Comparison Between Future Water Potential And Future Water Demand For Tanzania Water Basins

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ABSTRACT: Surface and ground water sources are the main water sources in Tanzania. In this study Comparison between water potential and water demand up to 2035 for Tanzania water Basins will be presented. The data for Surface water potential, Ground water potential and water demand for all nine major water basins in Tanzania for 2015, 2025 and 2035 were corrected. The Water demand considered were Rural and Urban Water demand, Irrigation, Livestock and Industrial water demand, Mining, Hydropower generation and Environmental Water Requirements. The total water potential (Surface and Ground Water) was calculated, thereafter the percentage of total water demand to total water potential was estimated for 2015, 2025 and 2035. In 2015 the percentage of total water demand to total water potential was 48.83 %, in 2025 is expected to be 56.24 % and in 2035 is expected to be 58.4 %, this implies that the country will face a water stress situation in coming years. The water potential is expected to increase by 0.92% from 2015 to 2025 and 0.071% from 2025 to 2035; this implies that the water potential is diminishing however there is slightly increase of surface water potential.

Keywords: Surface Water Potential; Ground Water Potential; Water basins; Comparison; Tanzania

1.0 INTRODUCTION

The main water sources in Tanzania are Surface and ground water sources. Rainfall plays an important role in ground and Surface water Recharge. The groundwater level reaches maximum during rainfall reason and decreases during dry season. The response of groundwater level dynamics is very sensitive to heavy precipitation in all patterns. Enhancing the utilization of heavy rainfall and flood resources is an effective way to increase groundwater recharge in the basin [1], [2], [3]. Inter-annual changes in groundwater storage apart from correlating to inter-annual rainfall variability also recharge varies substantially depending upon the geological environment. Annual recharge to shallow aquifers of Quaternary sands is estimated as much as 40% of annual rainfall, whereas in deeper aquifers of Mio-Pliocene sandstone and weathered crystalline rocks, annual fractions of rainfall generating recharge are estimated as 13% and 4%, respectively [4] and [5]. Surface water potential is very huge compared to groundwater potential. Surface water resources include, Rivers, Lakes, dams etc. Total renewable water resources is estimated to be 93 cubic kilometers per year of which 84 cubic kilometers per year are internally produced, and 9 cubic kilometers per year are accounted for by the Ruvuma River, which flows over the border from Mozambique. Renewable groundwater resources are estimated to be 30 cubic kilometers per year [6]. Tanzania Water resources are a critical to Tanzania's economy: water is a key to agricultural sector performance, domestic water supply, industrial production, Livestock, Mining sector and Environmental Water Requirement for wildlife. Water in rivers and reservoirs generate over half of the country's grid electricity through hydropower installations [7]. Currently the coverage of domestic water supply in Tanzania stands at 78% for Regional centres, 60 per cent for Small towns and district headquarters. For rural areas the coverage stood at 59.76 % [8]. Tanzania's annual renewable water resources are estimated to be 2,700 cubic meters of water per person per year. Based on projection of about 59.8 million population by year 2025, annual average available water per capital will be reduced by 45% to about 1,500 cubic meters per person per year which shows that the country will face a water stress situation [9]. In River basins Surface and ground water resources depletes while water demand rises [10]. In this study future water potential and future water demand for Tanzania water Basins will be compared.

2.0 DATA COLLECTION AND METHODOLOGY

2.1 Study Area

Tanzania has nine (9) major drainage (Water) basins (Fig.1) that, according to the recipient water body, can be categorized as follows:

- Draining to the Mediterranean Sea is Lake Victoria basin (IX) which is part of the Nile River basin.
- Draining to the Indian Ocean are Pangani River basin (I), Wami Ruvu River basin (II), Rufiji River basin (III), Ruvuma River basin(IV) and Lake Nyasa basin(V) which is part of the Zambezi River basin.
- Draining to the Atlantic Ocean is Lake Tanganyika basin (VIII) which is part of the Congo River basin.
- Internal Drainage Basin (VI) and
- The Lake Rukwa basin (VII)

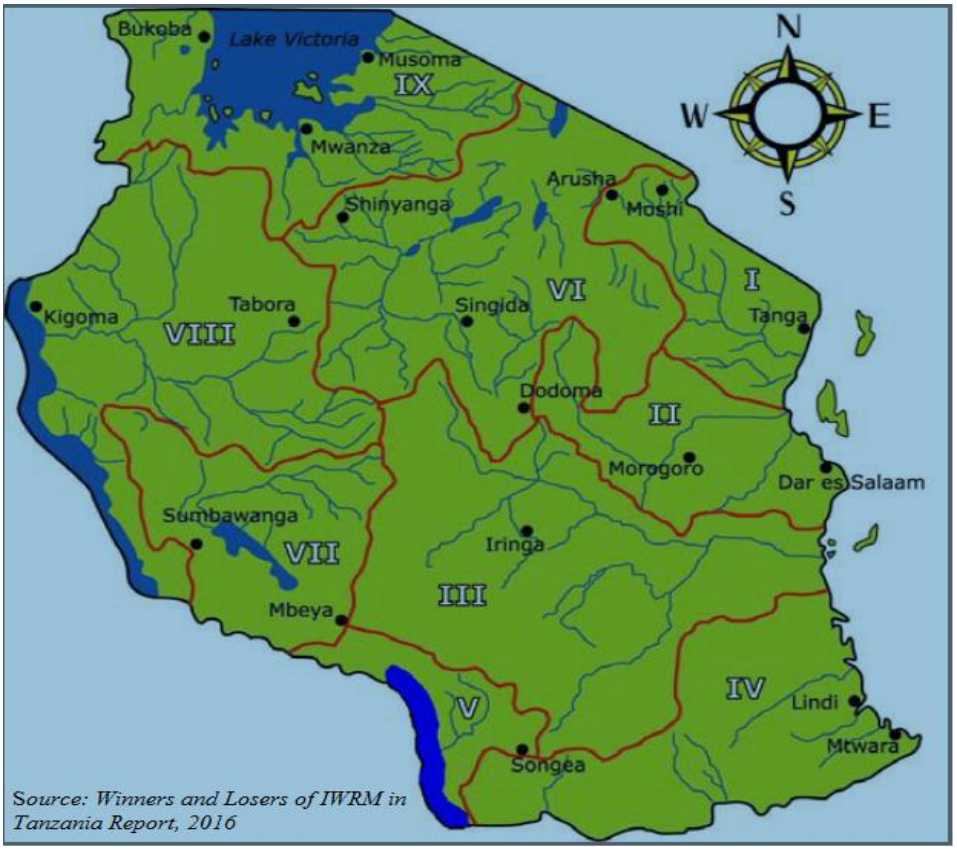

***Figure1**: Surface Water Basins in Tanzania*

2.2 Water Data

Present and future Surface and Ground water data (Table 1) for each basin were collected from Integrated Water Resources Management and Development Plan Reports for Tanzania Water Basins of 2012 to 2015. Water demand for all basins is counted for Rural and Urban Water demand, Irrigation, Livestock, Industrial, Mining, Hydropower generation and Environmental Water Requirements. The water demand is expected to increase in all basins (Table 1) for the period up to 2035. Total water potential (Surface and Ground Water) was calculated (Table 2) thereafter the percentage of water demand (D) was estimated for 2015, 2025 and 2035 using the formula.

$$D = \frac{\text{Total Water Demand}}{\text{Total Water potential (Surface and Ground)}}$$

3.0 RESULTS AND DISCUSSION

3.1.1 Data calculation and rearrangement

The data for each water basin were calculated and rearranged. The summation of total water demand and total water potential (Ground and surface water) for 2015, 2025 and 2035 was estimated.

***Table 1:** Water Demand and Water Potential in Million Cubic Metres per Year (MCM/yr)*

S/N	Basin name	Water Demand (MCM/yr)			Surface Water Potential (MCM/yr)			Ground Water Potential(MCM/yr)
		2015	2025	2035	2015	2025	2035	
1	Rufiji Basin	27,182.96	27,848.2	30,065.1	31,533.5	31,533.5	31,533.5	19,728.2
2	Lake Victoria Basin	19,648.3	24,968	21,375	23,321	23,321	23,321	7660
3	Pangani Basin	4588.4	4958.1	5300.02	4514.9	4586.9	4571.6	1466.3
4	Internal Drainage Basin (IDB)	5628.4	6842.2	7225.6	5,985	5,654	4,981	884.1
5	Wami Ruvu Basin	2655.1	3241.4	3769.9	3988.5	3988.5	3988.5	4,272.6
6	Lake Nyasa Basin	7,489.9	10,759.3	13,241.3	12,211	12,065	11,985	96
7	Ruvuma Basin	1,016.7	1,137.2	1,281	11,709	13,465	14,636.3	8,307
8	Lake Tanganyika Basin	4574.2	5271.2	5910.69	10,641	10,750	10,460	2,755
9	Lake Rukwa Basin	4628.8	4962.2	5326.9	9200	9200	9200	270.6
Total		77,412.76	89,987.8	93,495.5	113,103.90	114,563.90	114,676.90	45,439.80

Table 2: *Summation of total water demand and total water potential*

Years	2015	2025	2035
Total Water Demand (MCM/yr)	77,412.76	89,987.80	93,495.50
Total Water potential (Surface and Ground) (MCM/yr)	158,543.70	160,003.70	160,116.70

The comparison for total water demand and total water potential is illustrated graphically in Figure 2 below.

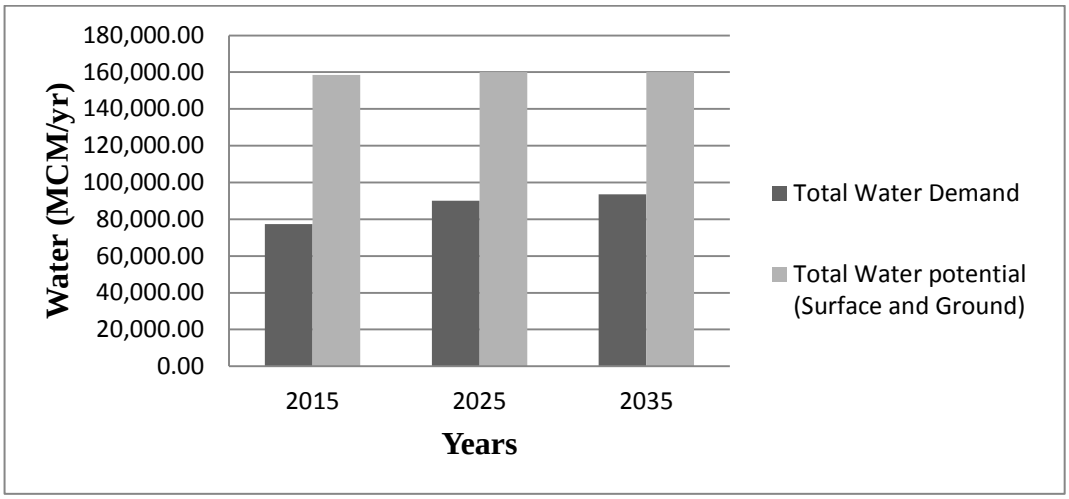

Figure 2*: Total future water potential against total future water demand for basins*

3.1.2 Percentage increase of Water demand

The total water demand in 2015 was 77,412.76 MCM/yr and water potential in the same year was 158,543.70 MCM/yr. The % of total demand to Total water potential in 2015 was equal to

$= \frac{77,412.76}{158,543.70} x100 = 48.83\ \%$. In 2025 the total water demand is expected to be 89,987.80 MCM/yr and the total water potential in the same year is expected to be 160,003.70 MCM/yr. The % of total demand to total water potential in 2025 will be equal to

$= \frac{89,987.80}{160,003.70} x100 = 56.24\ \%$. In 2035 the total water demand is expected to be 93,495.50 MCM/yr and total water potential in the same year is expected to be 160,116.70 MCM/yr. The % of total demand to total water potential in 2035 will be equal to

$= \frac{93,495.50}{160,116.70} x100 = 58.4\%$

3.1.3 Percentage increase of Water Potential

The total water potential is expected to increase slightly by 0.92 % (from 158,543 MCM/yr in 2015 to 70, 160,003.70 MCM/yr in 2025). Also from 2025 to 2035, the total water potential is expected to increase by 0.071 % (from 160,003.70 MCM/yr in 2015 to 160,116.70 MCM/yr in 2025).

4.0 CONCLUSION

There is rapid increase of water demand for all water basins in Tanzania. In 2015 the percentage of total water demand to total water potential was 48.83 %, in 2025 is expected to be 56.24 % and in 2035 is expected to be 58.4 %. This implies that the water demand is expected to increase by 7.41% from 2015 to 2025 and by 2.16% from 2025 to 2035. The water demand increases more rapidly compered to increase of water potential which is 0.92% from 2015 to 2025 and 0.071% from 2025 to 2035. This implies that that the country will face a water stress situation in coming years. The water potential is expected to increase by 0.92% from 2015 to 2025 and 0.071% from 2025 to 2035; this implies that the water potential is diminishing however there is slightly increase of surface water potential. The ground water recharge potential is expected to remains unchanged in 2035 for all water basins. In future the countries' water potential will depend on Lake Victoria and Rufiji Basin which appears to have huge reserve of surface and ground water potential while Pangani, Internal Drainage and Wami Ruvu Basins appears to have the lowest surface water potential they may face water stress situation in future.

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