Marsabit County Water Resources Factsheet

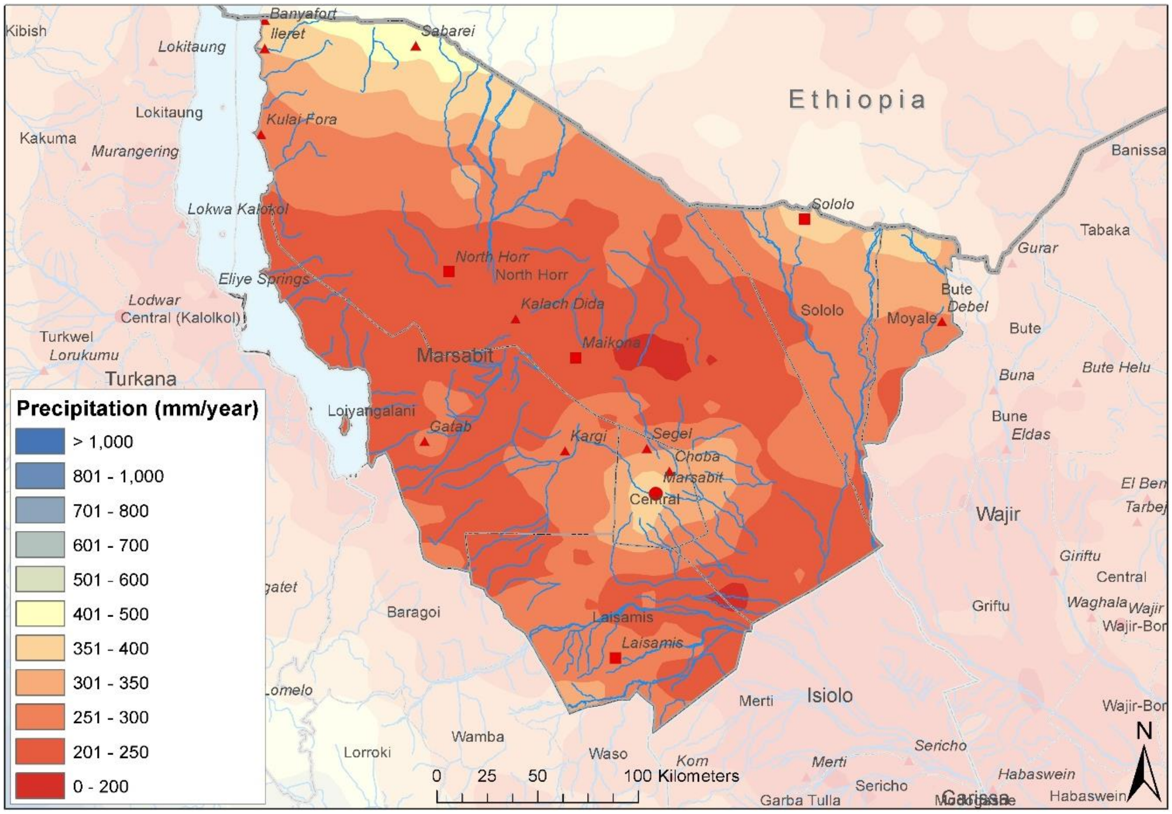
A 3R and MUS Analysis

Kenya RAPID is coordinated by:

Millennium Water Alliance

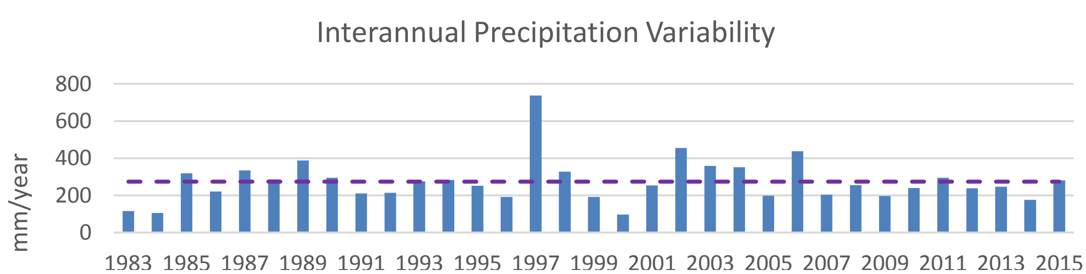
Factsheet developed by:

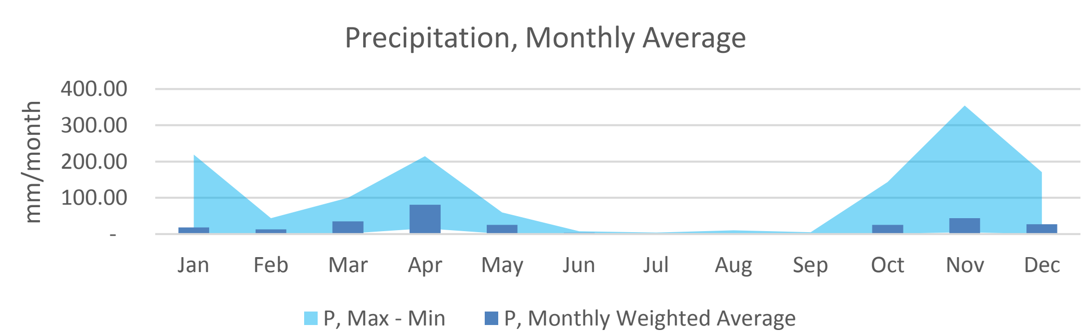
AcaciaWater



Local context

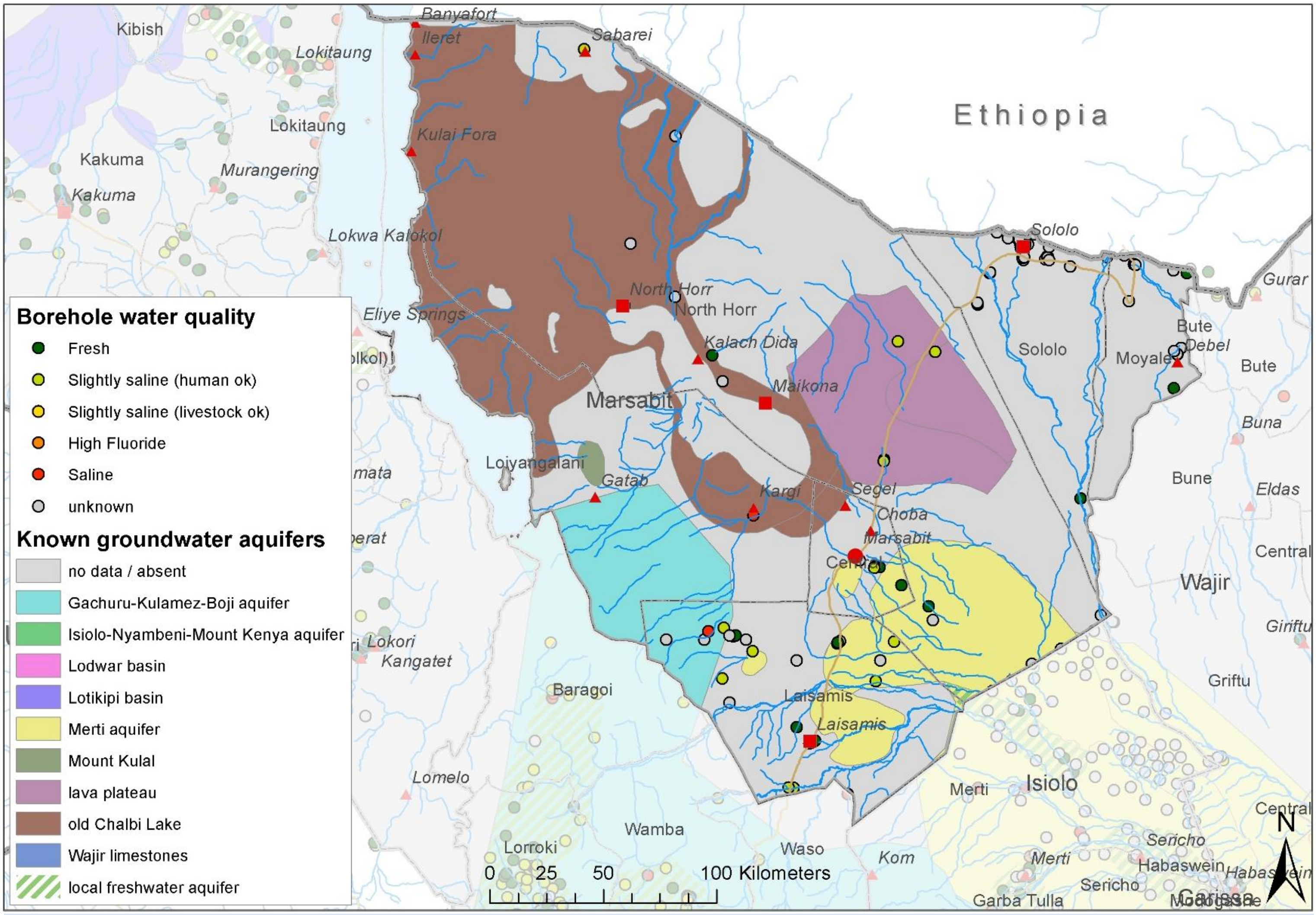
Marsabit County is located in the North of Kenya. It borders Ethiopia to the North, and the counties Wajir to the East, Isiolo and Samburu to the South, and Turkana to the West. There are no permanent rivers in the county. Marsabit County is approximately 71,000 km² in size. Most of the county constitutes an extensive plain lying between 300m and 900m asl, bordered by hills and mountain ranges to the north and west, of which Ol Donyo Ranges (2066m asl), Mt. Marsabit (1865m asl) and Mt. Kulal (2235m asl) are the most notable features. Run-off from these hills feed the eastward flowing ephemeral rivers of Milgis and Merille and drain into the Sori Adio swamp. Projections indicate that the county will have a total population of around 373,000 in 2017. There are several ethnic groups in Marsabit, including Borana, Samburu and Rendile. Approximately 80% of the population are semi-nomadic, while 10% are occasional nomads and 10% are fully settled.





Climate

Large parts of Marsabit County belong to the driest parts of Kenya. The rainfall patterns are bimodal and display both temporal and spatial variation. Based on daily precipitation data (NOAA Arc-2, 1983-2013) Marsabit receives on average 275mm of rainfall per annum, with an interannual precipitation variability of 100mm to 740mm. Likewise, duration, amount and reliability of rainfall also increases with increase in altitude. North Horr at 550m above sea level (asl) has a mean annual rainfall of 150mm, while Mt. Marsabit (1,865m asl) and Mt. Kulal (2,235m asl) receive 800mm on average. The average annual temperatures are hot, ranging from 20 to 35°C. January to March and September to October are the warmest months with a mean of 30°C. June and July are the coolest months with temperatures averaging 24°C.

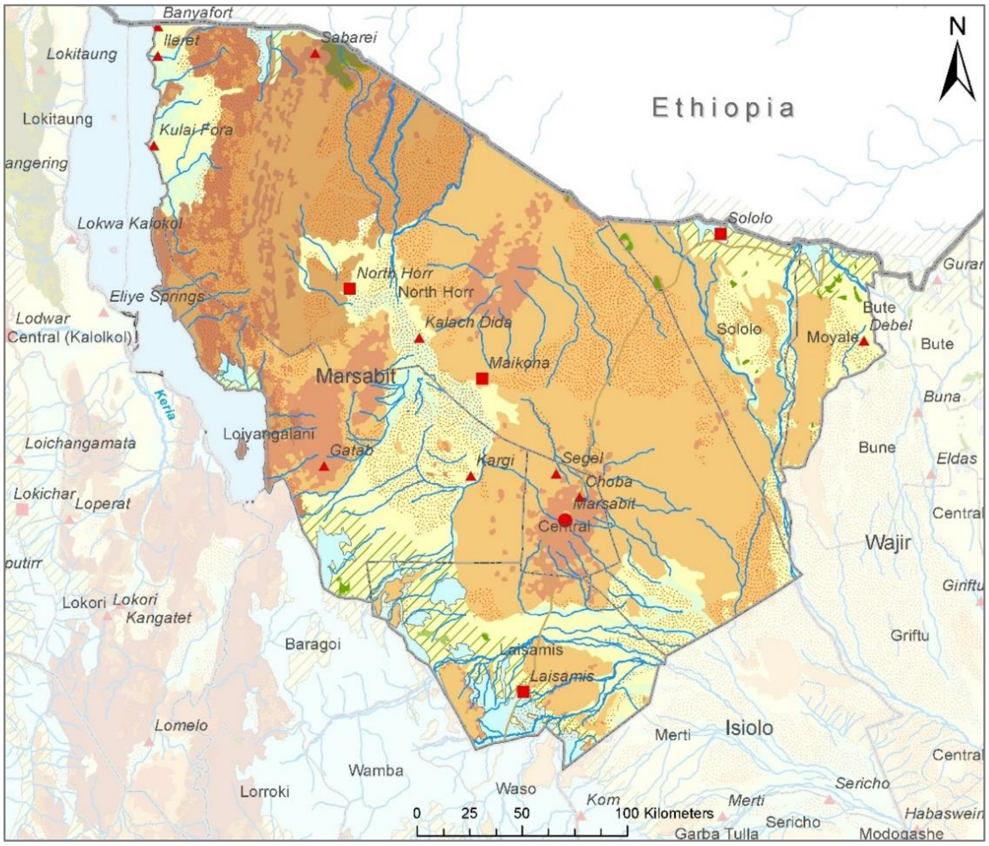


Deep groundwater potential

The most predominant geological formation in the county is volcanic rock. Only in a few areas these volcanic rocks are interrupted by pockets of quaternary sediments. Nevertheless, many parts of Marsabit County are known to have productive deep aquifers. The borehole database (which is currently being updated with the data provided within the Rapid program by the counties) shows that Mt. Kulal has productive boreholes. On the high altitude area surrounding Marsabit Town, borehole siting and drilling can be challenging due to unstable volcanic formations, and deep groundwater levels (>200 meters below ground level). On the lower slopes groundwater appears to have a higher potential, as many good yielding deep boreholes are present with water strikes generally between 50 to 150 mbgl, and with boreholes with a yield of up to 20 m^3/h present. Most productive boreholes appear to be related to water bearing fractured bedrock. Generally the water quality is reported to be good, but some of these aquifers have water quality problems due to high salinity, while the omnipresent volcanic rocks are associated with presence of high fluoride levels in the groundwater.

The large depression between the hills of Mount Marsabit, Mount Kulal, Hurri Hills and the Ethiopian plateau, is the Chalbi Desert and forms the largest drainage system in Marsabit County, covering an area of 948 km^2. The depression receives run-off from the lava and basement surfaces of the surrounding mountains and hills. The lowest part of this depression is seasonal (Old) Lake Chalbi (the 'grey' area south and west from Kalach Dida in the figure above), which is covered by recent sediments. Although, groundwater potential in the depression of (Old) Lake Chalbi is currently still unknown in terms of volumes and annual recharge, high yielding boreholes can be found here, especially south of the Marsabit – North Horr ridge and around North Horr town.

The rest of the county is covered by rocky, stony and rugged lava plains with poor soil development. Some of these soils in the western part of the county have acidic moisture and are saline in the Chalbi Desert. The groundwater potential in the sedimentary areas of these plains is expected to be low. Generally the bedrock in the lowland areas is varying from 20 and 80 mbgl. The larger area around the depression, which is still considered the Old Chalbi Lake aquifer (the brown filled area in the figure above), has limited rainfall in the Chalbi desert and presence of saline soils, especially the area between North Horr and Lake Turkana. The recharge and quality aspects of groundwater are therefore not expected to be advantageous for efficient groundwater abstraction. Moreover, the low success rate of boreholes in the sedimentary areas appears very often also related to inadequate hydrogeological assessments and poor application of geophysics.




Infiltration pond


Underground storage tank


Water pan


Subsurface dam potential

Zone 3C/3F: volcanic mountains and gentle sloping areas with high potential for water pans and valley dams. Soil and water conservation interventions such as contour bunds and gully plugs can reduce erosion, and increase groundwater recharge.

Zone 4A/flooding areas: 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: flat sedimentary areas 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. Small dams, infiltration ponds and spate irrigation can be used to increase groundwater recharge.

Zone 5B indicates saline soils.

3R potential

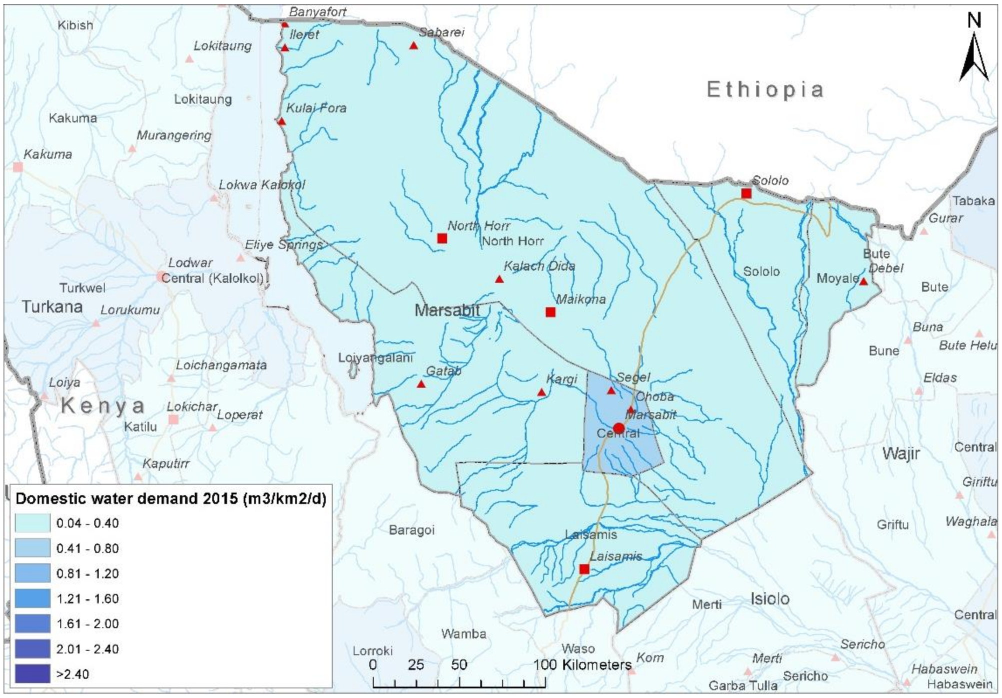
The low-lying area in Marsabit is generally a low potential rangeland which forms approximately 75% of the county's total land area (zones 3F, 4B & 4C). As a result of low, unreliable rainfall and high rates of evaporation, the soils are often shallow and poor. Zone 3F is typified by gentle sloping (volcanic) areas with generally low potential for water buffering. Overland flow can spread over a large area, leaving alluvial deposits behind. These two aspects makes construction of water pans and valley dams possible, but soil cracking might give problems after periods of prolonged drought.

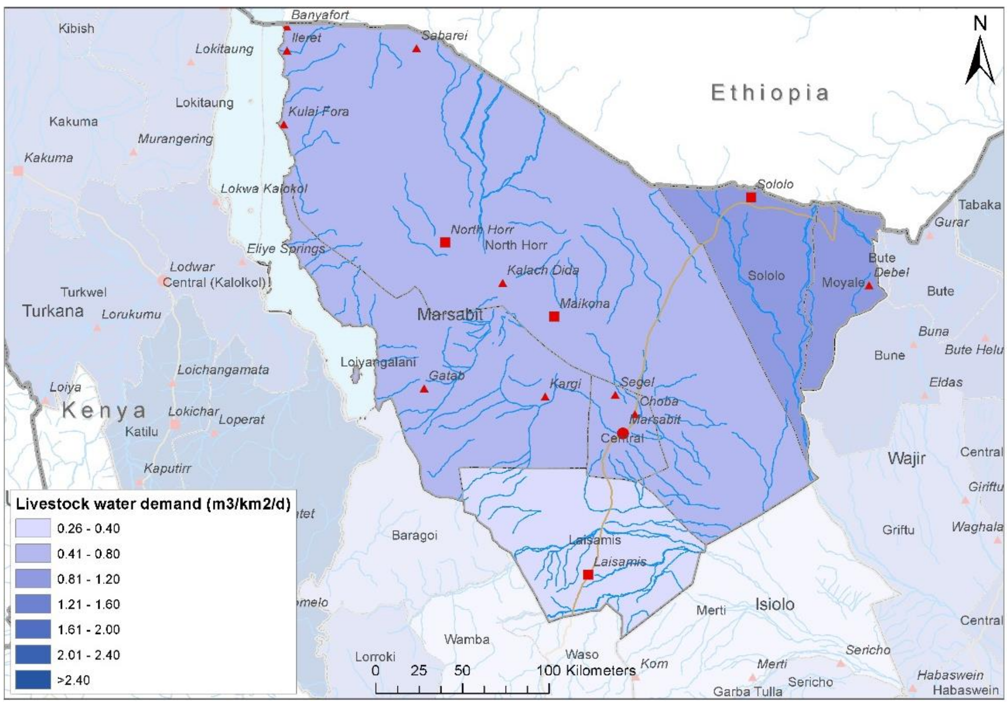
The sedimentary sandstone areas (Zone 4B) produce sandy weathering products, thereby providing potential for sanddams or subsurface dams, if slopes of 2 – 5% and pronounce stream beddings exist. A thick, often saline, overburden of 30m or more and lack of pronounce slopes, make it uninteresting to consider these options.

The flat sedimentary areas (Zone 4C) can mainly be found in Moyale, at Old Chalbi Lake and in the floodplains northeast and –west of Laisamis. Due to lower velocity, overland flow may cause natural infiltration. Together with the deposit of clayish sediments this provide fertile soils and function as the main dry season grazing lands, which may be enhanced by the application of small dams, infiltration ponds, spate irrigation and floodwater spreading. In addition, there are good opportunities to store overland flow in water pans and closed (underground) storage tanks, while SWC measures can help to strengthen rangelands, agricultural productivity and groundwater recharge. Construction of pans requires proper lining using impermeable natural material.

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

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





Water Demand

With change from pastoralism to agro-pastoralism, settling of pastoralists is occurring more and more with increased domestic water demand focused on towns. In thinly populated Marsabit County this is mainly the case for the major towns Loiyangalani, Laisamis, Sololo, Marsabit Town and, especially, Moyale. More than 60 percent of the households in the county rely on the more than 850 (unprotected) shallow wells and 60 boreholes. Only the piped water in Marsabit Town is treated at a water supply plant. Water from other sources is untreated and often saline. Increased prolonged droughts in combination with increased water demand, water levels drop to minimum levels causing acute water shortages during the dry season. With an expected growth of 3% of the population per year, water use will grow with more than 35% until 2025 due to population growth. If water supply is brought up to national standards (20 L /capita /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, livestock will stay in the area, in dry years, they will mainly move to grazing grounds that stay green longer. Due to the fact that the area is already near maximum carrying capacity for livestock, local leaders don't expect that livestock numbers will increase in the future.

Recommendations & outlook

Water availability in Marsabit County fluctuates a lot, due to limited and erratic rainfall. To make water available during the dry season, storage of rainwater and other sources of water (such as groundwater) are needed. The landscape offers opportunities to retain water, as the 3R potential section already showed. In most areas of Marsabit especially water pans, underground tanks and infiltration ponds show high potential. The water quality of Lake Turkana is unsuited for most uses, options for desalinization could be explored. Deep groundwater is available too, but requires further hydrogeological assessment of volumes, annual recharge, productive aquifer depths and quality, in order to ascertain sustainable groundwater abstraction. Proper geophysical surveys are needed to avoid hitting groundwater with high salinity and fluoride levels.

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 financial resources result in the highest increase of water access. Within the project, support to the county water sector plans will be given in order to support local government with the strategic planning around water sources and water infrastructure development.