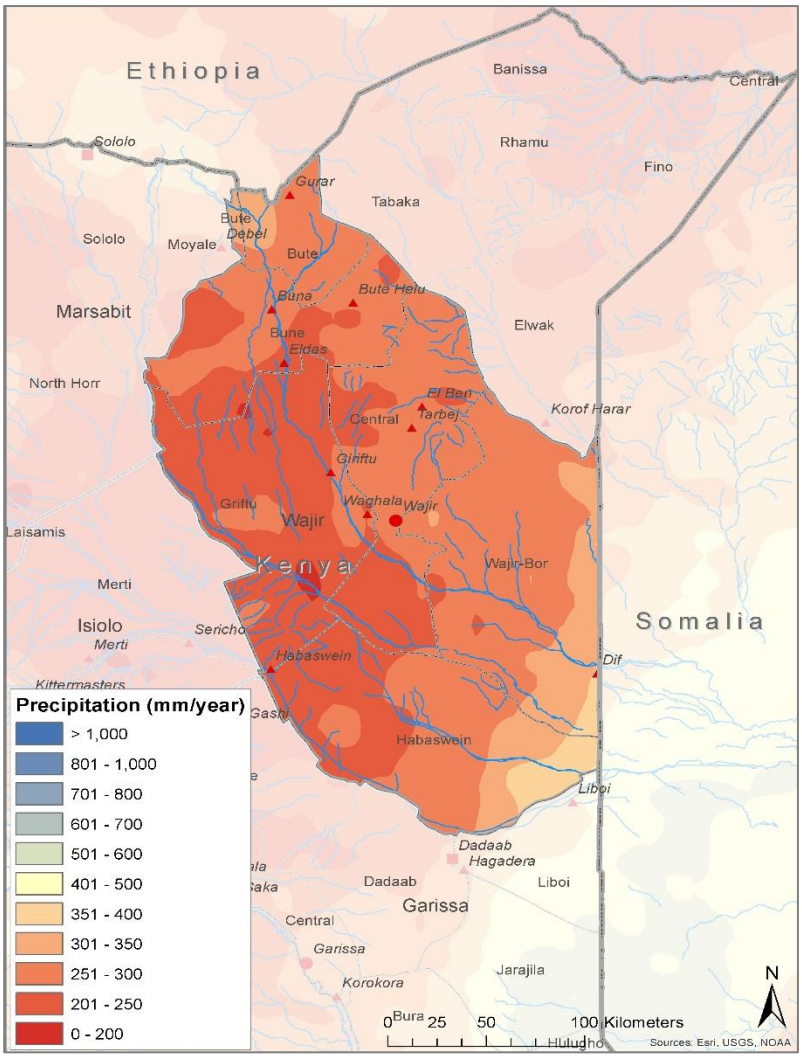
Wajir County Water Resources Factsheet

A 3R and MUS Analysis

Local context

Wajir County is located in the Northeastern region of Kenya. It borders Somalia to the East, Ethiopia to the North, and the counties Mandera to the Northeast, Marsabit to the West Isiolo the Southwest and Garissa to the South. The Ewaso Ng'iro River forms the Southern boundary with Garissa County and is the main source of water. Wajir County is approximately 56,000 km² in size, whilst the topography is featureless and flat with altitudes ranging between 150m and 460m asl. Projections indicate that the county will have a total population of around 850,000 in 2017. Crop activity is carried out in the Lorian Swamp and along seasonal rivers in Bute, with sorghum, beans and vegetables the main crops grown. Besides the seasonal Ewaso Ng'iro River there is the groundwater reservoir Yahud near Wajir Town. It provides water for wildlife and quarry activities, but is often saline and unsafe for drinking. The county has more than 14,000 shallow wells, 206 water pans and over 100 boreholes according to its CIDP (2015).



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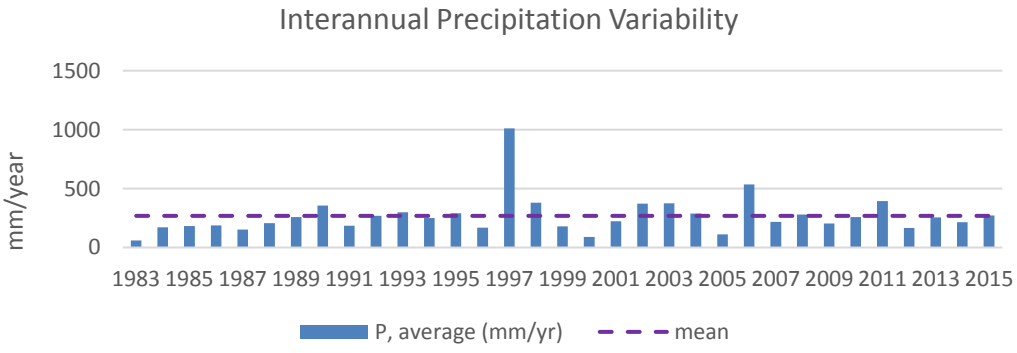
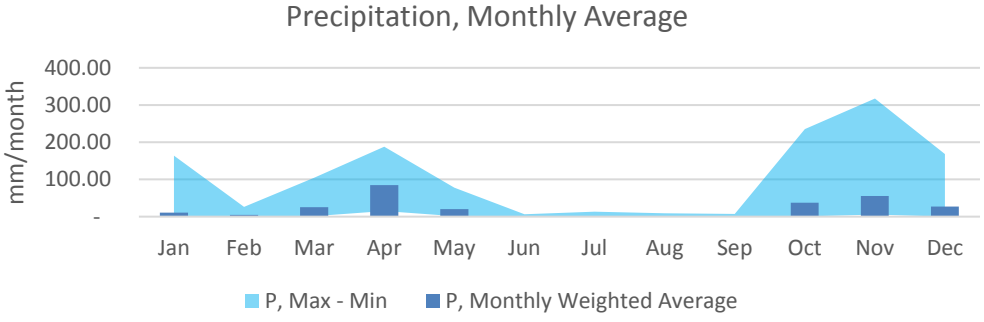
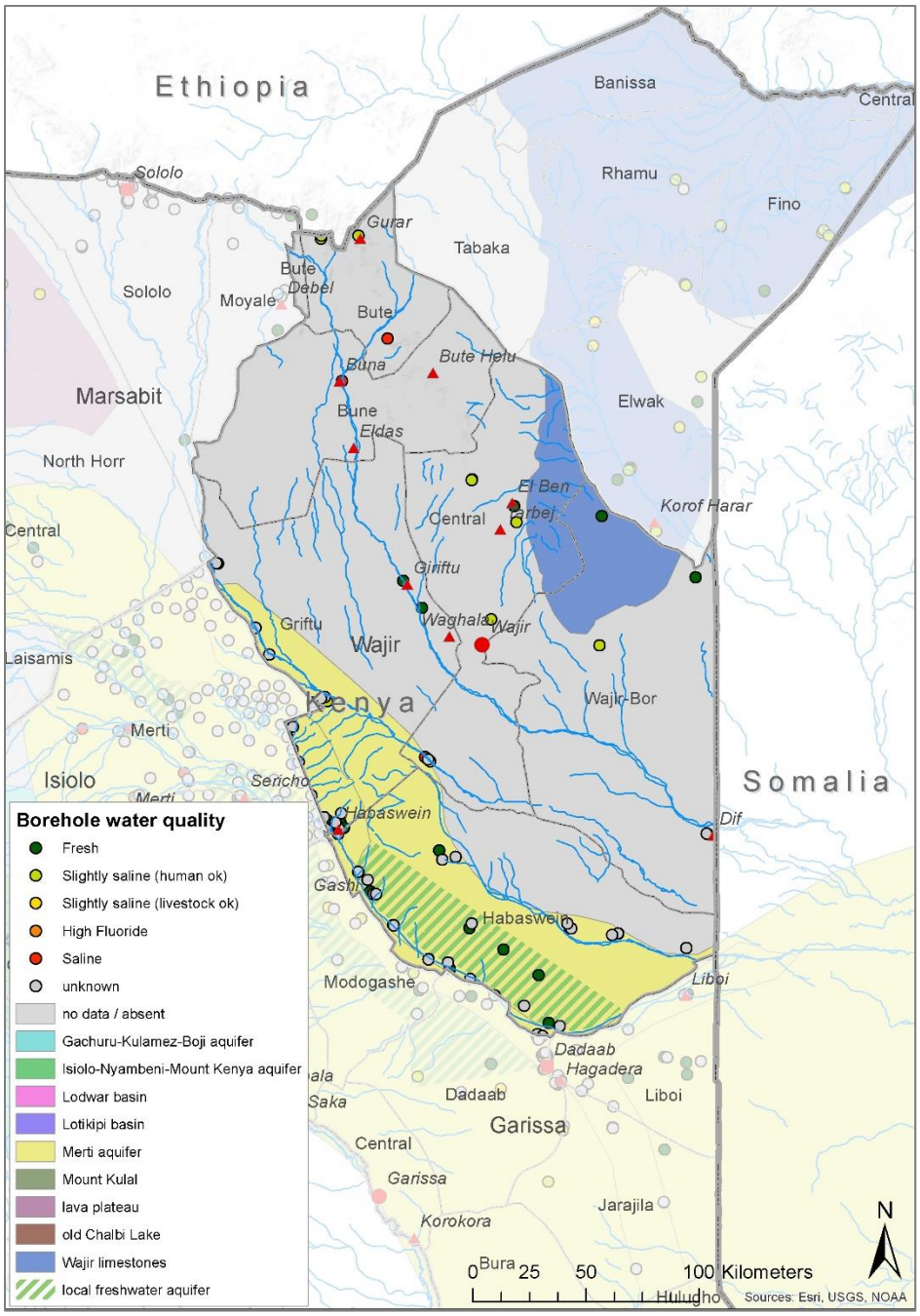
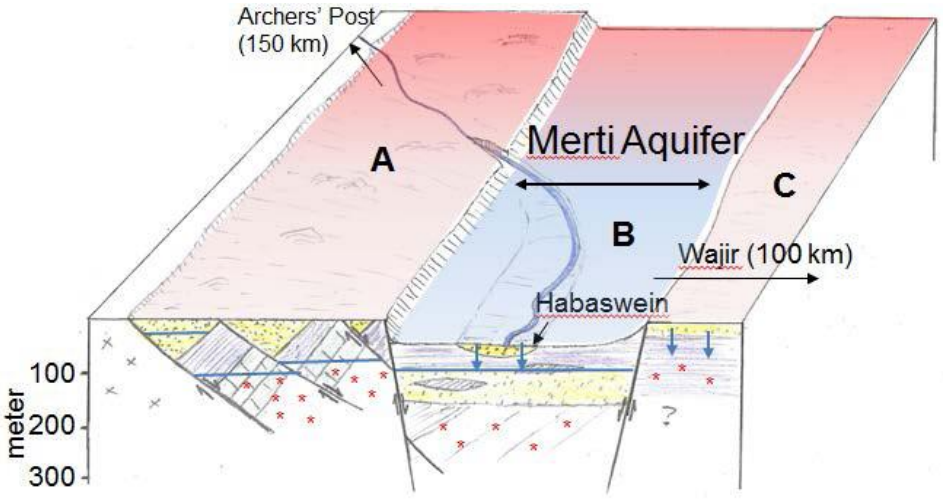




Climate

Wajir is a semi-arid area with a hot climate. Annual average temperature is 27.9 °C while the humidity is around 62%. With a mean annual rainfall of around 270mm (based on NOAA Arc-2 daily precipitation data, 1983 – 2013), it receives the least rainfall of the five project counties. The higher areas of Bute and Gurar in the North, and the south eastern areas close to Somalia receive higher rainfall of around 350mm. June until August are the driest months with no significant rain, while April is the wettest month with an average of 85mm. The precipitation variability graphs on the left show that rainfall is bimodal with huge annual variability and intense events creating flashfloods flowing through seasonal rivers, worsen the prevailing drought and food insecurity in Wajir County.

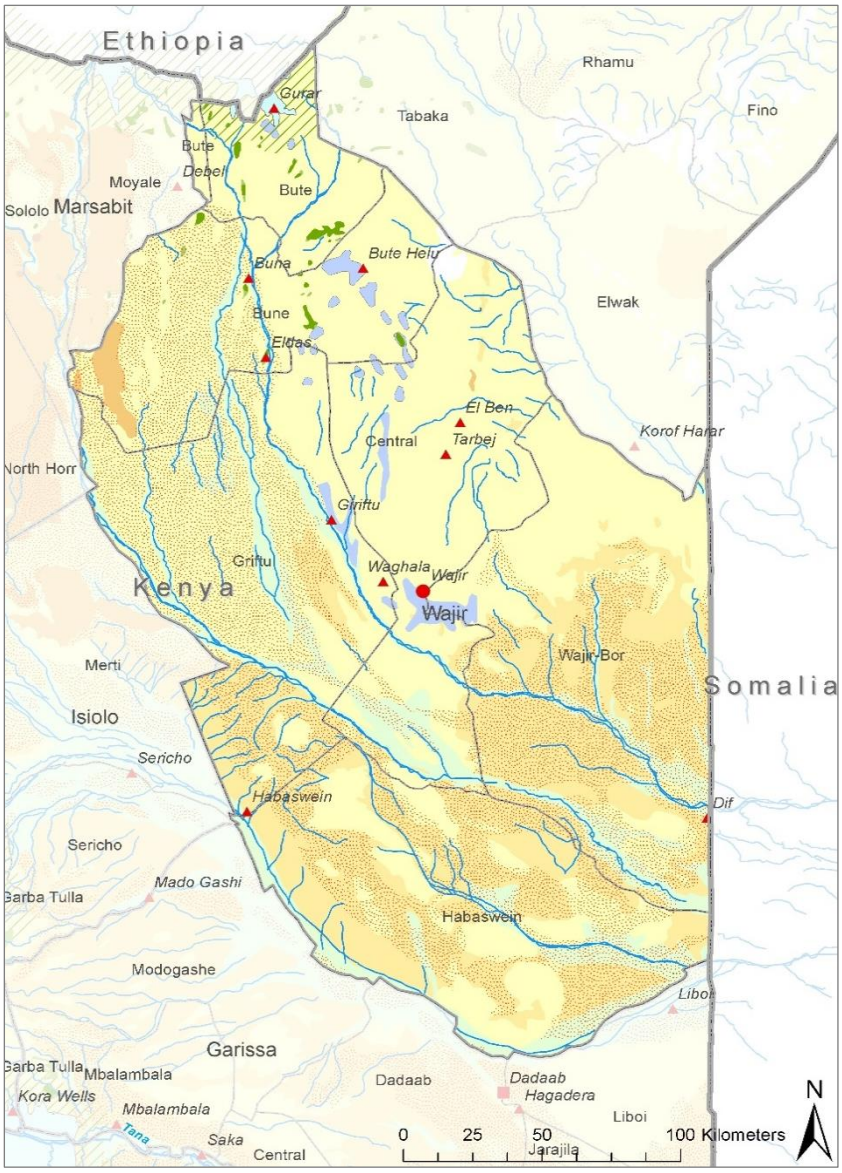




3D block diagram if the Anza Rift and the Merti Aquifer located in sediments. Central Merti Aquifer near Habaswein is the southernmost part of this Aquifer in Wajir County. The Graben structure in the centre is the result of Cretaceous rifting (source: Arjen Oord, 2014)

Deep groundwater potential

The main aquifer relevant to Wajir County is the Merti aquifer with the Ewaso Ng'iro River being the major (seasonal) drainage system recharging the groundwater. Fringes of the aquifer extend up to 70km into Wajir County, but is limited by the presence of adjacent saline water bodies. The freshwater aquifer of the Merti is confined by 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. Based on the average Central Meri aquifer dimensions and a mean specific yield of 0.33 m^3 of the aquifer material, the estimated stored water volume is approximately 84 billion m^3. Studies suggest that the total annual recharge of the Merti aquifer is around 5 Mm^3 (EWL, 2013; Vreugdenhil, 2013), although this still requires further research. Outside the Graben structure local freshwater aquifers can be found. The top of the confined Merti aquifer is found at rather uniform depths between 110 and 180 m below ground level (m bgl). Successful boreholes tap the more permeable zone of the Merti Formation commonly 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 is expected to lead to groundwater mining and aquifer depletion. The young consolidated sedimentary and limestone rocks in central northern Wajir may exhibit substantial and promising groundwater potential, while its level of fracturing and weathering seems not yet fully investigated. Further investigations are also required on the Buna aquifer in northernmost Wajir. More in-depth hydrogeological studies are recommended for both areas, including geophysics and exploratory drilling. Another main source of water is Lake Yahud, a permanent underground reservoir 7km east of Wajir Town. It provides water to wildlife and quarry activities, but is too saline for human consumption.



Infiltration pond

Underground storage tank

Water pan

Open well

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 have 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.

Zone 4D: recent limestones with shallow groundwater potential. Many shallow wells exist with varying quality and capacity, which can be strengthened with direct aquifer infiltration. The limestones can form a good base for water pans.

3R potential (Retain, Recharge, Reuse)

The soil structure of Wajir County is fairly uniform and predominantly characterized by sedimentary sandstone (Zone 4B) and variable sedimentary (Zone 4C) formations. Due to widespread saline soils (Zone 5B), mainly in Eastern, Southern and Western Wajir, the shallow fresh groundwater infiltration has limited potential.

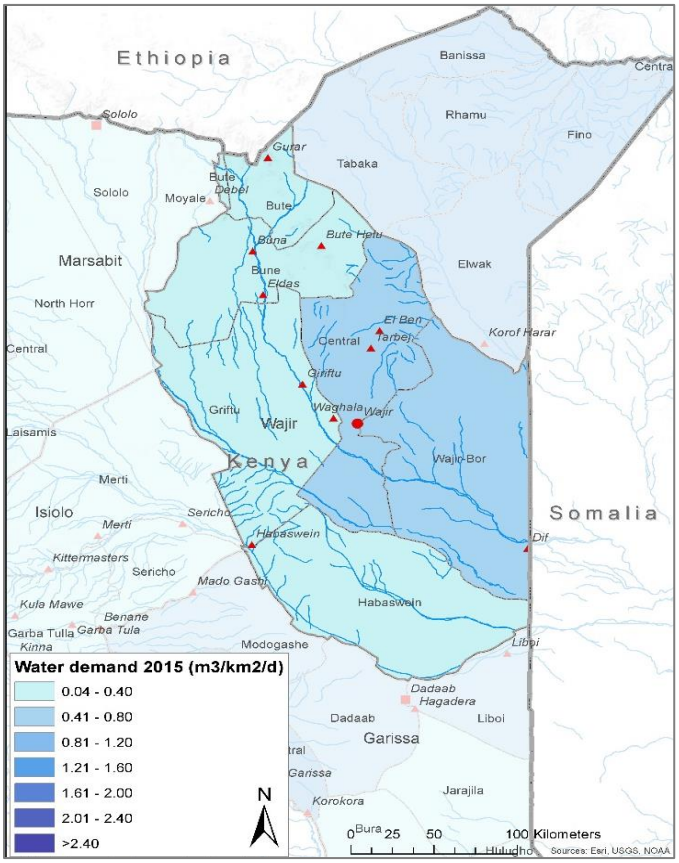
Nevertheless, locally and after on-ground verification 3R interventions may still be promising. The sedimentary sandstone formations (Zone 4B) produces sandy weathering products. They may therefore provide potential for sanddams or subsurface dams, if slopes of 2 – 5%, pronounce stream beddings and fairly shallow basement rock exist. The area with seasonal streams leading to the Ewaso Ng'iro escarpment southeast of Habaswein and the northernmost area around Gurar with shallow basement rock, look particularly promising.

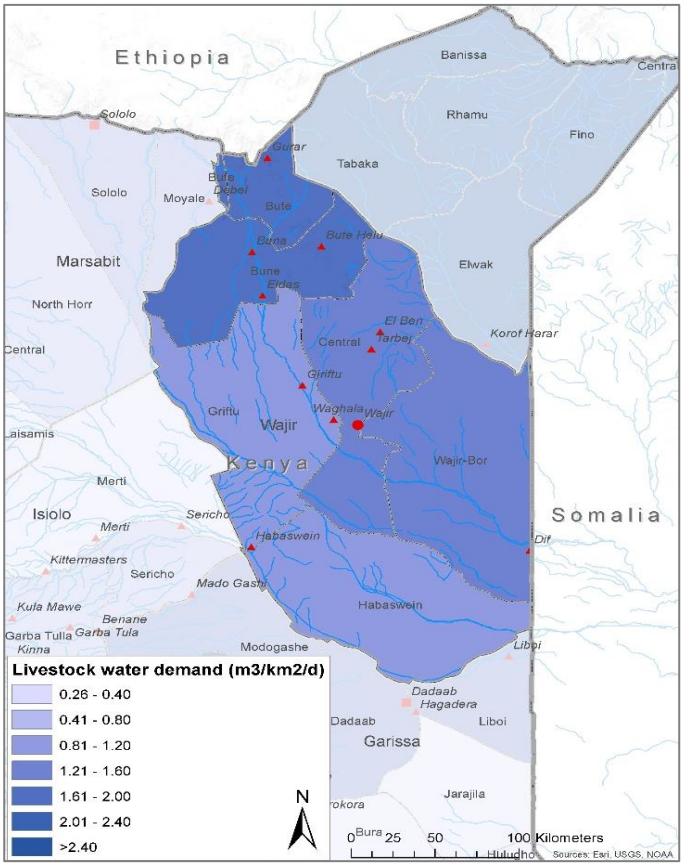
The variable sedimentary formations (Zone 4C) can mainly be found in Central, Western and Northern Wajir. They consist of different types of lithological and geological formations, with different kind of soils. This results in various infiltration rates and permeability towards the deeper layers.

Floodwater spreading might prove to be another effective measure on the flat land of Wajir, most notably in the central, northern and eastern parts (Zone 4C), 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 and groundwater recharge. Implementation of pans will require proper lining using impermeable natural material or should be used for infiltration and combined with an abstraction well.

Alluvium sediments (Zone 4A) along the Ewaso Ng'iro and Lak Bor rivers create a high potential for shallow groundwater storage, which can be enhanced by floodwater spreading. Lak Bor is the ephemeral river running from Ethiopia through Bute, passing south of Wajir Town and into Somalia at Dif. 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 run-off, and infiltration and storability rates. The implementation of multiple, cascading interventions





Water Demand

With change from pastoralism to agro-pastoralism, settling of pastoralists is occurring more and more with increased domestic water demand focused on villages, towns and main places. The majority of these places are located along the main roads and (ephemeral) Ewaso Ng'iro and Lak Bor rivers in the county. With many unprotected shallow wells this is the main water source for multiple uses. With increased prolonged droughts on the one hand, and increasing water demand on the other, water levels drop to minimum levels causing acute water shortages during the dry season. This is particularly most visible with shallow groundwater levels in and around Wajir town. Although only in the hundreds, water pans and boreholes are the other main water sources. Livestock is the major user of water (53%), followed by domestic use (30%).

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 %.

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 Wajir County 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 rainy 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. Focus should be even more on strategic planning and targeting those areas where the financial resources result in the highest increase of water access.

Although annual precipitation in Wajir County is low and evaporation high, the landscape offers some opportunities to retain water. Most promising and effective interventions to make more water available appear to be water pans with infiltration for rangelands and development of shallow groundwater for domestic water use. It, however, still remains uncertain if with these interventions water availability problems will be resolved until the end of the dry season. Deep groundwater is available locally as well, but should be surveyed well to avoid hitting saline groundwater and used wisely taking in account the limitations of mining of the aquifer. Within the project, a hydrological framework or toolbox will be developed in order to support local government with the strategic planning around development of water sources and water infrastructure.