The present and anticipated river basin and coastal impacts of water abstraction along the Rufiji river catchment, Tanzania

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1.0 Background

Water abstraction from rivers and its impoundment by damming is becoming a common practice in Tanzania, where the major drivers for water abstraction stems from:

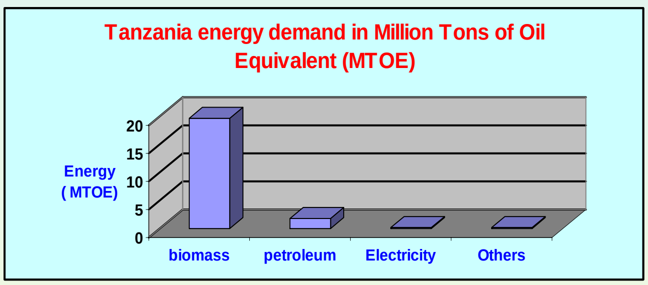
❖ The need to improve national food security.

❖ Un-certainty of the rain-fed agriculture.

❖ The intensification of farming on the highland areas.

Irrigation is therefore considered as a viable solution for stabilizing agricultural production in Tanzania. Consequently, a total of 851,000 ha in different river basins are considered to be suitable for irrigation development, and 73 % of this land is located in Rufiji river basin, the largest river basin in Tanzania.

On the other hand, the most important driver for water impoundment by damming in Tanzania is the growing demand for electricity. The Tanzania's domestic energy demand is potentially driven by the fast growing demographic changes and the economic activities, which have been rapidly growing during the last ten years, but still dominated by biomass based fuel (90%), comprising of fuelwood and charcoal.



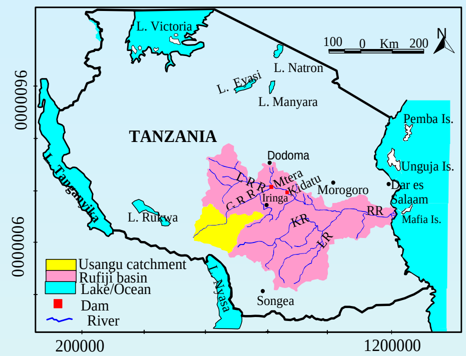
The Tanzania hydropower potential, estimated at 4.7 GW is currently highly under-utilized, as it is utilizing less than 10% (about 561 MW) in electricity generation. The total electricity consumption is about 863 and 302 MW is derived from thermal plants.

Future damming is therefore considered as one of the viable solution of the Tanzania's national campaign to address the existing challenges in the energy sector, which include:

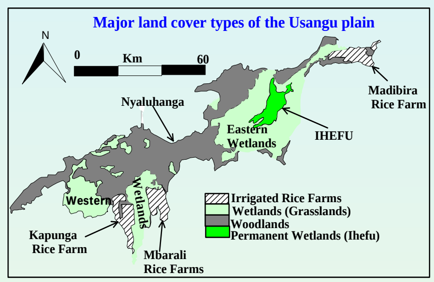
❖ Growing demand for electricity in various sectors.
❖ Balanced socio-economic growth.
❖ Reduction of the biomass fuel.

2.0 Scope and objectives of the study

The present study examines the anthropogenic pressure due to irrigation and damming on the Usangu catchment located in the Upper Rufiji basin, their impacts on the catchment as well as their coastal impacts. The study also quantifies the anticipated water abstraction on lower Rufiji flood plain and delta due to the planned future irrigation developments and the anticipated coastal impacts.



GRR = Great Ruaha River, LRR = Little Ruaha River
KR = Kilombero River, LR = Luwegu River, RR = Rufiji River



3.0 Study area

❖ Usangu plain, with a total area of 5800 km² is part of the Usangu catchment (20811 km²), which in turn belongs to the Ruaha catchment of the Rufiji basin.
❖ The Rufiji basin is conventionally divided into: 1- the Upper Rufiji consti-tuting of the Great Ruaha (84,000 km²), Kilombero (40,000 km²) and Luwegu (26,000km²) catchments, and 2- the Lower Rufiji (19215 km²), which start at the confluence of the three catchments of Upper Rufiji.
❖ The three rivers Great Ruaha, Kilombero and Luwegu feed the Rufiji, supplying 15%, 62% and 18% respectively of the Rufiji total flow.

❖ The major land cover units of the Usangu plain consist of 1- The wetlands consisting of the seasonally inundated open grassland (*mbuga*), 2- a small perennially flooded swamp (*ihefu*), 3- woodlands and 4- Irrigated agricultural land

4.0 Human pressure on the Usangu catchment

❖ Historical changes on the land use/land cover, biodiversity, water resource use, river flow volume and catchment degradation during the last five decades have been documented by various studies.

❖Both socio-economic drivers (demand for farmland, pastureland, water resource) and climatic drivers (poor rainfall on the plain) are cited as the major driving forces for the reported changes on the Usangu plain.

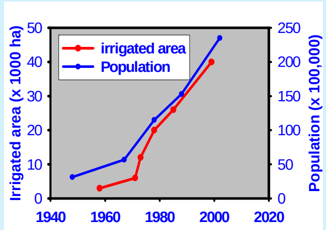
The present and anticipated ...

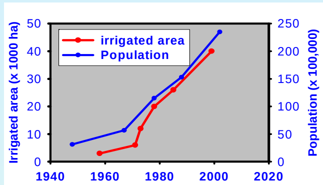
4.1 Population pressure

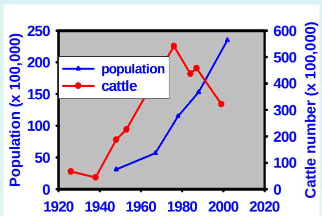
The population of the Usangu plain grew by almost six times during the last 50 years, with the fastest population growth rates occurring between 1978 and 1988 and much slower thereafter. Analyses of population dynamics between wards reveal evidence of immigration as the major driving force for observed population changes.

4.2 Irrigation

Opportunities for irrigation due to the presence of water and fertile land on the Usangu plain alluvial fans is reported to be one of the key driving forces for the observed population growth. Although formal irrigation was introduced in Usangu plain in about 1940, up to until early 1970's the area under irrigation grew rather slowly. The irrigation expansion is paralleled with increasing quantity of water abstracted from the river.







4.3 Livestock growth

The livestock growth on the Usangu plain was largely driven by the immigration of other ethnic groups from northern and central Tanzania during the last five decades. Another important driver for the livestock growth in Usangu is the catchments carrying capacity, estimated at 550,000 cattle. This is considered to be a major physical boundary limiting the livestock growth. The third factor is the changing availability of grass and water, which varies from place to place with the seasons.

5.0 State changes, environmental and socio-economic impacts

5.1 Changes on the fans

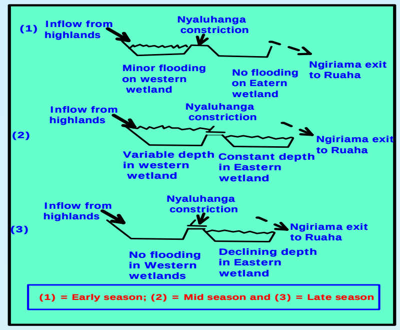
❖ Prior to 1950, the fans were dominated by acacia woodland and high species diversity, supporting high densities of large herbivores.
❖ With the increasing pressure from farming and pastoral groups (from 1950's onwards), most of the acacia woodland were cleared.
❖ The fan areas are currently characterized by low species diversity and low number of wild large mammals.
❖ Competition on resource use has intensified with the pastoral groups becoming major losers.

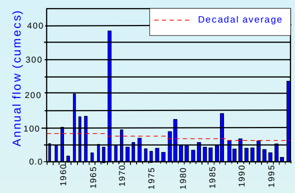
5.2 Changes on the wetlands

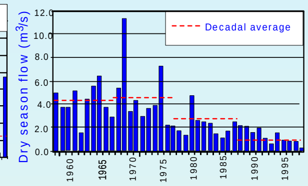
❖ Historically, the sustainability of the wetlands had largely depended on the seasonal flooding of the Great Ruaha river, with the hydrological interaction between the western and eastern wetlands.
❖ Currently the regular flooding of the western wetland has ceased.
❖The Great Ruaha river (and few other perennial rivers) no longer flow during the dry season.
➢ Possible causative factors for the observed changes include: 1-The increasing water demand (due to irrigation, livestock & domestic water consumption) 2- Decreased rainfall on the highlands during the recent past.

5.3 Results of recent studies

❖ Historical analysis of over 100 rainfall stations found no evidence of decreasing rainfall trends. On the other hand projected climatic scenarios for Tanzania predict decreasing rainfall trends for Great Ruaha catchment.
❖ Estimates sectoral water demands reveal that: 1- The average Annual irrigation water demands is about 35% of the total river flow, 2- annual livestock and domestic water demands are significantly low (equivalent to only 109 and 83 ha respectively of irrigated rice).
❖Analyses of river flow data revealed that, while there was no changes in both the wet season and annual flow records, there was clear evidence of reduced dry season flow.
➢ The observed changes on the wetlands are "dry season phenomena" mainly related with the Irrigation agriculture on the plain.

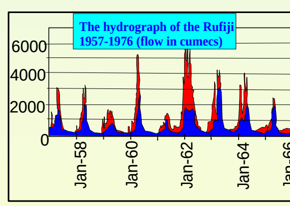


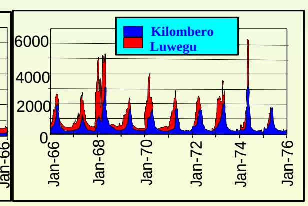




5.4 Further downstream changes

❖ Further downstream changes along the Great Ruaha river are associated with the damming at Mtera (3200 Mm^3)and Kidatu (125 Mm^3).
❖ Potential coastal impacts of the two dams include: 1- reduced annual water discharge, 2- reduced peak water flows or flooding events 3- increased mean rate of river flow downstream of the dams, and 4-reduced sediment flux downstream of the dams.
❖However, since the water downstream of the Mtera and Kidatu is not used for irrigation, the first impact can be neglected.
❖The impacts 2-4 would depend on the relative contribution of the fluxes from the Kilombero and Luwegu tributaries.
❖ Studies on these tributaries reveal that, while the Kilombero is the principal contributor of the fresh water fluxes, Luwegu is the principal contributor of the sediment fluxes and also responsible for the irregular flood peaks.
➢ Furthermore, the impact of increased runoff and sedimentation due to the upstream human activities such as deforestation, which could amplify the peak floods and sedimentation at the coast is attenuated by the damming at Mtera and Kidatu.





6.0 Anticipated impacts due to future irrigation on Lower Rufiji

❖ In recognition of the existing agriculture potential of the Lower Rufiji floodplain and delta, and the historical problems caused by the natural (wild) floods of Rufiji river, 65,000 ha have been designated for future irrigation development.
❖ Using the current water demand estimate for rice irrigation at Usangu plain (estimated at 31,104 m^3 per hectare per annum), the annual irrigation water demand for 65,000 ha on Lower Rufiji would be 2022M m^3; equivalent to 7.5% of total Rufiji river annual fresh water flux to the sea, and also equivalent to an average flow of 64m^3/s.
❖ The dry season irrigation abstraction will likely be higher than 64m3/s and will constitute a significant proportion of the Rufiji, which varies between 100 and 300 m^3/s.
❖Reduced flow due to the anticipated future abstraction would lead to increased salinisation, with associated multipliable effects on the delta ecosystem and socio-economic dynamics.
➢ - This would have positive impacts on the mangrove (mangrove land coverage would increase), but would have negative impacts on agriculture.