Water dynamics in the seven African countries of Dutch policy focus: Benin, Ghana, Kenya, Mali, Mozambique, Rwanda, South Sudan

Report on Kenya

Written by the African Studies Centre Leiden and
commissioned by VIA Water, Programme on water innovation in Africa

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Leiden, September 2014

Water - Kenya

This report has been made by the African Studies Centre in Leiden for VIA Water, Programme on water innovation in Africa, initiated by the Netherlands Ministry of Foreign Affairs. It is accompanied by an ASC web dossier about recent publications on water in Kenya (see www.viawater.nl), compiled by Germa Seuren of the ASC Library under the responsibility of Jos Damen. The Kenya report is the result of joint work by Marcel Rutten, Ton Dietz, Dick Foeken and Fenneken Veldkamp. Blue texts indicate the impact of the factual (e.g. demographic, economic or agricultural) situation on the water sector in the country. The authors used (among other sources) the ASC web dossier on water in Kenya and the Africa Yearbook 2013 chapter about Kenya, written by Nic Cheeseman (see reference list). Also the Country Portal on Kenya, organized by the ASC Library, has been a rich source of information (see http://countryportal.ascleiden.nl).[1]

Political geography of water

The Republic of Kenya is part of the East African Community. The capital and largest city is Nairobi. The name is derived from a small stream (Enkare Nairobi: 'the stream which is cold') found in the area occupied by the Maasai pastoralists before the arrival of the British colonizers. Kenya lies on the equator with the Indian Ocean to the south-east, Tanzania to the south, Uganda to the west, South Sudan to the north-west, Ethiopia to the north and Somalia to the north-east. Kenya has a population of more than 45 million. The country is named after Mount Kenya, the second highest mountain in Africa; at the border with Tanzania the other African giant mountain can be found, Mount Kilimanjaro, and Mount Elgon is located on the border between Kenya and Uganda.

Figure 1 Map of Kenya

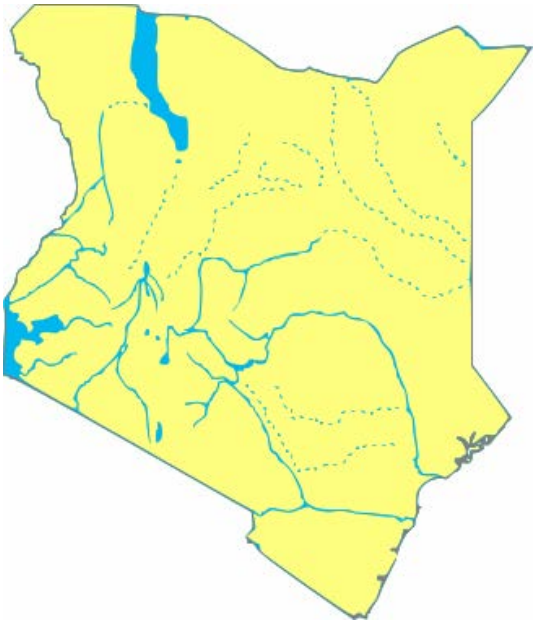
Source: http://countryportal.ascleiden.nl/kenya

[1] The report has been realized on the basis of short-term desk research and makes no claim of being definitive, complete or scientifically substantiated.

Kenya's hydro-geographical situation is quite complicated. There are five major 'water towers' in Kenya, namely: Mt Kenya, Aberdare Range, Mau Complex, the Cherangani Hills and Mt. Elgon as depicted in Figure 2 below. These water towers give rise to five drainage basins which are critical to the country's socio-economic wellbeing. The major drainage basins are those of Tana River and Lake Victoria. The Tana River system gets most of its water from the northern Aberdares and the Mount Kenya area, and – after feeding a hydro-electric plant after a major dam – flows through the semi-arid and arid drylands of the East, feeding the irrigated areas of Hola and Bura and the smaller irrigated zones near the Coast (Tana Delta). North of Tana we find the Ewaso Ngiro River system connecting the Northeast of Kenya (and Kenya's Somali ethnic group) with Somalia. South of the Tana we find the Athi-Galana River system, connecting the southern part of the Aberdares/Nyahururu Ridge and its rich coffee and tea areas near Thika Town, rapidly expanding Nairobi and Athi River Town, and the relatively dry Machakos and Kitui maize and sorghum areas as well as the huge Tsavo national parks, with the Coastal areas and emptying in the Indian Ocean near Malindi, and its famous coral reef zone (Marine protected area). The southern Coastal towns of Mombasa, Kenya's major port city, and Kilifi Town are connected to smaller river basins. In the North Coastal cities Lamu (on an island) and Kipini (at the mouth of Tana River) are of growing geopolitical importance, as they are near Somalia, but also because they are the focus areas of a major development plan: building a big harbour to connect South Sudan and Northern Kenya's oil-rich areas with the Kenya Coast and from there to global customers, bypassing Sudan's harbours on the Red Sea (for details see section on Economy).

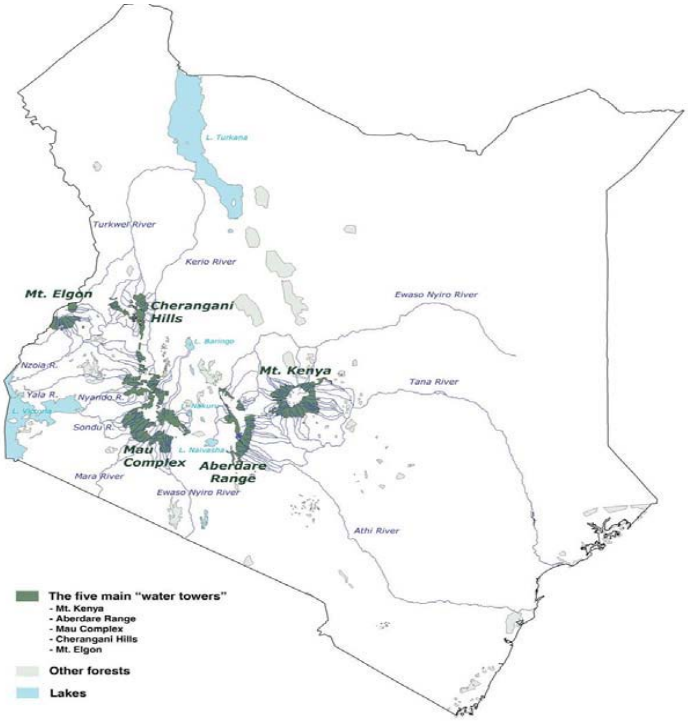
Kenya has nine lakes with a total surface area of 10,747 km². Most of the lakes are saline with the exception of Lakes Victoria, Naivasha and Baringo. In the North, Lake Turkana gets its water partly from the Omo River system in Ethiopia, where irrigation and hydropower activities and plans threaten water security of Lake Turkana (and of the people depending on fisheries there). Another part of Lake Turkana's water comes from the Mount Elgon area and the Suam-Turkwell River system (where a huge hydro-dam was built in the 1980s in the area between Pokot and Turkana ethnic groups, the Turkwell Gorge Dam). And a third part of the water comes from the Kerio water system, getting most of its water from the western Highlands (southeast of Eldoret Town), bordering the famous Rift Valley. In the Rift Valley there are important lakes: from Lake Turkana in the North via Lake Bogoria, Lake Baringo, Lake Nakuru (near Nakuru Town), Lake Naivasha (near Naivasha Town) and Lake Magadi (the salt lake, near Tanzania). Most of these are important tourist destinations, and part of a tourist circuit that also includes Amboseli National Park in the south and the Maasai areas.

Figure 2 Main lakes and rivers



Source : Wikimedia Commons

Figure 3 Water towers in Kenya



Source: UNEP

The western part of Kenya is part of the Nile system, via rivers like the Mara River that empties in Lake Victoria. In these areas there are a few small and medium-scale irrigation areas (e.g. Ahero and the Kano Plains). A small part of Lake Victoria (and particularly the Winam Gulf near Kisumu City) belongs to Kenya. Most of the other parts of Lake Victoria belong to Tanzania and Uganda. Its borders form one of the most densely populated areas of Africa, and the Kenyan lands adjacent to Lake Victoria are part of Kenya's poorest, and politically most marginalized areas, inhabited mostly by the Luo, Kisii and Luhya ethnic groups. Those groups lost most of the political battles after Kenya's independence in 1963; Kenya was either dominated by a political and economic elite of Kikuyus (Presidents Jomo Kenyatta, Mwai Kibaki and Uhuru Kenyatta included) or by the political elite around Kenya's second President, Daniel arap Moi, from the Kalenjin ethnic group living near Kenya's Great Rift Valley.

Figure 4 Elevation

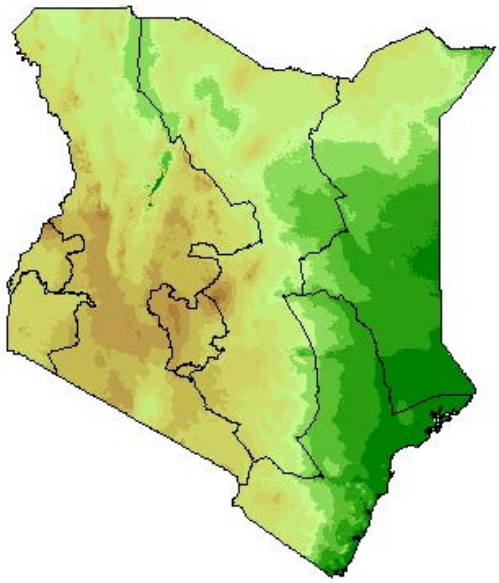


Figure 5 Land Use

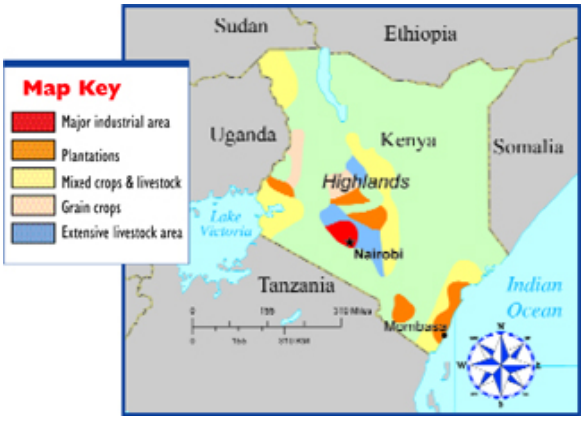


Figure 6 Population

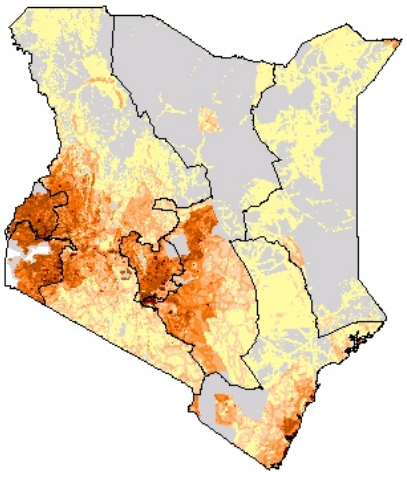
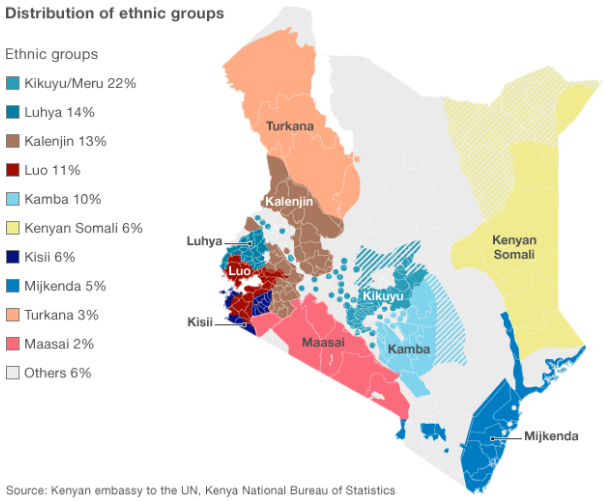


Figure 7 Ethnicity



Source elevation: http://www.fao.org/countryprofiles/maps/map/en/?iso3=KEN&mapID=603
Source land use: http://www.jrank.org/history/pages/8365/Looking-At-KENYA.html
Source population: http://www.catsg.org/cheetah/07_map-centre/7_3_Eastern-Africa/thematic-maps/Kenya/human-population.jpg
Source ethnicity: Kenyan embassy to the UN, Kenya National Bureau of Statistics (retrieved from bbc.com)

Figure 8 Precipitation

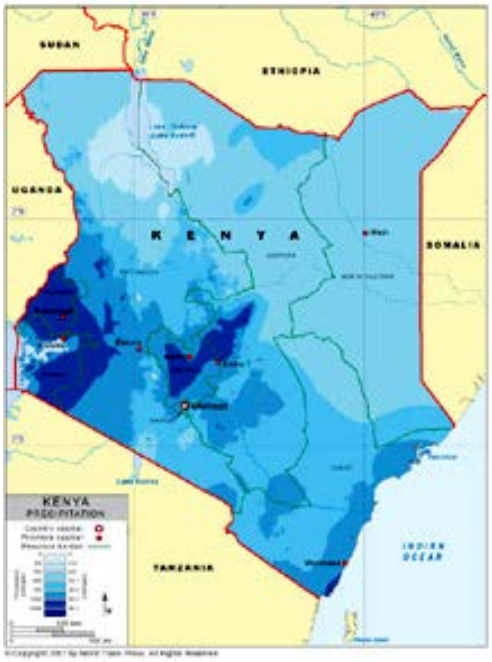
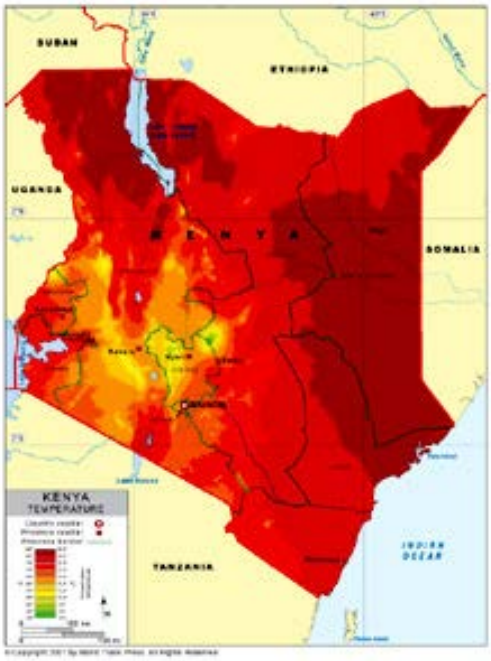


Figure 9 Temperature



Source Precipitation map: http://www.bestcountryreports.com/Precipitation_Map_Kenya.php
Source Temperature map: http://www.bestcountryreports.com/Temperature_Map_Kenya.php

Most of Kenya is semi-arid or even arid. A small part of the country southwest of the Great Rift Valley towards Lake Victoria, and east of the middle range of Great Rift Valley towards and around Mount Kenya is both humid and endowed with very good soils. Here most of Kenya's agricultural areas can be found: maize and wheat, but also coffee and tea. The recent growth in horticulture and flowers mostly come from semi-arid to sub-humid areas, with irrigation using lake, river and ground water (e.g. the flower industry near Lake Naivasha). Recently vast artesian groundwater reservoirs have been discovered in the Northwest, in the Turkana area. Kenya's semi-arid/sub-humid areas in part of the southeast (Machakos and Kitui) are relatively densely populated. Droughts have been a regular feature in most of dryland Kenya, but occasionally floods happen as well. And the Coastal zone is threatened by sea level rise and storm damage.

Most of Kenya has a bi-modal rainfall pattern, with most rain falling in April-May (both in Nairobi and Mombasa), and a second period around November-December. Depending on where one is in Kenya, the driest periods are in January-February or in June-October. Nairobi borders the humid areas towards the West and the drylands of the East.

Figure 10 Rainfall and temperature in Nairobi

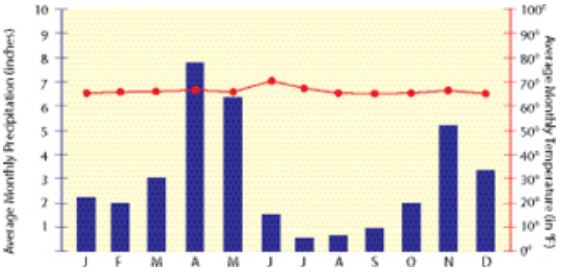
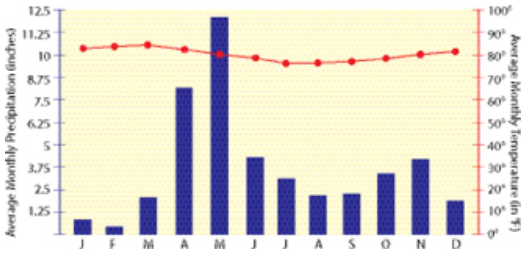


Figure 11 Rainfall and temperature in Mombasa

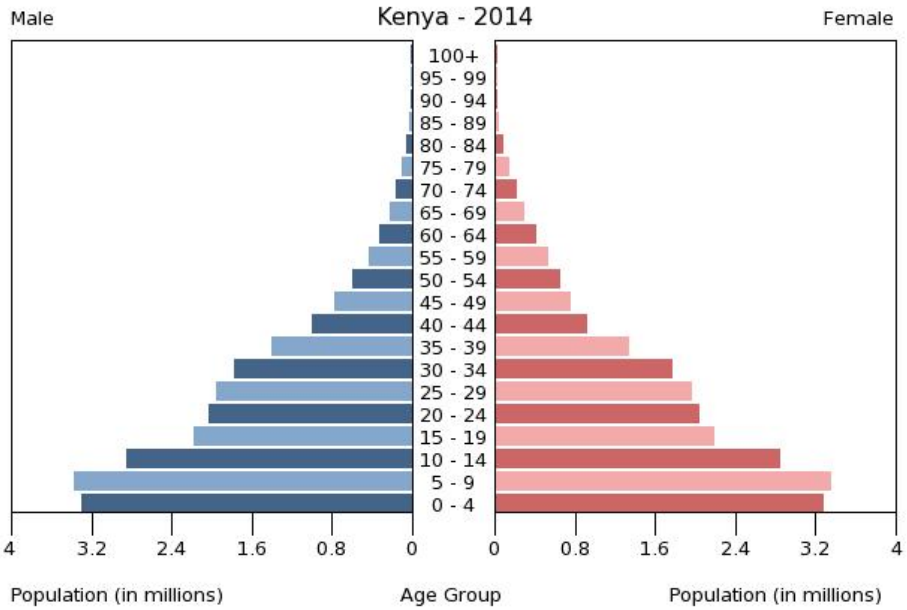


http://www.jrank.org/history/pages/8365/Looking-At-KENYA.html

Demographic situation: population, urbanization, water consumption trends

Kenya has about 45 million citizens (2014 estimate) and an average annual population growth of 2.68% (2005-2010) which is much lower than in the past. One of the reasons for this drop is excess mortality due to AIDS (1.6 million people have AIDS, the 4th highest position in the world, according to the CIA World Fact Book).

Figure 12 Population pyramid



Source: CIA World Factbook

Almost a quarter (24%) of the population lives in an urban environment. UN projections suggest that by 2025 this percentage will have risen to 30%. The major urban areas are Nairobi (3.4 million inhabitants) and Mombasa (972,000 inhabit-

ants, 2011). Other fast growing towns are Kisumu, Nakuru, and Eldoret. It is also worth noting that some of the most populous areas are (or have been) the UNHCR-managed refugee camps [Dadaab and Kakuma] in the eastern and northwestern drylands of the country, as a result of refugee migration from Somalia and South Sudan/Uganda. Nairobi's boundaries have recently been shifted outwards and the city is likely to link to smaller satellite cities such as Kitengela and Thika in the years to come. As Gitahi (2011) stresses this growth will likely raise conflicts with the rural hinterland as Nairobi and other cities get water from the rivers in these areas.

According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation 2014, 82% of the urban population and 55% of the rural population had access to *improved* drinking water sources (protected sources) in 2011; hence, 18% of the urban population and 45% of the rural population had access to *unimproved* drinking water sources (unprotected sources and surface water).[2] Almost 30% of the total population had access to *improved* sanitation facilities in 2011, so 70% of the total population had access to *unimproved* sanitation facilities. There is hardly any difference between the urban and the rural areas for sanitation facilities because a large part of the urban population lives in squalid conditions.

Looking at a longer period of time - i.e. the 1990 to 2011 period - there was not only an increase in the number of people *with* access to improved water sources, but also an increase in the number of people *with no* access to improved water sources. This applies in particular to the urban areas: in urban Kenya, the number of people *with* access to improved drinking water doubled between 1990 and 2011, but the number of people *with no* access to improved drinking water grew fourfold! This can be related to the high urbanization rate in Kenya: most people who migrate to town end up in one of the informal settlements, where drinking water facilities are often non-existent. Comparable figures apply to sanitation facilities, be it to a lesser degree (table 1).

[2] These percentages may be rather optimistic: according to IMF (2014), 60% of the urban population and 40% of the rural population had access to improved drinking water sources.

Table 1

1990-2011	NATIONAL POPULATION			URBAN POPULATION			RURAL POPULATION		
Water	% growth popu-lation	% growth access to im-proved water source	% growth NO access to im-proved water source	% growth popu-lation	% growth access to im-proved water source	% growth NO access to im-proved water source	% growth popu-lation	% growth access to im-proved water source	% growth NO access to im-proved water source
	91	237	41	152	198	35	59	255	53
Ghana	69	174	-50	144	170	15	27	181	-60
Kenya	78	152	21	151	126	432	63	166	12
Mali	83	324	-11	178	367	-35	54	309	-9
Mozambique	77	144	42	161	179	113	54	112	36
Rwanda	54	71	26	485	414	1200	31	44	12
South Sudan	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sub-Sah. Africa	70	119	24	125	128	112	49	117	12
Northern Africa	41	49	-13	58	60	32	24	38	-32
Africa	65	98	21	106	106	102	45	95	10

1990-2011	NATIONAL POPULATION			URBAN POPULATION			RURAL POPULATION		
Sanitation	% growth popu-lation	% growth access to im-proved sanita-tion facility	% growth NO access to im-proved sanita-tion facility	% growth popu-lation	% growth access to im-proved sanita-tion facility	% growth NO access to im-proved sanita-tion facility	% growth popu-lation	% growth access to im-proved sanita-tion facility	% growth NO access to im-proved sanita-tion facility
Benin	91	607	128	152	351	120	59	1162	142
Ghana	69	266	56	144	286	124	27	238	20
Kenya	78	106	68	151	199	134	63	96	52
Mali	83	168	68	178	195	170	54	116	47
Mozambique	77	273	57	161	206	137	54	594	43
Rwanda	54	193	-12	485	457	534	31	167	-27
South Sudan	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sub-Sah. Africa	70	96	61	125	120	129	49	88	40
Northern Africa	41	76	-50	58	61	18	24	93	-57
Africa	65	88	52	106	93	123	45	90	32

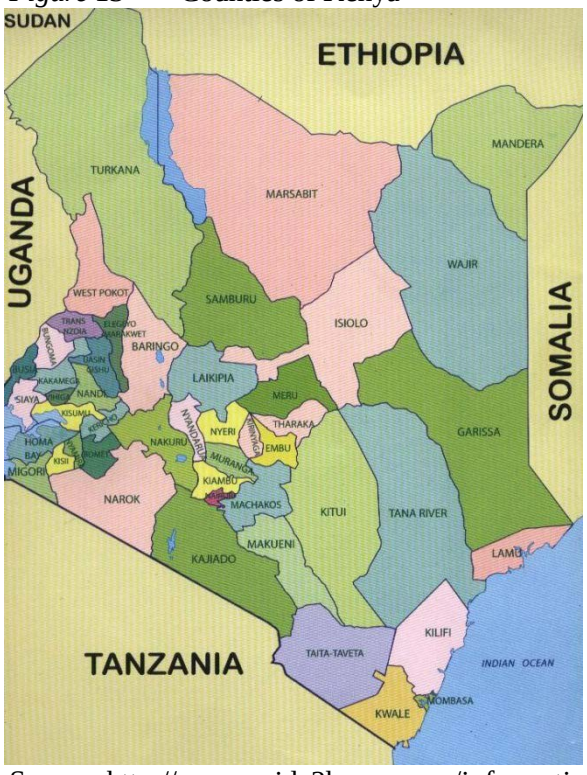
Source: WHO/UNICEF (2013), Progress on sanitation and drinking-water: 2013 update, pp. 14-35
Geneva / New York: World Health Organization / United Nations Children's Fund.

Political situation and institutional setting

Political situation

Following the adoption of the 2010 constitution, Kenya embarked on a process of devolution of power. The new constitution formally constrained the overwhelming power of the presidency, and it decentralized power and a considerable amount of finance to 47 new counties. There was a widespread, though inflated, popular belief, especially in poorer regions feeling left out of historical government largesse, that with devolution on hand, development was finally at hand (Holmquist 2014). However, the process of devolution is still marred with unclarities over budgets and responsibilities between the central and county council governments. The devolution process, which includes the creation of 47 counties and transfer of more than 30 percent of public expenditures from central to county level, is the biggest reform that Kenya is facing (IMF 2014). Also at central level newly introduced institutions as the National Land Commission ran into problems with the Ministry of Lands over the division of tasks and responsibilities.

Figure 13 Counties of Kenya



Source: http://www.guide2kenya.com/information/53/Counties-of-Kenya

The general and presidential elections in March 2013 passed relatively peacefully (compared to election violence in 2007-2008) and saw Jubilee Coalition's Uhuru Kenyatta declared President and William Ruto Deputy President. Relations with Western donors have become problematic due to the cases of the International Criminal Court (ICC) against the President and Deputy President for their alleged roles in the 2007-2008 post-election violence. Kenya also made international headlines following the Westgate terrorist attack in September 2013, killing almost 70 people. The Somali Islamist group Al-Shabaab claimed responsibility saying the attack was a punishment for Kenya's invasion of Somalia in 2011. The government has been criticized for its handling of the (aftermath of the) attack, and the infringements on freedom of speech it has enhanced through the adoption of a new Media Bill. Protests have been aired by journalists and civil society groups.

By contrast, Kenya received international acclaim as the first African country to launch an Open Data website. The website contains over 400 datasets, more than 200 of which are on Kenya's newly created counties. Kenya watchers feel that the ICC crisis takes away time and attention needed to address the food and economic problems the country has to face like in the field of water development.

Institutional setting of water

Over the past decades, the Kenyan Government has undertaken several water sector reforms in an attempt to increase water access (Sambu & Tarhule 2013). The first attempt to 'reform' the water sector came as early as 1974 when the first National Water Master Plan was launched (Kisima 2007). The primary aim of the Plan was to ensure availability of potable water, at a reasonable distance, to all households by the year 2000 – under the legal framework of Water Act Cap 372. In line with the Plan, the government upgraded the Department of Water Development of the Ministry of Agriculture into a fully fledged Ministry of Water to coordinate actors involved in the provision of water and sanitation services (Mumma 2005; Kisima 2007; Gakuria 2008). The government attempted commercialisation of services from the late 1980s, backed by donors such as Germany and the World Bank. A new Water Policy was launched in 1999, and a new Water Act in 2002. Since then, a major overhaul of the water sector (see Table 2) has been taking place, and much hope was placed in private-sector participation (Nilsson & Nyanchaga 2008). The Water Act 2002 provides for the establishment of three levels of institutions for the provision of water supply and sewerage services: Water Services Regulatory Board, Water Services Boards, and Water Service Providers. The management of water resources is under the Water

Resources Management Authority and Water Resources User Associations (Owuor & Foeken 2009).

Table 2 Roles and responsibilities of institutions in the water sector reforms

Ministry of Water and Irrigation	Policy formulation, sector coordination, monitoring, financing and supervision.
Water Resources Management Authority	Regulation of water resources management
Water Services Regulatory Board	Regulation of water and sewerage services
Catchment Areas Advisory Committees	Advise the Water Resources Management Authority on issues concerning management of water resources at the catchment level
Water Services Boards	Responsible for the efficient and economical provision of water services within their area of jurisdiction through signing of service provision agreements with Water Service Providers
Water Resources Users Associations	Provides a forum for conflict resolution and cooperative management of water resources in designated catchment areas.
Water Service Providers	Direct provision of water and sewerage services as agents of Water Services Boards.
Water Appeal Board*	Handle disputes in the water sector.
Water Services Trust Support	financing of pro-poor water services in unserved areas.
National Water Conservation and Pipeline Corporation	Bulk water supply, dam construction, flood control, land drainage, ground water development and Ministry of Water and Irrigation reserve Water Service Provider
Kenya Water Institute	Training and research

Source: adapted from MWI (2005) quoted in Owuor & Foeken (2009)
* some changes are around the corner as with the Water Appeal Board that will be done away with.

The overhaul of responsibilities took time to become clear to all parties involved. And many unclarities are still around as concluded by a World Bank policy brief in 2013, not in the least because of the recent devolution of power to the counties. '*Water services in Kenya are at an important and exciting crossroad. Devolution of the water services function has assigned responsibility for water provision to democratically elected county governments that now face the challenge of being responsive to the needs of their electorates and to honour the constitutional obligation to progressively provide water services to all people. The role of national government will change to policy development, sector oversight and support. An independent regulator can play an important role to monitor progress on the right of water and ensure funds are effectively spent. The track record of water companies shows that they continue to make an important contribution in service delivery, and county governments would be well-advised to build on this momentum, rather than overhauling the system rapidly.*

Understanding and addressing the challenges identified in this note can help smoothen the transition process, ensuring that services continue to be delivered and access extended while policy and institutional reforms are designed and implemented.'

Munyao (2011) highlighted legal issues, in particular the impact of the formalization of water user groups of the Upper Ewaso Ng'iro river. It was found that large-scale users dominated these new water management institutions and as a result benefited most. Aarts & Rutten (2013) also noted a lack of financial resources and implementing capacity. They also stress that training of WRUA members is too much restricted to a few officials and that most communities need a full-time professional manager to run the WRUA effectively.

The World Bank advice to make use of water companies to assure service delivery is challenged by a large number of studies. Onjala (2002: 163, 292) describes the start of private water companies in Kenya in the mid-1990s. These companies were owned by the municipalities and the major reason for advocating privatization of municipal services appeared to be the lack of resources by urban governments. Privatization was primarily a way to help relieve the local authorities of the financial burden in providing such services.

The Water Service Boards (WSBs) were created to take full responsibility for the provision of water services through signing of Service Provision Agreements with Water Service Providers (WSPs). Sambu & Tarhule (2013) studied 44 WSPs and concluded that performance was poor and none of them was able to meet the MDGs by 2015.

As Nilsson & Nyanchaga (2008) suggest, the Water Service Providers for their part - being commercial entities - may not identify the urban poor as their primary customer group. As much as Kenya's water sector reform may seem to have accomplished an historic turn-around in the sector, from the viewpoint of the urban poor, much is still the same.

Changing informal institutions and behaviour is the real challenge. Reformers must acknowledge the long-term dynamics of urban water supply systems; there will always be resistance to change from actors with vested interests in the system. Owuor & Foeken (2012b) studied the implementation of the Lake Victoria Water and Sanitation programme (LVWATSAN) in the secondary town of Homa Bay and confirmed the problem of vested interests especially at the expense of the low-income settlements. Although LVWATSAN led to various considerable improvements in terms of water supply at the level of the municipality, they also concluded that *a lot remains to be achieved, especially in the low-income settlements. The daily water production and supply of 3,000 m^3 is still far below the estimated demand of about 18,000 m^3 per day. The water supply situation becomes worse with the unpredictable water rationing that can take up to three*

days in the two studied low-income areas. For a number of households, the 'normal' daily water supply hours are short, irregular and unreliable. As such, residents in the two areas rely on other water sources – besides their main source (...) [including] water vendors, rain water, shallow wells, rivers and water from the Lake [Victoria]. As a result of all these problems, water consumption in the two areas appeared to have *strong seasonal components*: *during the dry season, the piped water is more unreliable, insufficient and interrupted; households spend more time and long distances looking for water; they rely more on unsafe water; are forced to survive with the little water available; and pay more in purchasing and treating water. Furthermore, as women and the girl-child shoulder the burden of fetching water, inadequate access to water has a major gender dimension in Homa Bay* (Owuor & Foeken 2012b: 37-38).

Finally, Nilsson & Nyanchaga (2008) state that it is necessary for institutions to create an incentive structure that is supportive of low-cost technology and provision in informal settlements, so that poor people can enjoy their entitlement to public services. In Nakuru, Ngugi (2012) came to a similar conclusion of the need for pro-poor water and sanitation incentive systems. Crow & Odaba (2010), describing the availability of water for women in a slum in Nairobi, mention the heavy expenditures of time and money needed, which confirms findings by Birongo & Le (2005) that poor households are forced to pay more for basic needs such as water than their neighbours in 'well-to-do' neighbourhoods. Local NGO Twaweza states that the poor in Nairobi's informal settlements pay up to 30 times more per unit of water compared with residents of more affluent neighbourhoods (IRIN 8 November 2010).

Birongo & Le (2005) zero in on troublesome Public-Private Partnerships and the role of corruption as a factor disrupting the governance system. Accusations of corruption at the highest level within the water sector were made by assistant minister Mwangi Kiunjuri when handing over documents to the Kenyan Anti-Corruption Commission which he claimed showed widespread corruption in the Ministry of Water and Irrigation (IRIN 8 November, 2010).

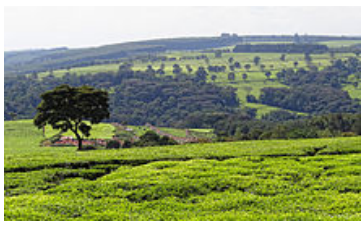
Carlberg (2012) points out for Kisumu that not the lack of (safe) water is a problem but the price for the urban poor. As a solution groundwater pumps have been installed in public spaces, which allows payments through mobile phones (see box 2 under section 'Economic setting'). But according to Foeken *et al.* (2013: 7), Kisumu's water provider KIWASCO (Kisumu Water and Sewerage Company) faces many more challenges: *in 2008, the company produced about 18,000 m^3 of water per day, but the demand was estimated to be about 45,000 m^3 per day. The result has been a severe water shortage. Moreover, Kisumu has one of the highest levels of unaccounted-for water – i.e. water that is provided but not paid for – in Kenya. When KIWASCO started its operations, the unaccounted-for*

water level was 75%. This was reduced to about 62% in 2008. This (still) high level can be attributed to, amongst others, non-functional (static) meters, illegal connections, as well as burst pipes and leakages. However, Owuor & Foeken (2012a) also mention a very successful local initiative in one of the low-income areas of Kisumu to improve the water and sanitation situation: the Wandiege Community Water Supply Project, which started as a self-help group in 2001 and became an officially registered water company in 2007 (beside 'big brother' KIWASCO).

Economic setting: economic situation, transport system, innovation, ICT

The overall national development objectives of the Government of Kenya are: accelerated economic growth; increasing productivity of all sectors; equitable distribution of national income; poverty alleviation through improved access to basic needs; enhanced agricultural production; industrialisation; accelerated employment creation and improved rural-urban balance. Despite political uncertainty in 2013, severe terrorist attacks (Westgate attack) and uncertainty surrounding the prosecution of President Kenyatta and deputy President Ruto at the International Criminal Court, Kenya's economy has performed reasonably well in 2013 and grew by 5.6%. Per capita GDP increased from $1,737 in 2012 to $1,800 in 2013, and is expected to grow to over 6% in 2014. This expectation may, however, change since a number of terrorist attacks on the Kenyan coastal towns took place in June 2014, hurting the tourism sector and foreign investment. Most of the growth is due to expansion in agriculture (4.6%), industry (6.4%) and the services sector (3.6%). Remittances continued to play a critical role in 2013. Official transfers climbed to $ 1.3 bn. Analysts believed that the investments of remittances in the housing sector was one of the reasons behind the sky-rocketing price of property in Kenya (Africa Yearbook, 2014).

Figure 14-16



A tea plantation (wikipedia)

A flower farm (©Rutten)

A Tourist Lodge (©Rutten)

Kenya's main export products are tea, horticultural products (flowers), coffee, petroleum products, fish and cement. Main export partners in 2012 were Uganda, Tanzania, the Netherlands, UK, USA, Egypt and DRC. Imports came mainly from India and China (over 36% combined; up from only 16% in 2005). Kenya is increasingly looking east and the troubles the heads of state have with the ICC will likely increase this share in the years to come as especially Western countries are blamed for pushing the ICC case.

The IMF stated in January 2014 that although Kenya's economic growth had improved over the years, sustained and even more inclusive growth that creates jobs is essential to ensure that all Kenyans can benefit. Three areas merit particular emphasis. First, continued implementation of fiscal devolution. Second, more infrastructure investment and social programmes, and improved revenue mobilization and transparency, especially in the management of natural resource wealth. Third, the process of regional integration needs to continue.

The high national debt and corruption allegations are matters of economic concern to the IMF. Unemployment is high (40%), as is the population rate below the poverty line: 43%. In 2008, Kenya developed a major development plan, Kenya Vision 2030, which should transform the country to a middle income society over the next years. Kenyatta's government has committed itself to continue this major challenge as developed by his predecessor Mwai Kibaki. One of the key aspects is a series of high-profile infrastructure projects notably the Lamu Port Southern Sudan-Ethiopia Transport Corridor (LAPSSET) (see Box 1).

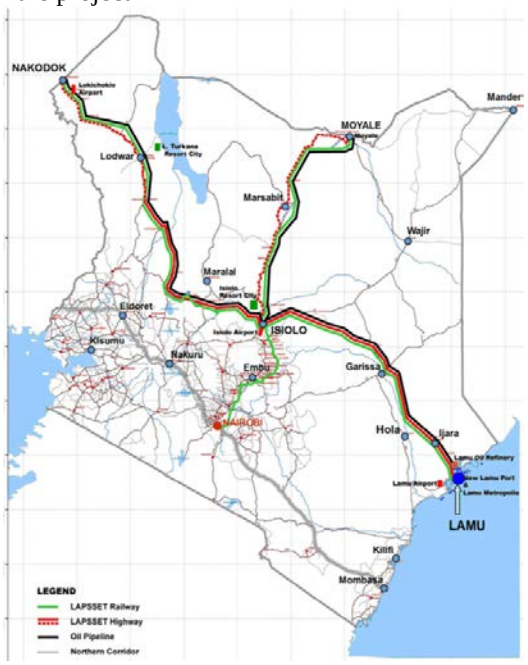
Kenya has four international airports (Nairobi, Mombasa, Kisumu and Eldoret). The arrival hall of Jomo Kenyatta International Airport burnt down in 2013. Rebuilding and extension of the airport is to be completed in the second half of 2014. Mombasa is the main sea port. The port is also of importance for Uganda, Rwanda and other landlocked countries. For many years it has suffered from insufficient cargo handling capacity and poor management. The development of the new port near Lamu is planned to assist oil exports from South Sudan and will also be linked to Ethiopia. Kisumu, bordering Lake Victoria, is the main inland port and has ferry connections to Uganda and Tanzania,

The road network has undergone a major overhaul in recent years, especially through Chinese contractors. Still, poor roads, a so far inadequate railway network, under-used water transport and expensive air transport have isolated mostly arid and semi-arid areas in the country, which is problematic for its farmers, including pastoralists and fishermen.

BOX 1: Infrastructure investments

The Lamu Port – South Sudan – Ethiopia Transport and economic development (LAPSSET) corridor is a multi-billion dollar flagship project under the Kenya Vision 2030 National Development Policy blue print. The project comprises 7 major components – a port in Lamu, an oil pipeline from Juba, South Sudan to Lamu, Oil refineries in Lamu and Isiolo, a railway link to South Sudan and Ethiopia, three resort cities and airports at Lamu, Isiolo and Lokichogio and a High Grand Falls along the River Tana for Hydropower generation. The LAPSSET Corridor will link South Sudan and Ethiopia, both landlocked countries, with the Indian Ocean through Lamu.

Map of the Lamu project, showing the scope of the project



Source: Wikipedia

The construction of the port was launched on 2nd March, 2012 by the Presidents of Kenya and South Sudan and the Prime Minister of Ethiopia. At the time of the mission, preparatory activities towards the official launch of the project had been undertaken. This included road construction and clearing of the port site among others. Fast start projects that had already been allocated funding include the drilling of 10 boreholes that will supply 1.2 million litres of water daily for Lamu residents and the proposed port and installation of a diesel power plant to generate one mega watt of power. China has also started connecting Lamu and Garsen districts to the national electricity grid.

The LAPSSET project is part of The Great Equatorial Land Bridge that will cut across the middle of Africa by a high speed road and rail network, a fibre optic cable and an oil pipeline starting from Lamu at the Indian Ocean in Kenya through Juba in South Sudan, Bangui in Central Africa Republic and finally link with the Atlantic Ocean in Cameroon, through Yaoundé and Douala. Ethiopia will also be linked to the bridge via a similar road, rail and fibre optic corridor that will branch out from Isiolo, Kenya and run to Addis Ababa. A major port, oil refinery and airport will be constructed in Lamu, Kenya. Two other airports, an oil refinery and three resort cities will be developed in Kenya alone. This project is envisaged to be the largest infrastructure project ever undertaken in Africa. *(Box continued on next page).*

The area in and around Isiolo has historically witnessed numerous conflicts between the different pastoralist communities and with neighbouring agricultural communities over pasture and water, especially in the dry seasons when pastoralists migrate to the farming communities areas. But lately, the conflicts have escalated and intensified with the reasons shifting to territorial claims. This is attributed to the LASSPET corridor's airport, tourist resort and communication hub to be developed in Isiolo. Likewise the Tana and Lamu regions witnessed several deadly encounters, partly linked to unclear land issues. Local action groups supported by international nature conservation organizations point at illegal land acquisitions by outsiders at the expense of the local population. Government officials and politicians party to the development plan had been able to obtain land around the port, resort city, and refinery plant sites with a view to speculative gain. In addition, an influx of outsiders was expected raising the population numbers in the area from some 100,000 to 1.25 m. Moreover, the port site and sailing route will cause massive destruction to both terrestrial and marine life, and will destroy Lamu, which is endowed with rich biodiversity, rich marine ecology, and coral reefs that are a major attraction to tourists, and which are fish breeding grounds (Noor 2014 in Pambazuka).

Kenya has more than 30 million mobile phone subscribers. Mobile banking such as the Safaricom-launched M-Pesa service is already increasing financial access amongst low-income groups with emerging opportunities for innovative saving and payment applications in the water service sector (see Box 2). Mobile phones also provide opportunities to address systemic operational inefficiencies and to govern water resource use and allocation more effectively. In Kenya a number of these initiatives have been started in the last few years, mostly in an urban setting. For water service utilities the Smart Water Systems (SWS) approach can break the downward spiral of poor operational and financial performance. By coupling mobile banking and smart water metering, SWS can create a secure, transparent and low-cost flow of funds and information between consumer, water service provider and delivery system. By driving down water payment transaction costs, revenue collection will increase and administrative costs will be reduced, it is hoped (Hope *et al.* 2011). Initial attempts were mostly supported by donors and geared at having the technology right. The challenge will be to have customers interested to upload submissions voluntarily. Other challenges to smart water technologies include security threats to physical assets (water meters are often stolen), access to and cost of capital, network coverage, and cost of mobile payment (Hope *et al.* 2011, Ross & Luu 2012).

BOX 2: ICT and water in Kenya

Launched in March 2007, the M-Pesa innovation is perhaps the most successful service of its kind in the world. Using their mobile phones customers can send up to Ksh 140,000 per day (approximately € 1100) with a maximum of Ksh 70,000 per transaction. Low demands can be serviced with the permitted transactions of as little as Ksh 50. This accelerates cash movement, particularly among the low income people. M-Pesa customers can deposit and withdraw money from a network of agents that include airtime resellers and retail outlets acting as banking agents. It has become a 'mobile wallet', especially for the huge proportion of consumers without bank accounts.

In relation to water it is known for example that using their mobile devices herders can now find out where to graze their cattle and directly pay for water and pasture. In sustained management of rural water supplies, there have been proposals to apply pre-paid services with the Solar Powered System proving most popular for its low running cost and secured revenue collection (Rutten & Mwangi 2012). M-Pesa could also be used to link potential customers and water vendors by providing water price data through SMS and the location where to get the best price (e.g. M-Maji in Nairobi). Mobile phones could also be used to pay for monthly water bills or make upfront payments to open up a community borehole for a maximum amount of water after having made the payment through mobile phone (e.g. see Carlberg 2012).

Agricultural dynamics

The African Studies Centre recently published a research report about Kenya's agricultural performance, together with ODI (as part of the Developmental Regimes in Africa project, funded by the Dutch Ministry of Foreign Affairs; see Dietz et al, 2014). One of the tables in that report highlights the long-term development of Kenya's food crop production, comparing 1961 and 2011. We reproduce that table here.

Table 3 Population and basic food production dynamics in Kenya, 1961-2011

							2011/1961
	1961	1970	1980	1990	2000	2011	index
Population (millions)	8.4	11.3	16.3	23.4	31.3	41.6	498
Cropping area (ha of harvested crops, x million)[1]							
Cereals	1.1	1.6	1.8	1.8	1.9	2.7	242
Pulses	0.6	0.7	0.7	1.5	1.2	1.5	229
Roots/tubers	0.1	0.1	0.2	0.2	0.2	0.2	231
Yield (kg/ha x 1000)							
Cereals	1.2	1.3	1.2	1.6	1.4	1.5	122
Pulses	0.4	0.5	0.5	0.5	0.4	0.5	122
Roots/tubers	7.0	7.7	7.4	9.7	7.1	15.4	219
Total basic food production (million tons)							
Cereals	1.4	2.1	2.2	2.8	2.6	4.1	295
Pulses	0.3	0.3	0.4	0.8	0.5	0.8	280
Roots/tubers	0.8	1.0	1.2	1.6	1.6	3.8	505
Food energy value of crop mix (kcal/kg) [recalculated from FAOSTAT]							
Cereals	3137	3136	3111	3101	3083	3124	100
Pulses	3414	3401	3405	3418	3414	3410	100
Roots/tubers	962	966	988	899	913	982	102
Weighed total [inferred]	2484	2547	2468	2458	2360	2202	89
Food energy value (kcal/capita/year x 1000)							
Cereals	516	582	427	369	256	305	59
Pulses	112	104	73	113	52	63	56
Roots/tubers	87	83	72	62	48	90	103
Total	716	770	572	544	356	458	64
Food energy value (kcal/capita/day)							
Cereals	1414	1595	1168	1010	700	834	59
Pulses	307	285	201	309	143	173	56
Roots/tubers	239	227	198	171	131	248	103
Total	1960	2107	1567	1489	974	1255	64

Source: Population data as used by FAOSTAT are from the World Population Prospects: The 2010 Revision from the UN Population Division; all production data: FAOSTAT crop production(final 2011 data, updated: 08 August 2013, accessed on 19 September 2013 from http://faostat.fao.org/site/567/default.aspx#ancor); food energy values recalculated from FAOSTAT Food Balance Sheets.

1 Roots and tubers are mainly potatoes, cassava and sweet potatoes in Kenya. Cereals are mostly maize, sorghum, wheat and millet as well as some rice. In 1961 sorghum and millet accounted for 20% of total cereal acreage; in 2011 it was only 14%; maize increased from 68% to 80%.

We also reproduce the table with an overview of all crop dynamics:

Table 4 Kenya's crop groups: harvested area (x 1000 ha), 1961-2011
In **bold** food crop groups with area growth faster than population growth for the fifty-year period as a whole (which almost quintupled: 2011/1961 index=498).

Crop	1961	2011	2011/1961 index		highest in
Cereals	*1106*	*2680*	*242*		*2011*
Pulses	645	1477	229		1995
Roots/tubers	108	249	231		2009
Plantains	1	3	250		2010
Pyrethrum	30	8	27		1975
Fibres	114	61	54		1985
Oil crops	72	247	341		2007
Fruits excl. plantains	54	195	363		2010
Tree nuts	11	35	308		1977
Vegetables	44	162	372		1999
Spices	5	6	126		2005
Coffee	42	160	384		1998
Sugarcane	18	64	363		2010
Tea	18	188	**1058**		2011
Tobacco	0	23	**5581**	+	2010
Total	2266	5556	245		2011
Basic food/ Total	82.0%	79.3%			

Note: Fruits exclude melons; vegetables include melons
Source: FAOSTAT crop production(final 2011 data, updated: 08 August 2013, accessed on 19 September 2013 from http://faostat.fao.org/site/567/default.aspx#ancor).

And we add the major conclusion of this report: "Kenya cannot afford its current low levels of food sufficiency. Over the past 50 years, the production of most basic food crops did not keep pace with population growth and the basic crops which did (potatoes, sweet potatoes, rice and beans) did so more through area increase than through yield increase (...). Kenya's attempts to develop non-food crops were partly successful: its non-basic food area went up from 18% of its total crop area in 1961 to 21% in 2011 (...). Of course, Kenya's tea production has been a textbook success story, as has the expansion of its various oil crops (seed cotton, oil palm, coconut). And the increases in production of sugarcane, fruits and vegetables (partly for the export market) can also be seen as major successes. But these cannot compensate for the lack of basic food security and the last few years have been quite alarming for Kenya's food-security situation. Kenya's total agricultural land increased from 4% of its 569,140 km² to 10%, but most of the remaining land is arid or semi-arid and regarded as too risky for agriculture or reserved for wildlife parks".

As is obvious from the tables above, the agricultural sector in Kenya is foremost characterized by smallholder and rainfed production of maize. The production of major food staples such as maize is subject to sharp weather-related fluc-

tuations. Production downturns because of droughts periodically necessitate food aid. Tea, coffee, pyrethrum, maize, and wheat are mostly grown in the fertile highlands, one of the most successful agricultural production regions in Africa. Livestock predominates in the semi-arid savannah to the north and east, and in the southern Maasai areas. But the dairy, poultry, and pig industries have all expanded rapidly as well, and can mainly be found in what Kenya calls 'high-potential areas' (and near the big cities). Coconuts, pineapples, cashew nuts, cotton, sugarcane, sisal, and corn are grown in the lower-lying areas. The agricultural sector cannot guarantee food security yet. Still, agriculture is the second largest contributor to Kenya's gross domestic product (GDP). Horticultural produce and tea are the main growth sectors and the two most valuable of all of Kenya's exports. The Lake Naivasha floriculture industry accounts for more than 70% (US$400 million) of the country's cut flower exports. Kenya's cut flower exports account for more than 40% of the EU retail market while generating 9% of Kenya's total foreign exchange revenue and contributing 2-3% to the Kenyan GDP. In 2008, the Netherlands accounted for 51% of Kenya's cut-flower exports followed by the UK (25%) and Germany (9%) (Hemel, 2013).

The other side of the coin is that a 2010 study conducted by the Water Resource Management Authority of Kenya found that the amount of illegal boreholes and abstraction points in the Naivasha area is almost double the amount of legal ones (WRMA 2010, Voorpijl 2011). Attempts have been put together to address these issues but according to Van Oel *et al.* (2014) there still is a mismatch between required knowledge and efforts by scientists and stakeholders in the Lake Naivasha basin to manage water resources in an integrated way. Naivasha is complicated due to its variety of interests (horticulture, floriculture, tourism, fishing, tourism, geothermal power generation and so on). Furthermore, this Rift Valley Lake has a complex geology and hydrological build up which is not yet fully understood and makes it hard to predict the water level of the lake. According to Becht (2007), however, lake levels have remained significantly below expectations since the introduction of flower growing.

Ngigi *et al.* also report of adverse effects of irrigated agriculture in the upper Ewaso Ng'iro basin which starts from the highlands of Mount Kenya. Decreasing river flows are attributed to (illegal) over-abstraction, mainly for irrigating horticultural crops and resulting in alarming conflicts among various water users (Ngigi et al, 2008). A call is made for flood storage to increase river flows during dry seasons.

Mwangi (2007) stresses the negative role of the fast growing number of smallholder irrigation schemes in the Mt Kenya region. Their performance is below the national average and more crop per drop does not seem to be on their minds. Poor scheme designs and weak institutions contributed to this underperformance.

Kabubo-Mariara *et al.* (2006) also stress that weak environmental management practices hamper agricultural growth. This is confirmed by Nyangena (2009) who studied practices of soil and water conservation (SWC) in three regions in Kenya and concluded that in most cases where it was practiced, SWC was beneficial to agricultural performance. Gitahi (2011) suggests the need to improve irrigation technologies and move from bucket to drip and low pressure sprinkler irrigation to raise outputs.

There are three major types of irrigation schemes in Kenya: smallholder schemes; commercial/private schemes; and (public) schemes of the National Irrigation Board. The private sector controls most of the farms under irrigation. It is foremost using river water. Over the years the use of sprinklers has increased. Since 1985 the area under irrigation has doubled to stand at some 100,000 ha by 2003 (FAO 2006). The growth over the years in the public sector, however, has been minimal. In fact, the long history of public irrigation development in Kenya is one foremost of failure. IFPRI (2010) concluded that the potential for irrigation investments in Africa is highly dependent upon geographic, hydrologic, agronomic, and economic factors that need to be taken into account when assessing the long-term viability and sustainability of planned projects. The irrigation potential of Kenya has been variously estimated at 350,000 to 540,000 ha and is mainly available in the Nile (Lake Victoria) basin and the East Coast (including Tana and Athi basins) (FAO 2006; Alila & Atieno 2006). Recently, attempts have been announced to revive the public schemes and increase the area under irrigation, especially at the coast.

Table 5 FAO 2006

Province	Area equipped for irrigation (ha)
Central	49 200
Coast	6 661
Eastern	13 986
Nairobi	2 000
North Eastern	5 803
Nyanza	8 575
Rift Valley	16 415
Western	563
Kenya Total	103 203
With groundwater	1 032
With surface water	102 171

Figure 17 A Kenyan farmer Mt Kenya region (Wikipedia)

Figure 18 Rice Irrigation Tana delta (©Rutten)

In their Vision 2030 the Kenyan authorities elaborated on the need to secure food and jobs for a growing population by raising productivity and production in the agricultural sector. Over-reliance on rain-fed agriculture was considered as one of the major causes of food insecurity. Subsequently, irrigation returned on the desk of the planners at the National Irrigation Board for rehabilitating dormant schemes. It was also realized that new areas should be brought under irrigation to address the country's food deficit. The aim was to promote micro schemes. A draft irrigation policy aimed to irrigate 1.2 million ha in the drylands of the country, which meant an (over)ambitious expansion of 32,000 ha per year (Ocra 2013).

However, recent attempts to revive some of the public schemes have already been seen to be most challenging. The Ocra consultants' study for FAO on the wisdom of developing (semi-) arid irrigation in Kenya concluded that although food security would be increased:

1. Irrigation potential is limited due to scarcity and quality of water;
2. To a large extent irrigation in ASALs is still for subsistence purposes;
3. Most schemes are perennially dependent on outside assistance, hence sustainability is doubtful unless they are commercialised
4. Risk of salinization and
5. Likely more conflicts with (agro-)pastoralists.

Dekelver (2003) reports of these conflicts for the pastoral Turkana in north western Kenya. Irrigation in this area has been developed from the 1940s onwards, but more seriously since the early 1960 drought. The Turkana authorities, however, concluded in the mid 1980s that especially the government-initiated irrigation schemes were uneconomic and heavily subsidised. Costs exceeded the value of crops produced. Besides, the schemes experienced a lack of qualified staff, water and land to expand, and they were confronted with salinity of soils. These negative outcomes were also familiar experiences for large- scale schemes as

developed in the irrigated areas of Hola and Bura along the Tana river. Unless profitable crops could be grown these schemes would never be successful, even if all other problems (seed and water provision, labour and credit availability) would be taken care of (De Leeuw pers. com 2014). Both schemes profited from Dutch expertise, and so did the Lower Tana Village irrigation scheme. The model of small scale irrigation also ended in disarray, among other things because local people could make more money outside agriculture, the maintenance costs, which appeared to be too high, and the peculiarities of a delta with shifting river beds (Zoebl pers. com 2014)

More recently developed plans to irrigate sugarcane in the heart of the Tana delta for ethanol production have been met with fierce opposition from pastoralists and (international) wildlife organizations (Smalley 2011; Pickmeier & Rutten 2013). The only operative large-scale government-run rice scheme is the Tana Delta Irrigation Project. Rice is also produced in Mwea (in Central Kenya; one of the classical irrigation schemes in Kenya), and more recently in western Kenya by a private developer, an American company (Dominion Farms), in the Yala swamp. Both schemes have recently been challenged because of problems with insufficient water provision and protests by the local community over water pollution and lost access to a crucial wetland (Dominion), respectively. In spite of intensified production methods Mwea still only produces some 30 bags of rice per acre as compared to 200 bags in China (Mwangi 2014). Loans from the World Bank and Japan are meant to rehabilitate infrastructure, build a new dam, and expand the irrigation scheme and double production in the years ahead.

The most ambitious irrigation project, however, has been the one million acres Galana-Kulalu scheme as part of the National Food Security Project launched in January 2014 by President Uhuru Kenyatta. It is located near the coast south of the Tana delta in a former government farm. Besides a 10,000 acres model farm the idea is to host a mix of large- scale commercial cultivation, small holders using ground water and greenhouses and livestock feedlot development. Israeli expertise and financing is involved. Doubts have been aired about the size of the scheme and its viability (Ngirachu, 02/07/2014).

Kenya is part of the East African Agricultural Productivity Program (EAAPP) financed by the World Bank and partners. The overarching goal of the EAAPP is to increase agricultural productivity and growth in eastern Africa, by focusing on priority commodities such as cassava, rice, wheat and smallholder dairy production. The project is implemented by ASARECA, the Association for Strengthening Agricultural Research in Eastern and Central Africa and supports the objectives set by African countries through the Comprehensive Africa Agriculture Development Programme (CAADP).

Kenya is also part of the World Bank's Water Security and Climate Resilience Project. The goals are to (i) increase availability and productivity of irrigation water for project beneficiaries; and (ii) enhance the institutional framework and strengthen capacity for water security and climate resilience for the country.

Energy dynamics

For many years the Kenyan energy sector has been plagued by the high cost of power and unreliability of supply (Rutten 2005:310). The extent to which the Vision 2030 objectives can be realised depends also on improvements of the energy supply. The realisation of these objectives is only feasible if quality energy services are availed in a sustainable, competitive, cost effective and affordable manner to all sectors of the economy, ranging from manufacturing, services, mining, and agriculture to households (National Energy Policy; final draft 2014). Development of the sector is largely dependent on foreign support, notably from the World Bank (transmission), Japan (hydropower) and Germany (geothermal). 45% of Kenya's electricity is derived from hydroelectric plants, 42 % from fossil fuels, 13% from other (renewable) sources (CIA World Factbook).

New investments in the energy sector are a priority for Kenya. A key aim is to reduce the heavy dependency on hydropower which during times of drought is less reliable. Besides energy import from Ethiopia, energy derived from a to be constructed wind park near Lake Turkana (Netherlands involvement) and coal mining (China involvement) are seen to be the most important ways to overcome the deficit. Recent discoveries of gas and especially oil in Turkana County come with challenges to the sustainable use of water aquifers and water quality. In the production phase, typical volumes of water involved would be approximately 50 gallons of water for every barrel of oil produced (Tullow Oil).

The 2010 Constitution states that the National Government is responsible for protection of the environment and natural resources with a view to establishing a durable and sustainable system of development including water protection, securing sufficient residual water, hydraulic engineering and the safety of dams. Kenya has an estimated hydropower potential of about 6,000MW comprising of large hydros (sites with capacity of more than 10MW) and small hydros. Of the large hydros, 807MW has been exploited and accounts for about 50% of installed generation capacity as at 2013, while about 1,450MW remains unexploited. Potential for small hydros is over 3,000MW, of which less than 25MW has been developed.

The amount of electricity that can be generated depends on how far the water drops and how much water moves through the system. This is a major challenge. Especially industries complain about power cuts because of hydropower being

vulnerable as poor rains results in energy shortfalls. Also during rains water is lost due to inadequate storage capacity estimated to be some 100GW per year. Other challenges are of a financial, technical and management nature and the need to relocate affected people (National Energy Policy Draft 2014:45/46).

By the end of 2013, more than 260 small hydropower sites had been identified and the largest number of sites are found in the Tana River drainage basin, mainly in the counties of Kirinyaga, Muranga, Meru and Tharaka Nithi, so areas with high population densities. Energy development projects have various impacts on communities. Key among these is both economic and physical displacement. Physical displacement of project-affected people is particularly prevalent in projects such as hydro power plants requiring water reservoirs, acquisition of way leaves during construction of transmission lines and pipelines. Others include the concern by local communities that they will not benefit from these projects (National Energy Policy Draft 2014). The Kenyan government will establish a Consolidated Energy Fund that, among others, will cater for hydro risk mitigation during times of prolonged drought and conservation of water towers.

Climate change and environmental issues

Climate change models for Kenya show a picture that for most areas foresee higher temperatures and higher precipitation figures (Waithaka *et al.* 2013), with a mean rise of about 2ºC and 200mm per annum over the 2000 to 2050 period.

Still, recurrent droughts, floods and the associated losses are concerns that have featured much in public debate in the recent past (Alila & Atieno 2006). By contrast, Mwangi & Rutten (2012) confirm for Kajiado county higher annual rainfall figures in the last decade but also stress that access to water is lost due to competition between users, especially large scale farmers mining ground water. In other areas, like near Mt Kenya, similar observations have been made, albeit that rains come less predictably than in earlier days. It has also been noticed that temperatures indeed seem to be on the rise.

In Kenya, there is a particular concern over tea – a critically important sector for the economy, but which is also highly sensitive, like coffee, to climate change. Given its economic importance, tea in Kenya is facing challenges under climate change threats, raising concerns over the long run about its viability. According to a FAO report on Climate Change and Tea in Kenya, already tea producers are facing reduced and erratic rainfalls, higher rate of hail or frost episodes as well as increasing temperatures that heavily affect yields and productivity levels. Over 500,000 smallholder tea producers are facing increased uncertainty about future livelihoods. The FAO has been asked to provide technical support

and carry out a climate change impact assessment on tea and provide policy support in formulating a climate-compatible tea sector in Kenya.

While tea (and coffee) might suffer from temperature rises, all climate models predict yield gains in areas that have not previously been able to cultivate maize. These are areas that were too dry for successful maize production. With new areas becoming available for maize cultivation, like most of the ASALs, there are challenges to managing these options prohibiting conflicts with the original land use practices like pastoralism.

A major obstacle to come to clear statements about Kenya's future climate situation is the lack of long term data series. Water Resource Management Authority (WRMA) inherited a deteriorated water resources network that had been reduced from about 1000 stations to less than 200. Besides the reduction in numbers, the data had many gaps where it was being monitored or there were no data at all.

Besides climate challenges the main environmental issues in Kenya are water pollution from urban and industrial wastes; groundwater mining, degradation of water quality from increased use of pesticides and fertilizers; deforestation; soil erosion and desertification.

Pressing needs

** Measures to deal with population growth*

Population growth figures paint a picture of the likely pressure on productive resources if the country is challenged to remain food secure with increased numbers to feed (Waithaka *et al.* 2013). Population growth, although slowing down, will make Kenya in the next decade become even more water scarce.

Table 6 Kenya (Medium variant) 2015-2025

Year	Population ('000)	Population density (pop/km2)	Period	Population growth rate%
2015	46,749	81	2005-2010	2.68
2020	52,906	91	2010-2015	2.67
2025	59,386	102	2015-2020	2.47
			2020-2025	2.31

Source: http://esa.un.org/unpd/wpp/unpp/panel_population.htm

Table 7 Availability of water in Kenya 2008-2025

Kenya	2008	2015	2025
Total renewable water (10^9m3/yr)	30.7		
Total renewable per capita (m3/cap/yr)	792	657	517

Source: http://www.unep.org/pdf/africa_water_atlas.pdf; author's calculation

The growth of the Kenyan population of over a million citizens annually translates in a growing scarcity of (renewable) annual water availability per person to slightly over 517 m3 (Table 7). Kenya faces a serious challenge to provide sufficient amounts of water for drinking as well as production of food and other needs. This will add pressure on an economy that needs high growth figures to provide jobs for a young population eager to enter the (formal) job market. Lack of data hampers the analysis of poverty trends but the World Bank estimates that national poverty has fallen to 39% in 2012/13. The continuing structural economic shift from agriculture to services and sustained economic growth in Nairobi and its expanding suburban areas have been particularly important drivers to lower poverty rates. However, inequality in Kenya is relatively high: Kenya's 2006 Gini coefficient of 47.7 was higher than that of neighbours Ethiopia, Tanzania, and Uganda. The strategy's target of adding one million jobs per year, if achieved, would give a big boost to reducing inequality. Recent plans to provide opportunities for graduates to engage as volunteers exemplifies the need and difficulty to meet the target of creating one million jobs annually.

** Sustainable economic growth and agricultural productivity*

The ambitions for the 2013-17 period are high and aim to move average annual real GDP growth rates up to 8.2%, even reaching double digit growth in 2017. This would require a significant acceleration from the recent growth levels, especially in agriculture which is projected to grow by 6.5 percent on average annually, compared to an average of 3.5 percent during 1997-2012. But the structure of the economy faces many challenges to be dealt with in the years ahead: low agricultural productivity, a narrow export base, high energy costs and a declining manufacturing sector besides major economic and social disparities (IMF 2014). Higher productivity is key and to that end investment in physical infrastructure (including ICT and science) and human capital, as well as through reforms in the public sector, security, land, education, and drought risk management are needed. A major issue will be how to fund this growth keeping debt sustainable. IMF suggests seeking innovative funding mechanisms including public-private partnerships, besides domestic revenue mobilization and efficient public spending. For agriculture, in particular, IMF officials urge to promote private sector participation in management of the irrigation schemes to be established foremost in the semi-arid regions (IMF 2014). The recent withdrawal of a large number of private companies from the Tana delta shows, however, that within these dry zones delta's and wetlands might not be the easiest places to engage in given opposition from nature conservation groups and local people. Still, care is needed to understand motives for resistance or support as these are place and group specific. (Examples are available whereby nomadic pastoralists and farmers welcome in-

vestors under certain conditions and for a wide range of reasons in certain locations, while nearby places, especially crucial dry season grazing areas, will be no-go zones for irrigated agriculture in the view of local livestock owners). Young agriculturalists, by contrast, are less negative as they hope to be able to acquire a wage employment opportunity instead of trying to make ends meet as a small scale farmer (Pickmeier & Rutten 2012). Meeting all these demands for (productive) water and jobs will be a balancing act.

The rise in the use of irrigated agriculture, using both surface and groundwater, using greenhouses seems to provide an opportunity also to assist youth groups to create jobs for themselves. However, if groundwater abstractions through deep boreholes go beyond the point of sustainable use, there is a risk that nearby shallow aquifers will be drained beyond restoration. The recent trend to move into mining of groundwater (both rural and urban) should be conducted with great care and in a sustainable manner only.

** Smart technology and institutional frameworks*

There is a need for smart and cheap technologies and institutional frameworks to create lasting business cases that can fulfil the demand for affordable and secure water. At the moment though, businesses are started in rural areas that harm the environment even further (charcoal production through felling of riverine trees, sand harvesting from the river bed for the construction industry, collecting rocks from rivers allowing too fast runoff during times of rain, mining and selling of groundwater and brokering of land to industries that pollute the environment).

In urban settings, like Nairobi, the use of groundwater seems to have increased rapidly since the drought of 2009, especially in well-off neighbourhoods where individual households have drilled boreholes in their backyards. Smart rain water harvesting should be promoted in urban areas. Serving the less well-off could be an interesting option for innovative businesses. In Mombasa, a Dutch entrepreneur has put up a company that is using high-end technology machines to recycle and clean waste water into bottled water at the same time creating employment. Making Kenya more investment friendly would be one aspect that needs attention, but unfortunately latest reports indicate that it has become less easy to acquire work permits for foreigners.

The use of mobile phones to pay water bills, report leakages and inform customers on availability and prices of potable water might also be a field for further scrutiny. Likewise, the rising shortage and costs of fertilizer might allow for projects that improve sanitation in the urban slums of the country, and make use of human waste as bio-fertilizers.

** Improvement of (urban) water governance*

Despite the far-reaching water reforms laid down in the Water Act 2002 and the *National Water Resources Management Strategy 2006-2008* (Kenya 2006a), water governance in Kenya still faces a myriad of challenges. In relation to urban water supply, Owuor & Foeken (2009) list the following:

- It is not clear whether the water companies are private or public. Whereas under the Companies Act, water and sanitation companies are registered as private, limited liability companies, they are 100% publicly owned by the local authorities and are managing public assets to give an essential public service.
- The water and sanitation companies have inherited old, dilapidated and in some cases obsolete infrastructure from the local authorities, the National Water Conservation and Pipeline Corporation and/or the Ministry of Water and Irrigation. So far, rehabilitation of the existing infrastructure is yet to be fully achieved.
- All the water companies have inherited employees previously employed in the Department of Water and Sewerage of their respective local authorities or from the Ministry of Water and Irrigation. Only the directors and managers have so far been hired competitively.
- Inadequate capacity to manage the increasing demand for water. The populations in Kenya's urban centres have increased and will continue to do so. A major challenge to the water companies will be to provide enough water, in quantity and quality, to the increasing population.
- Limited resources and high costs of operation and maintenance. As much as the water companies are supposed to run as commercial enterprises, they are incurring very high operation and maintenance costs, compared to the revenue they are collecting.
- Local political interference and corruption. In its strategic plan (2007-2012), Kisumu Water and Sewerage Company points "local political interference" as one of the risks towards good governance, financial resource mobilization, promotion of efficient utilization of resources and effective communication to stakeholders and customers (KIWASCO 2008).
- Inherited debts, liabilities and too many fees to be paid.
- Extension of water services to the low-income neighbourhoods. Poor planning has made it difficult for municipalities to put up a water infrastructure, especially in the mushrooming informal settlements. Their illegal status – at least according to the municipal authorities – has hindered the expansion of municipal services to serve them.
- Lack of autonomy to do major investments. Since the companies do not own the assets, they are only allowed to do minor investments. Water Services Boards who own and manage the assets are the ones responsible for investment.
- Flat rate tariffs will continue to persist as long as the problem of lack of meters and malfunctioning meters is not addressed.
- Despite the efforts towards controlling, reducing and stopping this unsustainable habit from the consumers, water companies are faced with the persistence of illegal connections, not only in low income areas as one would expect, but also in other parts of the city.

** Proper water governance and transparency in the energy sector*

The energy sector has reached a crucial moment in time. Oil exploration might create benefits for the (local) economy and create jobs, but will also put more pressure on nearby water resources. This is equally true for biofuels. Transparency stands out as a crucial factor. For hydropower development the need for proper water governance should be added to make sure downstream users are not affected negatively.

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