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

Report on Mali

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 - Mali

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

Political geography of water

The *République du Mali* is a landlocked Sahelian country in West Africa. Mali is bordered by Algeria to the north, Niger to the east, Burkina Faso and Côte d'Ivoire to the south, Guinea to the south-west, and Senegal and Mauritania to the west. Most of Mali is arid or hyperarid; part of the Sahara desert. The less arid southern part has a relatively high population density, especially the Bamako metropolitan area, and some parts of the cotton area in the southwest (Maps of the World 2014; Cherlet 2012; see also figure).

Figure 1 Map of Mali

Source: ASC country Portal

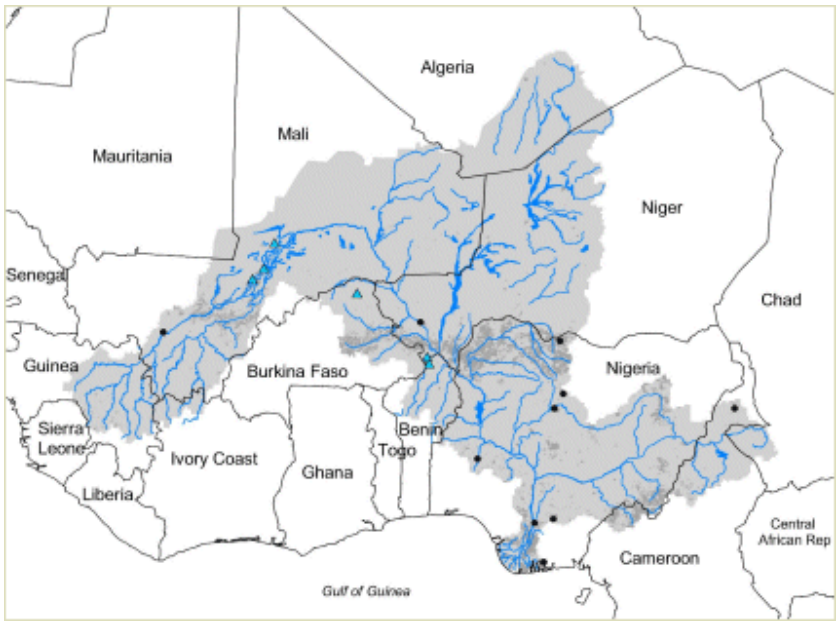
Figure 2 The city of Bamako

Source: Wikipedia EN

[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.

Mali's water situation is dominated by the Niger River (figure 3), although the western part of the country is part of the Senegal River water basin (the city of Kayes included), flowing to Senegal and into the Atlantic Ocean. The Niger River originates in the border zone between Sierra Leone and Guinea, flows to the northeast, via Bamako, Ségou, the Niger Inner Delta (a large area of lakes and floodplains in central Mali), Mopti, Timbuktu and Gao on to Niger and the border between Niger and Benin and then on to Nigeria, where it flows in the Atlantic Ocean at the Niger delta, having joined with a major tributary, the Benue River. The quantity of water entering in Mali from Guinea and Ivory Coast (i.e. about 40 km^3/yr) is actually greater than the quantity entering Nigeria from Niger due to the enormous decline in natural runoff in the Inner Delta. Whatever will happen in Guinea will influence Mali's' hydrological situation greatly (see also sector 6: energy dynamics). In the south there is a tributary river coming from Ivory Coast, near the cities of Sikasso and Koutiala. In the North and Northeast there are some seasonal desert streams after rains (Zwarts *et al.* 2005).

Figure 3 Niger River water basin



Source: Lasalle 2014

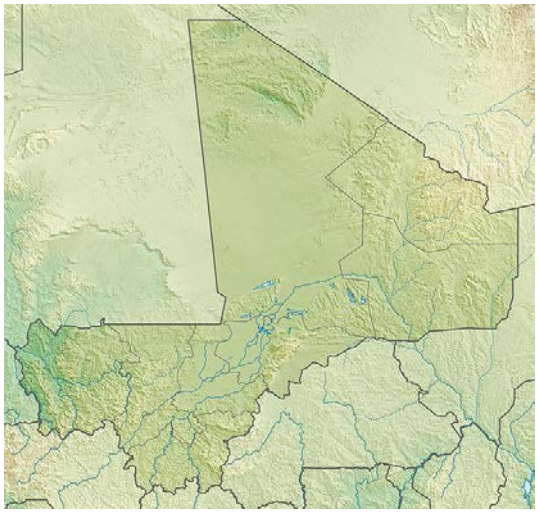
The climate is hot with average temperatures ranging between 24° and 32°C. The months between April to June are very hot, with temperatures often above 40°C, especially in the northern part of the country. The southern part has a semi-arid and subhumid climate. Towards the border with Guinea and Ivory Coast the climate can even be regarded as humid, with dense savannah woodlands. Cooler temperatures can be felt between November and February when the nights in the

north witness cold temperatures. The dry Harmattan wind from the Sahara blows in the month of December.

Figure 4 Satellite image of Mali

Source: Wikipedia EN

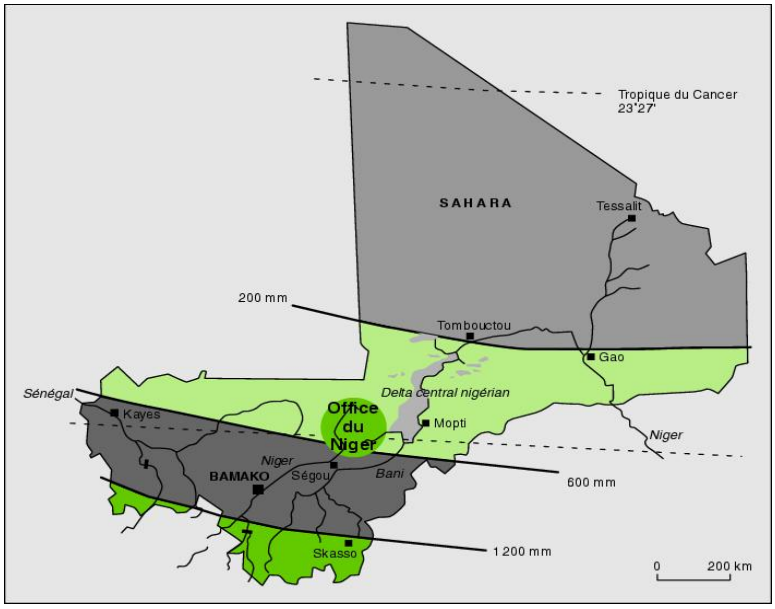
Figure 5 Mali relief map



Source: Wikimedia Commons/Carport

Annual rainfall measures around 1,400 mm in the south, 1,120 mm at Bamako and 127 mm in the northern part of the country (Maps of the World 2014; Cherlet 2012; see also figures 6 and 7).

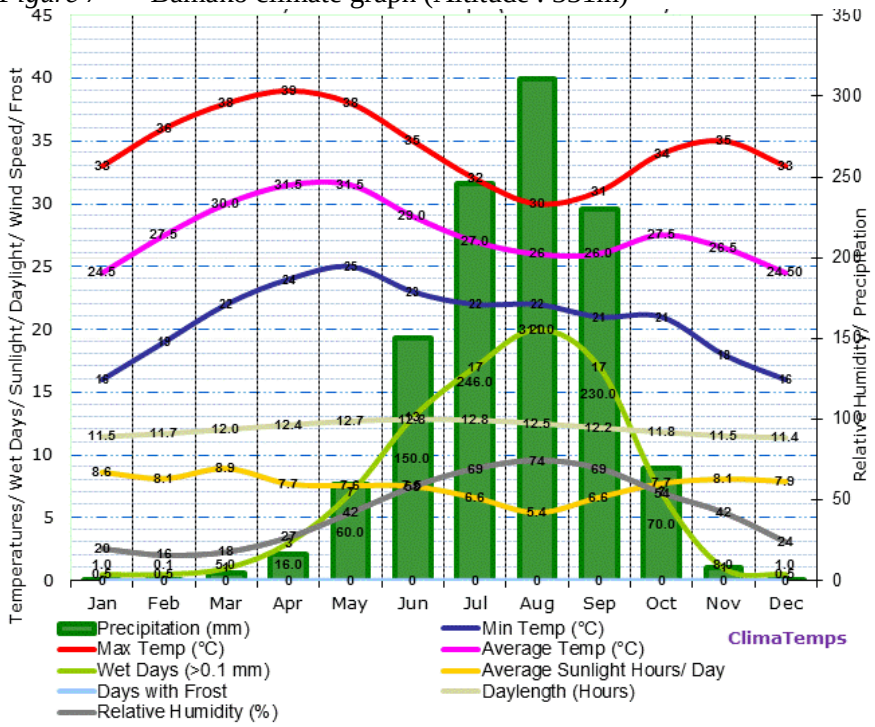
Figure 6 Rainfall levels Mali



Source: International Land Coalition 2014

Bamako's climatic situation is described as follows (Wikipedia): "Bamako has a hot and humid Sahelian climate and is very hot on average all year round. (…). The average temperature highs of every month is over 30 °C, with the warmest months being March, April and May, when the temperature reaches an average of 39 °C. Record highs of 46 °C have been recorded in the month of May. The coolest months are November to February, which experience average lows of 16–19 °C, although the temperature may fluctuate greatly, with highs of 47 °C having been recorded in February, for instance. During the winter months, rainfall is very scarce, with little rain falling from October to April and virtually no rainfall between December and February. The rainy season occurs in the summer, with the peak rainfall occurring in the months of July, August and September".

Figure 7 Bamako climate graph (Altitude : 331m)



Source : http://www.bamako.climatemps.com

Demographic situation: population, urbanization, water consumption trends

Mali has a population of approximately 16 million people. In 2012, 35% of its population lived in cities. The annual rate of urbanization is estimated at 4.8% between 2010-2015, while the annual rate of rural population growth in this same period is expected to be 1.9%, producing an average rate of 3% for the whole of

Mali (UNdata 2014; Broekhuis *et al.* 2005). Like elsewhere in the Sahel, the most important cities are often located in the southern regions along rivers. Mali's capital is Bamako (ca.2 million citizens in 2011), which is also located in the south on the Niger river.

Urban water demand may theoretically affect the water regime of the Niger river, but the urban demand of Bamako was estimated at 0.036 km3 per year around 2000; the effect is therefore extremely low. The two major impact factors on the hydrological regime of the Niger in Mali are the Sélingué reservoir (for power and irrigation; 0.83 km3/year) and the water intake by the Office du Niger for their irrigation scheme (2.69km3/year; which equals 8.3% of the total annual Niger river flow). Note that the irrigation scheme largely depends on additional water released from the Sélingué reservoir in the dry season (the main reason for creating the Sélingué reservoir was to produce electricity for Bamako, however). The per capita energy demand is higher in the cities than in the countryside. Also, city dwellers eat mainly bread and rice while rural people mostly eat millet and sorghum, thus urbanization affects the crops being grown. The shift from millet to rice production (if not imported) requires the cultivation of natural floodplains (such as the Niger Inner Delta) and the creation of irrigated areas (Zwarts *et al.* 2005 & 2009). Resource patterns have changed, partly due to population growth, and because resources have increasingly acquired both economic and monetary value (Haller 2002).

In 2012, 91% of the urban population and 54% of the rural population had access to improved water sources, thus 9% of the urban population and 46% of the rural population had access to *unimproved* drinking water sources. Also in 2012, 35% of the urban population and 15% of the rural population had access to improved sanitation facilities, thus 65% of the urban population and 85% of the rural population had access to *unimproved* sanitation facilities (WHO /UNICEF Joint Monitoring Programme for Water Supply and Sanitation 2014).

Let's look at a longer stretch of time. Between 1990 and 2011 there was 324% 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. This counts for both the urban population and the rural population (see table 1). This decline in the number of people with NO access to improved drinking water sources makes Mali (and rural Ghana) a positive exception between the countries analyzed in this report. There was, however, 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
	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.

According to a report from the Mali government (Republique du Mali 2012), groundwater around Bamako is highly contaminated by heavy metals (especially mercury and lead) and other toxic substances. Unsound management of waste and irrigation systems threatens resources of surface water and groundwater as well as water quality (Republique du Mali 2012).

Nearly one million people earn their livelihoods in the Inner Delta as fishermen, cattle breeders or farmers. They fully depend on the natural resources and the annual production of fish, cattle and rice is determined by river discharge and is insufficient to feed local people in the drier years. That is why many people have abandoned the drier parts of the Inner Delta in the past 40 years: further migration can be expected if additional water is diverted for irrigation, energy or other purposes (Zwarts et al 2005). Mobility has always been, and still is, an integral feature of life in the unstable west Sahelian climate conditions as the prime strategy for coping with instability. Current trends in population mobility will increase with increasing climate variability and climate change and this will have far-reaching consequences for policy formulation and recent trends in urbanization and population growth in more southerly areas (Broekhuis *et al.* 2004). (More about climate change under section 7).

Political situation and institutional setting

Political situation

After Tuareg ethnic militias started a rebellion in January 2012, low- and mid-level soldiers, frustrated with the poor handling of the rebellion, overthrew President Amadou Toumani Touré on 22 March 2012. After mediation by the Economic Community of West African States (ECOWAS) power was returned to a civilian administration in April 2012 with the appointment of interim President Dioncounda Traoré. The post-coup chaos allowed Islamic militants to set up strongholds. Hundreds of thousands of northern Malians fled the violence to southern Mali and neighbouring countries, exacerbating regional food insecurity in host communities. An international military intervention to retake the three northern regions began in January 2013 and within a month most of the north had been retaken. In a democratic presidential election conducted in July and August of 2013, Ibrahim Boubacar Keita was elected president. At the parliamentary elections of November and December 2013, Keita's party won 60 out of 147 seats, coalition parties 55 seats. Political opponents won 32 seats. The north in particular has remained unstable with terrorist attacks taking place in Timbuktu, Gao and Kidal. The UN peacekeeping mission MINUSMA - led by Dutch dip-

lomat Bert Koenders - seeks to bring stability to the region (CIA World Factbook; Africa Yearbook, 2014).

Institutional setting of water

Following the 2002 Water Code and 2000 Land Code the state owns all groundwater. The use, conservation, protection, and management of water resources is regulated by the Water Code which also requires permits for extraction of water, with exceptions for water used for domestic purposes and in amounts below specific volumes. Local governments are responsible for water supply under the Water Code. Between 2000 and 2012 six different ministers and three different ministries have held the water portfolio in Mali, including the Ministry of Mines, Energy & Water Resources and the Ministry of Environment & Sanitation. Practical planning and project implementation, however, are carried out by 'directorates', the executive arms of ministries, whose delineations have remained relatively stable over time. The National Hydraulic Directorate (DNH) is responsible for the planning and management of integrated water resource management and water supply and is the main entry point for donors interested in water-related cooperation. The National Directorate of Sanitation and of Pollution and Nuisance Control (DNACPN) has an important secondary role in water supply and sanitation projects. The Office du Niger (semi-autonomous government agency) uses by far the most water from the Niger river for its irrigation scheme in the Ségou Region (Zwarts *et al.* 2005; Cherlet & Venot 2013).

In the past, traditional pre-colonial institutions were highly developed and adapted to the natural environment and the insecurity of resource availability, including fluctuating water levels in the Niger Inner Delta. These institutions regulated, monitored and sanctioned the use of water, enabling different ethnical groups to use these resources sustainably. Due to external changes (such as shifts in market situations, infrastructure and transport, monitarizing processes), endogenous factors (institutions, organizations, ideology and bargaining power) altered. The locally developed institutions are not functioning anymore; however, they can possibly be reintegrated - when they can be monitarized - to realize their former beneficial tasks of reducing transaction costs and making resource use more secure and sustainable (Haller 2002).

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

About 10% of the population in Mali is nomadic and about 80% of the labor force is engaged in farming and/or fishing. According to the World Bank, in 2013 economic growth rebounded to 2%, up from 0% in 2012. However, there

still remains considerable uncertainty regarding the economic impact of the political crisis in 2012 and its subsequent recovery as security conditions seem to improve. In 2012, economic activity was negatively affected by the suspension of aid and foreign tourism and by the broad disruption due to the deterioration of security conditions. However, external factors not related to the political crisis have had a positive effect. These factors include relatively good terms of trade for Mali's products, and an exceptional agricultural harvest. In 2013, foreign aid resumed, representing an additional external inflow of over 10% of GDP compared to 2012, stimulating demand for domestic goods and services. First post-crisis household surveys suggest that per capita consumption decreased in the southern regions from 2011 to 2013, with the exception of Bamako. Benefiting from an abundant food supply produced in 2012, consumer price inflation strongly decelerated to -0.6% in December 2013, down from 5.4% in 2012, in spite of some reduction in energy subsidies (World Bank Mali Overview).

In 2013, public investments strongly resumed, financed through aid and increased domestic revenues. Current public expenditures also increased with security and electoral needs. The overall deficit nonetheless remained contained to around 1.9% of GDP (down from a revised 2.9% of GDP in 2012 accounting for recently uncovered arrears), and was easily financed with domestic and regional financing and budget support, notably from the World Bank. Real gross domestic product (GDP) is projected to increase by close to 5% given the progressive recovery of the service and construction sectors. Beyond 2013, growth is projected to accelerate to over 6% in response to a fiscal impulse financed by donor inflows. However this outlook remains uncertain as vulnerabilities due to climate change and commodity prices fluctuations are still latent (World Bank Mali Overview).

Economic activity is largely confined to the riverine area irrigated from the Niger. According to Zwarts et al (2005), improvement of the irrigation efficiency is not only possible but also essential for additional expansion of the irrigated area. In their study, they show that improving the performance of existing infrastructure as well as the economic activities in the Inner Delta itself is a significantly more efficient way to increase economic growth, reduce poverty and protect the environment in the region than building new hydropower plants (see also sector 6: energy dynamics). According to Haller (2002), it has been shown that in Mali more powerful users of natural (water) resources, such as city inhabitants with their capital, better equipment and bribe money, can change and influence institutions and gain access to the resources, whose management is increasingly claimed by the state. The issue is that the state alone is unable to control the common pool resources.

Mali has 25 airports, 600 km of railways, 22,000 km of roadways (5,000 km paved) and 1,800 km of waterways: mainly downstream of Koulikoro. Low water levels on the River Niger cause problems in dry years. In the months before the rainy season the river is not navigable by commercial vessels. The main port is the industrial city of Koulikoro on the Niger. It is also the final stop of the Dakar-Niger Railway. Mobile-cellular subscribership has increased sharply to about 70% of the population. The country has 250,000 internet users (2009). During the political crisis of 2012-2013 many Malians made use of the new communication possibilities.

Agricultural dynamics

Agriculture accounted for about 45% of Mali's GDP. In the dry north of Mali pastoralism is the main livelihood. The most productive agricultural areas are the southwestern region around Sikasso, along the Niger River, and the Inner Niger Delta. The production of cotton, fish, rice, pearl millet, maize, vegetables, tobacco and tree crops are most important here, but an earlier described shift from millet to rice production is occurring.

The Inner Niger Delta is the largest inland wetland in West Africa, with annual floods reaching up to between 25,000 and 30,000 square kilometers. About 1600 square kilometers in the southern part of the inner delta (5.1% of the total floodplain) are cultivated by farmers growing rice on the floodplains. Another 680km2 are managed as rice fields by Opération Riz Mopti and Opération Riz Ségou. Both areas are lacking irrigation but employ dikes and sluices to delay flooding, and to manage the water level during deflooding. However, if the floods are not high enough, the area remains dry. This means that rice production, as elsewhere on the floodplains, depends exclusively on local rain and the river floods; pumping occurs locally, albeit on a small scale. The few irrigated rice fields in the inner Niger delta have a more stable harvest; floodplain rice yield is low compared to irrigated rice fields (about 4 times), but has lower costs (USAID, 2010. Mali land tenure assessment report & Nations Encyclopedia 2014; Zwarts *et al.* 2009).

In Mali, land is classified as either state land or private land under the Land Code. State land includes all public property, including large surface water sources, land titled in the name of the state or transferred to the state, and all unregistered land, including vacant land. Private land ownership is recognized through land titling and registration. Most of the smallholder farmers or agropastoralists hold their land under customary systems. They have rarely registered their land, which is thus "untitled". Formally, most rural land is therefore under state ownership. Despite variations in customary law across regions and ethnic

groups, general principles of customary law recognize the right of clan and community members to access land for a residence and for farming. Competition over land and natural resources puts pressure on customary arrangements. Also, acquisition of land from customary land holders by (foreign) investors, is a relatively new development. In the irrigated lands managed by the Office du Niger, where this happens on a large scale, it also puts pressure on access to water. In these Office du Niger irrigated lands farmers have use rights. These rights are renewed annually if water fees have been paid. The 'Millennium Challenge Cooperation' (USA) program will introduce titles to irrigated land in the Office du Niger as a pilot. The Office du Niger irrigates more than 700km2. Future expansion of irrigation fields by the Office du Niger is only feasible if further improvements in water use are achieved: the water system in this irrigation zone has already been significantly improved. For example, in the 1980s for the production of one kilo of rice ca. 30,000 liter of water was needed; nowadays this requires 7,500 liters. A still more efficient water use is crucial, and not beyond reach (Djiré, Moussa. 2006.)

Energy dynamics

According to the World Bank, in rural areas of Mali, only around 13 percent of the population could access electricity in 2009. Through the Household Energy and Universal Access Project (HEURA), the International Development Association (IDA, the World Bank's Fund for the Poorest) joined the Mali government, local communities and the private sector to remedy this and as of May 2010, 43,311 grid connections covering about 650,000 people had been made by local private operators. In addition, the project has connected 803 public institutions, including 172 schools and 139 health centres (World Bank HEURA).

In 2010, about half of the electricity capacity was contracted from fossil fuels, and half from hydroelectric plants (CIA World Factbook). Presently, the only hydropower dam in the Upper Niger is the Sélingué Dam. It is a 44 MW hydroelectric and irrigation dam located in the Sikasso Region, on the Sankarani River, one of the affluents of the Niger River.

Figure 8 Location of Sélingué Dam

Figure 9 Location of Félou hydroelectric plant

Source: Wikipedia EN

In 2009 work started on the construction of a 62.3 MW hydroelectric plant at the Félou falls in the Senegal river, replacing a small 600 kW plant dating from the 1920s. More hydropower installations and dams for irrigation are being established in the Niger. International coordinating body for the Niger river is the Authorité du Bassin du fleuve Niger (ABN; see also Zwarts *et al.* 2005).

The water stored in the Sélingué reservoir in the wet season is gradually released in the rest of the year. Therefore, Sélingué releases add about 0.2 km3 per month to the river system, while 1.8 km3 is withheld in the period August to September (the average of the Niger river flow is about 40 km³/yr). The impact of the planned 2.9 times larger Fomi dam in Guinea will also be 2.9 as much on the water quantities. Other dams are also planned but due to lack of knowledge it is difficult to determine potential impacts.

These dams will however reduce water quantities of the Niger river, thereby reducing flood levels in the Niger Inner Delta. From the ecological perspective and from the viewpoint of sustainable development the floods are the heartbeat of resource production of the region. These floodplains are a world-famous wetland and of great importance to migratory birds from Europe, but also for people's livelihoods in and around the Inner Delta area. Flood levels have a direct impact on the survival of European migratory birds spending their northern winter here: they have greater survival chances with high floods. Further permanent reductions of the floodplains will lead to irreversible losses in populations of Palearctic and African bird species. Under extreme conditions, the water level in the inner delta reaches critically low levels. A minimum flow is required to pre-

vent unsustainable fish stock depletion in the central Inner Delta and pressure on remaining biodiversity. The proposed dams, combined with the extension of the irrigation area of Office du Niger and lower rainfall as a result of climate change will cause a general reduction of natural resources, seriously reduce flooding and harming the ecological significance of the floodplains (Zwarts *et al.* 2005 & 2009; Haller 2002).

Climate change

According to De Bruijn & van Dijk (2004), the main problem farmers and livestock keepers have to deal with in the Sahel is the climate with its low and erratic rainfall. Periodic droughts due to short rainy seasons are a major problem of Mali.

Risks resulting from climate variability have an impact that goes far beyond the domain of agricultural production alone: market prices react severely to rainfall. It has been shown that in Sahelian livelihood strategies, laws and institutions, moral codes, social security mechanisms, rituals and understanding of their environment have emerged out of the interaction between local actors and their environment while handling the high risks of climate variability and long-term change. With global warming, annual rainfall in the Sahel is likely to decrease 10-20% or even more in the next decades, although some sources suggest it may possibly remain at the same level.

A substantial part of the urban population does not have access to safe water and has to use wells, which are often contaminated, or has to buy drinking water, which is relatively expensive. Climate change will restrict the availability of surface water and will lower the underground level, thereby raising water costs and limiting water use by urban inhabitants. The water supply of the capital cities in the Sahel is already problematic. However, it is not the availability of water that currently presents the greatest problems, but the lack of organisation and investment in waterworks and drainage systems (Broekhuis *et al.* 2005; Zwarts *et al.* 2009; de Bruijn & van Dijk 2004).

Pressing needs

* *Regional agreements on responsible Niger river water use*

The Niger River is a lifeline for the numerous countries along its shores, whether it be for infrastructure, irrigation, energy generation, ecosystem services (including fishing), or other reasons. To deliver all these services the Niger river needs minimum water levels, while these same services consume water thereby limiting

the water quantities of the river. With a still increasing human population and (urban) consumption levels, the demand will further grow. An effective regional management plan in which all the Niger river bordering countries are involved is needed to assure responsible and sustainable use of the Niger river. The construction of a large dam in the Guinea part of upstream Niger River will have dramatic consequences for downstream users, both people and migratory birds.

**Improvement of drainage and waste system management*
Groundwater is still regularly (directly) used as drinking water, while recent reports have shown that at least around Bamako the groundwater is contaminated by heavy metals and other toxic substances. A lack of organization and investment in waterworks and drainage systems could worsen the situation: investments and waste control are desirable.

** Improvement and efficiency of irrigation systems*
With an increasing human population and (urban) consumption levels and a shift from millet to rice production, more irrigated land is needed. For the expansion of irrigated land improvement of the irrigation efficiency is both essential and conceivable.

References

AUTORITE DU BASSIN DU NIGER, ABN, http://www.abn.ne/

AFRICA YEARBOOK VOLUME 9: Politics, Economy and Society South of the Sahara in 2012, BRILL (2013), Mali Chapter, Martin van Vliet

AFRICA YEARBOOK VOLUME 10: Politics, Economy and Society South of the Sahara in 2013, BRILL (2014), Mali Chapter, Bruce Whitehouse

ASC COUNTRY PORTAl Mali: http://countryportal.ascleiden.nl/mali

BROEKHUIS, A., M. DE BRUIJN & A. DE JONG (2004) "Urban-rural linkages and climatic variability". In: A.J.Dietz, R.Ruben & A.Verhagen, eds, The Impact of Climate Change on Drylands: With a Focus on West Africa, Kluwer, Dordrecht: 301-321. http://opc-ascl.oclc.org/LNG=EN/PPN?PPN=298327007).

BRUIJN DE, M. & H. VAN DIJK (2004), "The importance of socio-cultural differences and of pathway analysis for understanding local actors' responses" In: A.J.Dietz, R.Ruben & A.Verhagen, eds, The Impact of Climate Change on Drylands: With a Focus on West Africa, Kluwer, Dordrecht: 301–321. http://opc-ascl.oclc.org/LNG=EN/PPN?PPN=298327651.

CHERLET, J.L.H. (2012), Development Aid to Water Management in Mali. The Actors, 'Global' Paradigms, and 'Local' Translations. Thesis: Università di Bologna & Ghent University. https://biblio.ugent.be/input/download?func=downloadFile&recordOId=2964760&fileOId=4336058

CHERLET, J. & J-P. VENOT (2013), Structure and agency: understanding water policy changes in West Africa. Water Policy 15(3): 479-95

CIA World Factbook Mali: https://www.cia.gov/library/publications/the-world-factbook/geos/ml.html

DJIRÉ, MOUSSA (2006), Improving Tenure Security for the Rural Poor: Mali – Country Case Study. Working Paper No. 4, Food and Agriculture Organization of the United Nations/Legal Empowerment of the Poor (FAO/LEP)
HALLER, T. (2002), Common property resource management, institutional change and conflicts in African floodplain wetlands. In: The African Anthropologist: (2002), vol. 9, no. 1, p. 25-35
INTERNATIONAL LAND COALITION (2014), ”Commercial pressures on land. Office du Niger.” http://www.commercialpressuresonland.org/sites/default/files/images/office-du-niger.jpg
LASALLE (2014), “Niger Watershed Map.” http://www.lasalle.edu/~mcinneshin/344/week03.htm
MAPS OF THE WORLD (2014), “Mali climate.” http://www.mapsofworld.com/mali/geography/climate.html
NATIONS ENCYCLOPEDIA (2014), “Mali-agriculture”: http://www.nationsencyclopedia.com/Africa/Mali-AGRICULTURE.html
REPUBLIQUE DU MALI (2012), RAPPORT NATIONAL SUR LE DEVELOPPEMENT DURABLE AU MALI. Dans la perspective de RIO+20 : http://sustainabledevelopment.un.org/content/documents/983mali.pdf
UNDATA (2014), “Mali.” http://data.un.org/CountryProfile.aspx?crName=mali
USAID (2010), Mali land tenure assessment report
WHO/UNICEF, *Progress on sanitation and drinking-water: 2013 update*, pp. 14-35. Geneva / New York: World Health Organization / United Nations Children's Fund (2013)
WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (2014)
WORLD BANK MALI OVERVIEW, http://www.worldbank.org/en/country/mali/overview, retrieved 21/8/2014
World Bank HEURA, http://go.worldbank.org/NHUJJ56T10
ZWARTS, L., P. VAN BEUKERING, B. KONE, & E. WYMENGA, eds, (2005) The Niger, a lifeline. Effective water management in the Upper Niger Basin. RIZA, Lelystad/Wetlands International. Sevare / Institute for Environmental Studies (IVM), Amsterdam / A & W ecological consultants, Veenwouden. Mali / the Netherlands
ZWARTS, L., R.B. BIJLSMA, J. VAN DER KAMP & E. WYMENGA (2009), Living on the edge. Wetlands and birds in a changing Sahel. KNNV Publishing, Netherlands