Drylands Learning and Capacity Building Initiative for Improved Policy and Practice in the Horn of Africa

DISCUSSION BRIEF: The Turkana Aquifer discoveries and development proposals[1]

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Introduction

After years of marginalisation, Turkana is very much in the news, with exciting exploitable oil reserves in the County as well as mineral resources. In addition, RTI/UNESCO recently announced the discovery of the Lotikipi aquifer, a vast underground lake the size of Lake Turkana, which is claimed '*could provide water for Kenya for 70 years*.'[3] This aquifer find adds onto four other smaller aquifers that were announced in the area earlier in 2013. The discoveries are based on new remote sensing technology not previously tested in Kenya. Assumptions about Turkana's future development potential need to be considered with some caution however, and this discussion paper supports the need for a critical review of the RTI/UNESCO report on its hydro-geological investigation in Turkana.

In order '*to complement efforts to increase community resilience to droughts …*', UNESCO felt '*it was strategic to support national and regional platforms to enhance capacity in climate prediction and drought forecasting and monitoring*'. Accordingly, on behalf of the Ministry of Water and Irrigation, UNESCO commissioned an '*advanced hydrogeological survey'* of northern and central Turkana County, to produce a groundwater resources investigation of an area of 36,000 km^2 - see Figure 1.[4] The zone is west of Lake Turkana, bounded to the north by the border of South Sudan (including the disputed Ilemi Triangle), and bounded to the west by the western Rift Valley escarpment bordering the Karamoja region of Uganda.

The RTI/UNESCO report includes the following statements and findings:

- Kenya is a nation '*in the throes of a deepening water crisis'*.
- Aquifers in three '*strategic locations'* were investigated '*directly in the field'*, namely Lodwar, Kakuma and Lokichoggio[5].
- Shallow aquifers with overall recharge capacity 2.08 BCM/year[6] were assessed, although their storage capacity was undefined due to the high variability of soil and geological conditions at the local scale.
- Aquifers that are deeper than 80 metres were also investigated, and '*five large deep (water) reserves with significant scope'* were identified. The total renewable groundwater resource was found to be 1.36 BCM/year.[4] Although there are significant volumes of water, the report contains warnings that '*extraction of water should be done with extreme caution to avoid over-exploitation'*. Furthermore, in the case of the Lotikipi aquifer, drilling explored to a depth 330 metres, encountering three aquifers of cumulative thickness 202 metres, the lowest being an ancient sedimentary aquifer (a palaeo lake) found at a depth of 300 metres, and perhaps

[1] This brief was originally produced by REGLAP (the Regional Learning and Advocacy Project for Vulnerable Dryland Communities) in November 2013, but was later revised and updated under DLCI.

[2] Contacts: sean@watres.com http://www.watres.com

[3] ITV News, Huge water reserve discovered in Kenya, 11th September 2013, www.itv.com

[4] Radar Technologies International (RTI): Advanced Survey of Groundwater Resources of Northern and Central Turkana County, Kenya, Final Technical Report, commissioned by UNESCO under the GRIDMAP Framework of the Government of Kenya, Ministry of Environment and Natural Resources, funded by the Government of Japan, August 2013.

[5] Lodwar town is Turkana's main governmental centre. Kakuma is the location of a large refugee camp, and Lokichoggio is located on the Kenya / South Sudan border, and was the launching point for relief operations into the once war-torn South Sudan.

[6] 1 BCM = 1 billion cubic metres = 1 km^3 (1 cubic kilometre).

extending 500 metres in thickness below this depth. Productivity in this palaeo lake may be less than the shallower aquifers, and '*there is concern that water in this deep layer may be of lesser quality*'.

- '… *Now that the resource has been properly mapped and assessed, Turkana County, as well as neighbouring counties and the nation at large, can begin to tap into the resource and build new economic opportunities … If developed safely and responsibly … (the water) offers new hope for 20 million Kenyans still living in poverty* …'.
- The total renewable groundwater resource of northern-central Turkana is estimated to be 3.442 BCM/year, comprising both the shallow and deep aquifers. Short-term, exploratory boreholes were recommended in Lotikipi and Lodwar to supply water to local communities, and the drilling of 200-500 shallow alluvial boreholes was recommended in high-potential areas identified by the survey.
- In terms of agricultural development potential, four target areas were proposed from a water potential perspective: (1) the riparian areas of the Turkwel river near Lodwar; (2) above the deep aquifer of Gatome; (3) above the deep aquifer of Nakalale; (4) the large area of the Lotikipi basin near the seasonal marsh.
- RTI/UNESCO presented two aquifer development scenarios that demonstrate the magnitude of the water find. The first scenario is to exploit the resource renewably, in which case, for example, at the '*normal rate of consumption'* 39.4 million people can be sustained (at the all-in daily rate 240 litres/capita inclusive, in all economic sectors). The second scenario is where the water is mined beyond renewable rates to total depletion, perhaps in a time of crisis, to serve the entire nation assumed to number 41 million people. In this case scenario it would last 70 years.

A very recent report was distributed by RTI at the National Water Summit[7] hosted in Turkana County from 9-10 October 2014. This recent RTI report was stated to have been prepared '*to raise general public awareness and for commercial impact assessment only*'.[8] RTI reported 37 boreholes having been drilled in the one-year period from September 2013, mostly by NGOs and aid organisations. RTI report that in this period '… *out of the vast possibilities from which to abstract new water supplies, the data shows that only a minute proportion of the Turkana population has gained improved access to water supplies within the past year* (RTI p.7-9)'. RTI laments that the National Water Master Plan launched by the Ministry of Water and Irrigation in March 2014 '*did not cite any of the Turkana tools and recommendations'* (RTI, Section 4).

Commentary on the Turkana water finds and prospects

The RTI/UNESCO 2013 report makes interesting reading in regard to the developments in remote sensing technology and the opportunities these provide for groundwater exploration; but a number of issues arise from the report, as outlined below. Experts have stated that '*a clear accounting of the methodology implementation in the project should be made publicly available and supported by sound documentation…*'.[19]

Traditional water sources in Turkana

Groundwater sources, in the form of springs and wells, have long been the mainstay of the Turkana area. In 1969 geologists reported that: '*The water supplies in the area, though small (apart from Lake Rudolf), are generally ample for the needs of the small nomadic population and their stock; the latter being necessarily limited by the poor grazing available'*.[9] In 1994, Turkana's Range Management Handbook stated: '…*compared to other districts in arid and semi-arid Kenya, Turkana District is exceptionally well supplied with water'*.[10] Traditional local knowledge has long recognised that potable water is available not far underground along the main river drainage lines, for instance along

[7] Mount Kenya University, in conjunction with UNESCO, Nation Media Group, the County Government of Turkana and Government of Kenya and the Institute of Capacity Building, held water summit in October 2014 to deliberate on sustainable groundwater management. The theme of the summit was: Water for socio-economic development.
[8] RTI. Taking stock of groundwater Discovery In Turkana (Kenya): The socio-ecomomic impact of WATEX exploration one year later (September 2013-2014).
[9] Walsh, J., and R.G. Dodson: Geology of Northern Turkana, Geological Survey of Kenya, 1969.
[10] MALDM: Range Management Handbook of Kenya, Vol II, 9, Turkana District, Ministry of Livestock Development and Marketing, Republic of Kenya, Nairobi, 1994.

the Turkweland Kerio rivers, and other seasonal watercourses. Traditional water sources, mainly shallow wells, once made up over 90% of all the water sources in the district.

Borehole drilling in Turkana

Borehole drilling technology has been introduced recently, albeit with mixed success. By 1994, five hundred boreholes had been drilled in Turkana, although less than 50% remained operational.[11] Kenya's Range Management Handbook questioned at the time whether '*there are too many boreholes in relation to the available forage*'. Permanent water sources lead to the concentration/settlement of human populations, and a consequent increase in surrounding habitat degradation. Many intervention agencies continue to drill boreholes however. For instance, Oxfam has drilled over 100 boreholes in the area since 2007, with a success rate of 70-80%.[12] RTI/UNESCO consider that there is need for capacity building in the water well drilling sector, a view commonly expressed by hydrogeologists and donors.

Prospects for the people of Lake Turkana

In 1969, the Turkana area population was estimated at 165,000 people.[13] In 2012, the Turkana County population was just over 1 million people, and forecast to increase to over 1.4 million by 2017.[14] The Kenyan population is forecast to almost double by 2030, and to treble by 2050 (compared to 2010 population levels),[16] and hence the nation's food requirements will increase substantially. In Turkana, the population's food needs have long surpassed the capacity of the area's traditional livelihood—pastoralism—due to many factors, including insecurity and lack of investment. Infrastructure in much of the area is non-existent, and the people of Turkana are amongst Kenya's poorest. Food relief interventions have become a permanent feature, and without significant, appropriate and immediate and sustained investment, the dependency situation will only deteriorate further.

The water discoveries suggest a wealth of new opportunities in prospect for the local people, but the reality may be very different. Whereas private property ownership is protected by the Constitution, water resources are vested in the nation. National resource exploitation requires sensitive management, especially in terms of the impact on local people and fulfilling their expectations in terms of benefit sharing. As stated above, RTI/UNESCO reported that the Turkana aquifer water resources could form a water reserve for the national population of 41 million people for 70 years (RTI[4] p.60), but there are already prevailing fears that the new found resources are destined to be removed from the area, as has happened in the past with the Turkwel dam's hydropower. To avoid potential conflict, national benefits from resource development should prioritise the people most local to the resource, and with the recent devolution of government to the Counties, there is now real potential to achieve this in Kenya.

Underground lakes, aquifer sustainability and declining water tables

Whilst the underground aquifer finds have generated considerable public interest, they are not altogether surprising as the area was once very wet: Lake Turkana was previously a freshwater lake 5-times its present size as little as 6,500 years ago, at which time the recharge to underground water aquifers was huge. Today these lands have arid and semi-arid climates, and are likely to become hotter and more arid with ongoing climate change. As a consequence of the area's low rainfall, the groundwater recharge is described by RTI/UNESCO as being '*considerably weak*', a fact which has an important bearing on water abstraction levels being sustainable.[4] If these sustainable levels are exceeded, the aquifer levels will diminish and their storage capacity can be permanently damaged. Aquifers beneath the city of

[11] Ibid.

[12] Oxfam: Personal Communication from Brian McSorley, November 2013.

[13] Avery, Sean: The Impact of hydropower and irrigation development on the world's largest desert lake. What future Lake Turkana? African Studies Centre, School of Interdisciplinary Area Studies, University of Oxford, December 2013.(http://www.africanstudies.ox.ac.uk/what-future-lake-turkana)

[14] Turkana County Government, County Integrated Development Plan 2013-2017.

Nairobi have in some areas been declining at the rate 10 metres per year due to over abstraction. There are also examples in other countries of major underground aquifers reduced by agricultural abstraction to the point where it is no longer economic to pump the water. The Al-Wajid aquifer in Saudi Arabia is an example where the water table in agricultural areas has declined 200 metres since the 1980s.[15]

Kenya's Water Resources Management Authority (WRMA) recently issued new Water Allocation Guidelines with which to determine sustainable national water abstraction levels. WRMA issues abstraction licences that specify abstraction limits, and these can be amended based on aquifer monitoring findings. It is essential that aquifer monitoring is carried out, as also recommended by RTI/UNESCO, and it is fundamental that managers of boreholes abide by the abstraction limits specified in their licences.

Kenya's National Water Master Plan – Groundwater resource assessment

Kenya's updated National Water Master Plan has predicted that groundwater potential exists throughout much of northern Kenya's arid and semi arid lands.[16] The Master Plan indicates the '*groundwater resources potential for development'* in the Lotikipi Basin as amounting to 20 – 100 mm/year, as compared to the figure of 96 mm/year derived from the RTI/UNESCO data. Other semi-arid lands in northern Kenya are also predicted to have comparable potential.[16] Historically the main challenge in the ASALs has not been a lack of water, but the practicalities of its utilisation; namely the costs of effectively extracting and distributing the underground water resources, and maintaining such infrastructure in remote areas. (The naturally high evaporation losses and infrequent and flashy runoff patterns have always posed a major challenge in regard to use of surface water sources, hence the reliance on groundwater.)

Comparing the RTI/UNESCO and National Water Master Plan water resource assessments

RTI/UNESCO announced that the Turkana aquifer water resource finds increase Kenya's water resources by 17% from 20.2 to 23.6 BCM/year".[4] By contrast the National Water Master Plan has determined Kenya's water resources to be 76.61 BCM/year,[16] i.e. more than 3-times the RTI/UNESCO figure. If the Master Plan is correct, then the Turkana aquifer find would equate to only 4% of the nation's water resource, from a land area roughly 6% of the entire country.

RTI/UNESCO has recommended that the remote sensing study technology be extended to the entire country, and further investigations are a good idea as it is otherwise premature to speculate that the Turkana water resource might become the country's reserve in a future national water crisis. The Turkana water resource needs to be contrasted with water resource availability throughout the country, and take into account full costs of exploitation and conveyance; only then can planners decide the national priority to attach to this particular water resource. As noted by the recent RTI report, the RTI/UNESCO recommendations have not been promoted widely.[8] In May 2014, WRMA launched hydrogeological investigations of Turkana and Marsabit Counties by local consultants.

Water quality

After the RTI/UNESCO findings were released, UNESCO arranged a water quality test of Lotikipi borehole water, which revealed an EC value of 8,000.[17] Kenya's rural water supply standards set the permissible level to be 750 and the EC limit to be 2,000. Thus the dissolved salt level of this water sample is 10-times the permissible level for rural and

[15] Al-Kahtani, Safar and Sobbhy M Ismaiel, Groundwater management in the Kingdom of Saudi Arabia: A case study of Al-Wajid Aquifer, December 2010.

[16] Nippon Koei / JICA Study Team: The Project on the Development of the National Water Master Plan 2030 (the Master Plan), Interim Report, for the Ministry of Water and Irrigation, Kenya, dated April 2012. See also "Workshop on Progress Report 4", dated August 2012.

[17] Data shared by Acacia Consultants (consultants on assignment from the World Bank) at a meeting dated 21st November 2014 in DLCI offices in Nairobi.

community water supply, and 4-times the absolute limit, and hence would not be suitable. UNESCO has since advised that the sampling was not undertaken competently and that the entire exercise must be repeated, and that the Ministry of Water and Irrigation is seeking World Bank's financial support to conduct a proper validation exercise.[18] Thus, this validation is not anticipated as an output by the consultancy team engaged by WRMA.

Rainfall in the Turkana rangelands and a critical view of RTI / UNESCO's recharge estimates

The RTI/UNESCO study area was 36,000km^2, and the renewable water yield stated to be 3.442BCM/year, and as mentioned above, this equates to 96mm of water spread equally over the entire study area. When viewed in these, albeit hypothetical, physical terms, the amount seems less impressive. It equates to 16.3% of the annual rainfall, and rainfall is in any case low in these semi-arid rangelands. The average annual rainfall is less than 200mm in some areas, but it is generally in the range 200 to 400mm, although it can reach as high as 600mm in the north of the Ilemi Triangle.[4]

Furthermore, the RTI/UNESCO recharge estimates are potentially far too optimistic: IGRAC have cited published recharge rates that are very much lower, with comparative recharge values for semi-arid and arid lands in the range 0.1 to 5%.[19] It is also worth bearing in mind that sustainable development yield is a fraction of the recharge. The National Water Master Plan assumed sustainable development yield to be 10% of groundwater recharge.[16]

Lake Turkana – Kenya's largest lake, and the world's largest desert lake

It is also useful to take a regional perennial surface water perspective when looking at overall resource availability. Lake Turkana forms the eastern boundary to the RTI/UNESCO study area, and is mentioned in their report. Lake Turkana is semi-saline and unsuitable for crop agriculture,[13] but it has less saline water than the RTI/UNESCO Lotikipi borehole test result referred to above, and rapid advances in desalination and solar energy technology mean even a semi-saline lake like Lake Turkana might eventually become an exploitable water resource. Small-scale reverse osmosis water treatment plants have been tried around the lake, mainly to remove the harmful excessive fluoride concentration in the lake water. These treatment plants are energy intensive high-pressure systems restricted to the provision of drinking water. Some of the new desalination and solar energy technology might reduce these constraints and offer potential for wider use. In Israel today, desalination provides 35% of domestic water supply, and will increase to 100% by the year 2050.[20]

Israel case study and lessons learned: Israel is a dry country whose annual rainfall averages 700mm but can be as low as 390mm over a ten-year period. 60% of Israel's land area is arid. Israel's dryland agricultural achievements, especially drip irrigation technology, are frequently held up as examples to emulate. However, the country's water resource management experience is also worth bearing in mind. Israel has exhausted its fresh water resources and now must desalinate saline groundwater, and ultimately seawater to meet its growing population water needs. In some areas water resource development has caused declining aquifers, salination of aquifers, pollution of aquifers by sewage, rivers drying up, and between 1930-97, the water level in the Dead Sea fell by 21 metres. Attempts to build dams and reservoirs to collect seasonal floodwaters in the Negev desert have failed because of large runoff variability, intensity of floods and technical difficulties.[21]

[18] E-mail communication from UNESCO to DLCI dated 28 November 2014.

[19] IGRAC (International Groundwater Resources Assessment Centre), October 2013. Review of the Report: Advanced Survey of Groundwater Resources of Northern and Central Turkana County, Kenya (RTI August 2013).

[20] Shimizo, Akiku. Center for Climate Law Change, Columbia Law School, Climate Law Blog, *Desailnation provides important source of scarce drinking water in Israel*, July 28th 2014.

[21] Sitton, Dr.Dov. Water in Israel: Historical & Technological Aspects in Development of Limited Water Resources, Jewish Virtual Library.

The Omo Basin — a trans-boundary water resource

Whereas Lake Turkana is semi-saline, the inflowing Omo River's waters are fresh, and reach the lake close to the study area, providing about 90% of the lake's total inflow. This major perennial river rises in Ethiopia's high rainfall highlands, and has an average annual flow variously estimated to be between 17.3 to over 20 BCM/year.[13] It discharges 14% of Ethiopia's entire surface water runoff, and its average flow is 6-times the combined renewable yield of the new aquifers reported by UNESCO.

The Omo Basin is undergoing major hydropower and irrigation development, and Kenya will share some of the benefits through purchasing power from the Sodo sub-station in Ethiopia.[13] The Omo Basin's most valuable renewable resource is its water. The Lower Omo's planned development covers up to 445,500 hectares, including the Kuraz sugar plantation currently under construction and comprising up to 175,000 hectares. The RTI/UNESCO water find of 3.442 BCM/year would sustain less than 70% of the irrigation water requirement of the Kuraz sugar plantation, with nothing left over. The Lower Omo is also semi-arid, and the water needs at the Kuraz sugar plantations serve to emphasise that irrigation water requirements in arid and semi-arid lands are enormous, almost beyond comprehension, and as such warrant careful study prior to investment. The Kuraz sugar plantation's estimated water needs equate to the gross water amount that would sustain 23 cities the size of Nairobi in 2010.[22]

Crop agricultural development targets in Kenya

Irrigation water requirements are seen as the most important factor in Kenya's water planning: today they account for 65% of Kenya's current water usage, and are forecast to increase to over 80% by the year 2030.[16] Kenya has ambitious plans to increase irrigation 600% nation-wide, with over 80% of the schemes being in arid and semi-arid lands. This irrigation expansion policy is also being emulated in other countries. Neighbouring Ethiopia's plans for commercial farmers producing food on 900,000 hectares of land within five years have encountered difficulties however, with only 10,000 hectares achieved so far by 2013.[23] Extreme arid areas like the Sahel have '*long suffered from drought, hunger and low economic growth*', and in the Sahel, the World Bank is also calling for '*more large-scale irrigation'*.[24] In October 2013 the World Bank promoted two summits '*on improving pastoralism and boosting irrigation in the Sahel'*:. The findings will be of direct relevance to areas like Turkana. On 22nd November 2013, Kenya's Minister for Agriculture was reported in the press addressing a food security assessment briefing in Lodwar: The Minister was shocked by the extent of drought, and said that in five years, the Ministry will have given the County the means to produce food to feed its own people. The Minister requested the allocation of 50,000 hectares of land to the Kenya Agriculture and Research Institute (KARI).[25]

Crop agricultural development is an important aspect of government policy, and a sustainable water supply will be fundamental to its success. The newly announced Turkana aquifers have raised expectations for the Turkana area, but the aquifer yield estimates may be too high, and at the same time water needs in arid and semi-arid environments are vast as the evapotranspiration rates exceed rainfall by an order of magnitude. The National Water Master Plan has calculated that in the Turkana area, the average annual water requirement for irrigation is about 20,000m^3 per hectare.[16] This is based on the water requirement of what the Master Plan calls a '*typical cropping pattern*;' specialist crops like cattle fodder might require three times this amount. Based on the 'typical' cropping pattern, the UNESCO

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[22] The population of Nairobi in 2010 was estimated to be 3,257,615, with gross water demand estimated to be 582,928 m^3/day (6.7 m^3/s) at an average daily per capita water demand of 180 litre/cap/day (Egis BCEOM & MIBP Partners Version 02, Water Sources Options Report, Feasibility Study and Master Plan for Developing New Water Sources for Nairobi and Satellite Towns, August 2011). At an irrigation effciciency of 70%, Kuraz will require at least 154 m^3/s (see Avery, 2013)

[23] Bloomberg News, Ethiopia push to lure farm investment falters on flood plain, 25th November 2013.

[24] World Bank Press Release dated 27th October 2013, "the Sahel: New push to transform agriculture with more support for pastoralism and irrigation".

[25] Daily Nation, 22nd November 2013: "Relief food to be supplied as drought bites".

find of 3.442 BCM/year would sustain an irrigated area of 172,100 hectares, equivalent to Kenya's entire irrigated area in 2011. If crops with higher crop water needs are selected, the potential irrigated area will be much less. These are indicative figures for discussion purposes only, and do not take into account water needed for other purposes; for instance domestic and livestock consumption, and the industrial needs of oil exploitation for which water needs have yet to be defined by the industry.

Whilst water is the main challenge facing crop development in Turkana, soil considerations are equally important, as was stated by RTI/UNESCO. Arid land soils are vulnerable to salinization, which destroys agricultural potential.[26] To avoid this, adequate good quality flushing water and good drainage are needed.

All these considerations demonstrate that there are considerable challenges facing large-scale crop production in Turkana. The engagement of KARI in research in Turkana is an excellent initiative, but is long overdue, and hopefully the findings will contribute to rationalising the country's irrigation development goals as was recommended in the National Water Master Plan.[16] The feasibility of crop production depends on the availability of water, but the Turkana aquifers are some years away from being proven and fully developed; and also some of the water is very deep and will be costly to extract, and water quality is uncertain. Studies alone could take another ten years, during which time population pressure in the Turkana area will require urgent government investment. Water resource availability will become critical and Kenya currently has an ongoing need to manage its existing resources effectively, by adopting major water conservation measures throughout the nation.

A recent study commissioned by FAO has identified the potential to increase the present irrigated areas in Turkana County from 2,666 hectares to 16,600 hectares, thereby not only meeting the County's food needs, but also achieving a food surplus to export beyond the County.[27] The FAO study investigated riverbank schemes along the Kerio and Turkwel rivers and found that these schemes are not sustainable without massive financial subsidies. The irrigation scheme infrastructure typically only lasts three years, for several reasons, including destruction by floods[27] and in some cases due to poor design.[15] The water resource availability assumptions by the FAO team may be optimistic, and it should be noted that the Turkwel and Kerio rivers serve as an important recharge mechanism through riverbed infiltration into the ground water table. The water removed by upstream irrigation schemes will no longer be available to recharge the alluvial aquifers downstream, and will reduce water availability to sustain riparian vegetation zones. Put into a different perspective, the water needed to irrigate 16,600 hectares in the arid lands is equivalent to the basic water need[28] of a human population of over 36 million people. It should also be noted that gravity water feed design considerations require these irrigation schemes to be built within or through the riparian zone adjacent to the rivers. Indigenous riparian forest is being cleared with local climate consequences, and irrigation canals are providing conduits for destructive floodwaters. Because of the sustainability issues of riverbank irrigation schemes, some NGOs have shifted focus, instead adopting small-scale borehole-based drip irrigation schemes located away from the rivers. These projects must also deal with a different range of sustainability issues.

Conclusion

The poverty levels in Kenya's Turkana area, as in other northern counties, are an ongoing national concern. Investment in infrastructure in the ASALs is essential, and is being planned. At the same time Kenya's virgin natural resources are finite and diminishing, and there is a shared duty to nurture these resources for future generations. Existing crop

[26] FAO, Corporate Document Repository: Socio-economic considerations in reclamation and management of salt-affected soils. Also Land and environmental degradation and desertification in Africa: "The magnitude of the problem".

[27] Ocra Consultants Ltd., Opportunities and Threats of Irrigation Development in Kenya's Drylands, Volume VI, Turkana County, 2013, study commissioned by FAO and funded by EU.

[28] Basic human need = 25 Litre/cap/day (Legal Notice N.171, The Water Resources Management Rules 2007, Kenya Water Act).

production systems should perhaps be optimised in the high rainfall areas of Kenya before developing new resources in the drylands.

Renewed support is also required to integrate the all-important livestock sector, and the Turkana County Integrated Development Plan rightly identifies livestock to be an economic pillar.[29] Studies have shown livestock to be more economically productive in arid lands than, for instance, irrigated sugar plantations.[30] Development plans will also require ongoing support for the wildlife sector, a remarkable national asset that traditionally integrates with livestock, although it can lead to conflicts with crop producers.

Land consolidation in highland areas is a difficult but necessary consideration, and a major investment impetus is needed throughout the country. FAO has warned that: '*Africa's natural resource base is being degraded and destroyed at a rate which will soon make food and agricultural production unsustainable*'.[26] Some countries are mining their groundwater aquifers to near destruction, and having instead to source food from abroad. These are typical costly consequences of poor resource management.

The Turkana water aquifers will take many years to develop, as will the oil development. Some of the Turkana water is very deep, of uncertain quality, and will be costly to extract. The large-scale crop development that is envisaged in the arid lands needs to be piloted and properly assessed. The progress with the crop development ambitions in neighbouring Ethiopia suggest that optimistic goals will need to be tempered with realism; with contingency measures being sustained in the interim development/testing period.

There is valuable African continent wide experience to guide the sustainable and integrated development of Kenya's drylands, a process in which DLCI participates. These experiences indicate exciting prospects where crop development is integrated with livestock production, and they also indicate the importance of community level commercial crop agricultural development, rather than the centrist large-scale systems, which have consistently failed in the past.

[29] Turkana County Government, County Integrated Development Plan (CIDP), 2013-2017.

[30] Behnke, Roy and Carol Kerven, Counting the costs: replacing pastoralism with irrigated agriculture in the Awash Valley, north-eastern Ethiopia, Working Paper No.4, IIED, March 2013.

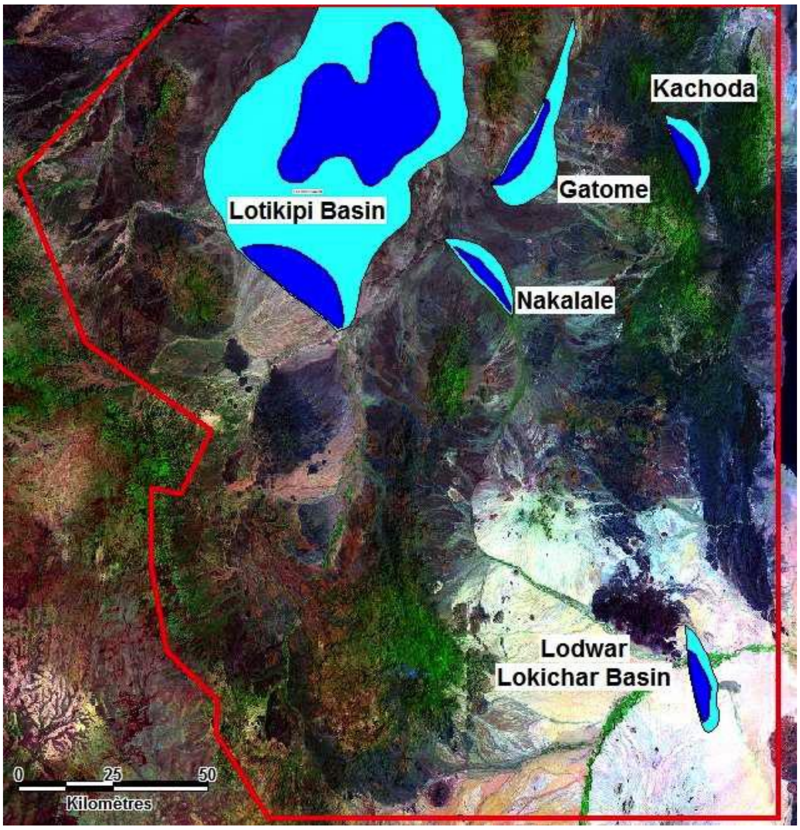

Figure 1: Turkana's regional deep aquifers (RTI, 2013) [4]

Humanitarian Aid
and Civil Protection

This brief was developed as part of a project funded by the European Commission Humanitarian Aid and Civil Protection Department (ECHO).

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