Isiolo County Water Resources Factsheet

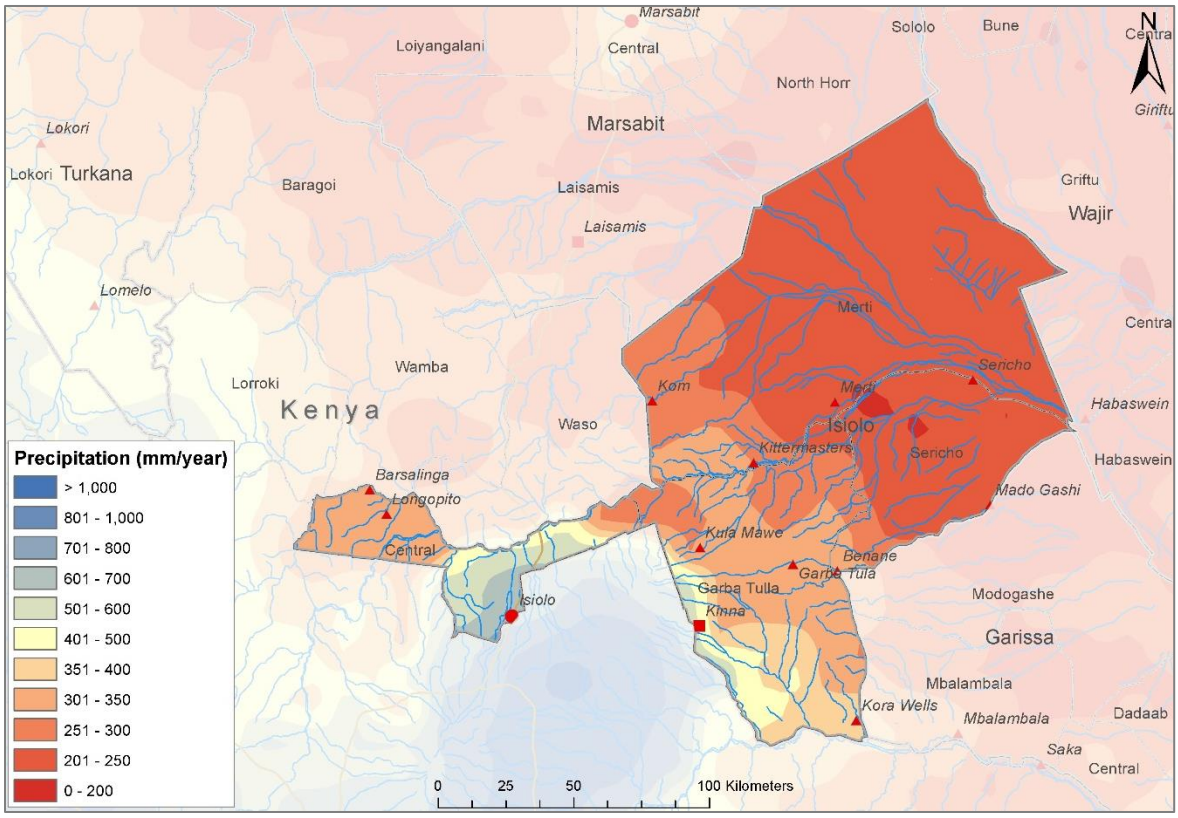
A 3R and MUS Analysis

Kenya RAPID is coordinated by:

MILLENNIUM WATER ALLIANCE

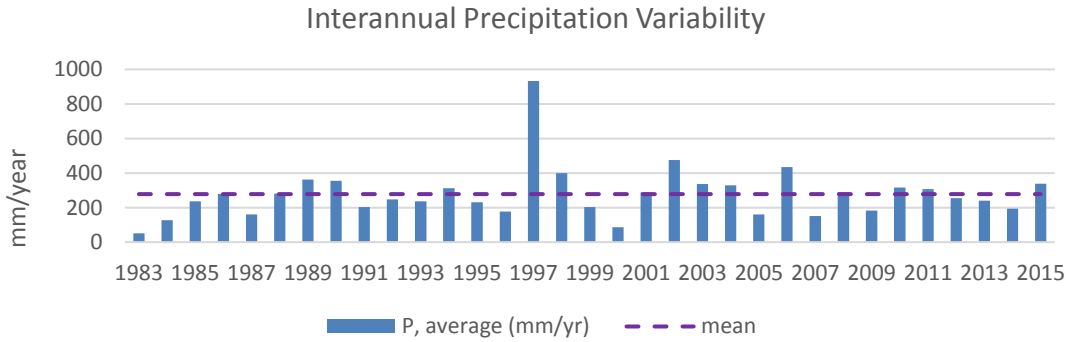
Factsheet developed by:

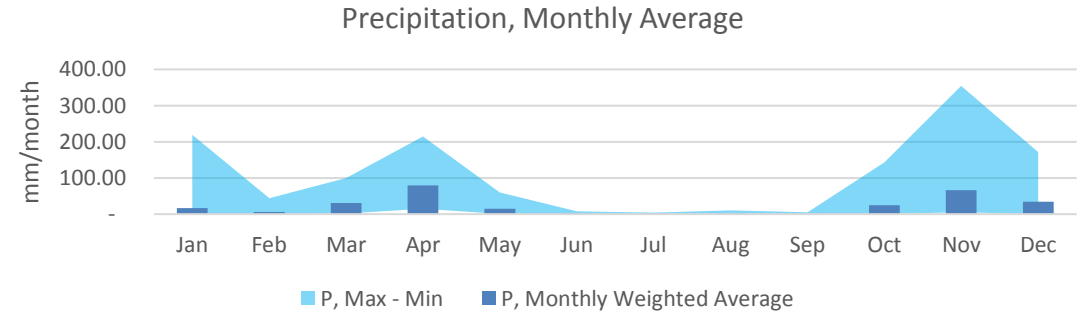
ACACIA WATER



Local context

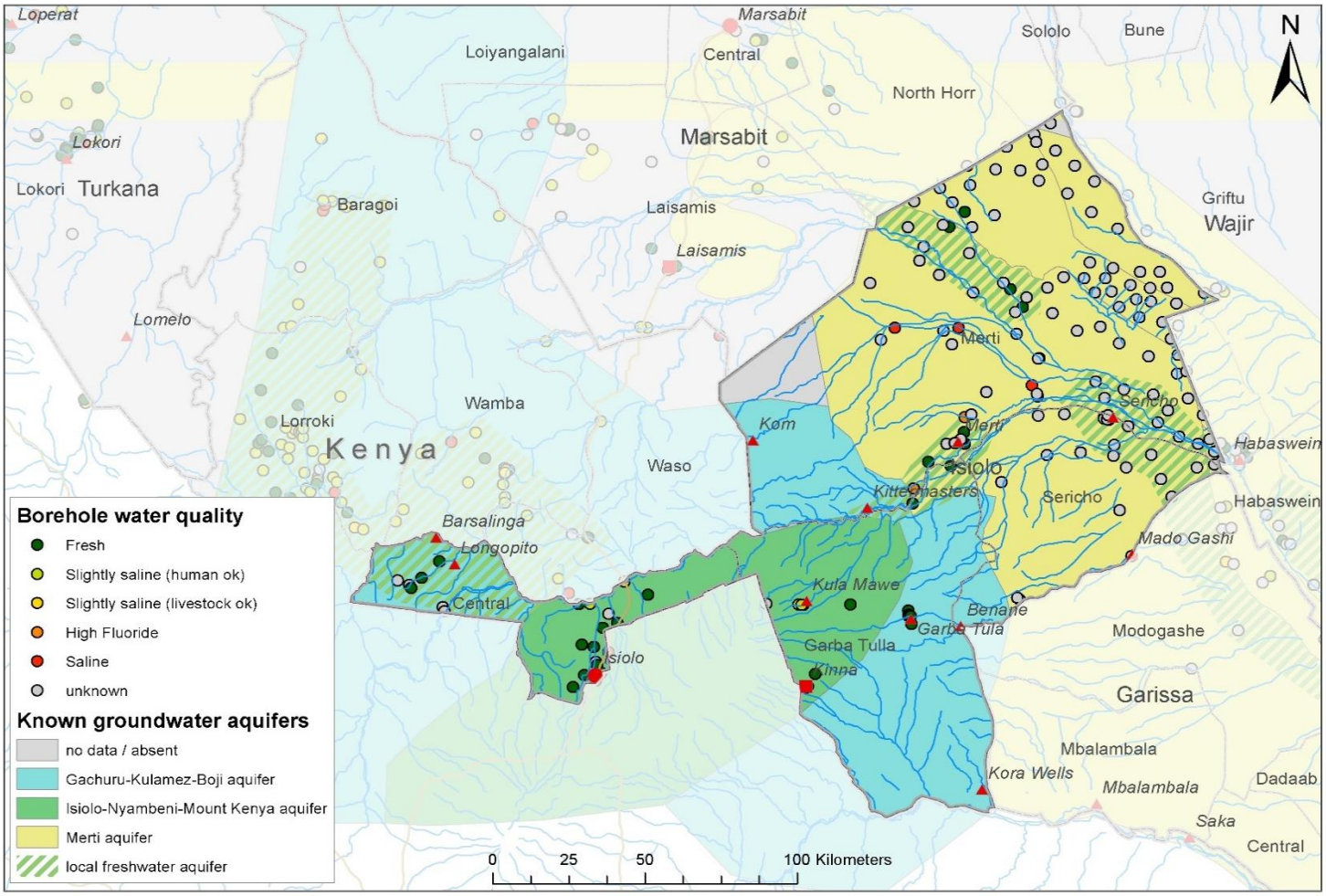
Isiolo County borders Marsabit County to the North, Samburu and Laikipia Counties to the West, Garissa and Wajir Counties to the East, and Tana, Kitui and Meru Counties to the South. The county covers an area of approximately 25,700 km². Most of the land is flat low lying plain which gradually rise from an altitude of 200m asl at Lorian Swamp in the northeast to about 1500m asl at Lewa Conservancy in southwest Isiolo. There are six perennial rivers in the county, namely: Ewaso Ng'iro, Isiolo, Kinna, Bisanadi, Likiundu and Liliaba rivers. Ewaso Ng'iro River originates from Mt. Kenya and the Aberdare ranges. The Isiolo River also originates from Mt. Kenya and drains into Ewaso Ng'iro River. Projections indicate that the county will have a total population of around 192,000 by the end of 2017. Over 80% of the land cannot support crop farming and is used as grazing land by pastoralists.





Climate

The county is hot and dry in most months in the year with two rainy seasons, displaying both temporal and spatial variation. Based on daily precipitation data (NOAA Arc-2, 1983-2013) Isiolo receives on average 278mm of rainfall per annum, with an interannual precipitation variability of 50mm to 930mm. About 65% of the total area of the county is considered very arid, mainly in northern Isiolo, and receives rainfall of between 150 and 250 mm annually. The arid zone in central Isiolo covers 30% of the total land area, with rainfall ranging between 300 and 350 mm annually, supporting grassland. A relative small part (5%) in southern Isiolo, near Mt. Kenya (5,199m asl), receives 400 – 650 mm on average. The wettest months are November and April, with an average rainfall of 80 and 66mm respectively. The mean annual temperature is 29°C.



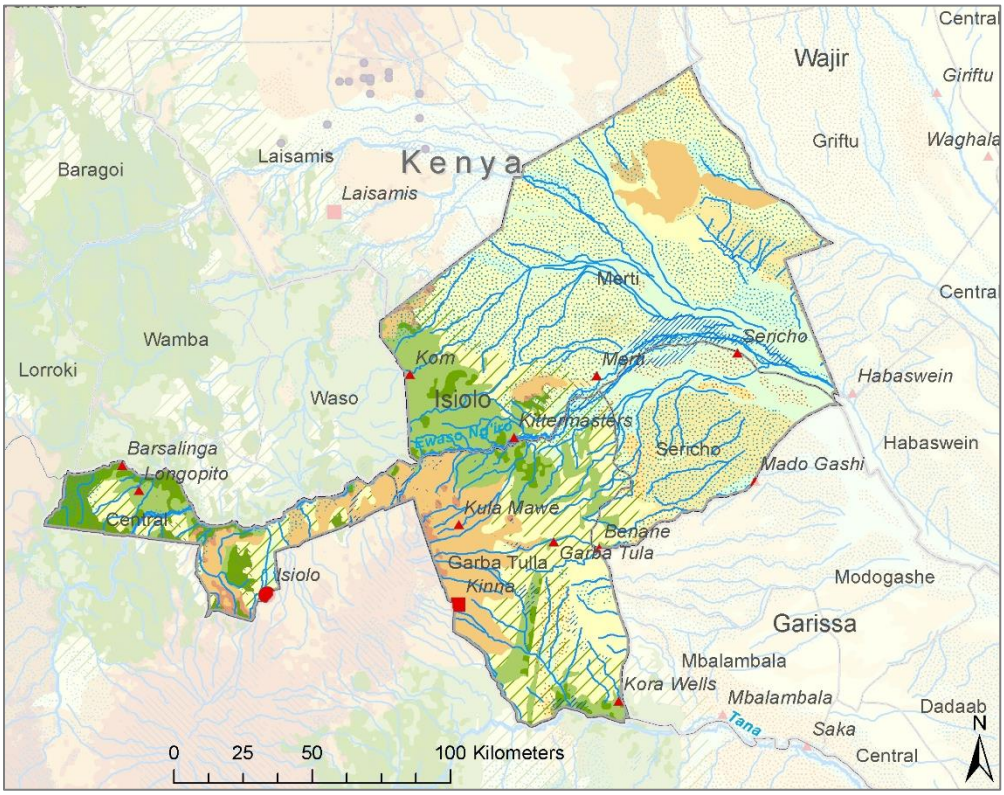
Deep groundwater potential

Isiolo County has a combination of metamorphic rocks and other superficial rock deposits. The areas covered with tertiary marine sediments in norther Isiolo have a high potential for groundwater abstraction. In general, three major aquifers can be found in the county, namely: the Merti aquifer, the Isiolo-Nyambeni-Mount Kenya aquifer and the Gachuru-Kula-Mawe-Bovi aquifer.

The Merti aquifer is situated in the tertiary rock, such as basalts, dominated Anza Rift. Groundwater is confined and found at rather uniform depths between 110 and 180 m below ground level (m bgl). Generally the water quality in the boreholes is found to be good, with some exceptions having water quality problems, mainly due to high salinity. On the lower slopes of Mt. Marsabit and in the Lorian swamp in northern Isiolo groundwater has higher potential, with many existing, good yielding boreholes present and water strikes between 50 and 100 m bgl. The estimate of the extent of the freshwater body is determined by the salinity that is allowed. Based on an average aquifer thickness of 15 metres, a length of 340 km, a width of 5 to 50 km and a specific yield of 0.33 m^3 the estimated total aquifer volume in the full Merti area ranges between 84 and 110 billion m^3 (REF). This is, however, mainly fossil water which is not renewed. The groundwater recharge to the Merti aquifer, which is mainly taking place in Isiolo County, is according to conservative estimations a mere 5.0 Mm^3/yr (EWL, 2013) although GIBB (2004) calculated a recharge of 33 Mm^3.

The Isiolo-Nyambeni-Mount Kenya aquifer covers the western part of Isiolo County and the Northern part of Meru County. It surrounds Mount Kenya and extends eastwards towards the Nyambeni hills. The volcanic rocks found in this area have good hydraulic characteristics and form extensive aquifers with a calculated safe yield of over 2.2 Mm^3/yr (30% of calculated groundwater flow) (Vreugdenhil, 2013). In combination with high precipitation rates on Mt. Kenya this leads to rather high aquifer recharge estimates. To prevent further lowering of water levels and negative environmental impacts, interventions should refrain from the area closer to the Ewaso Ng'iro River and downstream of Isiolo Town, and focus more on areas upstream from Isiolo Town in order to secure sustainable, long-term groundwater abstraction.

The Gachuru-Kula-Mawe-Bovi aquifer lies within the larger Garbatulla area. The characteristics and geology of this aquifer are related to the Isiolo-Nyambeni-Mount Kenya aquifer. The total amount of recharge within this area is relatively low as it encompasses localized aquifer systems in basement complex areas. The hydrogeological properties for these kind of groundwater systems are generally limited and difficult to assess, with strong variances in yields and quality, including high probability of excessive concentrations of fluoride (IGRAC, 2004).



Sanddam

Infiltration pond

Underground storage tank

Water pan

Subsurface dam potential

Zone 1A/1B: mountains/gentle sloping areas with shallow hardrock and high potential for rock catchments, and for sanddams and subsurface dams in the seasonal rivers with sandy riverbeds.

Zone 3C/3F: volcanic mountains and plateaus with generally low potential for water buffering. Water pans and valley dams are, however, possible although soil cracking might cause problems. These zones have potential for (deep) groundwater recharge, especially near the edges. 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 as 4A, with better potential for (deep) groundwater recharge 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

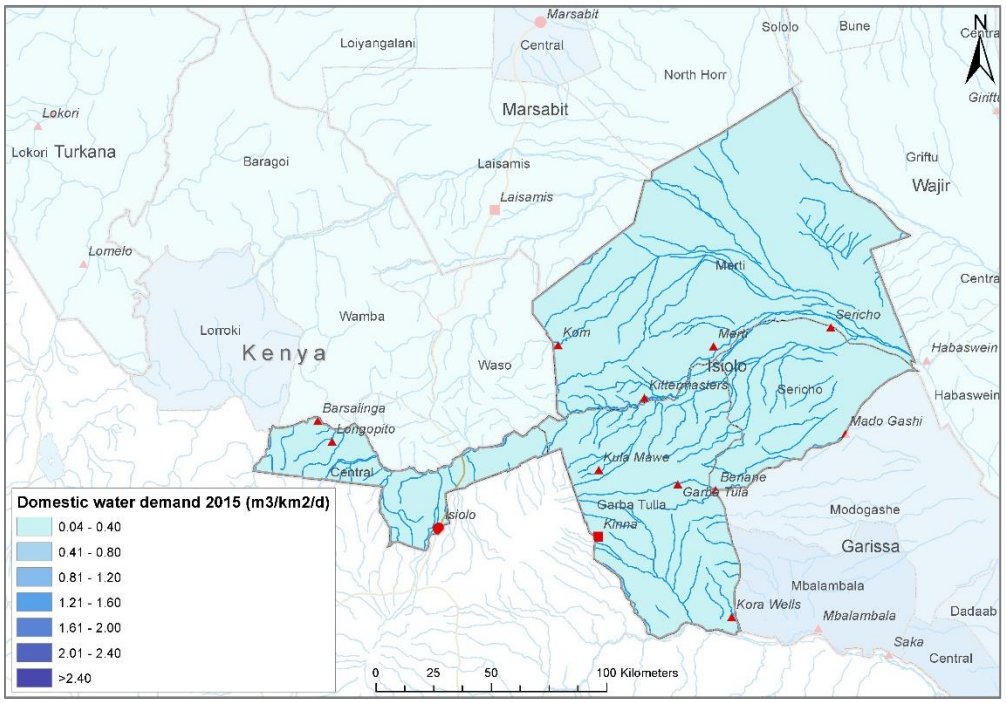
The low-lying plains of northern and eastern Isiolo are mainly a result from weathered sandstone formations and sedimentation. Potential for aquifer recharge can be found at locations throughout the county. However, the widespread saline soils (Zone 5B), may locally limit the potential. The gentle slopes of Zone 1A/1B and sedimentary sandstone formations of Zone 4B might produce sandy weathering products, and may therefore provide potential for sanddams or subsurface dams, if slopes of 2 – 5% and pronounce sandy stream beddings exist. Seasonal streams leading to the Ewaso Ng'iro River and Lorian swamp look particularly promising.

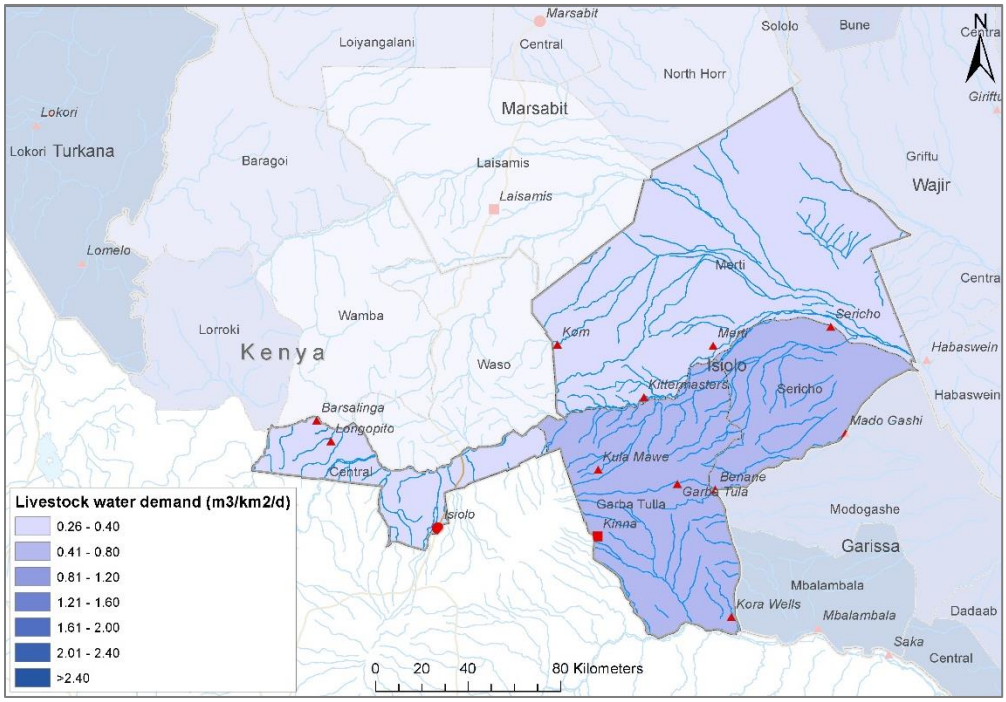
The variable sedimentary formations (Zone 4C) consist of different types of lithological and soil formations. This results in various infiltration rates and permeability towards the deeper layers. Floodwater spreading and other soil and water conservation measures might prove to be an effective measure on the flat land of Isiolo's plains, increasing the green areas for livestock grazing and groundwater recharge. In addition, there are good opportunities to store overland flow in water pans and closed (underground) storage tanks. Construction of pans requires proper lining using impermeable natural material.

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

Zone 3C is typified by gentle sloping (volcanic) areas with generally a low potential for water buffering. Overland flow can spread over a large area, leaving alluvial deposits behind. With proper lining construction of water pans and valley dams has high potential.

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 villages and towns. Capital investments under Kenya Vision 2030 and the LAPSSET Corridor are expected to boost (urban) population growth and, thus, water demand further. Isiolo Town is already experiencing a very high urban population growth of about 30%. High aquifer recharge rates on Mt. Kenya are believed to sustain the total projected abstraction scenario until 2050 (11.7 Mm^3/yr) for great parts of Isiolo County. Over 58% of the domestic water is sourced from boreholes and 17% from shallow wells. Nevertheless, Merti, Garbatulla and Sericho areas are poorly served with water sources, particularly during the dry season. More than 73% of the villages rely on water sources that are unsafe and beyond 5km reach. Up to 58% of the water sources have saline water or excessive fluoride levels, hence limiting the availability of potable water, especially for human consumption. If water supply is brought up to national standards (20 L/capita/day with the water source within 1km distance) this means that water supply needs to increase with more than 400%. This all calls for comprehensive domestic water planning in the coming years. Pastoralists also have to walk often over 10km to the nearest water source, requiring water source planning for livestock too.

Recommendations & outlook

Water availability in Isiolo County fluctuates a lot, due to the erratic and spatial variation of rainfall. To make water available during the dry season, enhanced groundwater recharge and storage of rainwater are needed. The landscape offers opportunities to retain water, as the 3R potential section already showed. In most areas of Isiolo especially water pans, underground tanks and infiltration ponds show high potential. 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.

Population growth and, thus, water demand is increasing rapidly, while distances to nearest water points are still large. To comply with national standards a lot of water supply systems need to be developed. Focus should be more on strategic planning and targeting those areas where financial resources result in the highest increase of water access. Within this project, support to the county water sector plans will be given in order to support local government with the planning around water sources and infrastructure development.