

# Effects of Human Activities on the Nile Basin: Lessons from Kenya

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## Abstract

Kenya has five major water towers arising from indigenous montane forest areas. Lake Victoria drainage basin is of special interest as nearly half of the country's population lives in this basin. It is endowed with abundant water and other natural resources. Destruction of water towers and lack of proper harnessing of the other four water towers, places more pressure on Lake Victoria drainage system, which produces water for drinking, domestic, agricultural and industrial use, fisheries, biodiversity, and hydropower, among others. The systematic destruction of the *Mau* Complex in particular has had adverse effects in the nation's weather pattern in general and the Nile (Lake Victoria) basin in particular. The paper documents the specific human activities on the *Mau* Complex and the Lake Victoria drainage system and their overall effect on the Nile basin. Research methods were in qualitative form. The qualitative study focused on secondary data (archival sources). Data was analysed using thematic analysis. Recommendation for policy is highlighted as it is hoped that the results of the study will improve our understanding on the Nile Basin and support policy-makers in designing better future policy.

## Keywords

Basin, Drainage, Towers, Nile

## 1. Background Information

Worldwide, as is reported by the United Nations Environment Programme (UNEP), there are 263 international transboundary river basins, with 59 of these in Africa (UNEP, 2009). Kenya has five major water towers arising from indigenous montane forest areas, namely, Mount Kenya, Aberdare Range, *Mau* Complex, the *Cherangani* Hills and Mount Elgon, which give rise to the five drainage basins of *Tana* River, Lake Victoria, Rift Valley and inland Lakes, *Athi* River and the

Coast, and *Ewaso Ng'iro* (Nyingi et al., 2013).

The Nile Basin has a population of around 160 million people covering eleven countries: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, South Sudan, Tanzania, and Uganda (Abteu & Melesse, 2014; Clayton et al., 2014). The water resources in the Nile basin are already over-tapped with ongoing conflict over the Nile River (Zeidan, 2015; Reichert, 2019). According to the United Nations Environment Programme (UNEP), transboundary nature of the basin increases conflict due to difficulties in the shared management of declining water resources (UNEP, 2009). In addition, places with water pollution also exacerbate cooperative management efforts.

The Nile countries lay claim to the waters based on their relative power, access to external patrons from outside the basin and access to alternative sources of water (Waterbury, 2002). Growing population and limited water resources has led to significant fluctuations in Nile River flow with record droughts (Abteu & Melesse, 2014). Despite the Nile not having enough water to meet the various needs of the Nile basin countries, competing projects are coming up across the various Nile Basin countries leading to further water stress on the river (Clayton et al., 2014). Furthermore, local livelihoods, wildlife, and species habitats are affected by human activities in the Nile Basin (Ma et al., 2021; Yesuph & Dagnew, 2019). In addition, the Nile Basin nations' countries are vulnerable to famine and disease (Allan & Nicole, 1998; Kameri-Mbote, 2006).

## 2. Situating the Research

Kenya, a Nile Basin country, is considered a water scarce nation with only 647 cubic meters of renewable freshwater per capita, characterised by high spatial and temporal variability and extremes of droughts and floods (Republic of Kenya, 2006). Due to the topographical land formation of the Great Rift Valley, Kenya has five major water towers arising from indigenous montane forest areas (Republic of Kenya, 2006; Nyingi et al., 2013).

The water towers, namely Mount Kenya, Aberdare Range, *Mau* Complex, the *Cherangani* Hills and Mount Elgon, give rise to five drainage basins. The drainage basins are namely *Tana* River covering 21.7% of the country; Lake Victoria covering 8% of the country; Rift Valley and inland Lakes covering 22.5% of the country; *Athi* River and the Coast covering 11.5% of the country; and *Ewaso Ng'iro* (*Nyiro*) North covering 36.3% of the country (Seegers, et al., 2003 in Nyingi et al., 2013). The *Mau* complex water tower which covers over 400,000 Hectares, is the largest of the 'five water towers' of Kenya (UNEP, 2009).

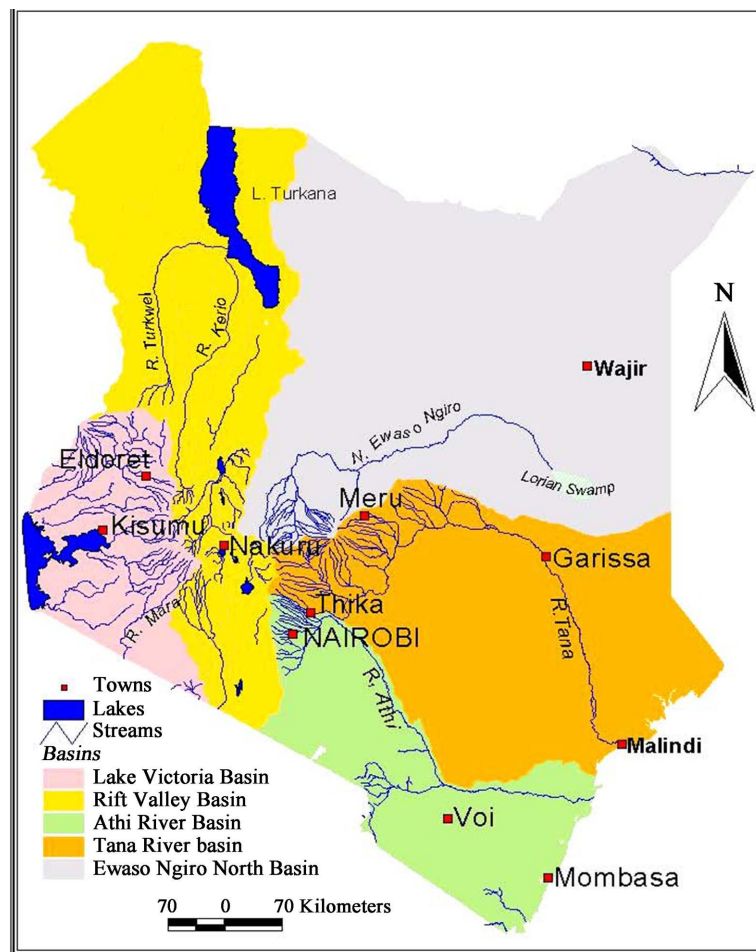
Lake Victoria Basin is located in the upper reaches of the Nile River Basin (*ibid*). In addition, the basin is shared by Kenya, Uganda, the United Republic of Tanzania, Rwanda, and Burundi, and occupies about 251,000 Km<sup>2</sup>, while the Lake itself covers 69,000 Km<sup>2</sup>. Lake Victoria is the second largest lake in the world and the largest in the developing world (Okungu et al., 2005). The lake surface area is shared by Kenya (6%), Tanzania (51%) and Uganda (43%). The

lake has a wide land catchment area, which is almost three times the size of the lake, and extends over Kenya, Uganda, Tanzania, Rwanda and Burundi (*ibid*). This is the area from which rivers carry water, nutrients, sediments and pollutants into the lake and is about 193,000 Km<sup>2</sup>; of which the catchment area in Kenya covers 42,460 Km<sup>2</sup> (see **Table 1** and **Figure 1**). Waters feed it from the

**Table 1.** Land catchment area in the lake Victoria basin.

Country	Catchment area	Catchment area %
Tanzania	84,920	44
Kenya	42,460	22
Uganda	30,880	16
Rwanda	21,230	11
Burundi	13,510	7
<b>Total</b>	<b>193,000</b>	<b>100</b>

Source: Okungu et al. (2005).



Source: Republic of Kenya (2006).

**Figure 1.** Drainage systems of Kenya.

*Kagera, Mara, Simiyu, Gurumeti, Yala, Nyando, Migori, and Sondu–Miri* rivers, which account for 20 per cent of the Lake’s water, while the remaining 80 per cent is from direct rainfall (Awange, et al., 2008) in UNEP (2009). As is presented in **Table 2**, Lake Victoria Basin, which is the smallest in size, has more than 50% of the national surface water resources (Republic of Kenya, 2006).

The increase in human population and activities has led to increased pressure and diminishing of natural resources such as forests, grassland and water, leading to conflicts over these resources (Gichuhi, 2013). The study examines the effects of human activities on the Nile basin. Specifically, the study examines the effects of human activities in the Nile basin on increased diminishing of natural resources; the effects of human activities in the Nile basin on increased resource conflict; and to propose solutions to protect the Nile basin.

The study or inquiry is based on Kenya’s experience of a long period of destruction of the water towers, specifically the *Mau* catchment area. The *Mau* forest complex is Kenya’s largest canopy forest eco-system and the single most important water catchment in the Rift Valley and Western Kenya (Gichuhi, 2013). The lake and the catchment area are rich in a variety of habitats. The catchment has multiple land use types ranging from pastoralism to large-scale commercial farms and ranches, and wild life (Maasai Mara National Reserve and Lake Nakuru National Park).

### 3. Human Activities and Drainage System

The five “water towers” of Kenya, Mount Kenya, the Aberdare Range, the *Mau* Forest Complex, Mount Elgon, and the *Cherangani* Hills, are montane forests and the five largest forest blocks in the country (UNEP, 2009). They form the upper catchments of all the main rivers in Kenya (except the *Tsavo* River originating from Mt. Kilimanjaro). The “water towers” are sources of water for irrigation, agriculture, industrial processes, as well as to all installed hydropower plants.

These montane forests are also surrounded by the most densely populated areas

**Table 2.** Spatial variability of average annual surface water availability.

Drainage area	Volume in million cubic meters per year	Percentage of water abstracted
Lake Victoria	11,672	2.2
Rift valley	2784	1.7
Athi River	1152	11.6
Tana River	3744	15.9
Ewaso Ng’iro	339	12.4
National	20,291	5.3

Source: The aftercare study on the National Water Master Plan, July 1998 in Republic of Kenya (2006).

of Kenya, because they provide enough water for intensive agriculture and urban settlements (DRSRS and KFWG 2006) in (UNEP, 2009). In addition, the forests supply timber and non-timber products to the communities living within their surroundings. The forests are however being lost or degraded by extensive illegal, irregular, and ill planned settlements and illegal forest resource extraction.

The decrease in forest cover and increased soil erosion has affected the rivers negatively and lakes through sedimentation and reduced water flow (Gichuhi, 2013). For instance, Lake Nakuru National Park, which is a home to flamingos and has the largest Euphorbia forest stand in East Africa and a wildlife rich savannah and highland moist forest, has been receding due to reduced river flow because of negative impact of human activities on the *Mau* catchment. The *Mau* Complex forms part of the upper catchments of all but one of the main rivers on the west side of the Rift Valley (UNEP, 2009). These rivers act as arteries carrying the *Mau*'s waters throughout western Kenya—from Lake Turkana in the north to Lake Natron in the south as well as to Kenya's most populous rural areas in the Lake Victoria basin.

Population increase is associated with changing farming practices which has led to changes in land use and land cover (Mulatu et al., 2019). Also, human activities have had a huge and deleterious impact on original plant cover (see Williams, 2019). This he says is done by a few farmers using simple tools and fire. Each year, fire is used to burn dead grass before sowing. In addition, there are also the effects of drought and overgrazing resulting in desertification and soil erosion. According to Duncan et al. (2019) population growth along with anthropogenic activities cause water pollution of rivers. Human activities in the watershed including deforestation and irrigation, has about changes the river flow including diversion and pollution.

#### 4. Methodology

The study area is in the Nile Basin catchment area. Specifically, the study focuses on the *Mau* Complex located in the Rift Valley. The *Mau* catchment is the largest montane forest in East Africa and largest drainage basin in Kenya. It is a source of many rivers flowing into numerous lakes including Lake Victoria, which receives 60% of its water from the *Mau*. The western part of Kenya is part of the Nile system, via rivers like the *Sondu* and *Mara* River that empties in Lake Victoria (UNEP, 2009).

Qualitative research design was employed. It involved employment of secondary source analysis which is the re-analysis of data that was originally compiled by another researcher for other purposes. This involved conducting desktop research to obtain secondary data. Desk study review of the water catchment areas and related information available were looked into in-depth. This helped to clarify the context of the research. The data included published reports, statistics, documents and historic data. The desk study identified key factors affecting the water towers and the vulnerability the population and specific geographic area.

Qualitative data collected was coded as an important step towards data analysis. Collected data was itemized and extraction of relevant information done. Report writing was done in Microsoft Word.

## 5. Results and Discussion

This part presents the details of the desktop research. Anthropogenic activities in Kenya, a country Most of Kenya's surface water originates in its five mountain areas of Mt. Kenya, Aberdares, *Mau* complex, Mt. Elgon, and *Cherangani* (Republic of Kenya, 2006). These critical sources are commonly referred to as "Kenya's water towers" and they support the major sectors economy. The *Mau* catchment area is undergoing significant changes in terms of deforestation, and human settlement. The rivers originating from the *Mau* forest and Mount Elgon, in the Cherangani hills, flow into Lake Victoria which is the main reservoir of the river Nile. There have been increased forest excisions leading to the declining forest cover and human settlement in forests for agriculture. Communities or squatters have also taken up farming inside forest in what is commonly referred to in Kenya as the *Shamba* system (Kagombe & Gitonga, 2005). The result has been illegal logging, and destruction of wildlife (bird and animal) their habitat. Deforestation has resulted in increased flooding. Floods have led to loss of life (see **Box 1** and **Figure 2**), damage of ecosystems, increased risk to public health,

### **Box 1.** Human activities.

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1. Deforestation
  - 1.1. Forest fragmentation
  - 1.2. Edge effects
  - 1.3. Floods
  - 1.4. Soil erosion
  - 1.5. Direct loss to wildlife habitat
  - 1.6. Rising water table
  - 1.7. Salinity
  - 1.8. Water-borne diseases
  - 1.9. Aquatic weeds
2. Irrigation
  - 2.1. River diversion
  - 2.2. Soil erosion
  - 2.3. Pollution of ground water and surface water
  - 2.4. Destruction of water quality
  - 2.5. Water logging and salinization
3. Increased water withdrawals
  - 3.1. Sinking of boreholes
  - 3.2. Sinking of wells

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Source: Desktop Data (2022).



Source: Butynski and Dong (2016).

**Figure 2.** The excised forest area.

damage to property and business and a threat to water quality (WHO, 2014; Nile Basin Capacity Building Network for River Engineering, 2005). There has been an increase in sinking of wells and boreholes in the basin leading to increased water withdrawals (Mumbi & Fengting, 2020). This affects the ground water quantity and quality (Ridgway et al., 2016).

The destruction of the water towers in Kenya continues unabated with politicisation of conservation efforts. The ambiguous implementation of the water towers protection and preservation has resulted in piecemeal incursions and fragmentation of the ecosystems. If the status quo continues, the water towers will continue to be degraded.

## 6. Conclusion

The knowledge on the impact of human activities on the Nile Basin, Kenya is relatively small and there is ample scope for more research in the area. Efforts to promote research in the basin should be enhanced. The importance of legislation on riparian protection, compliance and enforcement of the legislation should be emphasized. There should be a continuous process of capacity building of the law enforcement officers together with the communities around the water towers. This will go a long way in ensuring that the basin is conserved besides being used in a sustainable manner.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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