

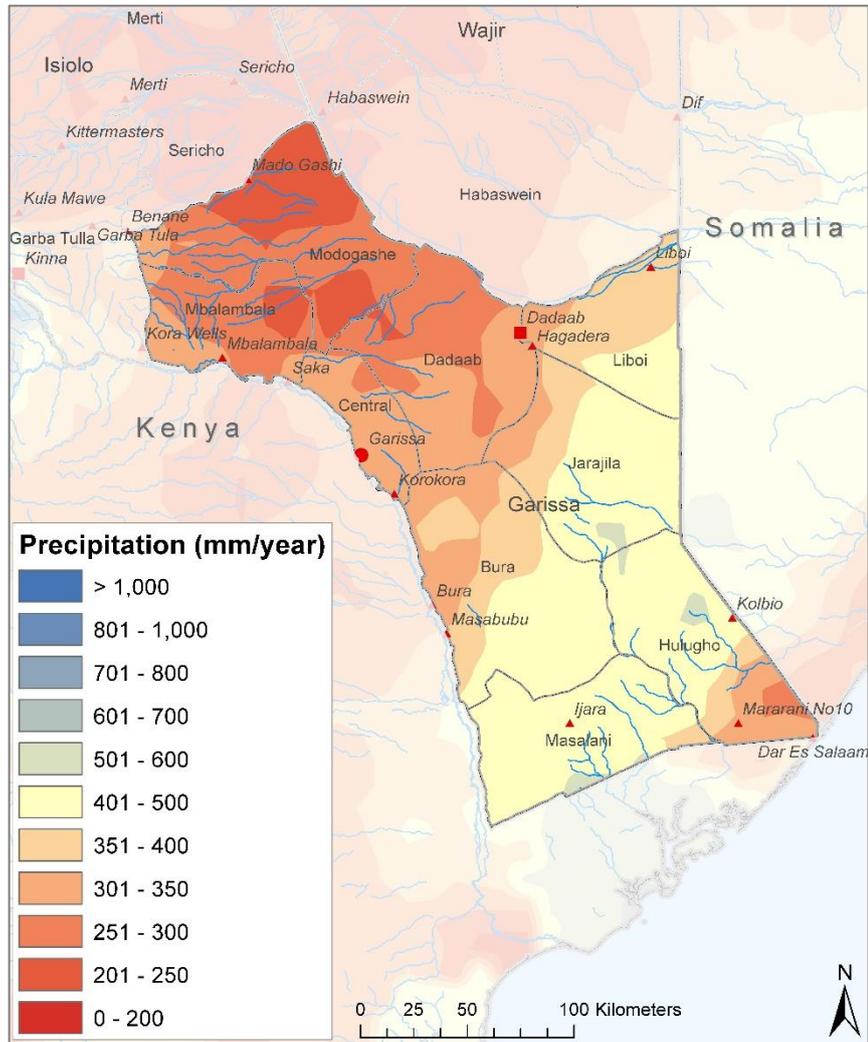
Garissa County Water Resources Factsheet

A 3R and MUS Analysis

Local context

Garissa County is an administrative county in the former North Eastern Province of Kenya. Garissa County is bound by the Tana River on its western and southwestern borders, Lamu County to the South, the Republic of Somalia to the East and Southeast, Wajir County to the North and Isiolo County to the Northwest. The Ewaso Ng'iro River forms the Northern boundary with Wajir County. Garissa County is approximately 45,000 km² in size, whilst the topography is flat and low lying, with altitudes ranging between 70m and 400m above sea level.

People of Garissa mostly rely on one of the nine river based water supply schemes along the Tana River, boreholes, water pans or shallow wells. Water from these sources is without treatment generally unsafe, while the county experience acute water shortages during the dry season.



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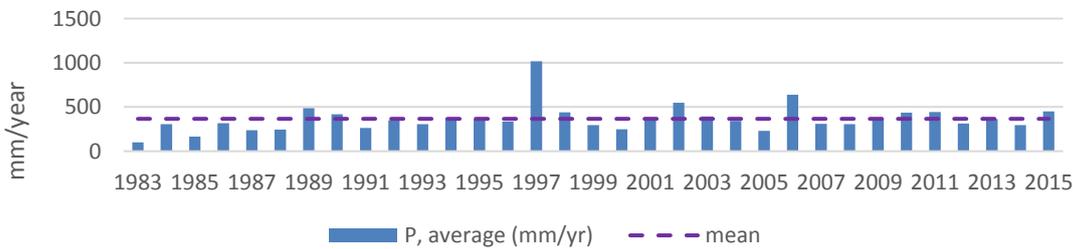


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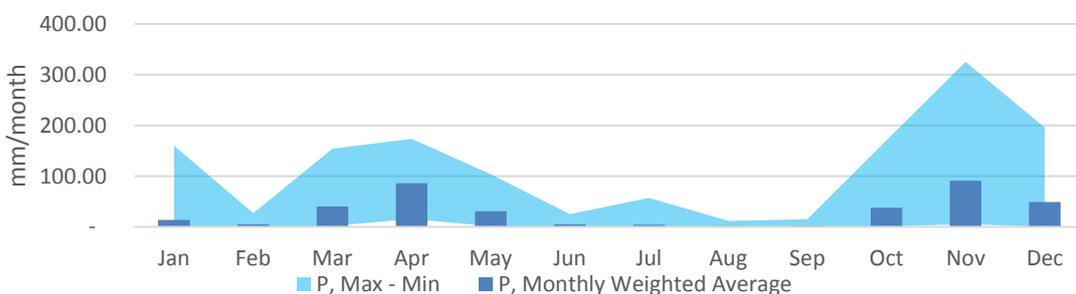


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Interannual Precipitation Variability

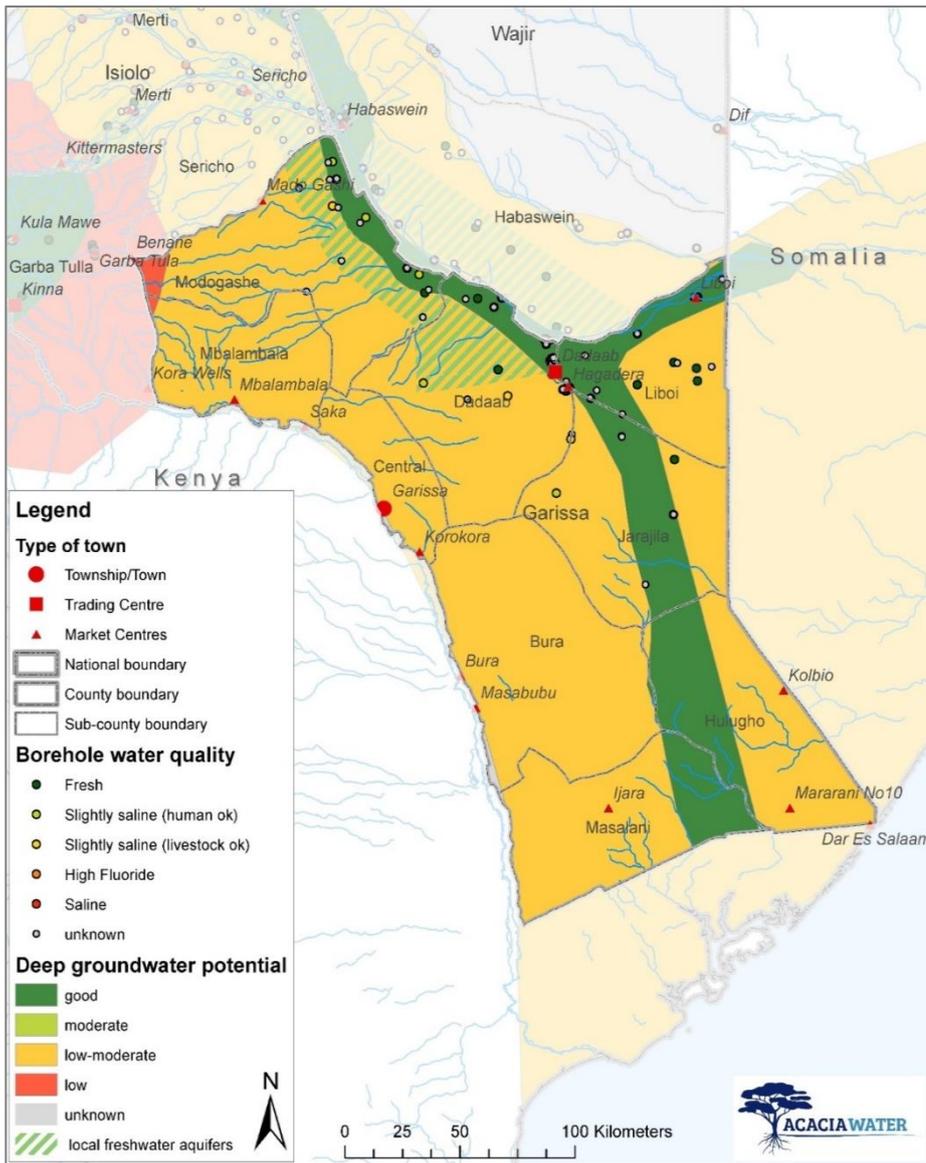


Precipitation, Monthly Average



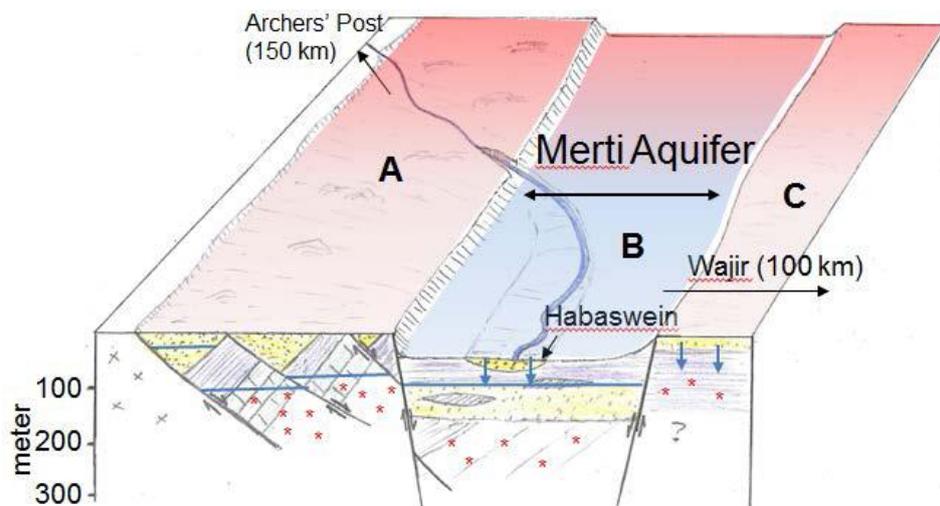
Climate

The climate of Garissa County can be typified as a hot steppe climate. Based on daily precipitation data from 1983 – 2013 (NOAA Arc-2), the mean annual rainfall is around 360 mm. The inter-annual and monthly precipitation variability graphs on the left show that rainfall is erratic, with intense events creating flash floods flowing through seasonal rivers, exacerbating the prevailing drought and food insecurity in Garissa. Analysis of the annual average net precipitation (Net P: evapotranspiration (ET) – rainfall (P)) shows that Garissa County has on average a negative mean annual net precipitation varying between + 50mm in the north and -800mm in the south.

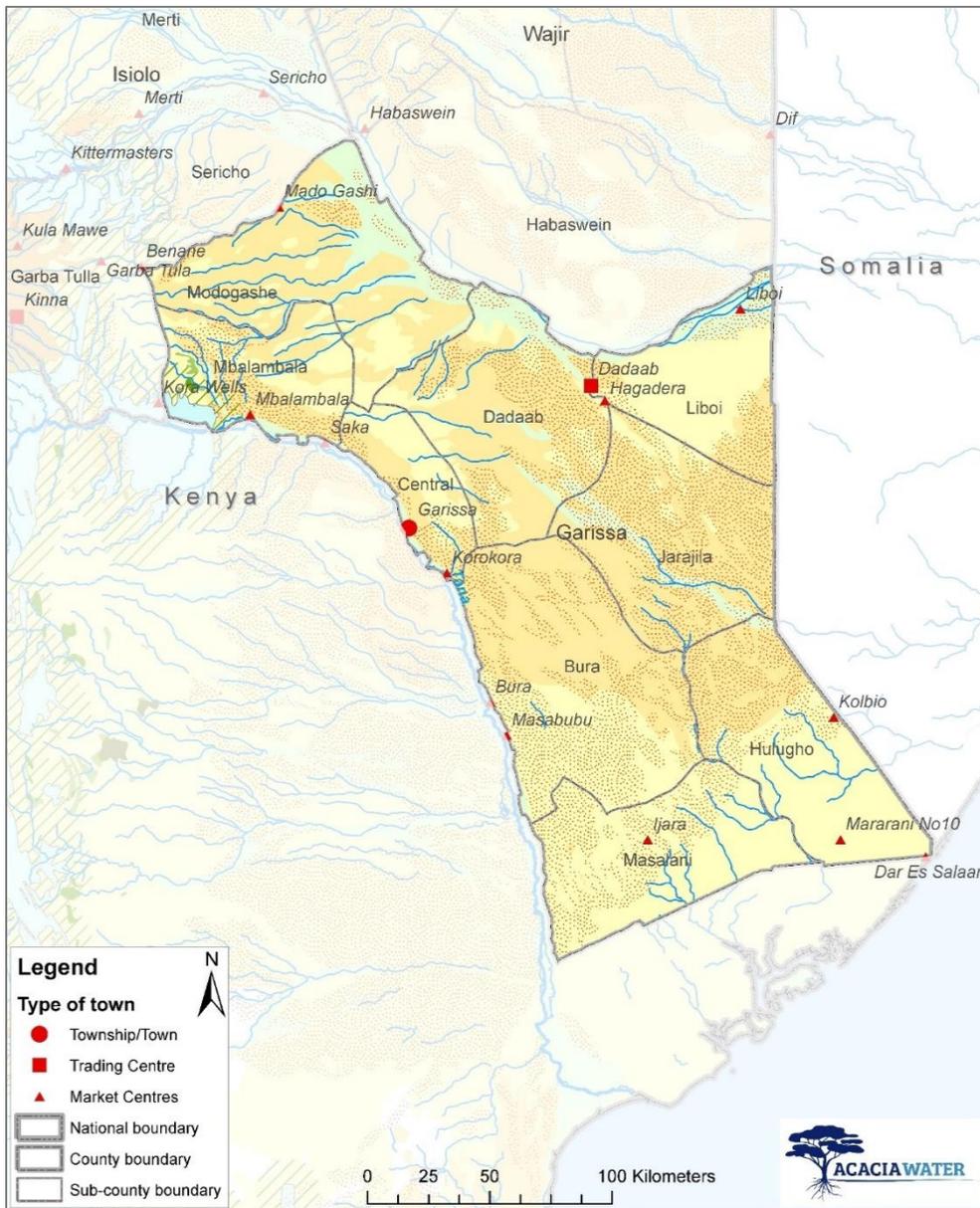


Deep groundwater potential

The main aquifer relevant to Garissa County is the Merti aquifer with the Ewaso Ng'iro River being the major drainage system recharging the groundwater. From the Tana aquifer system only its fringes extend into Garissa County (< 20km). Both aquifers are limited by the presence of adjacent saline water bodies. Main freshwater aquifers are typically confined to the Graben structure as shown in the figure left below. The central Merti aquifer extends from the northeast of Habaswein (Wajir) into Somalia at Liboi and to Lamu to the South. The aquifer is relatively narrow at Habaswein (app. 15-30 km) and broadens to 70 km near Dadaab. The extent of freshwater for human consumption in the central Merti aquifer is estimated to comprise about 9,000 km², whilst for livestock an estimated area of about 106,400 km² is available (GIBB, 2004). Based on the average central Merti dimensions and a mean specific yield of 0.33 m³ of the aquifer material, the estimated stored water volume is approximately 84 billion m³. A study by EWL (2013) suggest that the total annual recharge of the Merti aquifer is around 5 Mm³, although GIBB (2004) calculated a recharge of 33 Mm³ based on assumptions on horizontal flow and an EC-derived dilution factor. Outside the Graben structure local freshwater aquifers can be found (e.g. in Dadaab sub-county). The top of the confined Merti aquifer is found at rather uniform depths between 110 and 180 m bgl. Successful boreholes typically tap the more permeable zone of the Merti Formation between 105 to 150 m bgl. Effects of increased abstractions have been assessed for the low and high end of current recharge estimations. The projected 2050 abstraction rates lead to a likely drawdown of 20m or more, and any further increase in abstractions would lead to groundwater mining and aquifer depletion (Vreugdenhil, 2013).



3D block diagram of the Anza Rift and the Merti Aquifer located in sediments. Central Merti Aquifer near Habaswein is the Northern Most part of this Aquifer in Garissa County. The Graben structure in the centre is the result of Cretaceous rifting (source: Arjen Oord, 2014)



3R potential

Garissa County is predominantly characterized by sedimentary sandstone formations (Zone 4B). This produces sandy weathering products, and may therefore provide potential for sanddams or subsurface dams, if slopes of 2 – 5% and pronounce rivers exist. Due to the flatness of Garissa the most western part of the county, around Kofa Wells, appears to be most promising for dams.

The various sedimentary formations (Zone 4C) which can mainly be found in southern Garissa and East of Dadaab exist of different types of lithological formations, with different kind of soils. This results in various infiltration rates and permeability towards the deeper layers.

For both sedimentary formation zones (4B & 4C) shallow groundwater infiltration may be limited due to widespread saline soils (Zone 5B). Nonetheless local potential for aquifer recharge can be found at locations throughout the county. Floodwater spreading can be well applicable on the flat land of Garissa, increasing the green areas for livestock grazing. In addition, there are good opportunities to store overland flow in water pans and closed (underground) storage tanks, while soil and water conservation measures can help to strengthen rangelands, agricultural productivity and groundwater recharge.

Alluvium sediments (Zone 4A) along the Ewaso Ng'iro and Tana rivers create a high potential for shallow groundwater storage, which can be enhanced by floodwater spreading. With horizontal resistance potentially being small, the sand layering in these zones can provide good opportunities for riverbank infiltration.

The 3R potential map is still a generalized map with an indication of possible 3R interventions. On-ground verification is always required, such as the determination of local soil and geology types, surface runoff, and infiltration and storability rates. The implementation of multiple, cascading interventions will increase water storage efficiency.



Infiltration pond



Underground storage tank



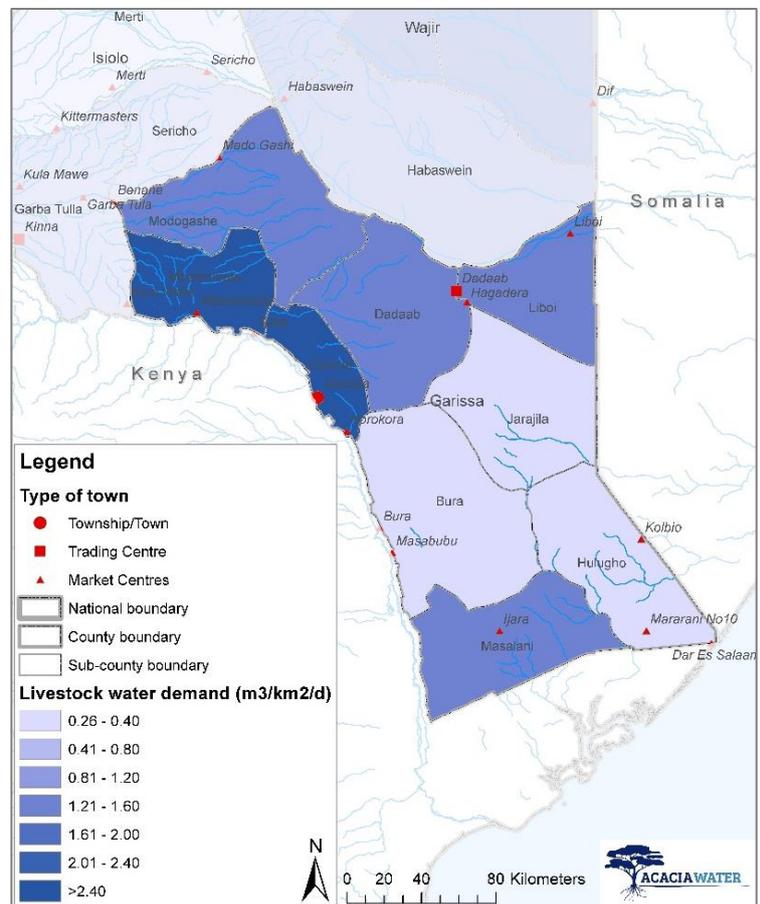
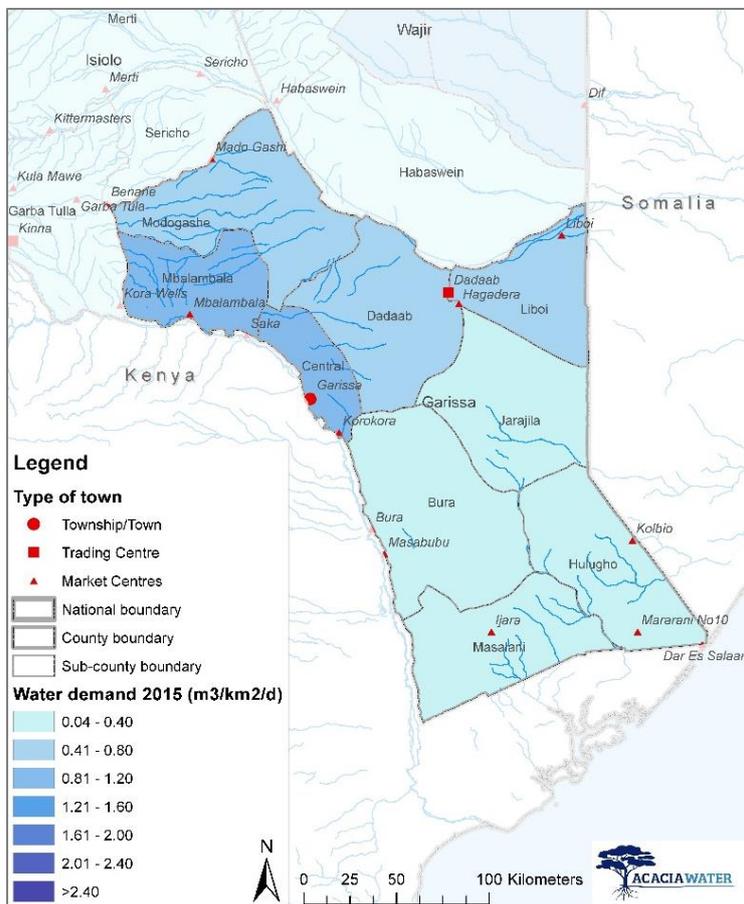
Water pan

Zone 4A: flat areas with river sediments and potential for water pans, and possibly shallow wells and riverbank infiltration. Small dams, infiltration ponds and spate irrigation can be used to increase groundwater recharge. Some rivers might have potential for subsurface dams.

Zone 4B: Sandstone formations has similar characteristics, but might have better potential for (deep) groundwater and groundwater storage.

Zone 4C: variable sedimentary formations, with potential for water pans and underground tanks. This area suffers most from land degradation. Soil and water conservation and rangeland management can provide groundwater recharge.

Zone 5B indicates saline soils.



Water supply and demand

Since settling of pastoralists is occurring more and more, domestic water demand in the area is focused on the villages, towns and main places. The majority of these places are located along the roads in the area. Main water sources are boreholes (33%) and unprotected wells (10.3%). In Garissa town water with tap connections are available (24.8%). The other sources are sources like streams, dams, water vendors and protected wells and springs. The average distance to the nearest water point is around 25 km. Based on the water service ladder, this would mean that the current water use per household is less than 5 l/person/day.

With an expected growth of 3% of the population per year, water use will grow with more than 35% due to population growth in the coming 10 years. If water supply is brought up to national standards (20 l/person/day with the water source within 1 km distance) this means that water supply needs to increase with 440%. This does not include the refugees that are living around Dadaab.

Water use for livestock depends on the amount of rain, in years with plenty of rain, cows and camels will stay in the area, in dry years, they will mainly move out of Garissa area towards grazing grounds that stay green longer. The majority of the goats and sheeps remain in the area. Due to the fact that the area is already at maximum carrying capacity for livestock, local leaders don't expect that livestock numbers will increase in the future.

Recommendations & outlook

Water availability in the area fluctuates a lot, due to limited rainfall. Because rain only falls during rain seasons, rain water storage is needed in order to have water available outside the rainy season.

Actual domestic water use seems to be low, due to large distances to nearest water points. In order to bring this to national standards, a lot of water supply systems needs to be developed. Strategic planning and targeting those areas where the financial resources result in the highest increase of water access.

The landscape however, offers opportunities to retain water, in order to make more water available, both with water pans for rangelands or development of shallow groundwater for domestic water use. Deep groundwater is available locally as well, but should be used wisely taking into account the limitations of mining of the aquifer.

Within the project, a hydrological toolbox will be developed in order to support local government with the strategic planning around development of water sources and water infrastructure.