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

Report on Mozambique

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 – Mozambique

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 Mozambique (see www.viawater.nl), compiled by Germa Seuren of the ASC Library under the responsibility of Jos Damen. The Mozambique report is the result of joint work by Ton Dietz, Roeland Hemsteede 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 Mozambique and the Africa Yearbook 2013 chapter about Mozambique, written by Joseph Hanlon (see reference list). Also the Country Portal on Mozambique, organized by the ASC Library, has been a rich source of information (see http://countryportal.ascleiden.nl).[1]

Political geography of water

Figure 1 Map of Mozambique

Figure 2 Map of Mozambique cities

Source figure 1: http://countryportal.ascleiden.nl/mozambique
Source figure 2: http://commons.wikimedia.org/wiki/File%3AMozambique_map_cities.png

[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.

República de Moçambique is a country in Southeast Africa bordered by the Indian Ocean to the east, Tanzania to the north, Malawi and Zambia to the northwest, Zimbabwe to the west and Swaziland and South Africa to the southwest. The capital and largest city is Maputo. Before 1975 the country used to be a Portuguese colony. After Independence there was a long civil war between the governing Frelimo party, and Apartheid-South Africa-backed Renamo, which lasted until 1992. After that civil war Mozambique became one of the 'high-growth' countries. Following the recent big gas discoveries in front of the Northern Coast (and into the Tanzanian part of the Indian Ocean) the country sees itself as one of the African cheetahs, moving fast to middle-income status.

Figure 3 Mozambique location map

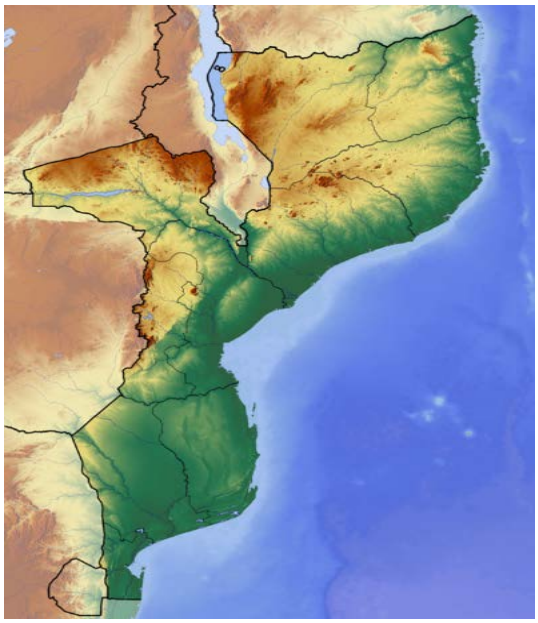


Figure 4 Mozambique vegetation map

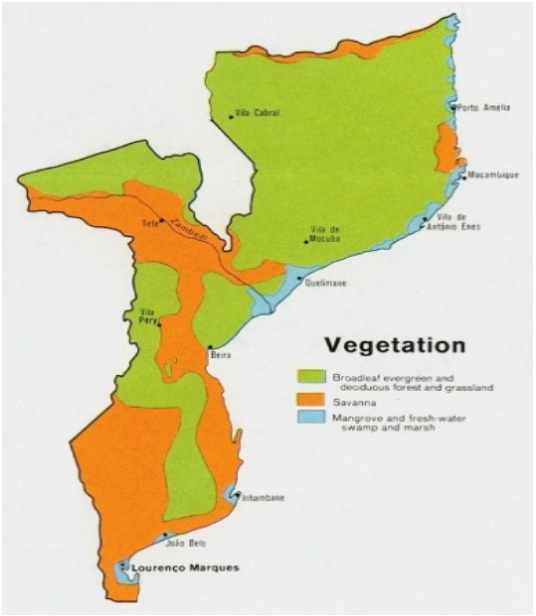
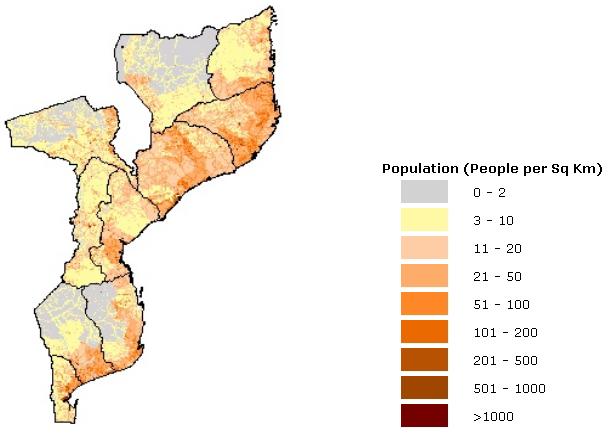


Figure 5 Map of population density



Source fig. 3 http://commons.wikimedia.org/wiki/File%3AMozambique_location_map_Topographic.png
Source fig. 4 http://mapas.owje.com/img/Mapa-de-Vegetacion-de-Mozambique-6242.jpg
Source fig. 5 http://www.catsg.org/cheetah/07_map-centre/7_2_Southern-Africa/thematic-maps/mozambique/human-population.jpg

Mozambique has many river systems, which all flow towards the Indian Ocean. The biggest system is the Zambezi, which gets its water mainly from Zambia, but also from Angola, the Caprivi strip in Namibia, the extreme north of Botswana, most of Zimbabwe, and all of Malawi (including the Lake Nyasa area, which forms the border between southern Malawi and northwestern Mozambique). Zambia already makes use of the Zambezi river for large-scale irrigation purposes (e.g. the Nakambala Sugar Estate near Mazabuka; but there are many other plans, partly related to the idea of using sugarcane for ethanol production for energy purposes) and for hydro-electricity (with the Kariba Dam in the Zambezi River itself, at the border between Zimbabwe and Zambia, and the Itezhi-Tezhi Dam on the Kafue tributary the biggest ones). Further development of Zambezi water use in upstream countries can and will have a major impact on what can be done on the Mozambican side. Already in colonial times Mozambique started a major hydroelectric plant: the Cahora Bassa Dam in the Tete area (e.g., see Isaacman, 2001).

Figure 6 Zambezi river basin

Source: http://upload.wikimedia.org/wikipedia/commons/9/99/Zambezi_river_basin.jpg.

From north to south the following river systems are of importance for Mozambique:

- The Rovuma River, forming the boundary with Tanzania, and with the Lugenda River as a tributary; the city of Lichinga lies between that river and Lake Nyasa
- The Messalo River
- The Lurio River, flowing into the ocean south of the coastal city of Pemba
- The Ligonha River, south of the city of Nampula, the leading city in the north of Mozambique
- The Licungo River, north of the coastal city of Quelimane
- Then the Zambezi River, with the City of Tete on its banks
- The Pungoe River, emptying near the port city of Beira
- The Revue-Buzi River system, with the city of Chimoyo nearby
- The Save River, coming from southeastern Zimbabwe
- The Changane River, also coming from Zimbabwe, feeding into the Limpopo River, partly also coming from South Africa. It enters the Ocean near the City of Xai-Xai. The coastal city of Quelimane, north of Xai-Xai is not connected to a major river system.
- Maputo, Mozambique's coastal capital city in the extreme south is not connected to a major river system (only some smaller rivers, with water coming from Swaziland and South Africa, the Komati or Incomati River included; this river reaches the Indian Ocean in Maputo Bay).

All coastal cities are occasional victims of severe storms and floods, and they have to cope with the impact of sea level rise.

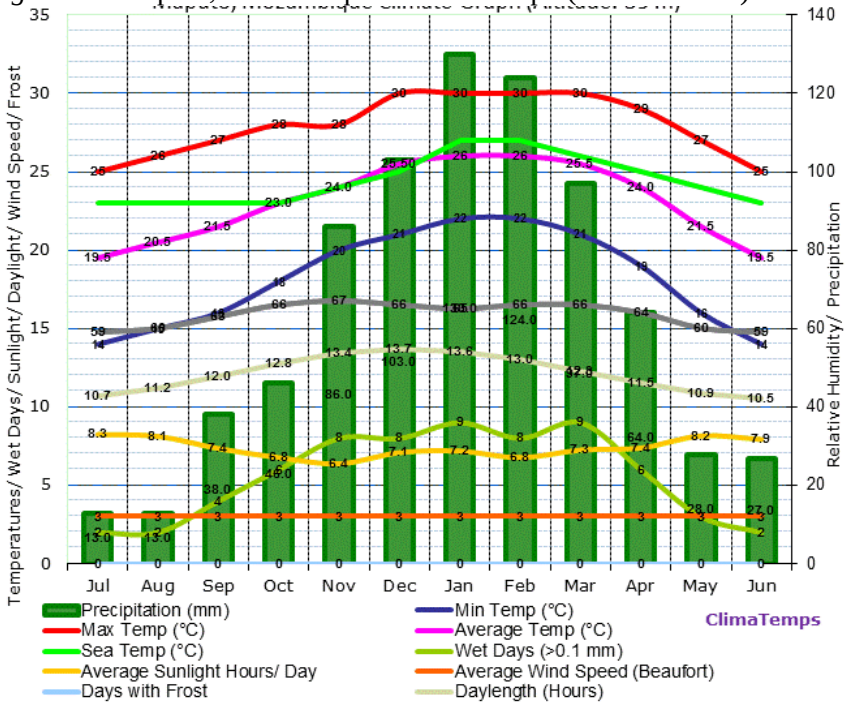
Figure 7 Floods in 2014

Source : http://ewn.co.za/-/media/8EB5DAF21976439E9CF7A4339B6B561E.ashx

Most of Mozambique belongs to the sub-humid climatic zone, with relatively low population densities. In Tete Region and in the south-western area near Zimbabwe and Limpopo there are dryer, semi-arid zones. In the North there are

pockets of more humid zones. Maputo has one rainy season between November and April, the summer season; and one dry season in winter (May-August).

Figure 8 Maputo, Mozambique Climate Graph (Altitude: 39m)



Source: http://www.maputo.climatemps.com/graph.php

The fact that many of Mozambique's waterways originate in different countries presents a unique challenge to its management. Pollution originating abroad will impact the quality of drinking (and irrigation) water in Mozambique, especially for those relying on unimproved water sources (see below) (Slinger, Hilders, & Juizo, 2010).

Demographic situation: Population, urbanization, water consumption trends

According to the UN Statistics Pocketbook, Mozambique has 24 million citizens (2011) and an average annual population growth of 2.2% (2010-2015).

The country has a fairly high urban population: 31.4% of the total population (2012), which is partly caused by the long civil war (1977-1992) and partly by recurrent drought in the hinterlands. It has an average annual urbanization rate of 3.1%. Major urban areas are Maputo, the capital, with 1.15 million inhabitants, and Matola (790,000 inhabitants), which is connected to Maputo.

According to the WHO /UNICEF Joint Monitoring Programme for Water Supply and Sanitation 2014 update, 80% of the urban population and 35% of the rural population had access to *improved* drinking water sources (protected sources) in 2012; 20% of the urban population and 65% of the rural population had access to *unimproved* drinking water sources (unprotected sources and surface water).
44% of the urban population and 11% of the rural population had access to *improved* sanitation facilities. 56% of the urban population and 89% of the rural population had access to *unimproved* sanitation facilities.

This means Mozambique is falling short of its targets to "achieve 55% coverage of the rural population with safe drinking water supplies by 2009, and 70% by 2015. For rural sanitation, the targets were 40% by 2009 and 50% by 2015" (IOB, 2011). Reaching these targets will require considerable effort and failing to reach them presents a threat to public health.

Let's look at a longer period of time (see table 1). Between 1990 and 2011, not only did the number of people with access to improved water sources grow (in the cities with 179%), but also the number of people with NO access to improved water sources grew, also in the cities: with 113%.

The same counts for access to improved sanitation facilities: while the number of people with access to these facilities grew considerably (for the rural population with 594%), the number of people with NO access to improved sanitation facilities grew as well, e.g. in the cities with 137%.

Improvements in water and sanitation are considered to be instrumental in poverty reduction and in spurring economic growth (Salomon Lda, 2008).

Table 1

1990-2011	NATIONAL POPULATION			URBAN POPULATION			RURAL POPULATION		
Water	% growth population	% growth access to improved water source	% growth NO access to improved water source	% growth population	% growth access to improved water source	% growth NO access to improved water source	% growth population	% growth access to improved water source	% growth NO access to improved 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 population	% growth access to improved sanitation facility	% growth NO access to improved sanitation facility	% growth population	% growth access to improved sanitation facility	% growth NO access to improved sanitation facility	% growth population	% growth access to improved sanitation facility	% growth NO access to improved sanitation 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

Mozambique is having elections on 15 October 2014; Frelimo President Guebuza cannot be re-elected. In 2013, opposition party Renamo unexpectedly resumed military action, ending 20 years of peace after the end of the civil war against Frelimo in 1992, thus posing a threat to the country's relative stability. Particularly recent ambushes and killing along the main North-South route (near Renamo strongholds) and also kidnapping-for-ransom (mainly in Maputo) pose threats to the internal security in the country. Another threat to stability are the national demands to spread the wealth more equally. Strikes by doctors, former troops and widows for higher salaries or pensions have occurred on a regular basis (Africa Yearbook, 2014).

As for international affairs: the Africa Yearbook (2014) writes that a government-guaranteed $850 million European bond issue in 2013 for six coastal patrol boats and 24 tuna fishing boats for a new Mozambican government fishing company, Ematum (National Tuna Company), part-owned by the security services, led to a stir since there had not been any internal discussion about it. The IMF and several other donors were furious. Donor-government relations had already become worse after a group of donors put pressure on 'governance' improvement in 2010. The government resisted, and has become more bold in its relationship with 'demanding donor agencies'. While foreign aid paid 51% of the state budget in 2010, it dropped to 34% in 2013. President Guebuza is looking for cooperation with neighbouring countries like Malawi and other Southern African Development Community (SADC) countries. Also the recent rapid growth of Brazilian involvement in Mozambique's development, and the expectations of the prospects of gas and coal exports strengthen the Mozambican Government's bargaining position vis-à-vis the OECD donor countries.

Institutional setting of water

Mozambique is divided into ten provinces and one capital city with provincial status. The provinces are subdivided into 129 districts. Water is partly governed by the Ministry for the Coordination of the Environment (www.micoa.gov.mz), the Ministry of Fishery (www.mozpesca.gov.mz) and the Ministry of Energy (www.me.gov.mz). (Please note that these websites are often not accessible). In 2007 the *Ministério das Obras Públicas e Habitação* published a major strategic document about the country's water situation; the *Estratégia nacional de gestão de recursos hídricos.*

Photo 1 Panoramic view of Maputo, the capital of Mozambique and the largest city in the country.

Source: Andrew Moir/Wikipedia

A risk originating in the political realm lies with *integrated water resources management*. Metha *et al.* (2014) argue that the laws regarding water are often at odds with (newer) policies. "*For instance, whilst it is stated in the Water Law that the State will play a key role in water supply and management, in the National Water Policy the same State will withdraw from any involvement in the provision of water*." (p. 534). Another risk they identify is that knowledge on policy level about water management is highly concentrated among a few people in Mozambique. On other levels, high turnover of staff is noted as an obstacle to successful implementation of projects. At operational and maintenance level staff is frequently illiterate (IOB, 2000, p. 60).

Lastly, the centralized and hierarchical structure of water management obstructs active stakeholder participation. This will remain a challenge for the future as this "*authoritarian streak has left Mozambicans with little experience of how to set up a responsive, accountable, democratic and representative management agency […]*" (Metha *et al.* 2014, p. 536). The fragmented governance landscape is confirmed by IOB (2011), which states that while water resources are state property, their management is decentralized and in part privatized. In essence, the government wants to act as a facilitator rather than a (service) provider.

Aside from knowledge being concentrated among a few people, existing knowledge/data are also frequently unreliable and/or hard to access. This is particularly problematic when many (international) parties are involved in water management and governance. Slinger, Hilders, & Juizo (2010) conclude that "*there is no shared basic data set, no shared basic knowledge, and no agreed-upon means of synthesizing and processing data, combined with distrust about other parties' intentions*". While their conclusions refer specifically to the decision making processes involving the Incomati river basin in the period 1991-2002 there is no reason to believe these issues have wholely been resolved and/or

are not present in other locations and situations. The Government of Mozambique also recognizes the problems with data availability when they state that *"Lack of accurate data, especially in rural and peri-urban areas, makes it impossible to estimate the true cost of extending sustainable and good quality water, sanitation and hygiene services to the poor"* (Salomon Lda, 2008). The implications for project planning emanating from this data deficiency can pose a risk to projects.

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

Mozambique was one of the world's poorest countries at independence in 1975. In 1987, the government embarked on a series of macroeconomic reforms designed to stabilize the economy. This, combined with donor assistance and with political stability since the multi-party elections in 1994, has led to huge improvements in the country's growth rate. Fiscal reforms, including the introduction of a value-added tax and reform of the customs service, have improved the government's revenue collection abilities. In spite of this, Mozambique remained dependent upon foreign assistance for 40% of its 2012 annual budget and over half the population remained below the poverty line.

The high dependence on aid, over 85% of all water and sanitation-related investments in the three years preceding 2010 (IOB, 2011, p. 41), means that continuation of programs or investment is at risk when donors withdraw.

In 2012, the Mozambican government took over Portugal's last remaining share in the Cahora Bassa Hydroelectricity Company (HCB), a significant contributor to the Southern African Power Pool. The government has plans to expand the Cahora Bassa Dam (one of the three major dams on the Zambezi river, see figure 9) and build additional dams to increase its electricity exports and fulfill the needs of its burgeoning domestic industries.

Burgeoning industries however also pose a risk to the quality of water for both domestic and agricultural usage. A case study of the Limpopo river basin found that *"[n]atural and anthropogenic derived contaminants generated at upstream countries (Zimbabwe and South Africa) such as heavy metals and nutrients were found to contribute for water quality deterioration at downstream Limpopo Basin"* (Chilundo, 2007, p. 69). Monitoring of the origins and levels of pollution is imperative when water from the Limpopo basin is used for agriculture.

Figure 9 Location of the Cahora Bassa Dam

Source: Google maps

In July 2007, the US government's Millennium Challenge Corporation (MCC) signed a $506.9 million Compact with Mozambique. Compact projects ended in September 2013 and are focusing on improving sanitation, roads, agriculture, and the business regulation environment in an effort to spur economic growth in the four northern provinces of the country.

According to the World Bank (World Bank Mozambique Overview) the country's achievement of Extractive Industry Transparency Initiative (EITI) compliance status is an important milestone in the country's economic management of natural resources. Alongside its natural resources, Mozambique's long coastline positions it as a natural gateway to global markets for neighboring land-locked countries.

Mozambique's economy grew by 7 percent in 2013 led by transport and communications, financial services and extractive industries. FDI inflows reached US$ 5.9 billion in 2013; international reserves increased by US$ 404 million over the year, and inflation remains low despite an expansionary fiscal stance and increased credit to the economy.

However, also according to the World Bank overview, the impressive trajectory of growth has not been matched by a concomitant reduction in poverty and creation of jobs, prompting questions about the current development model and the need for greater inclusiveness and economic diversification.

The deceleration of poverty reduction in the face of robust economic growth is the defining development challenge in today's Mozambique. The challenge is to diversify the sources of economic growth; integrate capital-intensive mega-projects with the government's poverty reduction strategy; and develop the agri-

culture sector which employs close to 80% of the workforce but remains largely unproductive and subsistence-based.

More broadly, Mozambique needs to improve provision of public goods to facilitate inclusive growth (e.g., infrastructure, education, health); set up well-targeted safety nets for the most vulnerable people; promote greater voice and citizen participation while building transparent and accountable systems, and, lastly but not least accelerate investment climate reforms.

The country's ability to attract large investment projects in natural resources is expected to fuel continued high growth in coming years. The CIA predicts that revenues from these vast resources, including natural gas, coal, titanium and hydroelectric capacity, could overtake donor assistance within five years (CIA World Factbook, retrieved 21/8/2014).

Mozambique has 98 airports, of which 77 are unpaved. Its railway system is being expanded to Nacala port, to Malawi and to a new offshore port at Macuze by the Brazilian mining company Vale. Mozambique has 460 km of navigable waterways: the Zambezi River is navigable to Tete and along the Cahora Bassa Lake. The major seaports are Beira, Maputo, and Nacala.

There is rapid growth in the mobile-cellular network (CIA World Factbook, retrieved 21/8/2014); mobile-cellular coverage now includes all the main cities and key roads, including those from Maputo to the South African and Swaziland borders, the national highway through Gaza and Inhambane provinces, the Beira corridor, and from Nampula to Nacala; there is extremely low fixed-line teledensity; despite significant growth in mobile-cellular services, teledensity remains low at about 35 per 100 persons.

The growing cellular coverage could also provide opportunities for data collection and dissemination of information in rural areas (Salomon Lda, 2008).

Agricultural and fishery dynamics

Subsistence agriculture employs the vast majority (80%) of the country's work force and smallholder agricultural productivity and productivity growth is weak. According to an ASC Working Paper by Ton Dietz and the ASC Food Security/Agrohub Research Team from May 2012, Mozambique's agricultural history of the last half Century was influenced by its turbulent history. Its population increased with a factor 2.9 in those fifty years, and the country's food production levels could not keep pace, and they already started with levels that could not at all feed the population. During the 1960s and 1970s food energy production further deteriorated (Mozambique became independent in 1975), to recover in the 1980s and particularly in the 1990s, to fall back again in the 2000s (see Table 2). In terms of contributions to the basic food basket, roots and tubers have always

been more important than cereals. Roots and tuber production grew slightly less than population between 1961 and 2009 and the production increase came both from area expansion and from yield improvements (both x1.6). Cereal production increased almost with the same relative figures as population; but here all growth came from area expansion, with maize as the most important cereal crop throughout the period. Yield growth for pulses was also slower than area expansion.

For Mozambique to be able to feed its population at minimum levels required by the WHO for a healthy life means that a major improvement is needed, particularly in yield levels. For cereals these were higher in 1970 than today, and for roots and tubers the same is true for 2000. So regaining some of the lost yield performance levels could already improve the food security situation by Mozambique's own food production.

Table 2 Population and food production dynamics in Mozambique, 1961-2009

	1961	1970	1980	1990	2000	2009	1961-2009
Population							
	7.8	9.4	12.0	13.4	17.0	22.9	X2.9
Cropping Area (x1000 ha of harvested crops)							
Cereals	732	686	1,113	1,548	1,828	2,036	X2.9
Pulses	135	120	150	290	200	218	X1.6
Roots/Tubers	760	815	885	961	993	1,204	X1.6
Yield (kg/ha)							
Cereals	880	1,000	600	480	870	880	X1.0
Pulses	480	560	400	320	500	770	X1.2
Roots/Tubers	3,480	3,600	4,200	5,920	5,490	X1.6	
Total basic food production (1000 tons)							
Cereals	642	686	663	738	1,587	1,785	X2.8
Pulses	65	67	60	92	100	167	X2.6
Roots/Tubers	2,647	2,985	3,715	4,722	5,878	6,614	X2.5
Food energy value (x1000 Cal/capita/year)							
Cereals	298	263	198	198	319	281	X0.9
Pulses	21	18	12	17	14	18	X0.9
Roots/Tubers	341	318	308	352	328	289	X0.8
Total	660	559	518	567	661	588	X0.9

According to the Africa Yearbook (2014), Mozambique's own food production potential is severely hampered by the policy to make South African food imports cheaper by manipulating the exchange rate in favour of urban food consumers, which is detrimental to Mozambique's own food producers.

Commercial agriculture might in the long run become a risk to the availability of groundwater for domestic use in parts of the country when they *"exploit aquifers rather than surface water"* (IOB, 2011, p. 35). With economic growth and (foreign) investment in agriculture increasing, land and water rights are increasingly an area of conflict. *"[T]hrough the Land Law, local communities, be it through customary occupation or through good faith occupation, are not only granted long-term land use rights, but also use rights to the resources connected to the land, including water. Anybody who now wants to gain access to local resources needs to negotiate with the community."* (Veldwisch, Beekman, & Bolding, 2013). In practice however these rights are not always observed. Striking a balance between developing commercial agriculture and safeguarding smallholder farming will be a challenge for the years to come.

Nkoka *et al.* (2014) add that proper attention is needed for the various 'hydraulic property relations', as these are often rooted in local traditions.

The Ministry of Agriculture of Mozambique awarded a 5.4 million dollar contract to an irrigation services provider consortium led by Royal HaskoningDHV. The consortium will develop and implement an irrigation system for 6,000 small farmers covering 3,000 hectares of rice fields. The sustainable irrigation project PROIRRI is funded by the World Bank and will run for a period of six years. The project objective is raising small agrarian food production and the productivity of farmers in central Mozambique. The project should increase food production from 1 to 1.5 rice harvests per year. At the end of the project the rice production per hectare will have increased from the current 1 ton per year to 4 tons per year. The resulting rice production will be 12,000 ton per year.

Mozambique is endowed with fairly rich fisheries resources, both marine and freshwater. The marine waters cover an area of about 100,000 km² with an exclusive economic zone (EEZ) of 200 nautical miles while inland waters cover an area of about 13,000 km². Fishery production for direct human consumption was 90,000 tonnes in 2003 (most recent figure, FAO). The marine fisheries resources are mostly located in the two major shelves, the Sofala Bank in the center and the Delagoa bight in the south. The main fishing areas are located at the Sofala Bank, Inhambane, Vilankulos, Chiluane and Beira.

Dams such as the Cahora Bassa dam in the Zambezi have reduced the fishing opportunities for people living along the Zambezi (Isaacman & Morton, 2012). This is a consequence of the flow management and is something that must be

considered when designing new hydroelectricity programs such as the Mphanda Nkuwa project sixty kilometers downstream.

Energy dynamics

Mozambique contracts its electricity mainly from hydroelectric plants. It is (after Lesotho!) the second country in the world to generate electricity solely by water-driven turbines (99.9% of the country's total generating capacity). As stated before, the Mozambican government has plans to expand the Cahora Bassa Dam and build additional dams to increase its electricity exports and fulfill the needs of its domestic industries.

This however provides opportunities for domestic industry yet poses a risk for the thousands of people that inhabit these locations and who have been hardly involved in the decision-making processes (Isaacman & Morton, 2012, p. 158).

Climate change

Natural hazards to Mozambique are severe droughts, devastating cyclones and floods in the central and southern provinces. Cyclones are expected to increase in frequency and magnitude as climate change continues (Chenene, Cuamba, Mavume, Queface, & Tsamba, 2011). 2013 saw the worst floods since 2000 (about the 'Great Flood of 2000'see Christie & Hanlon). In January 2013, the Limpopo River flooded, the town of Chokwé was completely under water. There was major damage to irrigation systems along the river. Desertification and pollution of surface and coastal waters also form a problem. Mozambique is party to the following international agreements: Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Hazardous Wastes, Law of the Sea, Ozone Layer Protection, Ship Pollution, Wetlands.

The European Commission in 2006 noted that *"[a]cross the country, average rainfall is expected to decrease by 5-10% during this century as a result of climate change"* (IOB, 2011, p. 34). Zhu & Ringler (2010) conclude, after assessing multiple climate change scenarios for the Limpopo river basin, that annual rainfall will have reduced significantly by 2030. Currently, per capita water availability in Mozambique is already below the African average (Chenene, Cuamba, Mavume, Queface, & Tsamba, 2011, p. 224). This places additional demands on the region's irrigation systems. As a consequence adequate measures will have to be taken to ensure sustainable agricultural production in the region. Moreover, it is expected that in the future rainfall will be concentrated in shorter periods of time resulting in more floods and droughts (Chenene, Cuamba,

Mavume, Queface, & Tsamba, 2011) (Chenene, Cuamba, Mavume, Queface, & Tsamba, 2011, p. 214).

Pressing needs

* *Involvement of communities & improvement of governance*

One major challenge is to actually reach the various targets set by the government. This requires, among others, creating meaningful community participation, particularly in rural water management. Insufficient involvement and commitment of community leaders can lead to shortfalls in the desired behavioral change (Mirasse, 2009). Nkoka, Veldwisch, & Bolding (2014) note that for farmer-led irrigation to be a success provision of inputs/maintenance is not sufficient but 'supportive social networks' (links to [traditional] authority) are also essential. It also requires improving governance and institutions; getting private sector involved for direct service provision and reconcile this with the limited financial opportunities rural citizens have to contribute to this (IOB, 2011). In urban areas the provision of water services has become a major challenge, due to the rapid growth of Mozambique's cities and the complex arrangements of water provision in the diverse urban communities, particularly in Maputo. Alda Vidal (2014) asks for specific attention for the role of women as water providers in a city like Maputo. Chimene (2013) points at the need to curb the considerable water losses in the major cities.

* *Coordination and compliance of policies*

Secondly, there is a need for "[a]chieving coordination and clear direction in the crowded donor/lender landscape for rural water and sanitation [. This] is a significant challenge for [Mozambique's] DNA and the Ministry of Finance" (IOB, 2011). Achieving institutional change is difficult as concluded by an evaluation of Dutch development assistance to (among others) Mozambique because "in many cases organisations in recipient countries were unable or reluctant to adapt their structures or mandates." (IOB, 2000). It is also a major challenge to deal with regional water issues, particularly with neighboring South Africa and Zimbabwe (e.g. see Carmo Vaz & Van der Zaag, 2003, on sharing the Incomati waters).

** Improvement of availability and usage of data*

Collection, reliability/quality, availability and usage of data on water and sanitation on all levels needs to be improved. Costs made related to WASH programs are often aggregated to such a level that they are of limited use to policy making (Salomon Lda, 2008, p. 85); budgeting, monitoring and reporting capacities need to be built further.

** Measures to deal with rainfall reduction and natural hazards*

Finally, strategies to deal with the expected impacts of climate change need to be designed: increasing numbers of droughts, floods and cyclones will occur while overall water availability per capita will decrease as a result of climate change and population growth.

References

AFRICAN STUDIES CENTRE, Working paper the agricultural performance of Africa during 1961-2009, Based on FAOSTAT data, May 2012 (www.ascleiden.nl/sites/default/files/pictures/agricultdynamicszambiazimbabwemozambique1.pdf).

AFRICA YEARBOOK VOLUME 9: Politics, Economy and Society South of the Sahara in 2012, BRILL (2013). Mozambique Chapter, Joseph Hanlon.

AFRICA YEARBOOK VOLUME 10: Politics, Economy and Society South of the Sahara in 2013, BRILL (2014). Mozambique Chapter, Joseph Hanlon.

ASC Country Portal Mozambique: http://countryportal.ascleiden.nl/mozambique

CARMO VAZ, A. & P. VAN DER ZAAG (2003), Sharing the Incomati waters: cooperation and competition in a balance. Paris: UNESCO.

CHENENE, M., B. CUAMBA, A. MAVUME, A. QUEFACE & A. TSAMBA (2011). Technological Barriers to Climate Change Adaption. In: L. Masters, & L. Duff, *Overcoming Barriers to Climate Change Adaption Implementation in Southern Africa* (pp. 201-226). Braamfontein: Africa Institute of South Africa and Institute for Global Dialogue.

CHILUNDO, M.N. (2007). *Design of a Water Quality Monitoring Network for the Limpopo River Basin in Mozambique.* Delft: UNESCO-IHE (MSc Thesis ES ; 07.28).

CHIMENE, C.A. (2013), Strategies and methods for apparent water loss management in developing countries. A case study of Mozambique. Delft: UNESCO-IHE. (MSC thesis MWI ; 13.19).

CHRISTIE, F. & J. HANLON (2001), Mozambique and the great flood of 2000. Oxford: James Currey.

CIA WORLD FACTBOOK MOZAMBIQUE: https://www.cia.gov/library/publications/the-world-factbook/geos/mz.html

IOB (2000). *Institutional Development: Netherlands support to the water sector 1988 - 1998.* Policy and Operations Evaluation .

IOB (2011). *More than water : impact evaluation of drinking water supply and sanitation interventions in rural Mozambique.* The Hague : Ministry of Foreign Affairs, Policy and Operations Evaluation Department (IOB).

ISAACMAN, A. (2001), Domesticating a white elephant: sustainability and struggles over water, the case of Cahora Bassa Dam. Zambezia, vol 28, no. 2, p. 199-228.

ISAACMAN, A.F., & D. MORTON (2012). Harnessing the Zambezi: How Mozambique's Planned Mphanda Nkuwa Dam Perpetuates the Colonial Past. *International Journal of African Historical Studies , 45* (2), 157-190.

METHA, L., R. ALBAC, A. BOLDINGC, K. DENBYA, B. DERMANA & T. HOVED, *et al.* (2014). The politics of IWRM in Southern Africa. *International Journal of Water Resources Development , 30* (3), 528–542.

MIRASSE, A.M. (2009). *COMPARING RURAL SANITATION CAMPAIGNS IN MOZAMBIQUE: LESSONS AND CONSIDERATIONS FOR ACHIEVING SUSTAINABLE RESULTS.* SNV Netherlands Development Organisation .

NKOKA, F., G. VELDWISCH, & A. BOLDING (2014). Organisational Modalities of Farmer-led Irrigation Development in Tsangano District, Mozambique . *Water Alternatives , 7* (2), 414-433.

ROYAL HASKONINGDHV: HYPERLINK http://www.royalhaskoningdhv.com/nl-nl/nieuws/nieuwsberichten/20140404pb-Groot-voedselzekerheidsproject-in-Mozambique/2366

SALOMON LDA (2008). *WASHCost Mozambique: assessment of the water and sanitation sector of Mozambique.* Maputo.

SLINGER, J.H., M. HILDERS & D. JUIZO (2010). The Practice of Transboundary Decision Making on the Incomati River: Elucidating Underlying Factors and their Implications for Institutional Design. *Ecology and Society , 15* (1).

VELDWISCH, G., W. BEEKMAN & A. BOLDING (2013). Smallholder Irrigators, Water Rights and Investments in Agriculture: Three Cases from Rural Mozambique. *Water Alternatives , 6* (1), 125-141.

VIDAL, A. (2014), Women and the production of water services: the case of female small scale water providers in Maputo. Delft: UNESCO-IHE (MSc thesis WM-WSM ; 14.22)

WORLD BANK MOZAMBIQUE OVERVIEW: http://www.worldbank.org/en/country/mozambique/overview

ZHU, T. & C. RINGLER (2010). *Climate Change Implications for Water Resources in the Limpopo River Basin.* International Food Policy Research Institute, Environment and Production Technology Division. IFPRI.