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# WHAT FUTURE FOR LAKE TURKANA AND ITS WILDLIFE?

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*In recent months, the international conservation agenda has been topped and dominated by wildlife crime, ivory, rhino horn and the illegal trade in live animals and animal parts. This is a welcome focus for a very unwelcome business. But there are other pressing conservation issues that would benefit from similar international focus and concern. One, which the EAWLS has long been concerned about, is the future of Lake Turkana, the Jade Sea of legend, (see SWARA 2013-2) and the impact of Ethiopia's Omo Basin development plans might have on the world's largest desert lake. In this article, hydrologist **Sean Avery** lays out the threats and the opportunities posed by one of the biggest water-related development plans of modern times.*

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On 23rd November 2013, Kenya and Ethiopia were to sign an agreement to “develop a joint plan for sustainably managing the environment and resources of Lake Turkana and its river basins for the benefit of both people and the environment”<sup>2</sup>. This did not take place, and at the time of writing, the reasons were not known. The Lake Turkana basin covers over 130,000 square kilometres, shared in near equal proportions between Kenya and Ethiopia, but also encroaching into South Sudan near the Ilemi triangle, and extending into Uganda in the west near Mount Elgon— see Figure 1.

In 1996, Ethiopia presented its master plan for developing the Omo Basin, an area populated today by about 14 million people.<sup>1,3</sup> The Omo river discharges 14% of Ethiopia’s annual runoff, an enormous resource almost matching Kenya’s entire surface water runoff. The highlands of the upper basin enjoy plentiful rainfall, whereas the lower basin’s lowlands approaching the lake are semi-arid.<sup>4</sup>

In 2006, Ethiopia started building the massive 243 metre high Gibe III hydropower dam on the Omo River, some 600 kilometres from the lake. In 2009, scientists claimed that there would be radical reductions in inflow to Lake Turkana due to reservoir leakages underground.<sup>5</sup> They forecast the lake dropping 10-12 metres with aquatic ecosystems declining. Also in 2009, the African Development Bank (AFDB) commissioned a hydrological study of the impacts on Lake Turkana, the first study of its kind on the lake itself.<sup>6</sup> This AFDB study modelled changes to hydrological cycles and modelled huge

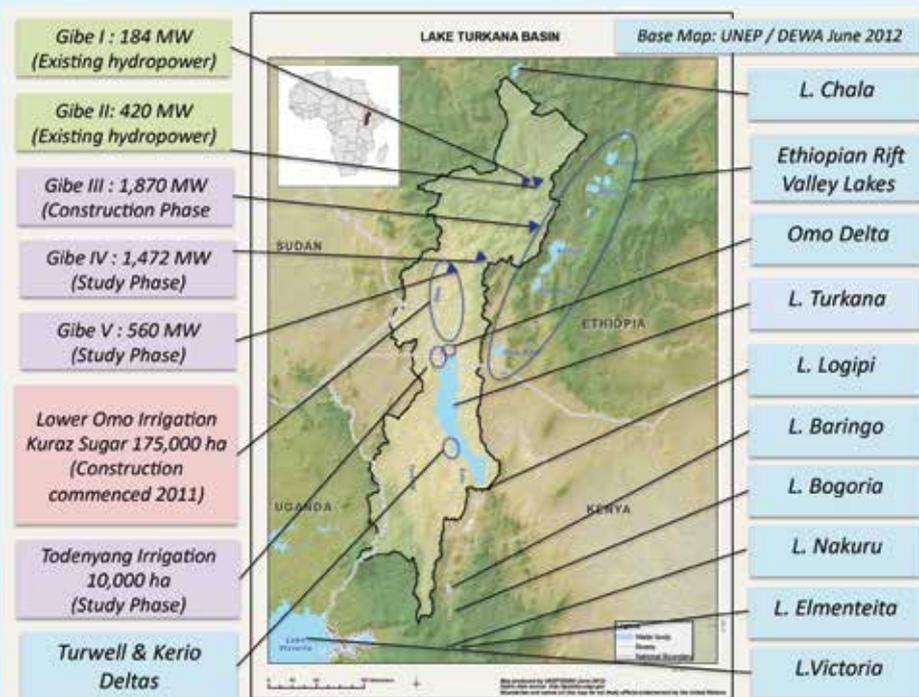


Figure 1: Lake Turkana Basin

drops in lake levels resulting from large-scale irrigation abstractions.

In 2011, Ethiopia commenced transferring 445,500 hectares of land in the Lower Omo from its traditional owners to commercial farmers from outside the area. Over 135,000 hectares of land were degazetted from the Omo and Mago National Parks, and from the Tama Wildlife Reserve, for conversion to sugar plantations.<sup>7</sup> The planned Lower Omo development’s land area is almost three times Kenya’s current irrigated area. The projects are mired in controversy. Neither feasibility studies nor Environmental and Social impact Assessments (ESIAs) have been released for the irrigation schemes. The Gibe III downstream ESIA was an afterthought done three years after dam construction started, and it did not investigate

impacts on Lake Turkana, and did not consult Kenyan stakeholders.

Lake Turkana was not within the study area of the Omo Basin Master Plan. International donors considered impacts on the lake to be of little consequence, and that these could be compensated through sharing benefits such as hydropower.<sup>3</sup> The World Bank however cold-shouldered the Gibe III project, but only because the direct sourcing of the contractor was not acceptable under the Bank’s procurement procedures.

Human rights organisations have decried the manner in which the irrigation projects are being implemented, claiming that this is a land-grab,<sup>8</sup> with the local people unwillingly evicted from their traditional lands by the authorities,

<sup>1</sup>Richard Woodroffe & Associates, and Mascott Ltd., Omo-Gibe River Basin Integrated Development Master Plan Study, Final Report for the Ministry of Water Resources of the Federal Democratic Republic of Ethiopia (15 volumes), December 1996.

<sup>2</sup>Communication from the Division of Early Warning and Assessment, UNEP, 15th November 2013.

<sup>3</sup>For more details see Avery, S.T., Lake Turkana & The Lower Omo: Hydrological Impacts of Gibe III & Lower Omo Irrigation Development, Vols I and II, African Studies Centre, University of Oxford, October 2012. <http://www.africanstudies.ox.ac.uk/lake-turkana-and-lower-omo-hydrological-impacts-major-dam-and-irrigation-developments>

<sup>4</sup>The upper Omo Basin’s highland rainfall exceeds 3,000 mm/annum in places. The lower Omo Basin’s lowland rainfall near the lake averages 300 mm/annum.

<sup>5</sup>Africa Resources Working Group (ARWG). A Commentary on the Environmental, Socio-Economic and Human Rights Impacts of the Proposed Gibe III Dam in the Lower Omo River Basin of Southwest Ethiopia, January 2009, ARWG-GIBE.org

<sup>6</sup>Avery, S.T., Assessment of hydrological impacts of Ethiopia’s Omo Basin on Kenya’s Lake Turkana water levels. Draft Report commissioned by the African Development Bank as part of mediation with Friends of Lake Turkana, November 2009. A Final Report was submitted in November 2010: [http://www.afdb.org/fileadmin/uploads/afdb/Documents/Compliance-Review/REPORT\\_NOV\\_2010\\_S\\_AVERY\\_TURKANA\\_Small\\_file.pdf](http://www.afdb.org/fileadmin/uploads/afdb/Documents/Compliance-Review/REPORT_NOV_2010_S_AVERY_TURKANA_Small_file.pdf)

<sup>7</sup>Ethiopian Wildlife Conservation Authority (EWCA), Existing Challenges: Plantation Development versus Wildlife Conservation in the Omo-Tama-Mago Complex, reported by: C.Enawag, D.Deksios, G.Timer, 2011.

<sup>8</sup>Oakland Institute, Understanding Land Investment Deals in Africa, Half a million lives threatened by land development for sugar plantations in Lower Omo. Land Deal Brief, September 2011.



PHOTO BY: KIERAN AVERY

Figure 2: South Island National Park

without adequate compensation, and to the accompaniment of physical abuses.<sup>9</sup> Leading members of the international community are being accused of turning a “blind-eye”, perhaps mindful of international vested interest and not wishing to upset a strategic partner?<sup>10</sup> Interestingly, the Omo Basin’s own Master Plan in 1996 drew attention to the lessons of people being displaced by government-sponsored commercial development, and warned strongly against repetition of past mistakes.<sup>3,1</sup>

The Lake Turkana National Parks comprise Sibilo National Park, Central Island, and South Island, listed together as a World Heritage Site, and believed threatened by the consequences of the Gibe III dam construction.<sup>13</sup> The World Heritage Committee has twice received recommendations from its experts that the Lake Turkana National Parks should be included on the World

Heritage endangered list, and each recommendation has been set aside by the Committee.<sup>11</sup>

The Omo is the reason Lake Turkana exists, providing 90% of the lake’s freshwater input. Lake Turkana is uniquely the world’s largest desert lake. Located within Kenya’s most arid area, this is Kenya’s largest lake, its semi-saline waters supporting Africa’s highest salinity fisheries, its ecology derived from the lake’s former fluvial connection to the Nile basin. 6,500 years ago, Turkana was a freshwater lake five times its present size, its water level nearly 100 metres higher than today, its waters spilling into the Nile Basin about 150 km north-west of the present lakeshore. This lake is an extraordinary example of climate change. As the region became increasingly arid, the lake level dropped and the basin closed with no outlet,

thereafter becoming progressively more saline (see Figure 3). The lake’s contemporary lowest levels occurred in the 1940s, 1950s and 1988, dry periods that occurred throughout Kenya. The lake’s level today is higher than those levels.

About one million people in Kenya live in the former Turkana, Samburu and Marsabit Districts that border Lake Turkana. These northern areas have long been neglected, with very little government investment. The area is insecure, with constant livestock rustling, and the people are amongst the nation’s poorest. They traditionally depended on pastoralism, a livelihood very well suited to these arid lands, but undermined by rising population challenges, insecurity, land fragmentation, restrictions in mobility, and absence of adequate governmental support for the livestock marketing

<sup>9</sup>Human Rights Watch. “What Will Happen if Hunger Comes?”; Abuses against the Indigenous Peoples of Ethiopia’s Lower Omo Valley; ISBN-56432-902-X, June 2012.

<sup>10</sup>David Turton, Aiding and Abetting: UK and US Complicity in Ethiopia’s Mass Displacement, Think Africa Press, 4th November 2013.

<sup>11</sup>Avery, Sean, “What future Lake Turkana”, African Studies Centre, University of Oxford, December 2013. <http://www.africanstudies.ox.ac.uk/what-future-lake-turkana>.

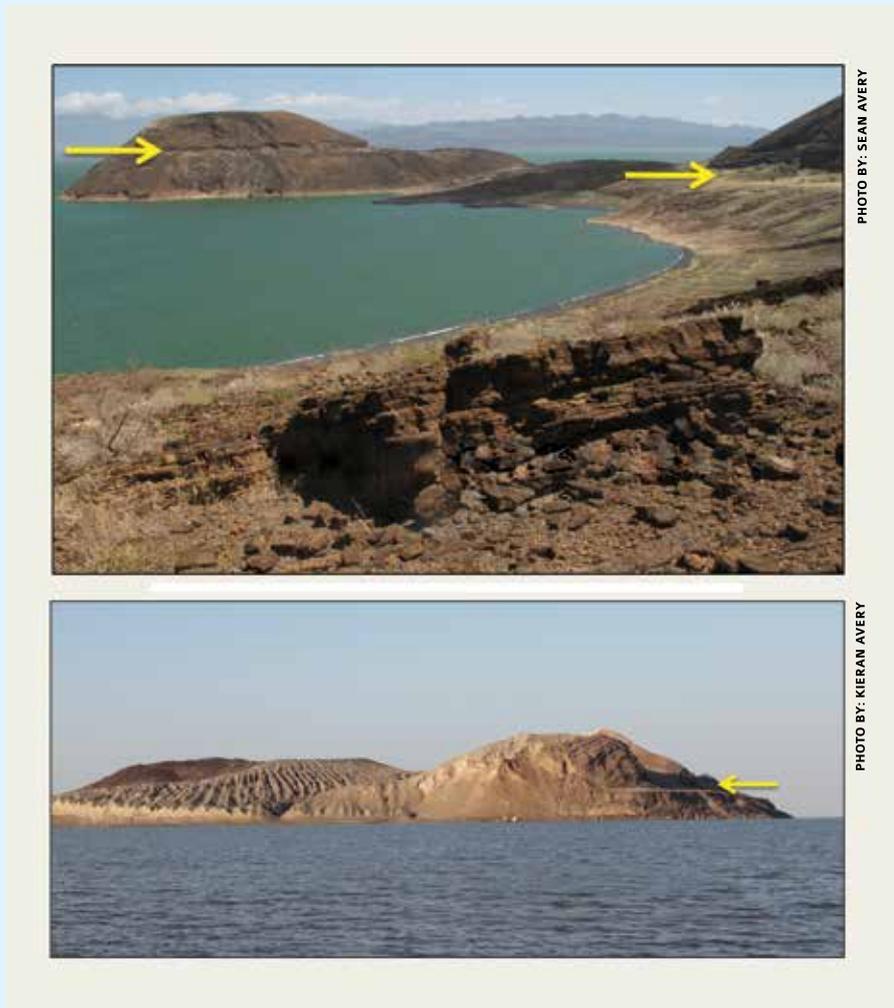


Figure 3: Palaeo shorelines on Lake Turkana's islands

sector. Alternative livelihoods have developed, including crop production and fishing, but to a limited extent. In some places today, up to 75 % of the food input is external food aid.<sup>12</sup>

In the 40 years since 1969, the population of Turkana District increased four-fold. By the year 2050, the national population will be treble the 2010 population. The area's wildlife is already threatened and in serious decline. Weapons proliferate throughout, thus adding to wildlife vulnerability. Wildlife is virtually non-

existent along the lake's western shore, and there is human encroachment into protected areas on the islands and the north-eastern protected area.<sup>13</sup> A recent field trip reported hardly any crocodiles, with crocodile nests witnessed being raided, and with animals (crocodiles and turtles) unfortunately taking baited fishhooks or entangling in fishing nets, and then drowning.<sup>14</sup> This depressing scenario of declining wildlife will be further compromised if the escalating poverty and human needs are not dealt with.

There are now real prospects of major infrastructure investment in the area, thanks to Government policy stimulated by the excitement surrounding oil finds in the region. A major transport corridor is planned through the area from Lamu to South Sudan.<sup>15</sup> These developments could be to the benefit of local people and wildlife, but if improperly managed could instead further impoverish local people and increase pressure on diminishing wildlife. The oil exploration is ongoing, and production is a long way off. In addition, UNESCO recently announced a deep palaeo freshwater lake beneath the Turkana rangelands west of the lake towards Karamoja. This lake is said to be the size of Lake Turkana, complementing four other deep-water aquifers announced earlier. The UNESCO team claims that these resources may have major implications and potential impact in terms of national and regional development. It is even suggested the resource might serve the nation for 70 years in a crisis.<sup>16</sup> Although there are real opportunities with the water, there is danger in raising unrealistic expectations. This water resource is dependent on the "weak aquifer recharge" characteristic of low rainfall areas. The quality of the deep-water reservoir is uncertain, and pumping costs will be prohibitive.<sup>17</sup>

Crop development in arid and semi arid lands requires huge water quantities, and the water sources will take time and investment to prove and develop.

Lake Turkana enjoys year-round sunshine and warm waters. The prevailing southeasterly winds drive surface currents in the upper layers, and cause reverse currents in the lower layers. The water column is well mixed, turbid, and well oxygenated. The surface current transports zooplankton to concentrate on the NW shores, leading to unusual concentrations of

<sup>12</sup>Brewin, M., Report for Oxfam Kenya: A Study of Small Businesses and Markets to inform Oxfam's strategy in Turkana District, Kenya, 2009.

<sup>13</sup>World Heritage Centre & IUCN, Mission Report, Reactive Monitoring Mission to Lake Turkana National Parks (Kenya), undertaken 14-22 March 2012, May 2012.

<sup>14</sup>Avery, Patrick. Kenya's jade jewel in peril from Ethiopia plans, SWARA, May-June Issue, pp. 16-21, 2012. <http://www.mursi.org/documents>.

<sup>15</sup>Lamu Port to Southern Sudan to Ethiopia Transport (LAPSET) Project: The main components are a road, rail and oil pipeline network from South Sudan to Lamu, with airports at Lamu, Isiolo and Lokichoggio, and resort cities in Lamu, Isiolo and at Eiei Springs on Lake Turkana.

<sup>16</sup>Regional Learning & Advocacy Programme for Vulnerable Dryland Communities (REGLAP), "The Turkana Aquifer Discoveries: A REGLAP discussion perspective" by Sean Avery, independent consultant, November 2013.

<sup>17</sup>Media Paper for REGLAP, prepared by Sean Avery, November 2013. Some of the water is up to 800 metres below ground.

<sup>18</sup>Hopson A.J (ed.). Lake Turkana: A Report on the Findings of the Lake Turkana Project, 1972-75; Volumes 1-6, University of Stirling (funded by the Government of Kenya and the Ministry of Overseas Development, Overseas Development Administration, London), 1982.



PHOTO BY: SEAN AVERY

Figure 4: A fine Nile Perch near Alia Bay (released unharmed)

in a perpetual state of change” with fish yields, species composition and main fishing grounds recurrently undergoing unpredictable and drastic transformations”.<sup>22</sup> This lake is “an unstable ecological system with the biological processes highly geared to the hydrological regimes”.<sup>22</sup> This lake is very different from other African Great Lakes<sup>22</sup> and is thus unique.

Thus, an engineered hydrological change that introduces stability in place of natural instability will potentially destroy the lake’s existing ecology.

Once construction is complete (estimated to be in 2014), the Gibe III dam will need the equivalent of almost the entire annual discharge into Lake Turkana to fill its huge reservoir, albeit spread over a three-year period. This means capturing a large proportion of the river’s nutrients. Lake Turkana’s level will drop two metres. This drop is short-term, and once Gibe III is full, the lake level will recover slowly. Gibe III will thereafter “process” 67% of the river discharges that ultimately reach the lake, storing and releasing this water according to engineered turbine releases that bear no resemblance to natural hydrological cycles. Sediments and other nutrients that settle in the reservoir will obviously never reach the lake. There will be uniformity in discharges from the dam throughout the year, low flows will be raised above natural levels, and floods will be attenuated. The entire annual hydrological cycle will be smoothed by the constancy of power generation requirements.

The dam designers have proposed an ecological flood release for 10 days in September each year. This has been criticised as lacking a proper scientific basis. It was not agreed with Kenya, and there is no guarantee that the releases will happen. In any case, the proposal will be rendered redundant

small pelagic fish and their predators.<sup>18</sup> The lake is popularly known as the Jade Sea, its colouration attributable to its blue-green algae, the lake’s dominant phytoplankton.<sup>18</sup> In spite of inadequately regulated commercial fishing, including encroachment into protected areas,<sup>14</sup> large handsome Nile Perch still flourish – see Figure 4.

The most profound seasonal changes in the lake arise during the annual flooding, which peaks in the period August to October. The principal flood source is the Omo river, which provides around 90 per cent of the lake inflow. The upstream seasonal inundation of offstream areas, and the runoff therefrom, releases valuable organic matter and nutrients, which are carried into the lake by floods. Nitrogen, one of the two most important factors limiting fisheries production (the other being light), is also transported into the lake.<sup>18</sup> The floods also stimulate the migration of spawning fish into the Omo itself.

Within the main lake, fish breeding tends to be greatest during floods. The

sediment-rich waters extend south right through the central sector of the lake, diluting the lake water and lowering the salinity levels in northern parts in particular. The sediment plume reduces visibility and fish tend to move to the lake surface and to the shore, and the reduced light penetration affects production of organisms that depend on photosynthesis. The influx of nutrients during the flood season initiates changes in the algal population, and the margins of the lake inundate.<sup>18</sup>

Floodplain fisheries such as Lake Turkana’s are reportedly Africa’s most productive.<sup>19</sup> Studies have shown that productivity increases with instability, that lake level changes promote interaction between aquatic and terrestrial systems,<sup>20</sup> and that annual fluctuations in lake level are very much more significant than absolute lake levels.<sup>21</sup> Lake Turkana’s peak production rates have been associated with peak rises in lake level, with declining production rates associated with falling lake levels.<sup>22</sup> Lake Turkana “is seemingly

<sup>18</sup>Welcome (1979), and Junk et al. (1989), both cited by J.Kolding and P.A.M van Zwieten in “Improving productivity in tropical lakes and reservoirs”, Challenge Program on Water and Food - Aquatic Ecosystems and Fisheries Review Series 1. Theme 3 of CPWF, C/o WorldFish Center, Cairo, Egypt. 139 pp. ISBN: 977-17-3087-8, 2006.

<sup>19</sup>Kolding, Plus ça change, plus c’est la même chose. On the ecology and exploitation of fish in fluctuating tropical freshwater systems. Dr. Scient. thesis, Department of Fisheries and Marine Biology, University of Bergen, ISBN 82-7744-011-1, 1994.

<sup>20</sup>Karenga, L., and J. Kolding. On the relationship between hydrology and fisheries in man-made Lake Kariba, Central Africa, Fisheries Research 22, 202-226, 1995.

<sup>21</sup>Kolding, Jeppe. A summary of Lake Turkana: An ever-changing mixed environment, Mitt. Internat. Verein. Limnol., 23, 25-35, Stuttgart, May 1992.

<sup>22</sup>Two hydropower schemes are planned downstream of Gibe III to complete the hydropower cascade (named Gibe IV and V respectively).

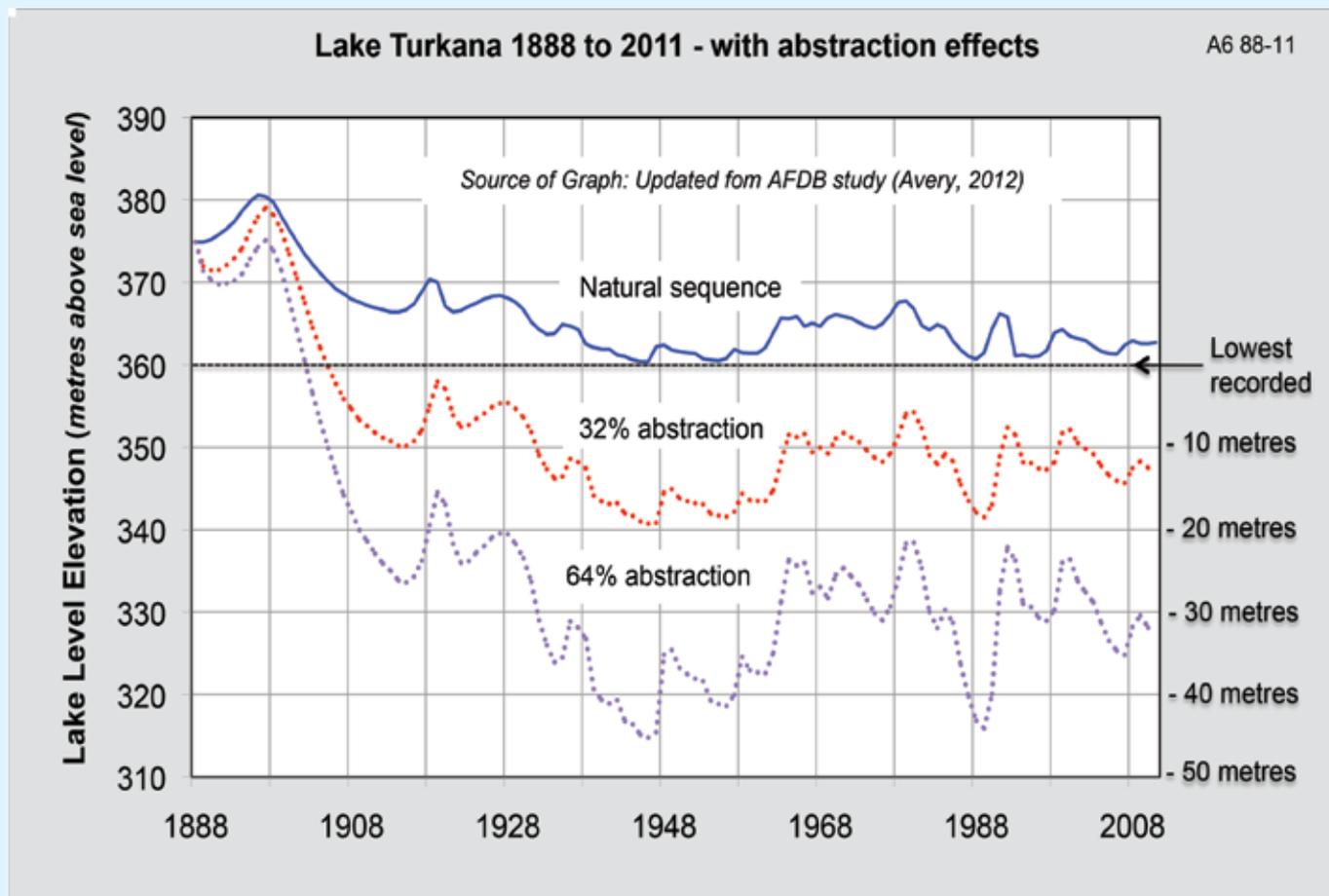


Figure 5: Lake Turkana water level changes with increasing abstractions from the Omo river

by the construction of another vast lake downstream of Gibe III.<sup>23</sup> Furthermore, if the ecological flood release is liable to damage newly constructed irrigation infrastructure downstream, it will obviously not be allowed.

Hydropower schemes are non-consumptive (apart from induced losses), but they totally alter the hydrological cycle. In contrast, irrigation schemes are very heavy water consumers, in Kenya predicted to account for over 80 % of the country’s water usage. Although the development feasibility studies have not yet been provided for Ethiopia’s Kuraz sugar plantations, it has been estimated that Lake Turkana might be deprived of up to 50 % of the entire river discharge and nutrients, and this would be permanent,

and could drop the lake level 20 metres.<sup>6</sup> The Kuraz sugar scheme is about 160,000 hectares in area, equivalent to the irrigated area in the whole of Kenya. The total agricultural area offered to investors in the Lower Omo amounts to 445,000 hectares. No studies have yet been provided to demonstrate to Kenya the feasibility of this ambitious crop development plan. If it materialises as planned, the Omo could be emptied in its entirety, which would mean that Lake Turkana might be destined to become Africa’s Aral Sea.<sup>24, 25</sup>

Fisheries experts have long held the view that drastic changes to the Omo’s natural hydrological cycles will destroy the lake’s fisheries ecology. Kenya’s National Water Master Plan

in 1992 warned of fisheries collapse with increased water consumption in the upper catchment.<sup>26</sup> The Omo Basin’s Master Plan in 1996 anticipated an adverse effect on fisheries from flow reductions and widespread use of chemical pesticides on plantations, and warned that fertiliser runoff would have both beneficial and detrimental consequences insofar as nutrient inflows.<sup>1</sup>

Many fisheries experts have since emphasised the lake’s hydrological dependence, and the potential destruction of the lake’s fisheries should hydrological cycles be altered.

The Omo Basin Master Plan in 1996 recommended a bilateral agreement with Kenya before altering the river flows. Disregarding this

<sup>24</sup>The Aral Sea, Central Asia’s most infamous man-made environmental disaster, was once one of the four largest lakes in the world. It steadily shrunk after rivers feeding it were diverted in the 1960s by Soviet irrigation projects (Wikipedia). By 2007, the lake was 10 per cent its original size (ibid.). Salinity levels rose, fishing ceased altogether, and salts blown by winds from the dried lake-bed are destroying pastures (UNEP).<sup>25</sup>UNEP. Vital Water Graphics - An Overview of the State of the World’s Fresh and Marine Waters, 2nd Edition. UNEP, Nairobi, Kenya, ISBN: 92-807-2236-0, 2008.  
<sup>26</sup>JICA funded National Water Master Plan for Kenya, Ministry of Water Development, 1992.

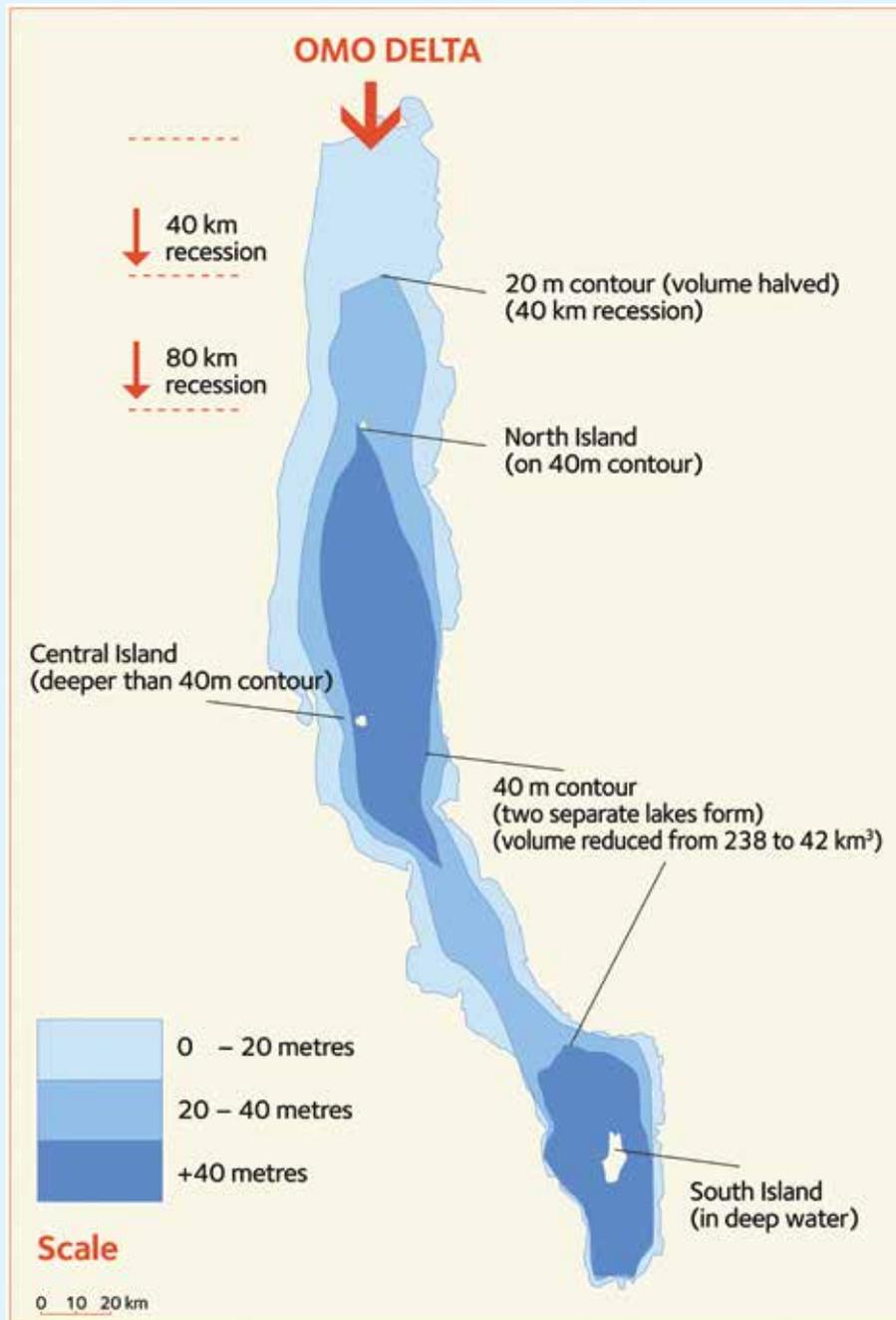


Figure 6: Lake Turkana’s bathymetry and lake recession consequences

Figure 5 shows the actual lake level variation from 1896 to date (solid blue line). In 1896, the lake was at its highest level in contemporary times. Two abstraction scenarios are superimposed to show how drastically the lake levels might reduce with increasing irrigation abstraction (dotted lines). To put the lake drawdown into perspective, the lake’s average depth is about 30 metres. Figure 6 shows the lake’s bathymetry and the extent to which the shoreline would recede for different lake level drop scenarios. The ultimate potential long-term scenario would be the lake becoming two small lakes, the north lake fed by the Omo, and the south lake fed by the Kerio and Turkwel rivers. The crater lakes on Central Island would also shrink, as their water levels follow the main lake level, and perhaps these small lakes may dry up altogether.

Ironically, climate change may provide some runoff volume respite. Over 20% increase in surface water runoff is forecast by 2030 in Kenya’s Rift Valley rivers.<sup>27</sup> On the other hand, Kenya Vision 2030 targeted a 600 % increase in the irrigated lands by 2030,<sup>27</sup> much of this being planned in the arid and semi arid lands, and any such developments will affect downstream flows in the associated rivers. Also, Kenya’s human population will treble from 2010 to 2050. Water demand will proportionally increase, as will the pressures on Kenya’s wetlands. Very careful management of the country’s natural resources is needed, as a water deficit is already apparent today. ●

recommendation has been counter productive, and it is almost too late, as Ethiopian national parks have been de-gazetted with agro-pastoralists displaced from their lands, and concerns have been voiced in Kenya for some time. Whilst the trans-boundary agreement currently being brokered is

a big step forward, it is late, and major hurdles have already been created. The predicted consequences on the lake will become apparent once Gibe III comes on stream along with the Lower Omo under extensive crop irrigation. Gibe III is nearing completion and the sugar plantations are under way.

### Acknowledgements

The author is grateful to the African Development Bank for the original commission to study the Lake Turkana hydrology, and for the African Studies Centre of the University Oxford for enabling extended studies.

<sup>27</sup>Kenya’s National Water Master Plan development to Year 2030, prepared by Nippon Koei / JICA Study Team, for the Ministry of Water, 2012. Kenya Vision 2030 targeted 1.2 million hectares of irrigated croplands, but recent estimates from the National Irrigation Board (NIB) reduced this to 765,575 hectares (the reduction being largely due to “degradation of water towers”). These figures are subject to increase with the Turkana aquifer find – see NIB presentation to REGLAP Media Briefing on Irrigation in the Drylands of Kenya at Intercontinental Hotel on 3rd December 2013).