



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

Report on Ghana

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

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Water - Ghana

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 Ghana (see www.viawater.nl), compiled by Germa Seuren of the ASC Library under the responsibility of Jos Damen. The Ghana report is the result of joint work by Ton Dietz, Francis Jarawura 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 Ghana and the Africa Yearbook 2013 chapter about Ghana, written by Kwesi Aning & Nancy Annan (see reference list). Also the Country Portal on Ghana, organized by the ASC Library, has been a rich source of information (see countryportal.ascleiden.nl).¹

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Political geography of water

The Republic of Ghana is a sovereign state located on the Gulf of Guinea and Atlantic Ocean in West Africa. It is bordered by Ivory Coast to the west, Burkina Faso to the north, Togo to the east and the Gulf of Guinea and Atlantic Ocean to the south (Wikipedia-EN; ASC Country Portal Ghana). Most of Ghana belongs to the Volta River system, with the White Volta coming from central-eastern Burkina Faso (including the area around its rapidly expanding capital city Ouagadougou) and the Black Volta from Western Burkina Faso. Whatever Burkina Faso does to its Volta water (many small dams have been constructed and many more are planned) has an impact on the availability of water on the Ghanaian side, not only as a source of water for human and animal consumption and as a (potential) source of irrigation, but very much also as water that is feeding the large Akosombo Dam that provides Ghana with a lot of its electricity. In the south-western part of Ghana smaller rivers, with water coming from within Ghana, serve the western part of the country, until they end in the Atlantic Ocean. Domestic and industrial urban water supplies are based almost entirely on surface water, either impounded behind small dams or diverted by weirs in rivers. Water supplies in rural areas, however, are obtained almost exclusively from groundwater sources.

Ghana's most important cities, Accra and Kumasi, are not directly related to any of the major rivers in the country. Ghana's coastal towns (Accra, port city Tema, Cape Coast, and Takoradi) are confronted with the risk of sea level rise and coastal erosion, while storms and floods occasionally cause havoc.

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.

Figure 1 Map of Ghana



Figure 2 Physical map



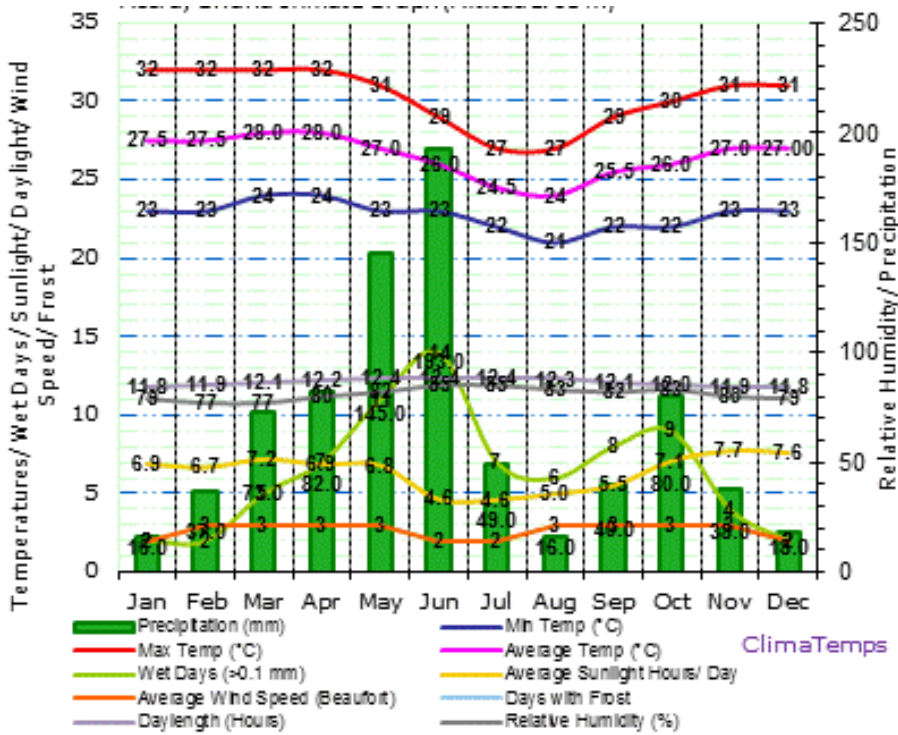
Source1:http://countryportal.ascleiden.nl/sites/default/files/pictures/ghana-cia_wfb_map.png

Source2:http://commons.wikimedia.org/wiki/File:Ghana_physical_map.svg

Most of Ghana belongs to the humid tropics (including its vast cocoa producing areas in the central-western part of the country). In the southeast (near Accra) conditions are somewhat dryer. The northern part of the country has a sub-humid climate, with occasional droughts and floods. The Sahelian droughts of the 1970s and 1980s also hit Northern Ghana. Many farmers responded by migrating southward (to the cities and to agricultural colonization areas in Ghana's relatively sparsely populated central zones), by combining upland with riverine fields, and by starting a lot of small-scale irrigation activities, making use of small dams. Ghana has a rather peculiar population distribution, with the highest densities in the Coastal and cocoa zones, and around the northern capital, Tamale, but also in the dry and rocky upper east and upper west areas, still a result of these areas being refuge areas during the harsh slave-raiding era until the end of the 19th Century.

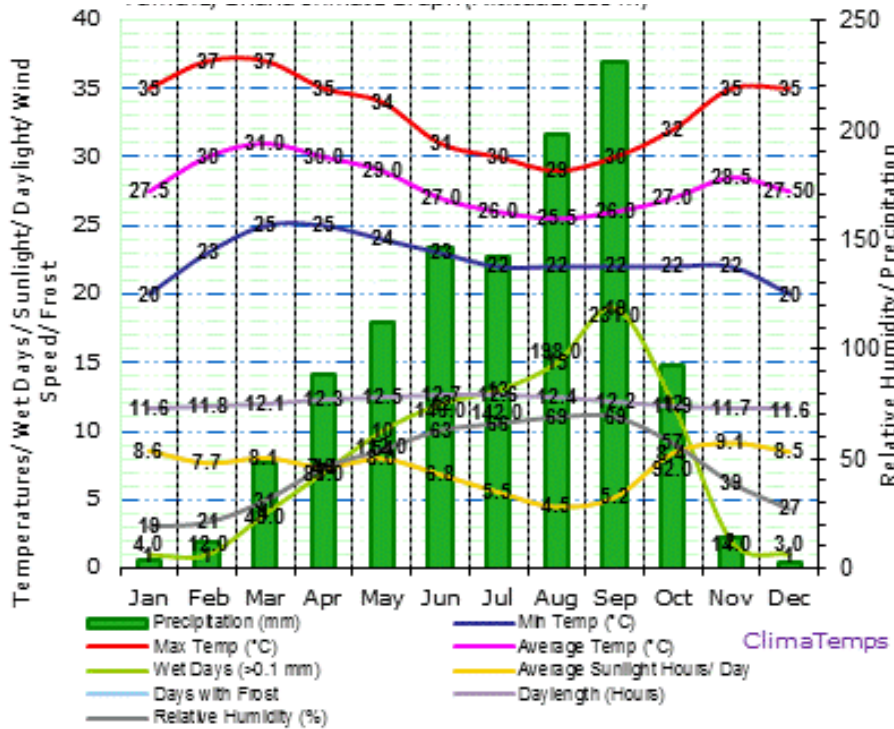
Southern Ghana, including Accra, has a bimodal rainfall pattern, with most rainfall in May-June and a secondary peak in October. July-September and November-February are dry months. The northern part of the country in the sub-humid zone of Ghana, including Tamale, has one rainy season, with a peak in September.

Figure 3 Accra, Ghana Climate Graph (Altitude: 68 m)



Source: <http://www.accra.climatemps.com/accra-climate-graph-sm.gif>

Figure 4 Tamale, Ghana Climate Graph (Altitude: 183m)



Source: <http://www.tamale.climatemps.com/graph.php>

Demographic situation: population, urbanization, water consumption trends

In 2011, Ghana had almost 25 million citizens. Between 2010 and 2015 it will have an average annual population growth rate of 2.3% (UN Data). This is lower than would be expected because of the effects of excess mortality due to AIDS (in 2012, 236,000 people had AIDS, the 25th highest position in the world, according to the CIA World Factbook).

More than half of the population lives in the cities (52.6% in 2012), and the average annual rate of urbanization will be 3.5% between 2010 and 2015 (UN Data). The major urban areas are Accra, with 2.6 million inhabitants, and Kumasi, with 2.1 million inhabitants.

According to WHO/UNICEF (2014 update), 93% of the urban population and 81% of the rural population had access to *improved* drinking water sources in 2012, hence 7% of the urban population and 19% of the rural population had access to *unimproved* drinking water facilities. However, in a blog the World Bank states that in Accra, over 50% of water provided is lost through leakage and pilferage. A key contributor to the situation is weak monitoring and evaluating capability at the municipal level. The World Bank has recently helped implement an ICT platform called “Taarifa” to help citizens and local governments monitor waste disposal (World Bank Blogs). See more on this in the section about the economic setting.

Access to sanitation facilities was much worse than access to improved drinking water: 20% of the urban population and 8% of the rural population had access to *improved* sanitation facilities, hence 80% of the urban and 92% of the rural population had access to *unimproved* sanitation facilities including open defecation.

Let's look at a longer stretch of time. Between 1990 and 2011 there was 174% growth in access to improved drinking water sources, and NO growth of the number of people that did *not* have access to improved drinking water sources. On the contrary, that number of people declined. However, this counts only for the rural population in Ghana (see table 1 below). This decline in the number of rural people with NO access to improved drinking water sources makes rural Ghana (together with Mali) a positive exception between the countries analyzed in this report. There was, however, in Ghana both an increase in the number of people with access to improved sanitation AND an increase in the number of people with NO access to improved sanitation facilities (WHO/UNICEF 2013).

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
Benin	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.

Population growth and rapid urbanization (due to rural-urban migration) are among the major constraints to the provision of water and sanitation in Ghana. The increased pressure on urban water systems and the rise of urban slums and failure to comply with housing regulations in the country are key concerns (Machdar, 2010). Slums and unauthorized structures, particularly those built on waterways, contribute to flooding during heavy rains. Also, the unplanned nature of the structures in urban slums makes it difficult to connect such localities to municipal water supply systems. Current policies are insufficient at addressing these challenges and necessitate a change in policy. Policy change will however be severely constrained by the tensions and contradictions between economic and social efficiency and vested political interest (Obeng-Odoom, 2011). (See also the section about the institutional setting of water).

Political situation and institutional setting

Political situation

Amidst political tensions about alleged irregularities surrounding the 2012 elections, the government of President Mahama (National Democratic Congress) came into office in 2013. With 85 (deputy) ministers it was first and foremost accused of being too big. The government has furthermore been confronted with allegations of corruption and misappropriation of state funds. And rising inflation led to popular dissatisfaction with president Mahama's economic policies (Africa Yearbook, 2014). On the other hand, Ghana is often portrayed as a country with embedded democratic institutions, and a rather fair political climate, after a period of harsh and economically unsuccessful authoritarian leadership, which lasted until the 1990s. Many Ghanaians in the global diaspora (many of whom travel to and fro; and many aspire to return to Ghana at the end of their lives or at least to be buried in ancestral ground) play major roles in the country's social and economic organization, and remittances play an important role, as well as migrant contributions to many local-level initiatives.

Institutional setting of water

Before 1996 water resources were subject to customary regimes; since an Act of Parliament in 1996 the Water Resources Commission (<http://wrc-gh.org/en/>) regulates and manages them. The Act of Parliament also states that ownership and control of all water resources are vested in the President on behalf of the people (Laube, 2007).

The mandate of the Water Resources Commission is however impeded by a number of overlaps with those of other institutions, thereby constraining its activ-

ities. A key example is the case where both the WRC and Volta River Authority (VRA) are vested with final authority to manage the resources of the River Volta. Efforts taken to resolve such overlaps have not only been slow but attained little success (Dorm-Adzobu & Ampomah, 2014).

The Ministry of Water Resources, Works and Housing (<http://www.ghana.gov.gh/index.php/2012-02-08-08-18-09/ministries/274-ministry-of-water-resources-works-housing>) formulates and co-ordinates the policies and programmes for the systematic development of the country's infrastructure requirements in respect of Works, Housing, Water Supply and Sanitation and Hydrology.

The WASH sector in Ghana has been constrained by interlinked political, administrative, economic, social and legislative factors (Osumanu, 2008). The high cost of treatment of water, high maintenance cost of water plants and equipment, water losses during distribution, increasing population and non-payment of water bills by consumers account for the public water sector's inability to supply adequate water. This has led to the involvement of the private sector to improve water supply services, but this move in itself is not a panacea to the problem of inadequate household water supply. The issue of privatization has been controversial because many consumers do not understand or accept why companies should make profits out of a basic necessity. The real issue is better management and efficient delivery of clean drinking water (Osumanu, 2008; Suleiman & Cars, 2010). The political will for reform is essential, but the responsibilities of government agencies for supplying water have not been defined clearly. Partnerships between the government, government agencies and citizens meant to create awareness of water issues - ranging from fighting corruption, conservation and reaching consensus on appropriate water rates, to creating laws to protect resources and mechanisms to resolve water disputes - have equally failed to achieve good results (Osumanu, 2010).

Decentralization is considered imperative in the effective delivery of water and sanitation in Ghana. However, the legal framework for the management of community water and sanitation has resulted in the existence of separate categories of institutions at district and sub-district or community levels with similar or overlapping roles. This situation presents a threat to water and sanitation provision as it has in some instances resulted in power struggles and rivalries. Removing this constraint requires the integration of such institutions at the district and sub-district levels and could ensure adequate legitimacy, reduce fragmentation of roles, and allow for greater organizational autonomy as well as accountability (Mpadu-Boakye & Laryea, 2009).

Present water policy in Ghana has sought to achieve more local decision making power in water management, and improved access and sustainability in water

supply. This objective has generally been achieved through the National Community Water and Sanitation Program (NCWSP). The program ensured that the ownership and management of water pumps and small town water systems constructed by the Ghana Water Company were handed over to communities. Following this, local users have created various rules and regulations to manage these facilities often reflecting local livelihood dynamics, local power dynamics and norms. These management systems have, however, been relatively more successful in the case of rural small pumps than in the case of small town water systems. Unfortunately, the reasons for this differential approach are unclear as studies about this are lacking (Eguavoen, 2007).

The Natural Resources and Environmental Governance (NREG) Program of the World Bank seeks to improve transparency in systems and procedures for natural resource management. According to the World Bank, Ghana (like many other West African countries) has experienced significant pressure on natural resources over the past 75 years. The 2005 Ghana Natural Resources Management and Growth Sustainability Economic and Sector Work (ESW) evaluated the economic costs to totaling US\$516 million of lost productivity due to damage to five types of natural assets: agricultural land, forest and savanna woodlands, coastal fisheries and wetlands, wildlife, and Lake Volta. In the backdrop of this situation, the International Development Association, the World Bank's fund for the world's poorest countries, has invested in the natural resources sector. Funds were augmented by the Netherlands Embassy, DFID (UK), AFD (France) and the European Commission (World Bank, Ghana Natural Resources and Environmental Governance Program).

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

In 2005 Ghana was acquitted of a large part of its debts, after which its economy grew considerably. This was also enabled by the discovery of oil fields. Annual growth percentages of 14% led the government to raise its expenditures enormously. In late 2010, Ghana was re-categorized as a lower middle-income country. Agriculture accounts for roughly one-quarter of GDP and employs more than half of the workforce, mainly small landholders. The services sector accounts for 50% of GDP. Gold and cocoa production and individual remittances are major sources of foreign exchange. Oil production at Ghana's offshore Jubilee field began in mid-December 2010. Estimated oil reserves have jumped to almost 700 million barrels and Ghana's growing oil industry is expected to boost economic growth through both oil infrastructure and revenue, and the trickle down effects to other sectors of the economy. This will invariably put additional pressure on

water systems as industrial demand for water will rise significantly. This could then result in not only increased water scarcities but also higher prices. Fixing such a situation will not only require ensuring adequate supply but increased financial capabilities of the general populace to access the commodity. Currently, however, the country faces the consequences of two years of loose fiscal policy, high budget and current account deficits, and a depreciating currency. The population is unhappy with living standards and claims they are not reaping the benefits of oil production because of political corruption. In August 2014 Ghana started talks with the IMF because of its depreciating currency (the cedi). In the last 12 months it lost 36% of its value compared to the US dollar, the worst performer in the world, boosting inflation to 15 percent. With the government not being able to adhere to spending controls and debts rising, investors seem to have lost faith in the economy, after a decade in which Ghana was heralded as one of the African lions and high-growth champions. IMF assistance may help to bolster confidence as the government prepared to sell \$1.5 bn in Eurobonds by the end of August (*NRC Handelsblad* 4 August 2014; Bloomberg 7 August 2014; CIA World Factbook).

Ghana is a member state of the Economic Community of West African States (ECOWAS) that seeks to promote economic integration across the region. It is also part of the West African Monetary Zone (WAMZ), a group of six countries within ECOWAS that plans to introduce a common currency, the Eco, by the year 2015. The other member states of WAMZ are Gambia, Guinea, Nigeria, Sierra Leone and Liberia.

According to the Ghana Statistical Service (GSS), the age dependency ratio for the country has seen a steady decline from 102.0 in 1970 to 76.0 in 2010, which means the economically active increasingly have less dependents (GSS, 2013). This is a positive condition for growth and development. Unemployment, however, remains one of the big problems and has attracted some youth demonstrations and extensive debate in the political landscape.

According to the President's 2014 State of the Nation, the country spent "almost \$ 1,5 bn in foreign currency on importing rice, sugar, wheat, tomato products, frozen fish, poultry and vegetable cooking oils", leading to public concern over the government's economic management abilities (Africa Yearbook, 2014).

Ghana's transportation and communications networks are centered in the southern regions, especially the areas in which gold, cocoa, and timber are produced. Most of the cocoa finds its way to the port of Amsterdam. The northern and central areas are connected through a major road system; some areas, however, remain relatively isolated. The Trans-West African Coastal Highway links 12 West African coastal nations including Ghana, from Mauritania in the northwest to Nigeria in the east.

Ghana has ten airports, almost 1000 km of railways, 10,000 km of paved roads, some 1,300 km of waterways (170 km for launches and lighters on the Volta, Ankobra, and Tano rivers; 1,130 km of arterial and feeder waterways on Lake Volta). Its major seaports are Takoradi and Tema (http://en.wikipedia.org/wiki/Transport_in_Ghana).

Competition among multiple mobile-cellular providers has spurred growth with a subscribership of more than 80 percent, which is still rising. Ghana has almost 1.3 million internet users.

The World Bank has recently helped implement an ICT platform called “Taa-rifa” to help citizens and local governments monitor waste disposal. Taarifa (<http://taarifa.org/>, meaning “headline” in Swahili) is a smartphone-based app that enables community-based reporting and monitoring of service delivery. Designed by an open source community, the platform is an online tool for information collection, visualization and interactive mapping which allows citizens to document and report issues and service delivery gaps via SMS, online feedback forms, email or Twitter.

Agriculture and fishery dynamics

According to Ton Dietz’s contribution to the ASC Community Country Day for Ghana and Benin (Dietz, February 2013), Ghana’s number of mouths to feed increased from 7.0 million to 23.8 million over the period 1961-2009. Dietz further noted that from 1961 to 2009, Ghana’s urban population rose from 23.8% to 48%, indicating a shift in the ratio of food producers to food consumers: relatively less farmers need to feed relatively more city dwellers. But according to Dietz, Ghana’s agricultural sector has responded favorably to this challenge.

During the period 1961 to 2009, while Ghana’s population increased by a factor 3.4, total food production increased by a factor 6.8 for roots and tubers, a factor 4.3 for pulses, and a factor 6.0 for cereals. The Food Energy Value per Capita has almost doubled, and is currently considerably beyond the minimum levels that the WHO uses for a healthy life. This is so since 2000. During the 1980s and 1990s the Ghanaian food production sector could not at all feed the national population adequately. The increases in food production between 1961 and 2009 can be attributed largely to increases in cropping area (as opposed to yields). Only in the case of cereals does the increase in yield significantly contribute to the increase in total basic food production. In the case of cereals, 59% of the increase in total food production is attributable to increases in cropping area, and 41% to an increase in yield levels. In the case of pulses this split is 70% and 30%, which is true also for roots and tubers.

According to the ‘Analysis of incentives and disincentives for cocoa in Ghana’ (Asante-Poku & Angelucci, 2013), Ghana is the world’s third largest producer and the second largest exporter of cocoa beans after Cote d’Ivoire. In 2010 exports of cocoa butter and paste to the USA increased dramatically from 32 million USD to 86 million USD, most likely because of the higher quality of cocoa products produced in Ghana (GAIN, 2012). Cocoa is considered to be the highest export crop earner for Ghana accounting for 8.2 percent of the country’s GDP and 30 percent of total export earnings in 2010 (Ghana Statistical Service, 2013; GAIN, 2012).

Cocoa production in Ghana is based on smallholder farmers. About 700,000 households are growing cocoa mostly on plots of 2-3 ha with small plantations (ICCO, 2007). Despite the high quality of cocoa beans exported by Ghana there is a negative incentive for producers to continue producing cocoa. Cocoa farmers have received price disincentives under the prevailing cost structure in the value chain. Disincentives arise from levies and taxation on cocoa exports, burdensome institutional framework regulating cocoa exports and lack of competition, and excessive transport costs. This leads to an increasing number of cocoa producers shifting from cocoa production to more profitable crops (Asante-Poku & Angelucci, 2013).

In the area of food crop production there have been frantic efforts to boost production and reduce post harvest losses. Early in 2013, a 80-tonnes capacity warehouse for food storage was opened in Bauza, a community in the Upper East region, funded by the Alliance for Green Revolution in Africa as part of the Ghana Arzakinmu Programme which provides training and storage facilities for communities in the Volta, Northern, Upper East and Upper West regions. So far, warehouses have been built in 18 communities and more than 12,000 small-scale farmers in these regions have been trained.

Ghana uses 66% of its total water availability for agricultural use (average 1992-2010). As Ghana’s agriculture is largely dependent on rainfall, rainfall variability and change are key challenges to this sector. A gradual shift to irrigation farming is therefore necessitated (Yaro, 2013). This among other strategies is crucial at ensuring the sustainability of the livelihoods of the majority of the country’s population that depend on farming.

The Ministry of Food and Agriculture (<http://mofa.gov.gh/site/>) looks after the Fishing sector. About 75 percent of the total domestic production of fish is consumed locally. Fish is expected to contribute 60 percent of animal protein intake. The per capita consumption is estimated to be about 25 kg per annum. Over 2 million fishermen, processors and traders participate in this sector. These and their dependants amount to about 10% of the population.

Fish is the country's most important non-traditional export commodity and the fisheries sub-sector accounts for about 5 percent of the agricultural GDP. Export earnings from fish and fishery products on average account for approximately 60 million US Dollars annually.

The fishing industry in Ghana is based on resources from the marine, inland (freshwater) and aquaculture sectors. The Volta Lake, reservoirs, fishponds and coastal lagoons are the main sources of freshwater fish.

Energy dynamics

In 2010, Ghana derived 60% of its total energy capacity from hydroelectric plants and 40% from fossil fuels (CIA World Factbook). The biggest hydroelectric generating plant in the country is the Akosombo Dam, which had an original electrical output of 912 MW, upgraded to 1,020 MW in a retrofit project completed in 2006.

Figure 5 Location of the Akosombo Dam



[http://en.wikipedia.org/wiki/Akosombo_Dam#mediaviewer/
File:Ghana_physical_map.svg](http://en.wikipedia.org/wiki/Akosombo_Dam#mediaviewer/File:Ghana_physical_map.svg)

A second, large plant is being built on the Black Volta river at the Bui Gorge, at the southern end of Bui National Park. This is a 400 megawatt hydroelectric project. The project is a collaboration between the government of Ghana and Sino Hydro, a Chinese construction company. Construction on the main dam began in December 2009. Its first generator produced power for the grid on May 3, 2013. The reservoir flooded about 20% of the Bui National Park and required the resettlement of 1,216 people. The Bui Power Authority seeks to address the ‘challenges’ that arise from these resettlement issues (Bui Power Authority website).

Figure 6 Location of the Bui Dam



http://en.wikipedia.org/wiki/File:Ghana_physical_map.svg

The key challenge to the energy sector is the availability of water from the Volta river to run the hydro-electric plants. Water availability on the river is largely influenced by climate variability and change but to a lesser extent also to Ghana’s neighbour Burkina Faso, which also uses the river for the generation of electricity and irrigation. Climate change through the exacerbation of rainfall variability and a general reduction of rainfall in the catchment area of the white Volta is already resulting in shortages of water in the river. This together with Burkina Faso’s usage of the water has rendered Ghana’s hydro-electric dams less dependable. Future climate change could result in further water stresses and therefore exacerbate existing, latent tensions between Ghana and Burkina Faso (Brown &

Crawford, 2008). However, through increased cooperation, particularly on hydro-power export, it is possible, even under circumstances of increasing variance of water flow, to devise sustainable water sharing strategies that will ensure steady flow of water for irrigation and hydro-electricity for both countries (Bhaduri, 2008).

Climate change and environmental issues

Ghana's forests are significant for watershed management: 22% of Ghana's total land area is covered by forests, although the country has experienced a high rate of deforestation for the past two decades, rising from 2% between 1990 and 2005, to 2.2% between 2005 and 2010 (FAO 2010). Ghana is currently developing a public procurement policy on timber and timber products, together with a national Wood Tracking System. Despite this, illegal logging remains a considerable problem. Research conducted by Chatham House revealed that the level of illegal logging has not seen any significant reduction in recent years, and that enforcement of the law is very weak (Chatham House, 2010; it is also interesting to consult the materials produced by Tropenbos International on Ghana: http://www.tropenbos.org/country_programmes/ghana).

Sub-Saharan Africa is the region expected to be hit hardest by climate change due to its location in the tropics and high dependence on ecosystem resources (IPCC 2007). According to the Environmental Protection Agency (EPA) of Ghana, climate change and variability is already posing a great threat to natural habitats and human livelihoods. The country has experienced about 20% decrease in rainfall since the 1960s accompanied by a rise in the frequency of extreme events, notably droughts and floods. Moreover, rainfall in Ghana has become more unreliable (EPA, 2000; Yaro, 2010). The high reliance on rainfall agriculture therefore exposes farmers to the impacts of climate change. Recurrent drought (and occasional floods) in the north of the country severely affects agricultural activities there.

In 2010 Ghana experienced severe floods, making thousands of people homeless. The UNDP with funding from the Norwegian government has asked the engineering and project management company Royal HaskoningDHV and HKV to develop early warning systems for natural disasters. The project focuses on bigger Accra, Kumasi and Cape Coast, Techiman and 5 other districts, covering an area where millions of people live. Also development organization SNV Ghana and the Project Management Unit of CREW (Community Resilience through Early Warning) in Ghana are involved. The National Disaster Management Organisation of Ghana is executive partner. The project is to be completed in August 2015 (Royal HaskoningDHV website).

Pressing needs

**Differentiated climate resilient measures*

The first and perhaps most important challenge to water supply in a country with less efficient water technology is water availability. Rainfall patterns in Ghana show a general decline in rainfall over the last 40 to 60 years largely resulting from climate change (Owusu and Waylen, 2009). However, as climate change impacts on both environmental and social-economic systems, it does not only shape the prospects for water availability but also access to it (Christensen et al. 2007). The impacts of climate change in Ghana are therefore expected to significantly aggravate water stress, thereby reducing food security (Eguavoen, 2012; Codjoe et al., 2012) and the energy generation capacity of the country (Yaro, 2013). In the recent past, the incidence of floods and droughts have risen with resulting loss of life and property, reduction in gross domestic product and crisis in the generation of power from the country's hydro-electric plants (Brown & Crawford 2008).

The effects of climate change in the country are spatially differentiated. The northern area is experiencing more debilitating consequences than the rest of the country, yet it is the region most likely to bear the brunt of climate change (EPA, 2000). In addition, climate models generated locally point to a drying thesis for this part of the country. Some other models project that wet areas in the southern part of the country might become wetter (Yaro, 2013). The high vulnerability of the northern part of Ghana to the current and projected water stress is not only as a result of its location but also as a result of high levels of poverty. People in this part of the country are relatively poorer than those in the southern part. As a result northern Ghana is expected to bear the brunt of climate change. It is thus imperative to give attention to differential vulnerabilities to water stress in policy decision making.

**Improvement of water governance*

The provision of water for various uses in the country will in addition to water availability depend on the effectiveness of water governance. As stated before, present water policy in Ghana has sought to achieve more local decision making power in water management, improved access and sustainability in water supply. This objective has generally been achieved through the National Community Water and Sanitation Program (NCWSP). The program ensured that the ownership and management of water pumps and small town water systems constructed by the Ghana Water Company were handed over to communities. Following this, local users have created various rules and regulations to manage these facilities often reflecting local livelihood dynamics, local power dynamics and norms. These management systems have, however, been relatively more successful in

the case of rural small pumps than in the case of small town water systems. Unfortunately, the reasons for this difference are unclear yet (Eguavoen, 2007). A likely reason could be the more homogenous nature of rural communities as against the more heterogeneous nature of small towns. Diversity, logically, constrains the formulation and success of binding rules and regulations or management strategies regarding common properties. One aspect of this diversity in the facet of livelihoods is the linkage between water and economic activities which could result in various power interactions and tensions.

** Improvement of availability and usage of data*

The emergence and uptake of new livelihood options such as irrigation, sachet and bottle water production (mainly through the development of underground water), small scale mining (that pollute water bodies) and small scale agricultural processing are examples of the increasingly diverse livelihood portfolios of some rural and urban areas. A true understanding of water management regimes via research is therefore required in charting future pathways that will effectively deal with the growing demand for water in an era of growing water scarcities in the country. Water governance is contingent on effective information flow and acquisition of knowledge. Unfortunately, Ghana's situation reflects one of a disconnection between information flow, knowledge acquisition and decision making. For example, as noted by Schiffer (2008) in the Upper East region, one of the catchment areas of the Volta River, the flow of collected data is not only inconsistent and often parallel but also disconnected and slow, which results in a gap between knowledge and decision making. The critical analysis of knowledge flow is crucial in addressing this gap as a means to ensure effective water management in the country particularly at a time when water resources are not only being diminished by the effects of climate change but under much pressure due to increasing population and livelihood diversification into water intensive economic strategies.

** Institutional capacity building*

In addition to the gap between knowledge and decision making, the institutions charged with the mandate of managing Ghana's water resources are under-resourced and lack the capacity to effectively carry out their mandate under a political atmosphere characterized by legal pluralism and weak governance. Weak institutional capacity of the Water Resources Commission, the leading institution, constrains its ability to ensure effective management of local water resources to the extent that there is the danger that local and national interest groups influence the reforms to legitimize their vested interest, thereby excluding others (Laube, 2007). The main objective of the WRC to ensure integrated water

management could therefore become a mirage if steps are not taken to strengthen its capacity as well as those of related key institutions, and remove legal constraints to its mandate particularly that relating to the overlap of functions.

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