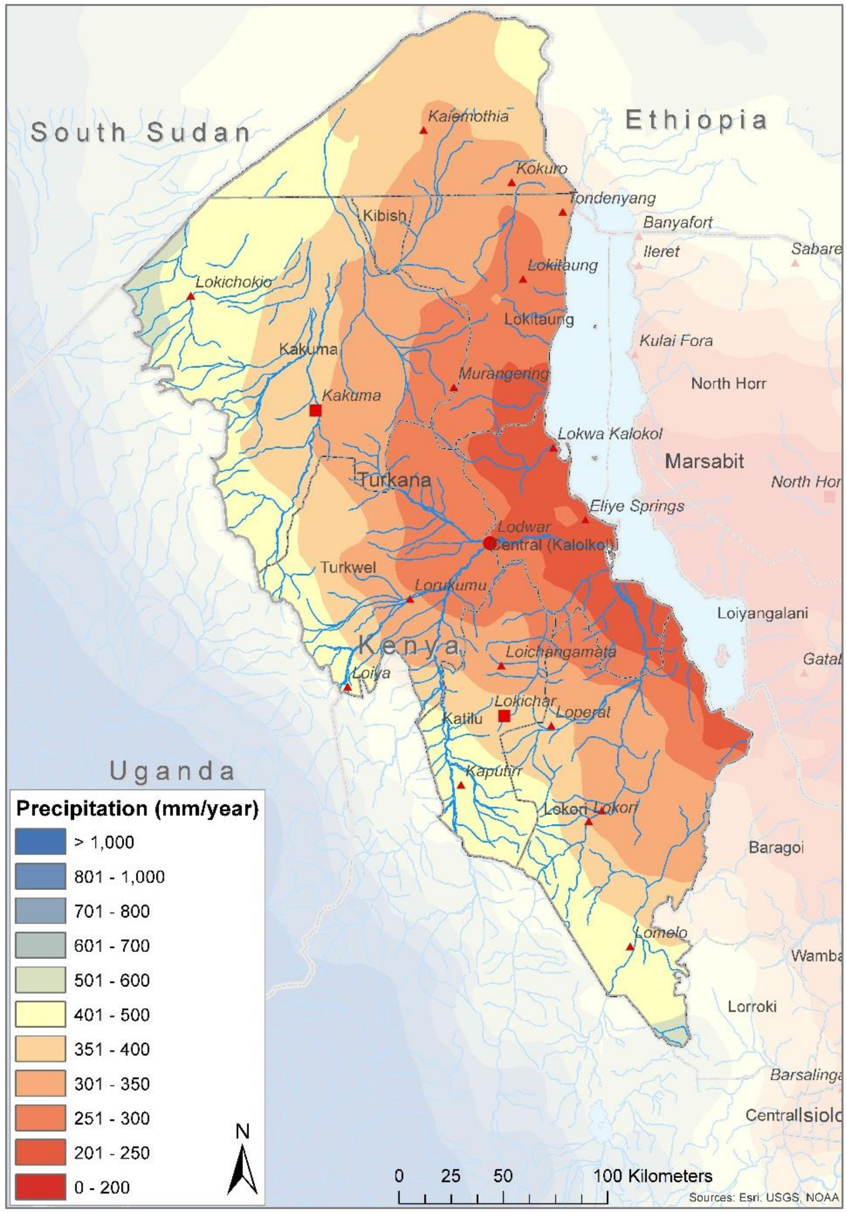
Turkana County Water Resources Factsheet

A 3R and MUS Analysis

Local context

Turkana County is situated in the northwestern part of Kenya and has a total area of 77,000 km². The saline Lake Turkana is a notable landmark and provides fishing opportunities. Most of the county consists of arid open lying plains dominated by shrub and grassland, which are subject to erosion by water and wind. The green mountain ranges along its western borders with Uganda and South Sudan provide important natural resources (e.g. wood). Charcoal burning is a major contributor to environmental degradation in the county. Along the Turkana and Kerio Rivers the largest number of people are settled because of their floodplains and presence of irrigated agriculture. Main crops produced are sorghum, millet and maize. The Turkana people are traditionally pastoralists with notable regional (cross-boundary) migration patterns. The total county population is about 1.3 million with an estimated annual growth rate of 3-6%.



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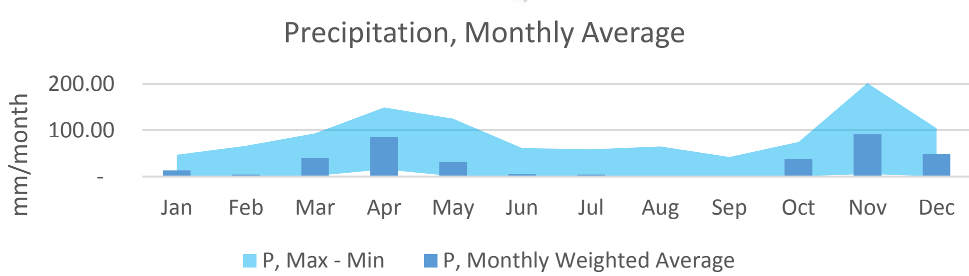
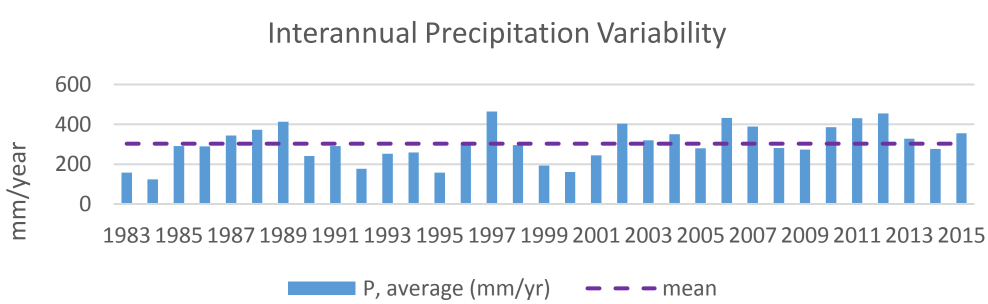
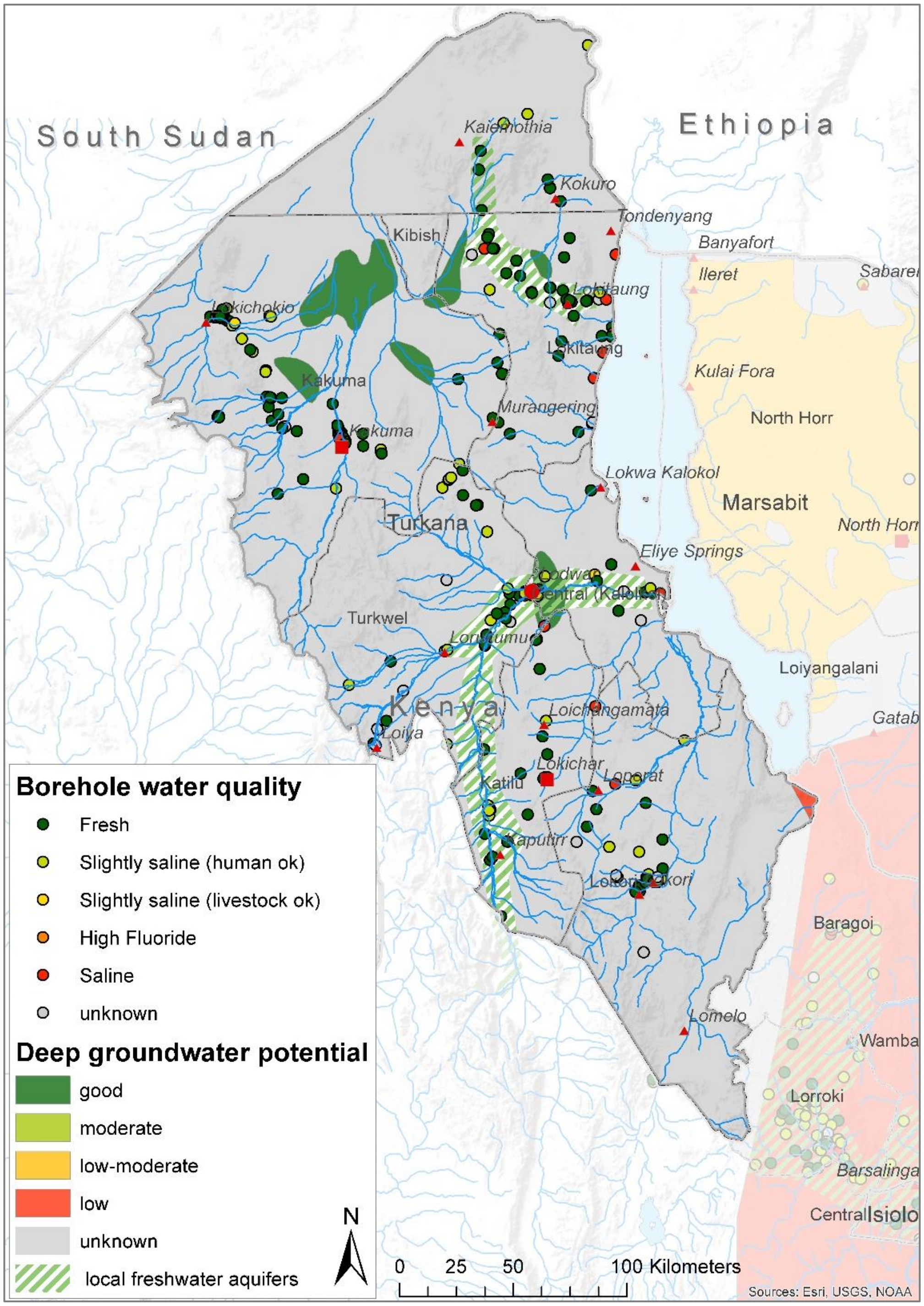
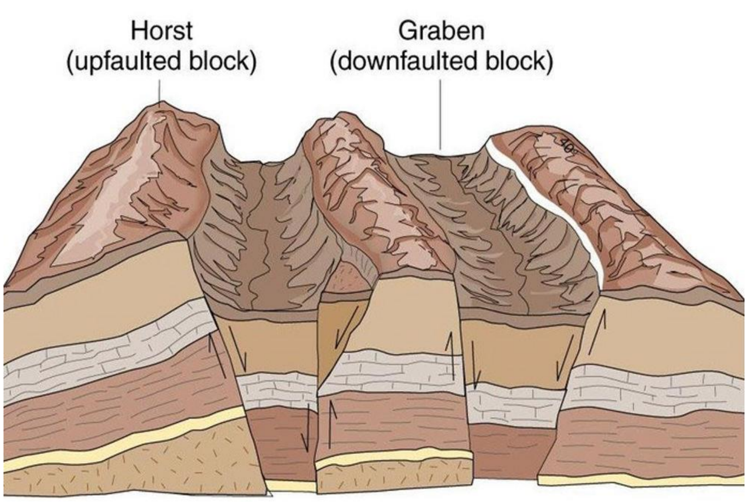




Climate

Turkana is a typical ASAL characterized by a hot climate. Rainfall follows a fairly erratic pattern varying significantly both over time and space, with short rains from October - December and long rains from March until July. Mean annual rainfall in Turkana County ranges between 125 and 480 mm with an average of 300 mm. Local lows of about 50 mm/year occur along Lake Turkana, while rainfall in the western parts are generally above 450 mm/year due to higher elevations. Brief rain storms occasionally result in flash floods causing loss of livestock and pasture. Low rainfall and high evapotranspiration also result into deposition of salt in the soil.

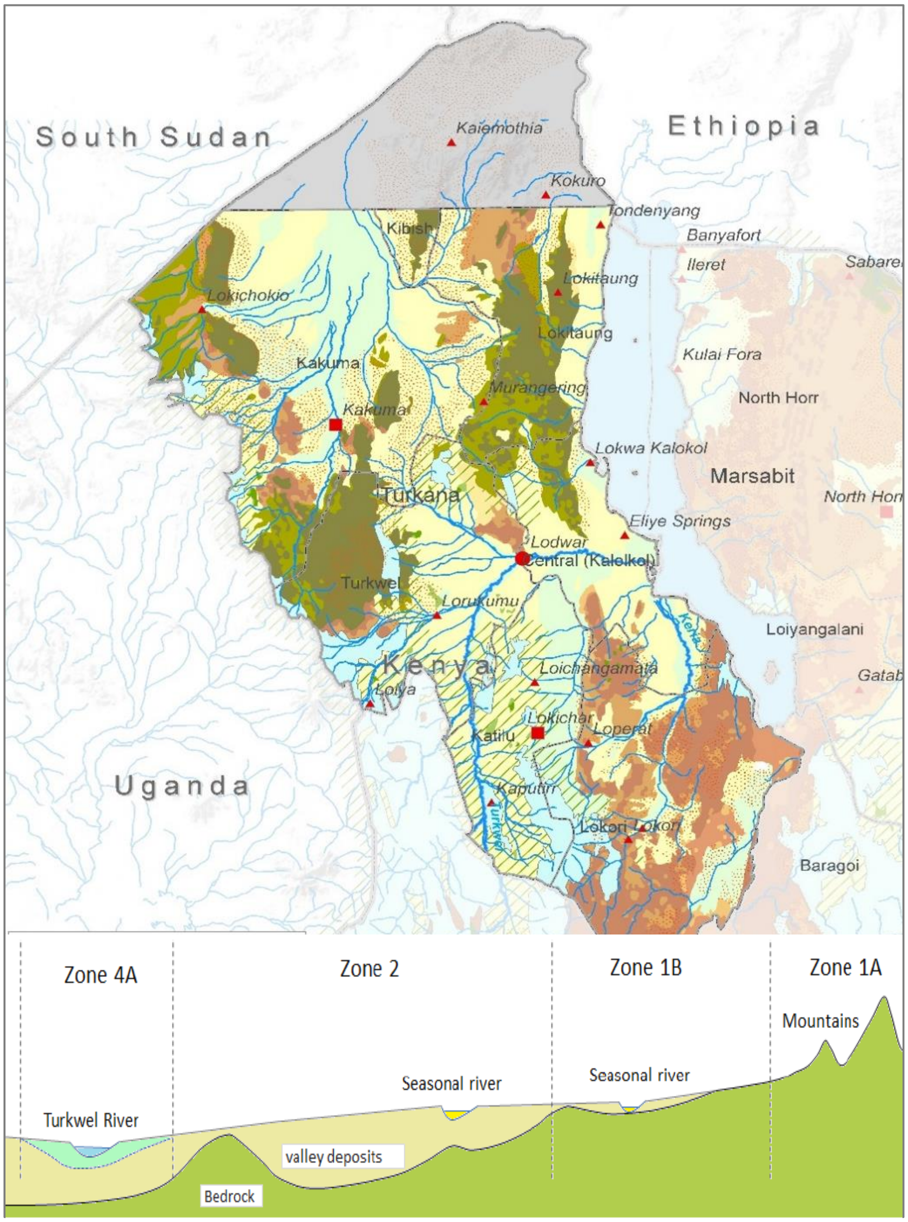




Visualization of how horsts (upfaulted block of land) and grabens (depressed block of land) are developed along parallel normal faults. A graben is a valley with a distinct escarpment on each side caused by the displacement of a block of land downward. (source: www.everythingselectric.com)

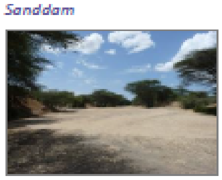
Deep groundwater potential

Due to a lack of research and available literature the hydrogeological properties for large parts of Turkana County still remain unclear. A groundwater study by RTI in 2013, however, suggested the presence of aquifer structures deeper than 80 m in northern and central Turkana, including five large deep reserves with significant scope. Turkana's lithology exhibits a relatively simple history of successive rift and sag basins, which were formed during Paleozic, Mesozoic and early Tertiary periods. Rifting in the northern Lotikipi basin caused several major North-South trending faults, which filled *grabens* (depressed blocks of land, see the figure left below) with basement-derived sandstones and silts. The five large identified aquifer reserves are linked to these main tertiary sedimentary basins in graben structure. Two of these aquifers, at Lodwar and Lotikipi, are confirmed with drilling by UNESCO, with estimated water storages of 10 and 248 million m3 respectively. The Lotikipi Aquifer is at a depth of 3 km. The potential for sustainable groundwater development is, however, still not confirmed and may prove to be significantly less, as improved measurements and estimations of groundwater volumes and quality distribution are still lacking. Even more concerns have been expressed about the specific recharge rates, which are, based on conventional literature, more in the range of 1-2% of the annual precipitation than the mentioned 16.3% by RTI. They seem to have neglected that evapotranspiration captures most of the water entering the soil due to high soil moisture deficits, and recharge only occurs during extreme rainfall events, which are rare and greatly localized in Turkana. Also the negative effects of groundwater development on, for example, existing users and ecosystems is not fully investigated.



Rock catchment

Sanddam



Subsurface dam potential

Turkwel River

Zone 1A: mountains and rocky areas with high potential for rock catchments and for (porous) sanddams in the seasonal rivers with sandy riverbeds (indicated on the map). Other streams have potential for open water storage in valley dams.

Zone 1B: flat to 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 (indicated on the map).

Zone 2: flat or gentle sloping areas near zone 1, with high potential for subsurface dams funded on a clay layer, shallow wells and water pans. Spate irrigation can be used to increase groundwater recharge.

Zone 4A: flat areas with river sediments, with high potential for direct river abstraction, riverbank infiltration and shallow wells. Spate irrigation can be used to increase groundwater recharge.

3R potential

Turkana County has a large range of 3R potential zones, which are divided based on geological and morphological features that have an impact on potential for recharge and retention of water. Important factors in this are:

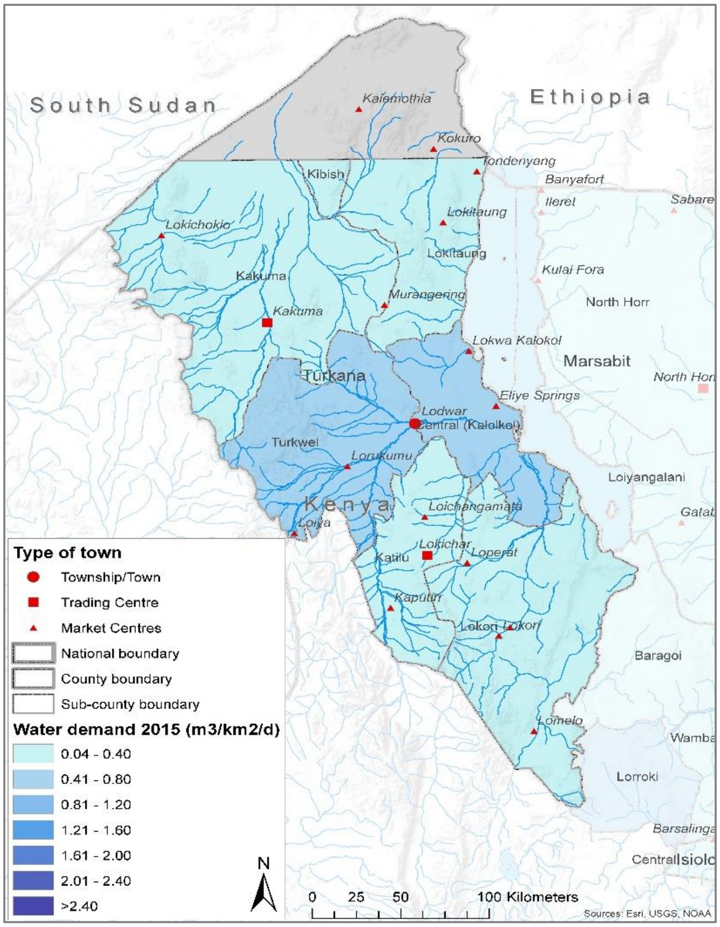
1) *The distinction between mountainous and plain areas.* On mountains the run-off velocity is high, and deep gullies may be found. In plain areas for example a dam in a gently descending river can create a long stretched reservoir, and floodwater spreading may be beneficial to increase shallow groundwater infiltration.

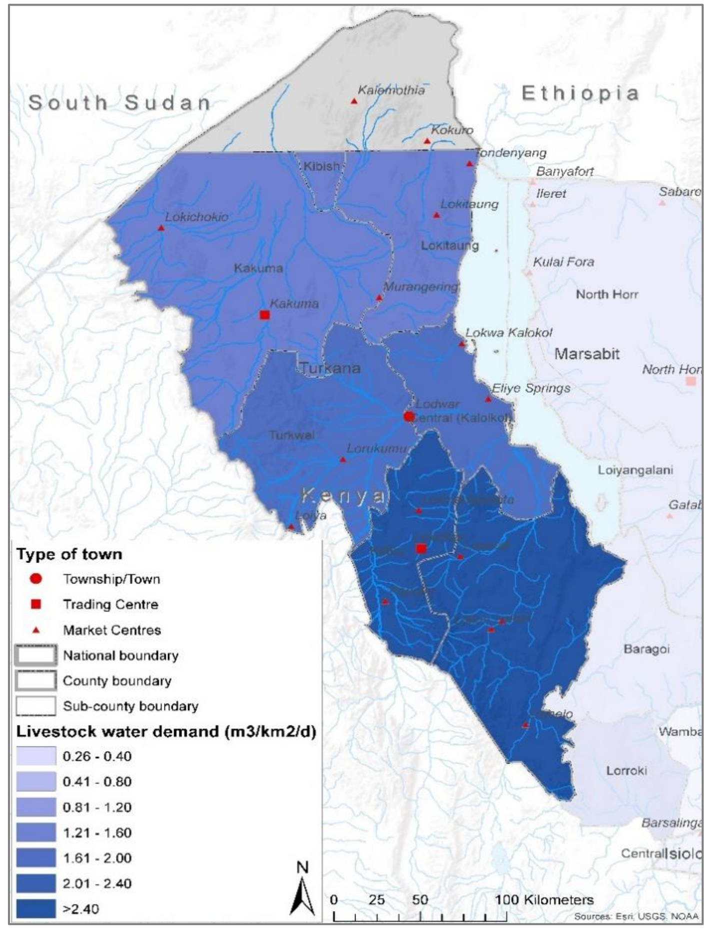
2) *The porosity of the rock or soil material.* The porosity or vertical permeability determines how fast water infiltrates into deeper layers. Low permeable soils are more suitable for rain water storage, while high permeable soils enhance groundwater recharge.

3) *Weathering products and sediments.* Locations with sandy sediments, which are abundant in Turkana, may provide the opportunity to create sand dams or subsurface dams. When the sediment consists of clayish material, it can provide the opportunity to reduce infiltration losses of reservoirs. It may also increase soil moisture potential, when combined with floodwater spreading. The alluvial sediments along the Turkwel and Kerio rivers show high potential for this.

The 3R potential map is still a generalized map with an indication of promising 3R interventions (see table below). On-ground verification is always required, such as the determination of local soil and geology types, surface run-off, and infiltration rates. The implementation of multiple, cascading interventions will increase the volume of water stored, and thus have a bigger impact.

	A Pans and/or valley dams	B Sanddams	C Subsurface dams	D Shallow, freatic groundwater: wells and riverbank infiltration	E (Flood)water spreading and spate irrigation	F Gully plugging, checkdams, and other run-off reduction	H Closed tanks
Zone 1A	x[1]	x	x	x		x	x
Zone 1B	x[1]	x	x	x	x	?	x
Zone 2	x	x[2]	x[2]	x	x	x	x
Zone 4A	x			X	x		x
Zone 4C	x			x	x		x





Water Supply and Demand

With ongoing changing livelihoods from pastoralism to agro-pastoralism, both domestic and agricultural water demand in Turkana County is more and more focused on the settlements along the main rivers. Main water sources are hand-dug shallow wells, direct river access and piped water from borehole and river abstractions. With advanced water supply systems (e.g. piped schemes) in urban and some market centres, the average distance to the nearest water point is often less than 1 km. For the whole county the average distance to the nearest water point is between 5-10 kilometres, whilst in remote areas the distances are as high as 20 km. Based on the water service ladder, this would mean that the current water use per household is less than 5 litres per capita per day (L/c/d). With an estimated population growth rate of 3-6% per year, (domestic) water demand will grow with about 85% within the coming 10 years. Bringing water supply to national standards (20 L/c/d, with water source within 1 km distance) will therefore be an important challenge.

Water use for livestock depends on the amount of rainfall. In years with plenty of rain, cows and camels will stay in the area, while in dry years they will move out of the county towards pastures that stay green longer (mostly to West Pokot, Baringo, Samburu and Uganda). Due to the fact that the rangelands are already at maximum carrying capacity for the current livestock numbers and with increasing erratic rainfall, it will be difficult to increase livestock numbers with the traditional approach. Therefore, a sound strategy on the use of the biophysical resources is required, otherwise (cross-boundary) conflicts between pastoralist groups will likely augment.

Recommendations & Outlook

Water availability in Turkana fluctuates a lot due to 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. The water quality of Lake Turkana is unsuited for most uses, options for desalinization could be explored. Deep groundwater is available as well, but requires further assessment of the discovered deep aquifers in order to ascertain sustainable long-term water provision from the aquifer and productivity for agricultural and domestic use, and to use mining of the aquifer prudently. Strategic planning of interventions is therefore required to achieve the biggest impact in terms of water access with the financial resources available.

Upstream developments, most notably damming of the Omo River in Ethiopia, will affect the annual freshwater inflow into Lake Turkana. This can endanger fishing opportunities on the lake, while the water will become more saline. Diplomatic consultations between Kenya and Ethiopia at international political level will be required to guarantee a base flow into Lake Turkana to mitigate the negative impact of upcoming interventions.