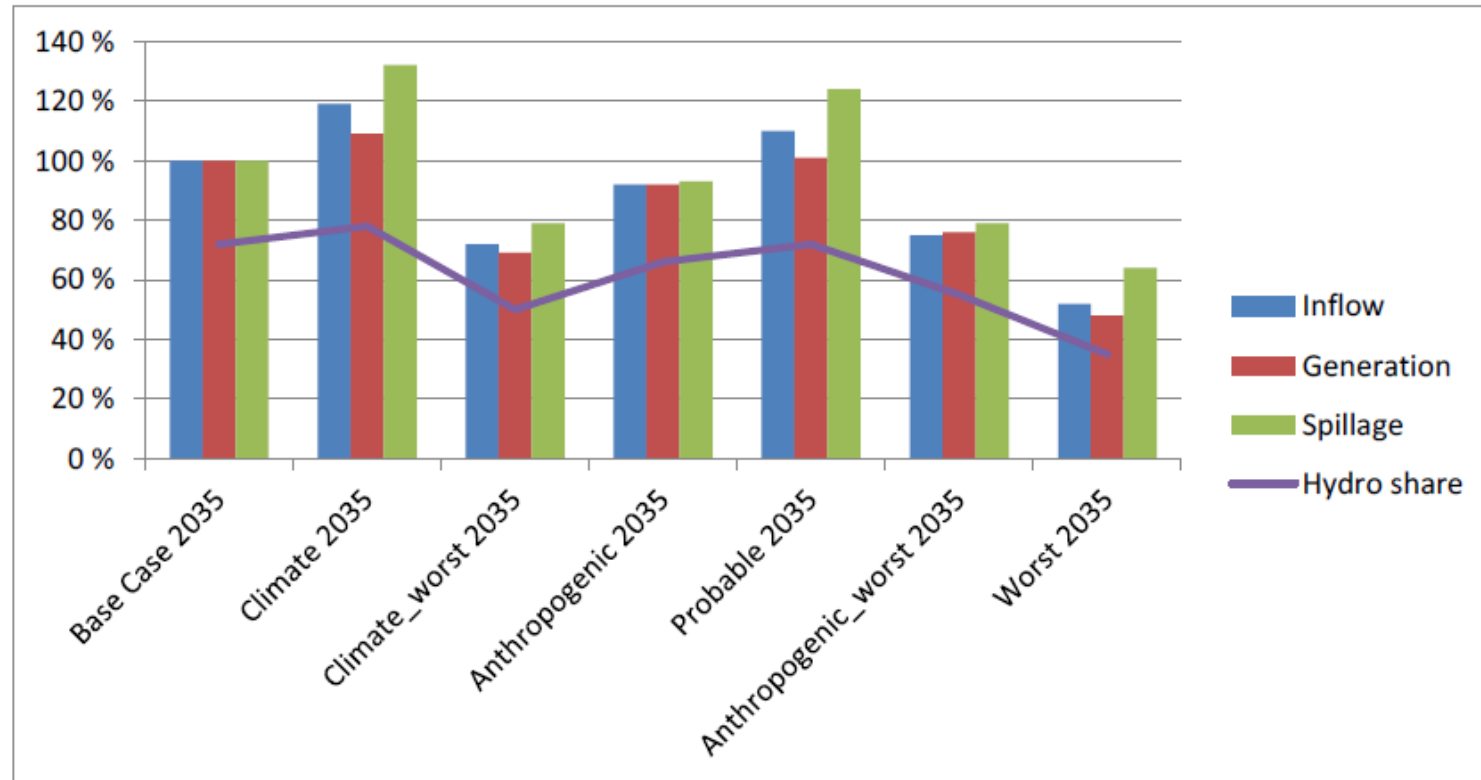


Figure 7.10 Annual means for inflow, generation, spillage and hydro share in energy mix, in percentage of the Base Case 2035 scenario

Overall conclusions

- Climate change is unlikely to negatively affect the average potential of future hydropower production. Rather, climate change will likely make hydropower more profitable. In the future, Tanzania's hydropower reservoirs will play an important role if climate change results in increased annual rainfall, and/or if rainfall patterns change as expected with more rain in the wet season and less rain in the dry season.
- The study indicates that a diversified power generation portfolio, anchored in hydropower and supported by other renewables and fossil fuel-based energy sources, is the best solution for Tanzania.
- The study has shown that the development of cheap and clean hydropower, as well as the expansion of irrigation, can both be achieved in Tanzania if well planned and operated.



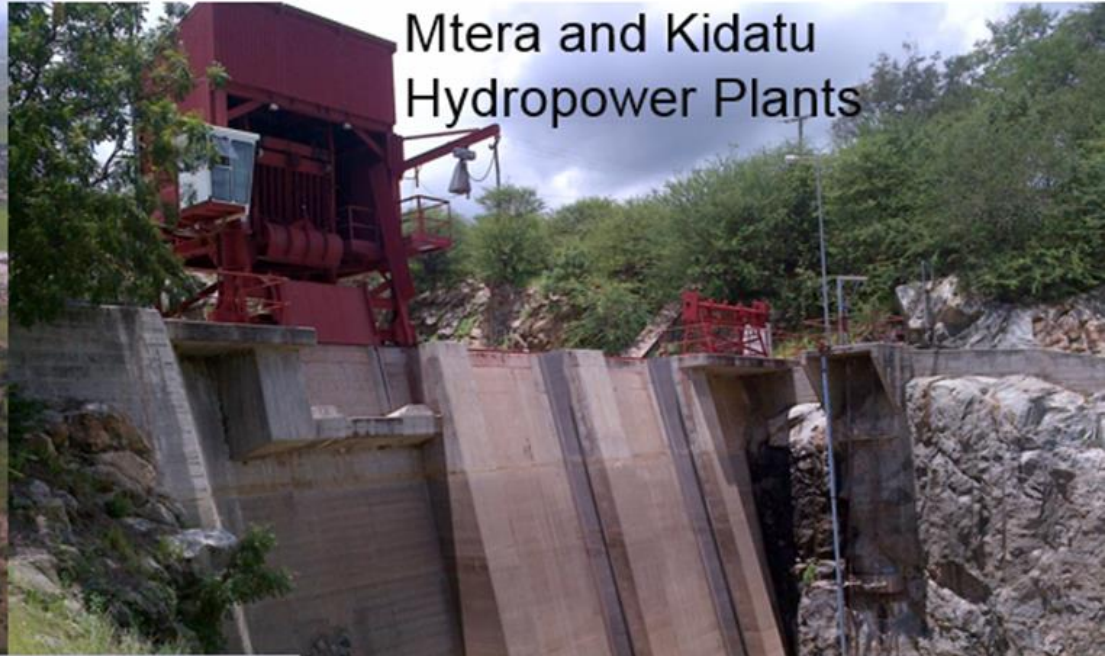
Recommendations

- In a future situation with climate change and increased pressure on the water resources from different water users, the sustainability of the system will to a large part depend on the chosen management of the reservoirs. For all new and existing hydropower plants a general recommendation is to establish a set of operating rules for the reservoir and power plant, to obtain the most optimal use of the water resource. In rivers with more than one power plant, include benefits from joint operation in the operating rules.
- Improve permit allocation systems, metering systems, water scheme monitoring and staff capacities of basin offices.
- Further recommendations to make hydropower more sustainable:
 - Review the existing hydropower plants to identify feasible upgrades.
 - Review the plans for new hydropower developments, in particular those with old Feasibility Studies. Update the plans to today's requirements and standards.
 - Prepare and follow plans for maintenance of the power plants
 - Establish monitoring of sedimentation in reservoirs, and a plan for regular flushing of sediments.
 - Review the network of hydrological and meteorological gauging stations, if necessary upgrade existing stations and establish new stations. The basis for planning of the future operation of the reservoirs and power plants needs to be the best possible, including forecasts of inflow and inflow statistics.
 - Strengthen the production planning capacity at the Grid Control Center in TANESCO, and if necessary update the modelling tools.

Irrigation, grazing and water supply



Mtera and Kidatu
Hydropower Plants



Ruaha National Park



SWECO

