



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

Report on South Sudan

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

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Water – South Sudan

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 South Sudan (see www.viawater.nl), compiled by Germa Seuren of the ASC Library under the responsibility of Jos Damen. The South Sudan report is the result of joint work by Marcel Rutten, Ton Dietz 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 web dossier on Water in South Sudan and the Africa Yearbook 2013 chapter about South Sudan, written by Peter Woodward. Also the Country Portal on South Sudan, organized by the ASC Library, has been a rich source of information (see <http://countryportal.ascleiden.nl>).¹

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Political geography of water

The Republic of South Sudan is a landlocked country in east-central Africa. It covers an area of 619,745 km², or about one third the size of Western Europe. Its current capital is Juba, which is also its largest city; however the capital city is planned to be changed, possibly to the more centrally located Ramciel, or to the city of Wau in the north-west. South Sudan is bordered by Ethiopia to the east, Kenya to the southeast, Uganda to the south, the Democratic Republic of the Congo to the southwest, the Central African Republic to the west and the Republic of Sudan to the north. Some of the northern areas are still disputed by Sudan and South Sudan, after they split (<http://countryportal.ascleiden.nl/south-sudan>).



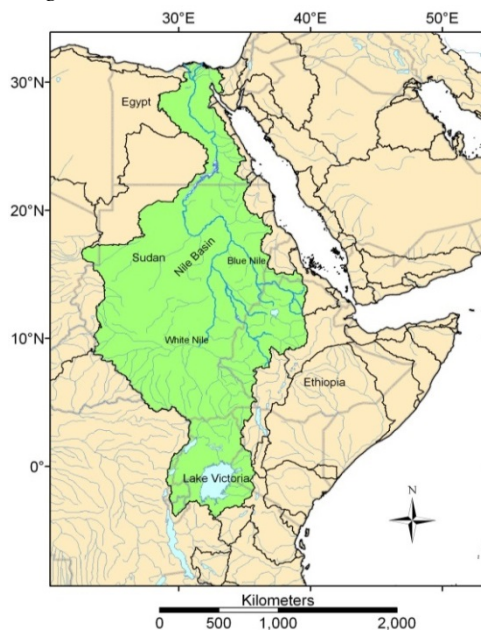
Source: CIA World Factbook



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.

A note on the history of this young state. On 9 July 2011, the Republic of South Sudan became the world's newest country. The realisation of the South's independence came after nearly four decades of civil war that devastated the lives and livelihoods of the South Sudanese. The consequences of the long conflict on people's lives, livelihoods and access to basic services were devastating, and the new country faces massive challenges in overcoming these. Some 2 million people were killed in the conflict, and twice that many were displaced - either internally or internationally as refugees. These groups have been returning to South Sudan since 2005 when the Comprehensive Peace Agreement (CPA) was signed, making return and reintegration one of the major policy concerns of the new government in Juba. But the war also took a heavy toll on the lives and livelihoods of those who were not displaced, or who were displaced locally. Livelihood recovery has begun across South Sudan in spite of new (internal) clashes (particularly Abyei) and conflicts with Sudan over borders and oil transport. Beyond the lingering conflicts, several major factors impinge on livelihood recovery. The first of these is rapid urbanisation, especially among youth, males and returnee populations. The second is a major influx of foreigners after the war, looking for economic opportunity (Maxwell *et al.* 2012). In the southeast of the country the so-called Ilemi triangle officially belongs to South Sudan, but is under the administration of Kenya, that treats it (and its oil and groundwater wealth) as part of Kenya. Here we also find (part of) the transboundary Lake Turkana basin (14,564 km²) comprising 2.35% of South Sudan territory. The remainder all belongs to the Nile basin (622,170 km² or 97.65%).

Figure 1 Nile basin

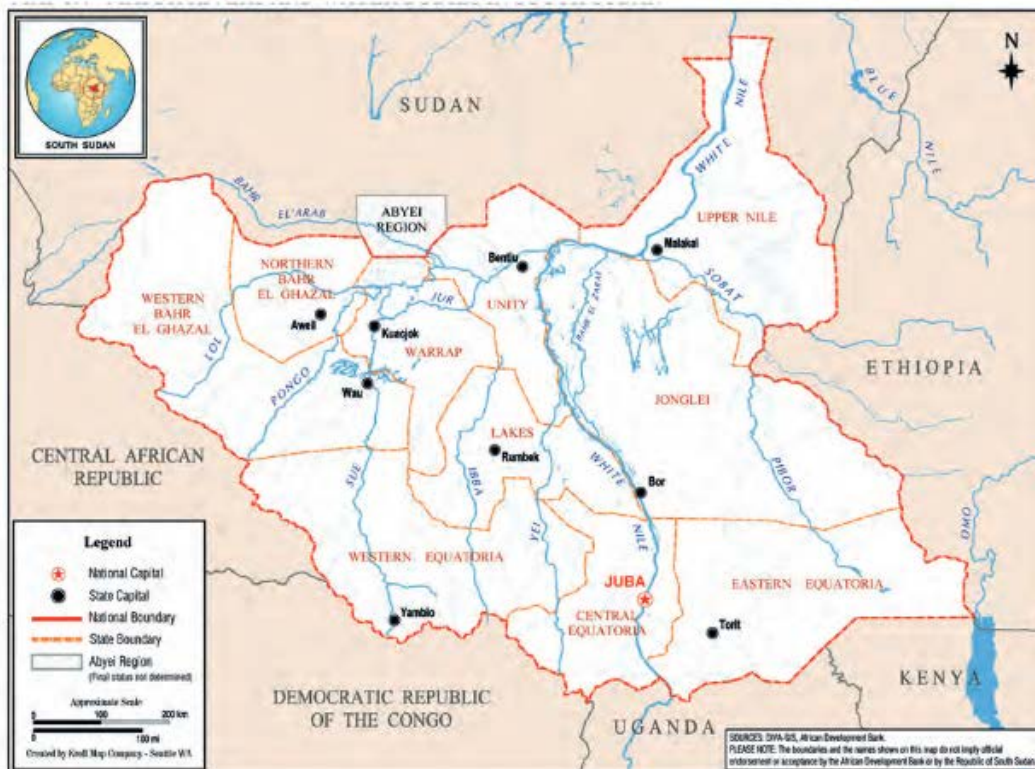


Source: http://www.eeescience.utoledo.edu/Faculty/Becker/images/Nile_Basin.jpg

The river Nile is the world's longest river of some 6,800 km. From Khartoum (Sudan) downstream it combines its two main tributaries, i.e., the White Nile (originating from Rwanda/Burundi and totalling 3,700 km) and the Blue Nile (whose headwater are in lake Tana, Ethiopia; totalling 1,450 km) - and includes the following 11 riparian countries: Rwanda, Burundi, Democratic Republic of the Congo (DRC), Tanzania, Kenya, Uganda, Ethiopia, Eritrea, South Sudan, Sudan and Egypt.

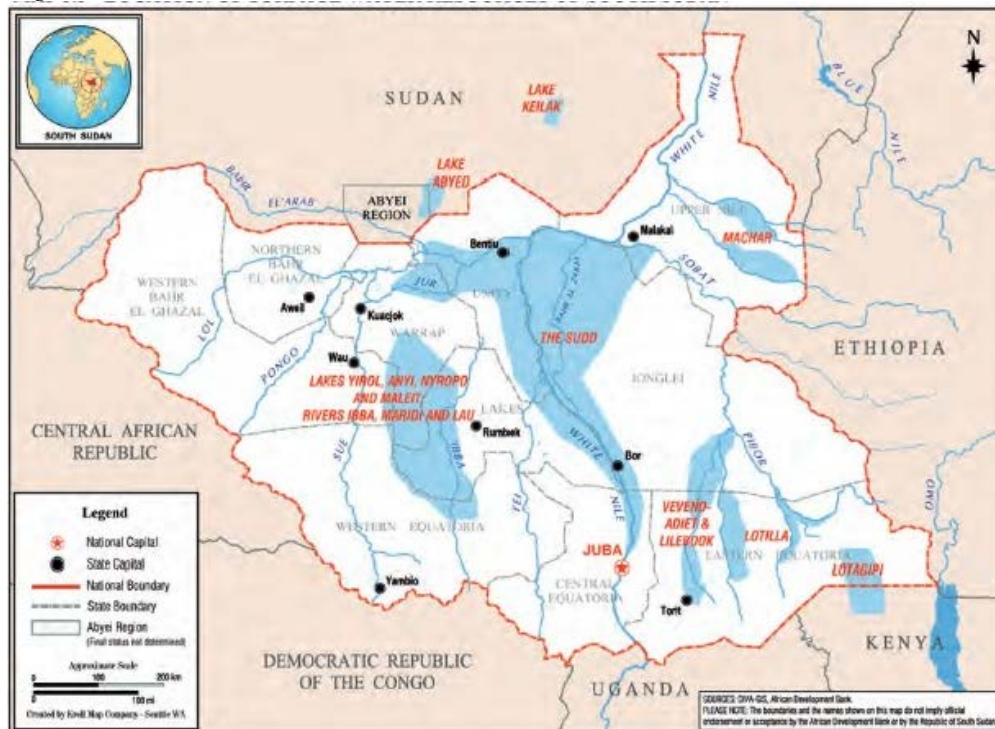
Although the White Nile is considered to be the primary stream of the Nile it is the Blue Nile that carries most of the water. An estimated 28 billion cubic meters, representing 30% of the flow of Nile water, passes through South Sudan to Sudan and on to Egypt. Three major South Sudanese tributaries meet and flow into the White Nile: the Bahr el-Ghazal (comprising three sub-basins of Kiir, Loll and Jur); the Bahr el-Jebel (comprising numerous tributaries such as Yei, Aswa and Kiit); and the River Sobat (comprising sub-basins such as Pibor, Akobo-Baro).

Figure 2 South Sudan Rivers



source: AfDB 2013

Figure 3 South Sudan surface waters



Source: AfDB 2013

About 50% of the flow into the White Nile is lost in the wetlands of South Sudan, due primarily to evaporation and transpiration. For example, The Bahr el Ghazal basin, which discharges about 12 billion m³ per annum, loses 11.4 billion m³ per annum of its flow to the Sudd wetland (see below). So although South Sudan has substantial water resources, these are unevenly distributed across the region and vary considerably from year to year. (North and South) Sudan's total natural renewable water resources are estimated to be 149 km³/year, of which 80% (119km³) flows over the borders from upstream countries, and only 20% is produced internally from rainfall (appr. 30 km³/yr) (UNEP 2007). Updated total renewable water resources for South Sudan have become available recently and put it at 49.5 km³/year. This translates in a 2012 per capita availability of about 4,567 m³/cap/yr. This reliance on externally generated surface waters is a key feature of Sudan's water resources. The share of water generated from rainfall is erratic and prone to drought spells. In dry years, internal water resources fall dramatically, in severe cases down to 15% of the annual average. This hydrologic variability, coupled with no investment in storage structures, has made South Sudan hostage to periodic floods and droughts (African Development Bank, AfDB 2013).

South Sudan is also home to the world's largest swamp, the Sudd, which covers 30,000 km². When high river discharges occur, water spills over the banks

of rivers and floods large areas of flat land lying below the river banks creating swamps with an area of approximately 3 million ha (1.4 million ha are seasonal and the remaining 1.6 million ha are permanent wetland). Not all the water discharged into the swamp areas flows out, creating this permanent swamp and giving the region its name: Sudd (meaning barrier/blockage in Arabic). The Sudd has been declared a Ramsar site. The swamps, floodplains and grassland contain over 350 species of plants, 100 species of fish, 470 bird species, over 10 species of mammals and a range of reptiles and amphibians (GoSS 2007). The Sudd is the largest source of freshwater fish in South Sudan and breeds eight commercially important species (e.g., Nile Perch, Nile Tilapia). Estimates indicate that the Sudd could provide 100,000 to 300,000 metric tons of fish annually on a sustained basis. The majority of fish caught are smoke dried or sun dried, and then transported to markets throughout the region (USAID 2013). There are many other wetland systems throughout South Sudan, some of which are quite extensive. Estimates show that wetlands comprise 7% of the total area of South Sudan (AfDB 2013).

Figure 4 The Sudd



Source:http://upload.wikimedia.org/wikipedia/commons/thumb/a/a5/Sudd_location_map.svg/800px-Sudd_location_map.svg.png

Whatever will happen upstream in the Nile Basin (in Uganda, Kenya, Rwanda and Burundi) will have an impact on the Nile waters (and the Sudd) in South Sudan. Whatever South Sudan will do with its vast water wealth will have an impact on the use Egypt and Sudan will make of the Nile waters, although most of the Nile waters used by (northern) Sudan and Egypt depend on the water coming from the Blue Nile in Ethiopia. Some of the tributaries feeding the White Nile in South Sudan also come from Ethiopia (notably the Gambella region) and link these two countries as well. *Geo-politically water will be one of the hot items of the whole region of the Nile Basin.*

Southern Sudan is thought to possess large areas of land underlain by rich aquifers. These water-bearing formations are recharged by seasonal rainfall and river flooding and in some cases extend across international boundaries. *The distribution and potential of groundwater and springs has not yet been fully determined and very little is known about the transboundary aquifers (GoSS 2007). In South Sudan, ground water is the principal source of drinking water, but very little work has been undertaken to determine the distribution and extraction levels of these resources (AfDB 2013). Salinity levels exceeding allowable limits have been observed in Jonglei and Unity states making ground water unsafe in some areas of these states. Other issues include the need to monitor ground water quality around oil exploration sites in Unity State and undertake assessments of the impact of the effluent from the waste stabilization and oxidation ponds around Juba.*

Figure 5 Precipitation zones

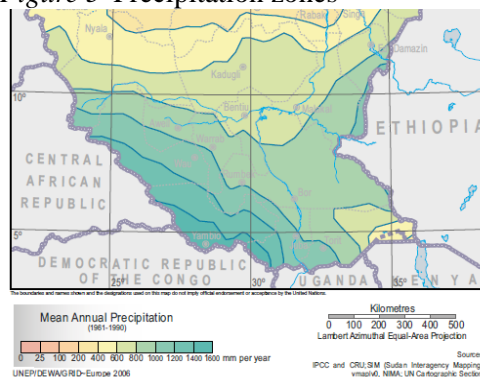
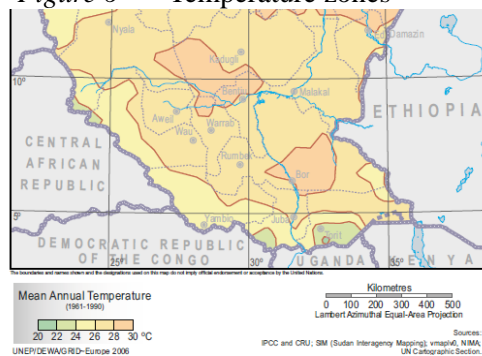


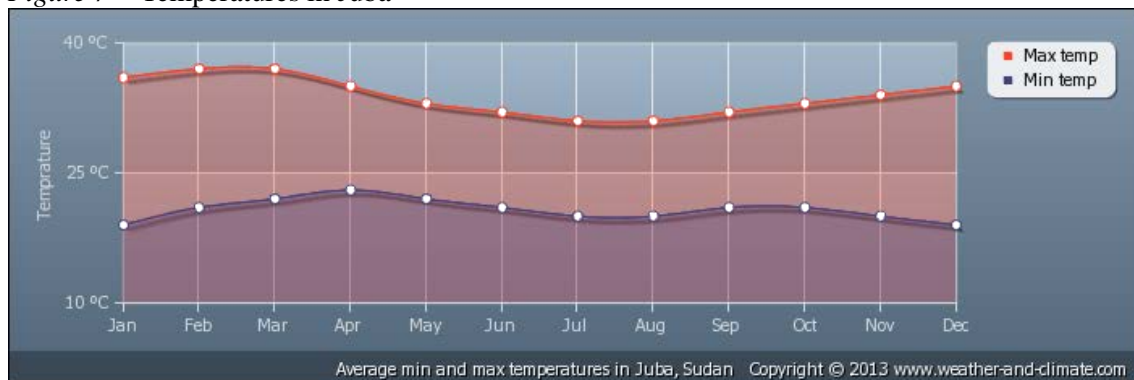
Figure 6 Temperature zones



Source figures 5 and 6: UNEP 2007

South Sudan's varied climate, ranging from the northern desert to tropical rain forests in the south, produces an annual rainfall measuring from 400 millimetres in the semi-arid areas to over 1600 millimetres per year in the tropical rain forest (GoSS 2007). Temperatures in Juba vary around 27°C all year round (maxima of 34°C and minima of some 19°C during the night). Humidity is high (40-80%).

Figure 7 Temperatures in Juba



Source: <http://www.weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Juba,Sudan>

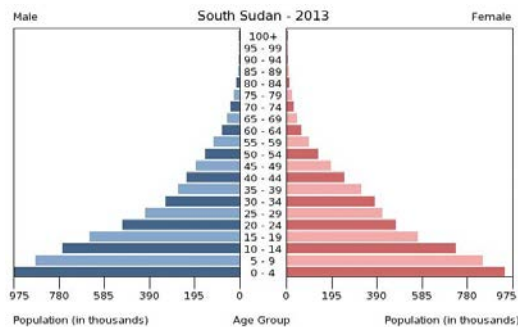
The most southern region of South Sudan belongs to the humid tropics; northeast of that humid zone the area is sub-humid and towards Sudan the area becomes semi-arid as is the area in the south east bordering Kenya. Despite the availability of abundant surface and ground water resources, millions of South Sudanese suffer from lack of access to improved water supply and sanitation services. Two in three people lack access to improved water services and over eight out of ten people do not have access to improved sanitation services. This means that more than six million people would be deprived of access to improved water supply services and about eight million people lack access to improved sanitation services (see more under section 2). Coupled with poor hygiene awareness, occurrence of water related diseases such as diarrhoea, cholera and guinea worm is high. The country is home to the largest incidence of guinea worm in the world. This is transmitted through drinking contaminated and stagnant water (AfDB 2013). The importance of water also stems from the fact that households in South Sudan rely on a combination of (rain fed) agriculture, wild food gathering and hunting, fishing, livestock keeping and barter/exchange as the basis of their livelihoods. Access to food is seasonal and location-dependent. Seasonal movements to areas of supply are needed to increase resilience in the face of natural hazards, such as droughts and floods. It is only when insecurity keeps people or cattle from moving, that unusually acute hunger occurs.

Demographic situation: population, urbanization, water consumption trends

According to the UN Statistics Pocketbook 2014 South Sudan had an estimated 10.8 million citizens in 2012. The average annual population growth will be 4% (2010-2015). The urban population in 2013 was 18.4%; the average annual urban population growth rate will be 4.2% (2010-2015), for the rural population this

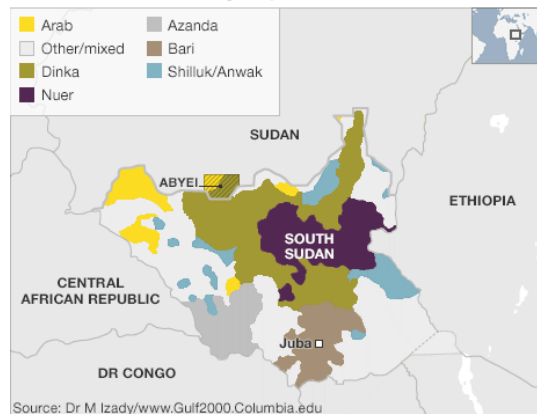
growth rate will be 2.9%. The major urban area is Juba, with 269,000 citizens in 2011. UN projections suggest that by 2025 the percentage of urban people in South Sudan will stand at some 25%.

Figure 8 Population by age groups



Source: CIA The World Factbook

Figure 9 Distribution ethnic groups South Sudan



Source: Dr M Izady/www.Gulf2000.Columbia.edu

The population of South Sudan is very young. Life expectancy at birth currently stands at 55 years. Many youngsters are uneducated in part because of the more than 20 years of civil war, as many children participated directly in the conflict as combatants. As a result the literacy rate of South Sudan is the lowest in the world (27%) (CIA World Factbook).

South Sudan is comprised of three main ethnic groups, the Nilotic, Sudanese Nilotic, and Sudanese groups. The Nilotic group includes the Dinka, Nuer and Shiluk ethnic groups which depend mainly upon cattle husbandry, fishing and agriculture. The Sudanese Nilotic share with the Nilotic genetic and linguistic features and as well as modes of subsistence (cattle rearing) and include Bari, Mundari, and Toposa. Finally, the Sudanese group encompasses the Zandi, Madi, Bon and others living in the geographic belt between west of the Nile and near Sudan's southern and south-western frontiers. Economic activity of these ethnic groups centres on agriculture rather than herding because of the spread of Tse-Tse fly in their locations. South Sudan embraces different faiths, including Islam (6%), Christianity (61%) and indigenous African beliefs (33%) (Pew Research).

Figure 10 The ten states of South Sudan



Source: http://en.wikipedia.org/wiki/South_Sudan

South Sudan is subdivided in three regions, ten states and 86 counties. These counties are further split in *Payams* (districts) and *Bomas* (subdistricts). The Bahr el Ghazal region in northwest South Sudan includes the states of Northern Bahr el Ghazal, Western Bahr el Ghazal, Lakes and Warrap. The Equatoria region in southern South Sudan includes Western Equatoria, Central Equatoria and Eastern Equatoria. The Greater Upper Nile region includes the states of Jonglei, Unity and Upper Nile. The latter state has the lowest percentage of poor people while Northern Bahr el Ghazal is the poorest.

Table 1 Population characteristics by State 2010

State	Population (2010)	Area (km ²)	Density (/km ²)	Poverty %	Food Secure %
Northern Bahr el Ghazal	820,834	30,543	26.87	75.0	57
Western Bahr el Ghazal	358,692	91,076	3.94	43.2	74
Lakes	782,504	43,595	17.95	48.9	59
Warrap	1,044,217	45,567	22.92	64.2	51
Western Equatoria	658,863	79,343	8.30	42.1	79
Central Equatoria	1,193,130	43,033	27.73	43.5	79
Eastern Equatoria	962,719	73,472	13.10	49.8	51
Jonglei	1,443,500	122,581	11.78	48.3	61
Unity	645,465	37,837	17.06	68.4	79
Upper Nile	1,013,629	77,283	13.12	25.7	62

Source: SSDP 2011; AfDB 2013

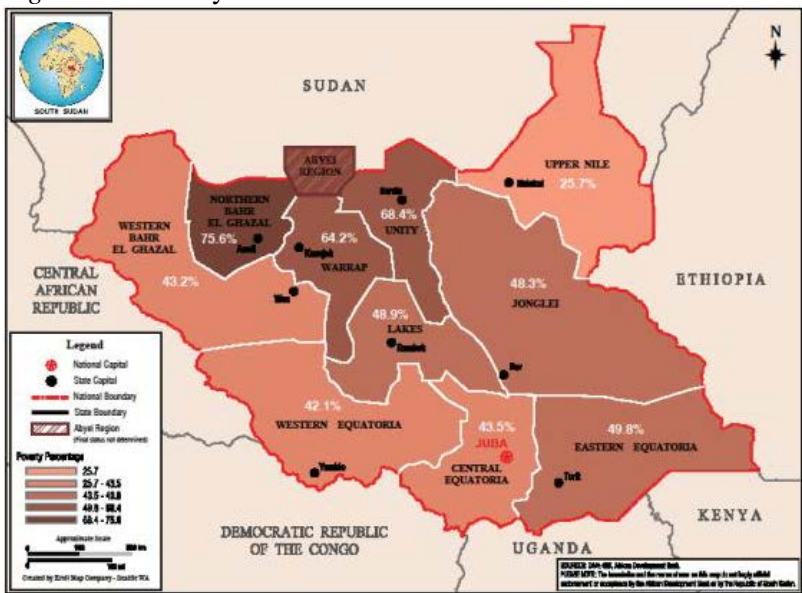
The vast majority of the population lives in rural areas with low population densities. Even though the density varies widely, the average population density for South Sudan is estimated at 13 people per km² compared to 166 in Uganda, 70 in Kenya, 83 in Ethiopia, and 36 people per km² for Sub-Saharan Africa in 2009. The major urban areas besides Juba are Yei (south of Juba in Central Equatoria), Wau (Western Bahr el Ghazal) and Malakal (Upper Nile). Other urban centres that are also state capitals are Rumbek, Yambio, Torit, Bor, Aweil, Kuajok and Bentui.

Figure 11 Population density



Source: AfDB 2013

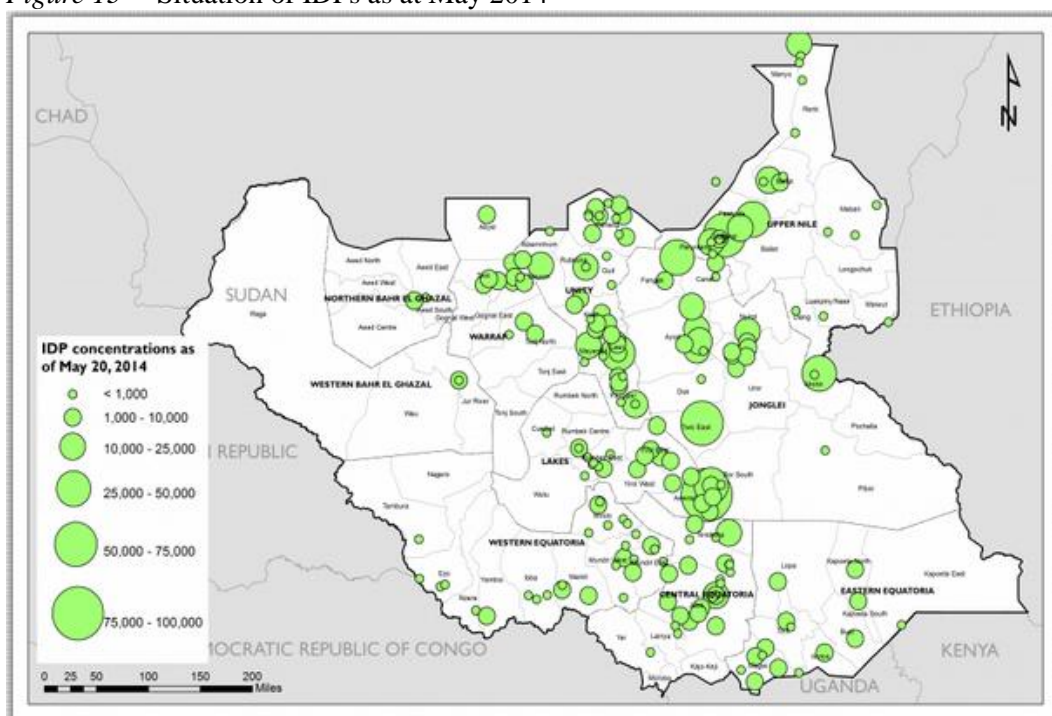
Figure 12 Poverty levels



Source: AfDB 2013

It should be realized though that South Sudan's population growth and population densities are influenced by major in and out migration. Newly erupted clashes from December 2013 onwards pushed many people out seeking refuge in neighbouring countries. In addition, many people became internally displaced when they sought safety in other parts of the country. A UNHCR 21-25 July 2014 update states that there are currently almost 250,000 foreign refugees in South Sudan, and 1.5 million Sudanese people are displaced by the violence of which some 400,000 stay in neighbouring countries, notably Ethiopia and Uganda (UNHCR 2014).

Figure 13 Situation of IDPs as at May 2014



Source: FEWS NET/OCHA

The post-CPA period, though, saw the return of South Sudanese from Ethiopia, Kenya, Uganda, Egypt, and further afield. More than two million people returned from Sudan to South Sudan from 2005 to 2010 (McEthinney 2012). In general people continue to return to South Sudan, placing further pressure on food and water supplies. There are as many as 500,000 South Sudanese still expected to return from Sudan and both the government and agencies are extremely concerned about the ability of South Sudan to provide for the growing number of arrivals (McEthinney 2012). Indeed the World Food Programme reported in 2013 that South Sudan had witnessed a significant increase in population to about 10 million in 2012 - largely due to the influx of returnees and refugees,

while the growth in cereal production has somewhat stagnated. The cereal deficit hit a record deficit of 475,000MT in 2012. In addition, lack of water in the areas where the returnees are being settled is also proving to be a major problem and given the limited resources available to the states it is becoming difficult for them to provide the water for the returnees. The state of infrastructure in most of the areas where these returnees would have been settled is also a major problem as it becomes difficult to transport the people, and they end up crowding the few accessible sites (SSDP 2011).

The 2010 South Sudan Health and Household Survey estimated access levels to improved water sources in urban areas to be 67% (UNOCHA 2014). This figure is also used by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (2014). However, the stated level is widely disputed as almost all urban water systems are dysfunctional and the majority of the population continues to rely on poor quality and often intermittent services. Estimates made by the \$30 million Southern Sudan Water and Sanitation Programme funded through the Multi Donor Trust Fund (MDTF) suggest that in 2009, access levels in urban areas were limited to only 14% (World Bank 2013). This is in line with the AfDB study which indicates that access levels in Juba, Wau and Malakal varied from 13% to 20% in 2010. Nationwide the AfDB report estimates that 15% of the urban population had access to improved water supply services. Part of this confusion about access to improved water sources is caused by a lack of first hand data as concluded by Lidonde (2009).

Donors supported the construction of treatment plants, booster stations and truck refilling stations in Wau and Juba. This translates into an average availability of water of 15 litres/capita/day, alarmingly low compared to a minimum average of 50 litres/capita/ day set for most urban towns in Africa. Moreover, less than 10% of investment costs were allocated to improving the distribution systems, partly comprised of health-risky old asbestos cement pipes. This aged distribution network also causes major leakage and losses, estimated to reach 50%. Further to this, the influx of IDPs to Juba meant that the system could not cope with the increase in demand. The lack of adequate system capacity led to a surge in the development of private wells. About 400 of them supply water to an estimated 56% of the population in Juba, considerably higher than the average for African urban dwellers at 33%. In addition, water is supplied either by tankers or by young men pushing bicycles through the streets transporting plastic water containers. Lack of clean water and sanitation, as well as poor hygiene practices, increase the risk of waterborne diseases that lead to illness and death, particularly among young children (GWI 2011). Today, Japan International Cooperation Agency (JICA) is supporting capacity building activities for the town's water supply station and is also planning to carry out design and construction works for

a new system with the intention of commissioning it after 2015 (AfDB 2013). The WHO/UNICEF 2014 update gives a total of 55% of the rural population having access to improved drinking water sources (protected sources). Other literature sources, however, stress that this clean water is mostly from boreholes provided by NGOs as emergency during the war. Many of these wells are facing problems nowadays and 30-50% are non-operational at any time. It is not uncommon for rural women and children to spend most of their day collecting water (USAID 2012; AfDB 2013). As a result the availability of improved water sources for the rural population is approximately 34% (SSDP 2011).

Levels of sanitation are even worse than those of access to improved water. Some of the reasons for this are (i) low priority on the development agenda (ii) burden of carrying costs on households (iii) absence of a single lead ministry and (iv) resistance to behavioural changes. For example, digging latrines is seen as a degrading job and by some as “inviting death”. Others claim that using a latrine might make a person infertile. More studies are needed to understand behavioural change. Apart from a few NGOs and development partners implementing sanitation projects, there is no dedicated budget towards improving sanitation and hygiene services (AfDB 2013). Table 2 shows the types of sanitation facilities used in the country.

Table 2 Access to sanitation (2010)

Facility	Access %			Pop with access (millions)		
	urban	rural	total	urban	rural	total
Flush toilet	9.3	2.9	4	0.16	0.22	0.38
VIP latrines	8.1	1.2	2.3	0.14	0.93	1.07
Pit latrines with slab	20.5	5	7.6	0.36	0.39	0.75
Composting toilet	0.7	0.2	0.3	0.01	0.02	0.03
Unimproved/open defecation	61.4	90.7	85.8	1.07	6.2	7.27
Total	100	100	100	1.74	7.76	9.5

Source: AfDB citing South Sudan Health and Household Survey 2010

According to the South Sudan Development Plan 2011- 2013 dignified housing, water and sanitation services for the people of South Sudan will enable people to live good lives where their unleashed physical and psychological potential will stimulate economic growth and sustainable development. Therefore, the rights to housing (habitat), safe water and improved sanitation are not only fundamental human rights but also locomotives for development. Unlike provision of housing, water and sanitation services are to a larger extent considered public goods that the Government has to provide. Nevertheless, the Government will need to create

an enabling environment for financing, cost recovery and private sector involvement in order to sustain these services (SSDP 2011).

Political situation and institutional setting

Political situation

South Sudan gained independence from Sudan in July 2011 as the outcome of the 2005 peace deal. The state plunged into a major crisis again in December 2013 amid a power struggle between President Salva Kiir and his deputy Riek Machar whom he had sacked. Fighting between SPLM government troops and rebel factions erupted, and within weeks the conflict had killed thousands and prompted more than 800,000 to flee their homes. The conflict has also grown into an ethnic conflict, with fighting e.g. between the Dinka and the Nuer, and into a conflict about control over the oil fields. The majority of the oil reserves are located in South Sudan, however, the pipelines, refining and export infrastructure are located in the north, making South Sudan dependent on Sudan. A dispute over revenue sharing in 2012 made South Sudan decide to cut the flow of oil through the pipelines via Sudan to the Red Sea, which hurt both countries economically. This decision was reversed in March 2013; however, oil production remained lower than before the cut and South Sudan kept looking for other export routes to overcome dependence on Sudan in the future (Africa Yearbook, 2014; BBC South Sudan Profile).

Several border disputes with Sudan continue to strain ties. The main row is over the border region of Abyei, where a referendum for the residents to decide whether to join south or north has been delayed. The conflict is rooted in a dispute over land between farmers of the pro-South Sudan Dinka Ngok people and cattle-herding Misseriya Arab tribesmen. Another border conflict zone is the Nuba Mountains region of Sudan's South Kordofan state, where violence continues between the largely Christian and pro-SPLA Nuba people and northern government forces. Inside South Sudan, a cattle-raiding feud between rival ethnic groups in Jonglei state has left hundreds of people dead and some 100,000 displaced since independence. Several rebel forces opposed to the SPLM-dominated government have emerged, including the South Sudan Liberation Army (SSLA) of Peter Gadet and a force originally formed by a former SPLA general, the late George Athor. Juba says these forces are funded by Sudan, which denies the accusation (BBC South Sudan Profile).

Some observers see a paradox in that South Sudan's aim to decentralize governance through building strong local institutions is counterproductive because these new institutions lack accountability. The goal of breaking power down into small administrative units while simultaneously seeking to portray and build a

strong central state combines two approaches at odds with one another, pulling Southern Sudan into opposite directions. Decentralisation, while theoretically the best way to govern Southern Sudan, has in reality often become an instrument to entrench 'tribal' lines over competition for resources (Schomerus *et al.* 2010).

For many Southern Sudanese, living in peace seems to come with two major expectations: personal security and access to resources. Witnessing development and better life through services is vital. The absence of tangible development in many areas has made the notion of peace insignificant and encouraged violent behaviour. Building of hospitals and gaining access to education are seen as vital in establishing peace, and this realisation needs to be at the heart of peace-building activities (Schomerus *et al.* 2010).

By defining conflicts as local and tribal, peace conferences have neglected the broader political context. Instead, a long-term local peace-building strategy is needed. This calls for a long term commitment that seems to be lacking at the moment. Moreover, the country needs fundamental reworking of the governance agreement between and within elites and communities if a negotiated settlement is to lead to a sustainable peace, claims the International Crisis Group (ICG 2014).

Although quite substantial funds have been allocated by donors to Southern Sudan, much of it has not yet been spent or has been used for recurrent expenditure rather than investment. The political turmoil the country is facing is partly responsible for this. There are also many accusations about misuse of aid money and other government income by the SPLM/SPLA leaders. South Sudan's rank on the 2014 Transparency International list of corrupt states is 174 out of 177 states.

Institutional setting of water

The lead ministry in the water sector is the Ministry of Electricity, Dams, Irrigation and Water Resources (MEDIWR). The Ministry is mandated to (i) develop policies, guidelines and master plans; (ii) oversee the operation of the South Sudan Urban Water Corporation; (iii) set tariffs for the sale of water; (iv) implement ground-water supplies of drinking water for the rural population until States and local governments assume such responsibilities; and (v) advise, support and build the capacity of State and Local governments in charge of water services. A Provisional Order (PO) passed in 2008 created the Southern Sudan Urban Water Corporation (SSUWC) as a semi-autonomous institution and made it responsible for operating urban water facilities. The provision of schemes for sewage disposal and treatment in urban areas is entrusted to the Ministry of Lands, Housing and Physical Planning.

The principal document guiding the country's water and sanitation sector is the Water Policy document. Adopted in 2007, the policy recognizes that access to improved water supply and sanitation services positively impacts the reduction of poverty and boosts economic growth. It underpins that provision of sufficient quantity and quality of water is considered a human right and shall be accorded highest priority. The policy highlights that investments in rural water supply and sanitation shall be targeted to those areas which are currently not served and/or experience acute water shortages. Experiences in this sector by a Dutch NGO about the lack of capacity and (too) ambitious plans at State level are presented in Bennet (2008).

In 2011, the Government adopted the water, sanitation and hygiene strategic framework. The strategy has been crafted to translate the water policy into action and aims at serving as a road map towards attaining the objectives of the policy. A key element of the framework dwells on speeding up rehabilitation and construction of water supply and sanitation schemes to ensure universal access of services to the people of South Sudan. It recognizes the low level of access to improved sanitation and hygiene services and proposes a reversal of the situation through techniques such as Community Led Total Sanitation (CLTS), a methodology for mobilising communities to completely eliminate open defecation (AfDB 2013).

At state, county and payam level, structures are also put in place to improve the water and sanitation situation. Foremost the State Ministry of Physical Infrastructure is responsible, but at the local level, lack of cooperation in planning is a problem. Water projects tend to be donor driven rather than based on needs assessments. This has dotted the countryside with 'monuments'. Knowledge about the number and locations of water sources such as boreholes is lacking (Schomerus *et al.* 2010).

There are also a number of Private Service Providers (PSPs) that are active in transportation of water and sewage services in the urban areas. In the absence of a Water Act, responsibilities of service delivery as well as regulatory functions are characterized by gaps and overlaps (AfDB 2013). The proposed programme for sustainable water and sanitation services calls for capital outlays of about \$ 2 billion. Given the large number of competing sectors such as education, health and other infrastructure services, there is a risk of securing insufficient public funds for water and sanitation.

Shortly after independence, South Sudan became the newest member state of the Nile Basin Initiative (NBI), an inter-governmental organization dedicated to equitable and sustainable management and development of the shared water resources of the Nile Basin (see box 1).

BOX 1: Nile Basin Initiative (NBI)

In the last century several treaties were put in place by Nile riparian countries. The 1929 Agreement between Egypt and Anglo-Egyptian Sudan gave Egypt complete control over the Nile, put substantial limits on the amount of water allocated to Sudan, and provided no water rights to any of the other riparian states. The 1959 Nile Agreement between Sudan and Egypt allowed the entire average annual flow of the Nile to be shared between Egypt and Sudan at 55.5 and 18.5 billion m³, respectively. The Agreement granted Egypt the right to construct the Aswan High Dam and Sudan the right to construct the Rosaries Dam on the Blue Nile and to develop irrigation and hydroelectric power generation. Upstream countries Burundi, DRC, Ethiopia, Kenya, Rwanda, Tanzania and Uganda were denied formal rights to the Nile water. Negotiations for creation of a Cooperative Framework Agreement started in 1997. In February 1999, the Nile Basin Initiative (NBI), which is a partnership among the Nile riparian states, was formally launched by the then nine countries that shared the resources of the river. With support from donors, the NBI aims at building capacities among member states, making investments in water resource development and management. Pressures are growing. The basin is home to more than 160 million people currently. As a result, seven upper riparian states launched the Nile Basin Cooperative Framework Agreement in a bid to establish a permanent organizational structure and ensure an equitable utilization among all the riparian states of the Nile. So far six riparian states have signed the Agreement (DRC, Sudan and Egypt have not yet signed the agreement). The lack of agreement among all the riparian states indicates that the utilization of Nile waters will continue to pose a challenge at least for the foreseeable future (source: Colins 2001; AfDB 2013; Howell et al 2008; Kibrome 2011).

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

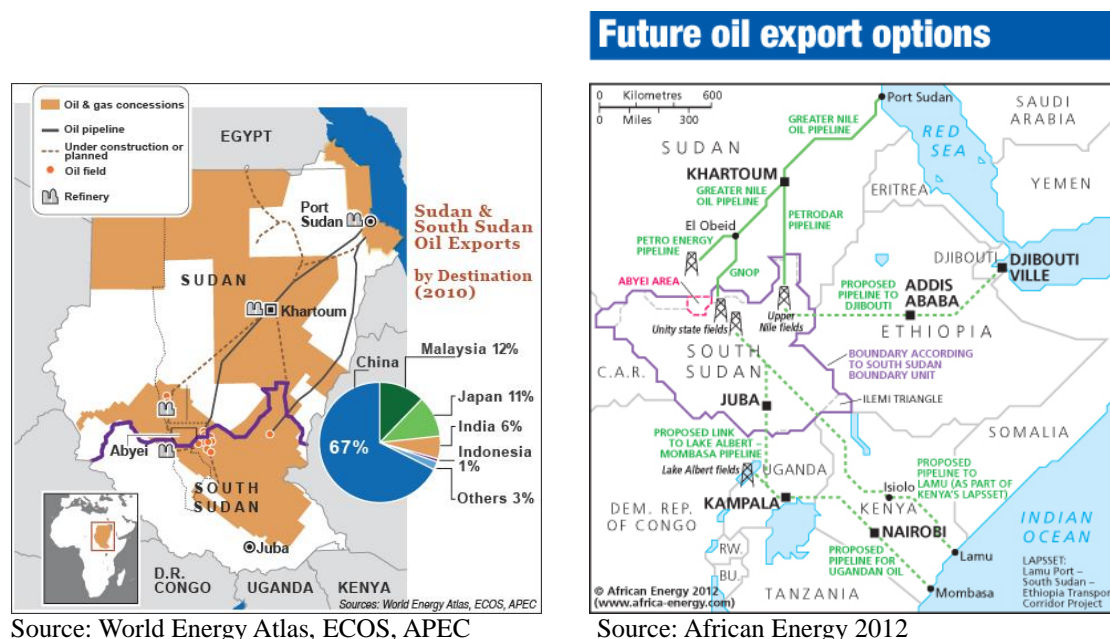
Despite its abundant natural resources (hydropower, fertile agricultural land, gold, diamonds, petroleum, hardwoods, limestone, iron ore, copper, chromium ore, zinc, tungsten, mica, silver), South Sudan is a relatively undeveloped, subsistence economy. The South Sudan government relies heavily on oil export revenues. Oil accounts for 98% of the government's revenues and contributes 60-80% to GDP. Oil was discovered in Sudan in the 1980s by Chevron; the first oil was produced and exported in 1999 following the completion of the pipeline from central Sudan to the Red Sea port of Bashair. Today foreign companies involved in Sudan's oil sector are primarily from Asia (China National Petroleum Company, Oil and Natural Gas Corporation (ONGC) of India, and PETRONAS from Malaysia (see also ICG 2012; Large & Patey 2011). The oil sector does not provide many jobs. Of South Sudan's work force, 85% are active in agriculture (including animal husbandry, forest use and fisheries) which accounts for only around 15% of GDP (World Bank South Sudan Overview).

During the past three years, the GDP of South Sudan has fluctuated because of changes in oil prices, and so has the value added by the petroleum sector. For the period as a whole, GDP has averaged about \$12.7 billion at current prices. Gross national income per capita has fluctuated, but has averaged about \$1,050 during

this period. South Sudan is therefore at the low end of the Lower Middle Income Country category as defined by the World Bank (AfDB 2013). However, most of its people can be regarded as belonging to the poorest on Earth.

In its South Sudan Development Plan of 2011-2013, the government states that given the country's abundant fertile land, water resources, its youthful labour situation but highly constrained skills, productivity and investment levels, the greatest potential for initial new growth is likely to be from the small-scale private, predominantly family-owned, agriculture and livestock sectors (SSDP 2011).

Figure 14 Sudan and South Sudan oil exports by destination (2010)



Furthermore, the strategy envisages a South Sudan that would exploit opportunities to process food products and raw materials for value addition, job creation and increased earnings. South Sudan will need to speed up the execution of the development plan because oil production peaked in 2009 and is projected to decline sharply over the next 10 years and is expected to cease in 2035 unless new oil fields are discovered. Moreover, as the oil pipelines, refining and export infrastructure are located in the north, South Sudan is – for the time being – heavily dependent on Sudan. In order to become less dependent, it is investigating other export routes, mainly the southern route to Lamu (Kenya) on the Indian Ocean. In April 2013, a deal was made with Japanese company Toyota to support the building of a proposed pipeline to Lamu (SSDP, 2011; Africa Yearbook, 2014).

The South Sudan Development Plan 2011-2013 has the following priorities for economic development: 1. Increase agricultural production; 2. Increase livestock

production; 3. Improve and expand the road infrastructure of the country; 4. Expand and improve the water and sanitation infrastructure of the country, and 5. Ensure good management of oil sector resources. The SSDP acknowledged that a key priority would be to create a situation where peace would prevail. Investments (from oil and foreign assistance) will be needed to fight poverty and create employment for a labour force that is growing at 250,000 per annum (AfDB 2013). A major influx of foreigners after the war, looking for economic opportunity, an asset in terms of the skills they have brought, are also quickly coming to be perceived as crowding less educated Southern Sudanese out of the labour market in their own country (Maxwell *et al.* 2012). Still, aggressive promotion and facilitation of domestic and foreign investors is planned to drive growth. The Ministry of Investment aims to improve the business environment. Doing Business Juba 2011 ranked the country 159 out of 183 (DB 2011). Starting a business is relatively easy, but subsequent steps (protection, credit, closure) are less well arranged. Very problematic cross border transport (rank 181) is a typical characteristic that shows the difficulties of doing business in South Sudan.

The transport system in South Sudan consists of four modes – road, rail, river and air transport – the largest being road transport. South Sudan's main access to the sea is through Mombasa in Kenya (which accounts for most of the traffic), Port Sudan and Djibouti ports. The country lacks roads linking major towns, feeder road networks between rural communities, and proper maintenance for all roads. Until recently South Sudan's road network of some 12,500 km had only 100 kilometres paved outside Juba (IMF 2011). South Sudan's road infrastructure was largely destroyed or left in disrepair during the protracted civil wars. A 192 km paved road between Juba and Nimule on the Ugandan border was constructed with USAID funds in 2012. In July 2014 it was announced that road maintenance and rehabilitation work would be funded by the Government of the Netherlands, and implemented by the UN World Food Programme Feeder Roads Special Operations.

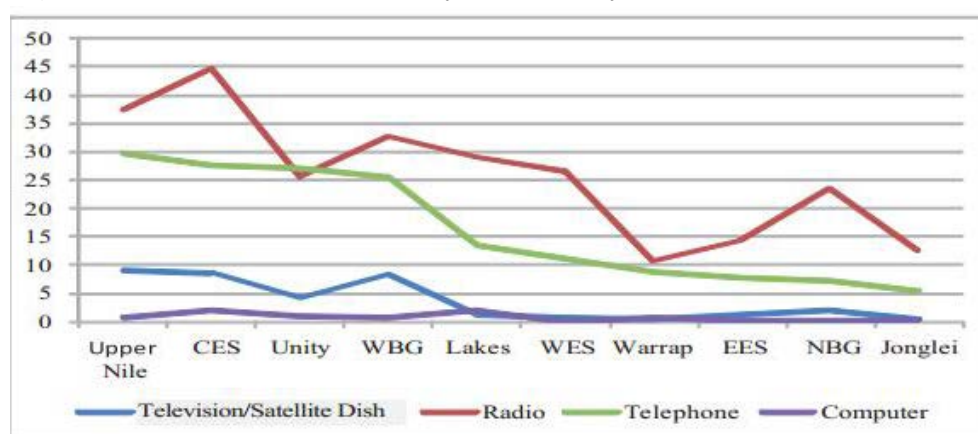
The density of paved roads in South Sudan is 0.2 km per 1,000 km², which is much lower than the averages of 16.9 km per 1,000 km² for Sub-Saharan Africa (AfDB 2013). This has: i) contributed to the slow economic growth and development of rural and peri-urban communities; ii) prevented people from connecting to markets; iii) imposed high transportation costs on traders and farmers that choose to carry products to markets; and iv) inhibited people's ability to access basic social services like health and education (USAID). South Sudan has a railway system of 248 km. The railroad between Babonosa (Sudan) and Wau was repaired in 2010 with \$250 million of United Nations funds (CIA World Factbook). In 2013 the Chinese government announced a \$5.2 bn investment in a rail network for East Africa linking South Sudan, Uganda and Rwanda to the

Kenyan coast. The bulk of the road freight has been imports through the port of Mombasa (Kenya). There are also plans for a new road link to Ethiopia to carry oil by truck (Africa Yearbook, 2014; see ICG 2012 for a map of the planned road network in South Sudan).

The section of the White Nile between Juba and the border with Sudan is navigable and it is about 1,300 km long. A number of tributaries are also navigable for certain stretches and periods of the year. The navigable part of White Nile and its tributaries crosses six of the ten states of South Sudan. The poor road infrastructure, presence of land mines in some areas and vast swampy areas make river transport a practical and cost-effective option to reach communities along the White Nile and its tributaries (AfDB 2013). Rehabilitation of water courses (dredging) and construction of suitable ports and beaches will form an important component of future transport strategy to facilitate navigation of waterways in Southern Sudan (GoSS 2007). Japanese support for the Juba River Port Expansion Project will transform the port into a modern well-equipped facility.

As far as communication is concerned, a media survey from September 2013 commissioned by US based NGO Internews found that radio remains the most accessible source of information for the vast majority of people in South Sudan, though males and younger generations have greater access to radio as well as to other technology-based sources of information. According to Internews South Sudan is in the early stages of building capacity for its media infrastructure. Few households own televisions or computers, and internet access is extremely limited.

Figure 15 Status of Access to ICT by household by State in South Sudan (2008)



Source: AfDB 2013

The 2011-2013 Development Plan envisions a key role for the ICT sector in the economic growth of the country. Mobile phone coverage should expand from

around 60 to 100% of the population between 2010 and 2020. Economic benefits accruing from the use of mobile phones and other ICTs especially for farmers/pastoralists include improved agricultural advisory services, market and product information.

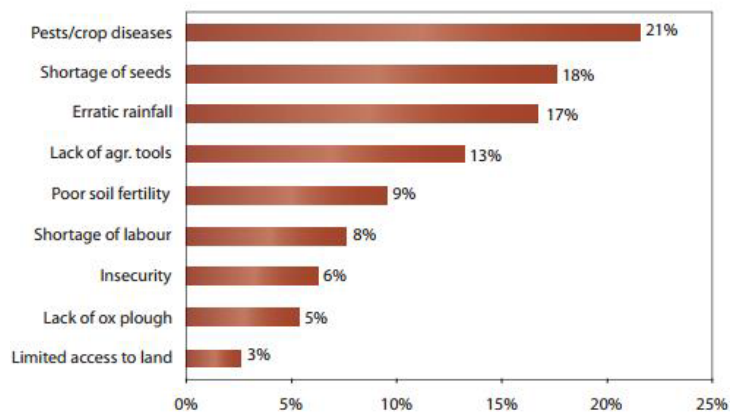
Agricultural dynamics

According to the South Sudan Country Profile of 'FAO in Emergencies', up to 95 percent of the country's population depends on farming, fishing or herding to meet their food and income needs. Sorghum is the main cereal, followed by millet and maize. Agricultural performance varies considerably from place to place and from year to year, ranging from the possibility of two harvests per annum in Greater Equatoria (notably Greenbelt area) to one harvest in the unimodal areas further north (e.g. Eastern Flood Plains). An estimated 75% of the country's land area is suitable for agriculture while approximately 330,000 km², or about half of the total land space, is potentially suitable for crop cultivation. However, in spite of having 50% of its arable land mass as prime agricultural land, only 4% of this area is cultivated continuously or periodically (AfDB 2013). The remaining is either grassland (23%) or covered with trees and shrubs (72%).

According to FAO-WFP reports, only about 10,000 km² were put under cultivation in 2008. The Western Flood Plains livelihood zone has the most cropland (34% of national cropland). Greenbelt and Eastern Flood Plains zones are the other two important crop production regions, accounting for, respectively, 18% and 26% of national cropland. Almost all irrigated crops (mainly rice) are in Upper Nile; rice on flood land is all in Northern Bahr el Ghazal while fruit trees and tree plantations are exclusively in the Green Belt Zone encompassing Western, Central, and Eastern Equatoria which have the longest Length of Growing Period (LGP) in South Sudan.

With assistance from USAID and the World Bank, the Government has formulated strategies for expansion of the cultivated areas in various parts of the country (AfDB 2013). Most cultivation is accounted for by smallholder subsistence farmers (0.5-1.5 ha) that, in the absence of fertilizers, pesticides and herbicides, practice some form of shifting cultivation. As a result South Sudan's average yield is low relative to most other countries in the region, averaging only 0.97 tonnes per hectare during 2005-2009; it is far below the average of 7.64 tons per hectare in Egypt where the bulk of the cereals are grown under irrigation. These low cereal yields in South Sudan stem from a range of problems faced by smallholder farmers.

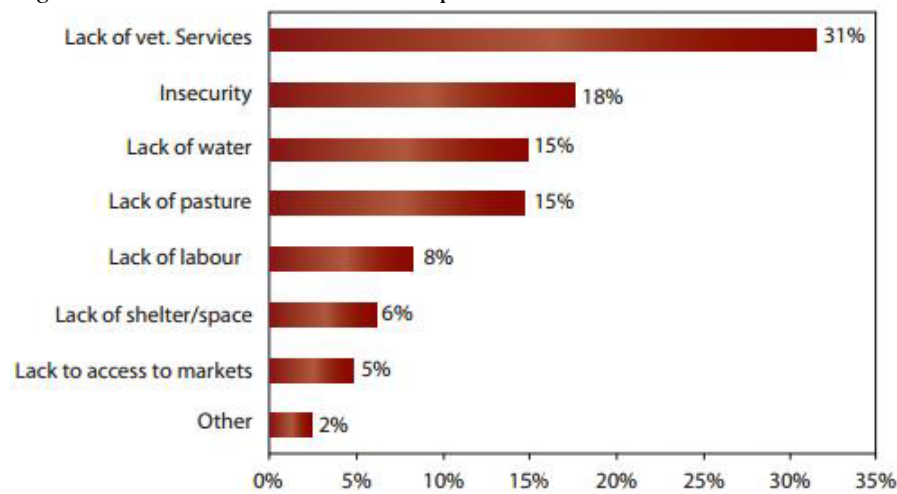
Figure 16 Constraints for crop production in South Sudan



Source: AfDB 2013

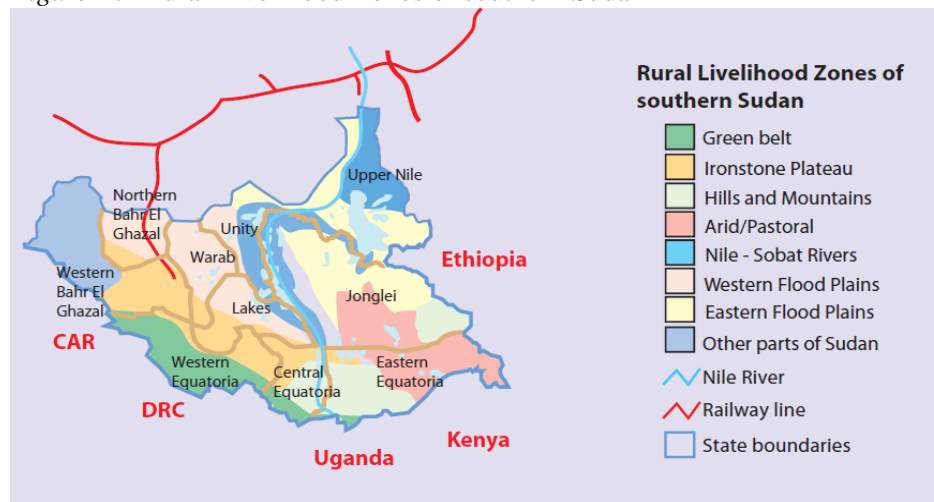
A survey undertaken in 2006 by Ministry of Agriculture and Forestry, with support from FAO and the WFP, asked farmers what were their primary constraints to improving crop production (see AfDB 2013). **Pests and crop diseases, shortage of seeds and erratic rainfall were the three most important concerns.** Southern Sudan has an abundance of livestock whose population is estimated at 10 million heads of cattle with an annual growth rate of 2-3%. The livestock sector contributes over 15% of GDP and employs, directly or indirectly, 70% of the population. As such the sector is of central importance in efforts to promote food security, poverty alleviation and enhanced economic growth. **Livestock is generally concentrated in areas where rainfall is marginal for cultivation and the distribution of livestock watering points is a major determinant of grazing patterns.** Seasonal migrations in search of water and pasture frequently result in land and water use conflicts between different pastoral and agro-pastoral groups. The current uneven distribution of water points often leads to the concentration of large numbers of livestock, especially during the dry season, with negative impacts on water resources and the surrounding environment. Key livestock zones are Arid Zone, Hills and Mountains Zone and Eastern Flood Plains. See below details of South Sudan's livelihood regions summarised from Muchomba & Sharp (no publication year stated, see reference list).

Figure 17 Constraints for livestock production in South Sudan



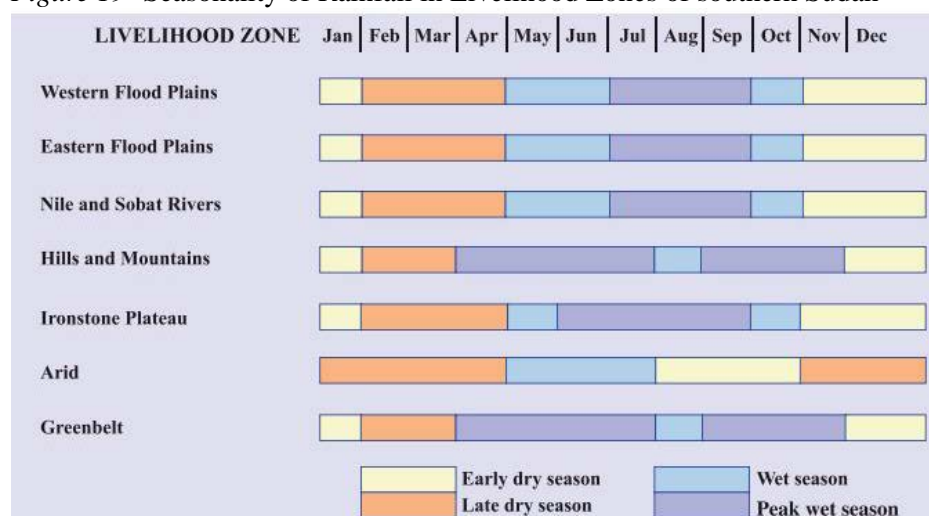
Source: AfDB 2013

Figure 18 Rural Livelihood Zones of southern Sudan



Source: Muchomba, E. & B. Sharp (no date)

Figure 19 Seasonality of Rainfall in Livelihood Zones of southern Sudan



Source: Muchomba, E. & B. Sharp (no date)

South Sudan's livelihood regions:

Greenbelt Zone:

The Greenbelt is the most fertile traditional cereal growing zone of southern Sudan. It has very reliable rainfall, with average annual precipitation of 1,350-1,600 mm. Most of the vegetation is luxuriant broadleaf woodlands, which decrease towards the north of the zone. The main economic activity is farming, with a wide variety of crops including sorghum, maize, millet, cassava, groundnuts, rice, sweet potatoes, fruit, sesame, tobacco, sugarcane, soya beans, vegetables and coffee. Households in the wetter south-western areas of the Greenbelt Zone rely almost exclusively on agriculture to meet their food needs. Here, surplus production is common. This is the traditional surplus-producing agricultural region, also known as the 'breadbasket' of southern Sudan. Unlike other zones, rainfall is usually not a limitation. Immense exchange opportunities exist with the neighbouring crop-deficit zones and as far as Uganda, but movement of this surplus is highly constrained by the extremely poor road network, which has discouraged farmers from producing as much as they potentially could.

Arid Zone:

In the Arid Zone, which occupies the south-eastern tip of the country, households practice a nearly pure form of pastoralism and there is almost exclusive reliance on livestock and livestock trade for food. This is the driest of all the zones, and here drought is the norm. The zone is typically dry Sahelian savannah, with an average annual rainfall of less than 200 mm. The soils of the large plains are predominantly sandy loam. There are few permanent rivers or water points. During the dry season (October to May), the cattle are taken to hills where there is grass and water. Along the Ethiopian border, there is a range of high country that offers good grazing and numerous water points. The zone is predominantly inhabited by two main ethnic groups (Toposa and Murle). Some households attempt to grow sorghum, but more often than not it fails, making the exchange of livestock for grain and access to water and pasture in neighbouring areas (including Kenya) a necessity. However, cattle raiding and poor relations with neighbouring communities often disrupt this critical access. Conflict mitigation and peace-building initiatives to address cattle raiding practices will need to be prioritised with the involvement of all local and neighbouring communities, including the Turkana of Kenya and Karamoja of Uganda.

Hills and Mountains Zone:

The Hills and Mountains Zone falls somewhere between these two extremes (agriculture and pastoralism), with reliance on cattle, trade and root crops increased in difficult years. A significant amount of cassava is grown and ensures that most households are food secure even during drought years. Drought (in the mountains) and floods (in the lowlands or plains) are not uncommon in this zone. Still, two distinct rainy seasons and the relationships between highland and lowland (plains) systems gives this Zone some unique characteristics that have helped to sustain its food security through times of conflict. Many different ethnic groups inhabit the zone, namely: Moru in Juba, Lotuka in Torit, Acholi in Magwi, Buya and Didinga in Budi, and Murle, Jie and Kachipo in the hilly parts of Pibor. Households in this zone are mostly agro-pastoral. Apart from land, cattle are the main asset in this zone. However, traditionally, there has been insecurity caused by cattle raiding among the many different ethnic groups. The improvement of the security situation remains the pivotal priority for local recovery, as well as inter-ethnic peace building initiatives to address the cattle raiding situation. Accelerating the removal of landmines and the improvement of the road infrastructure would promote access to and the expansion of existing markets such as Juba, Torit, Kapoeta and Lafon, and possibly support the emergence of new markets.

Western Flood Plains Zone:

In the Western Flood Plains Zone, livestock and agriculture, supplemented by fish and wild foods, are the main food sources. The zone is occupied by predominantly agro-pastoralist Dinka groups. Flooding of local rivers (the Nile's tributaries) usually occurs between July and September. Water levels in the zone's major river systems (Lol and Jur) depend on rainfall in their catchments that extend as far as the Central African Republic (CAR) border, as well as on local rainfall, which feeds swamps and tributaries along the course of the rivers. Flooding is a normal and important feature of these river systems, supporting fish and water lily production. The Western Flood Plains Zone has been at the centre of the war with its close proximity to the northern areas, the presence of the railway line, and strategic political positioning. Opportunities for increasing food security start with promoting cash income opportunities, strengthening market infrastructure, and improving road conditions and links with northern Sudan and the crop-surplus Greenbelt.

Eastern Flood Plains Zone:

The Eastern Flood Plains Zone is quite similar to the Western Flood Plains, differing primarily in that households cultivate less and move longer distances for grazing, water, fishing and exchange. The Eastern Flood Plains Zone is characterised by flat, low-lying terrain with black cotton soils. Savannah grasslands and acacia trees are the typical vegetative cover. Annual rainfall tends to occur between June and September, and ranges from 700 to 1,300 mm. Flooding of the Sobat River and its tributaries normally results from either local rains within the zone, and/or heavy rainfall in the Ethiopian highlands. Thus it is possible for flooding to occur even in a year when there is no heavy local rainfall. The steep banks of the Sobat tend to limit overflow, thus constraining the areas where wet season grazing is found. Crop performance tends to be unreliable due to poor agricultural practices, the difficulty of cultivating the heavy black cotton soils, and unpredictable weather patterns. Human productivity is seriously undermined on a periodic basis by dry season water shortages, which are a predominant and chronic feature of this zone. As water becomes scarce, people have to move increasingly long distances, and residents have been known to walk up to five days to find water. In addition to extended migration patterns, water shortages also give rise to a high incidence of waterborne illnesses and malnutrition during the dry season. Insecurity worsens the health and water situations for those who do not migrate: during conflict, more members of the family stay at the homestead, increasing pressure on local water sources. The zone is occupied by four ethnic groups: the Nuer, Dinka, Anyuak and Shilluk. These ethnic groups - and the clans within them - have a long history of conflict over pasture, water and cattle. These long-standing conflicts have periodically resulted in serious food insecurity. Challenges include lack of cohesive local political leadership, and poor infrastructure for facilitating access to food and non-food needs. This includes poor access to local and cross-border trade with Ethiopia.

Ironstone Plateau Zone:

The Ironstone Plateau Zone is mostly agricultural and has a strong potential for increased trade and exchange with the three neighbouring zones of Western Flood Plains, Hills and Mountains, and the Greenbelt. It is also a potential source of much needed labour, particularly for the Greenbelt Zone. The sparsely populated Ironstone Plateau contains a range of ethnic groups, predominantly a Nilotic group of Luo, with other groups including Dinka, Fertit, Azande, and many others. Households in the Ironstone Plateau Zone are heavily dependent on crop production and are well placed to access surpluses in the neighbouring Greenbelt. Rainfall averages between 950-1300 mm annually in the zone. The lateritic soils do not hold water well and become shallower towards the north of the zone, contributing to some of the most acute water problems in southern Sudan. Agro-climatic conditions favour sorghum, which is the main crop, besides some maize growing. Drought-resistant cassava and wild yams are widely used to compensate for grain shortfalls following a poor harvest. Drought often affects local crop yields. Improving access to water will also be critical as it will reduce the pressures on scarce labour, freeing up time from collecting water for more productive activities.

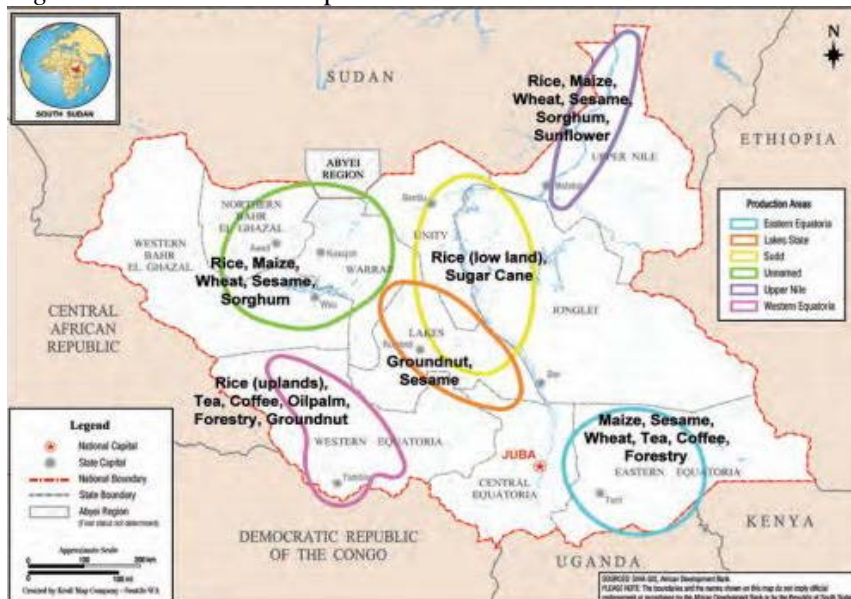
Nile and Sobat Rivers Zone:

The Nile, Sobat and Pibor rivers and the vast oilfields are the most significant natural resources in this zone, providing one of the highest levels of water and pasture availability in southern Sudan. Open water sources are often shared with livestock, and water is also collected from local pools during the rains. Dry season pastures are predominantly found along the rivers and swamps and are often shared by different community groups. This overlapping need for grazing areas has traditionally been the source of regular conflicts. The zone receives between 700-1,300 mm of rainfall annually. The area is prone to seasonal annual flooding (July-December) from the Nile and Sobat rivers, which increases yields of fish and wild plants. This zone is distinct from the Eastern and Western Flood Plains zones in that local livelihoods are far more dependent on the rivers, which harbour the most productive fishing and water lily harvesting areas in southern Sudan. In addition crops and livestock contribute significantly in the Nile and Sobat Rivers Zone. Tobacco sales also provide an important contribution to household incomes. Other economic opportunities include flood recession agriculture (i.e. following annual flooding) and the potential for horticulture for domestic and export agricultural markets. Where recession agriculture is not possible, irrigation may be a viable alternative. This livelihood zone is predominantly inhabited by the Dinka, Nuer and Shilluk ethnic groups. Current challenges include: limited access to major markets; underutilisation of Nile River Basin transport; and untapped water-dependent production potential. Concurrent improvements would have to be made to road and market infrastructure, and environmental protection would need to be made a priority. Source: Muchomba & Sharp (no date)

An important unresolved practical issue is the pace at which land can be developed. The answer depends on the extent to which the Government, with assistance from the donor community and private investors, addresses the existing constraints to agricultural expansion in South Sudan. The aim is to increase the total cultivated area from 2.7 million ha in 2010 to 4 million ha by 2020 and perhaps 6-7 million hectares by 2030 (AfDB 2013). Moreover, the strategy is not yet clear if this expansion should be based on small-scale and/or large-scale farms involvement. Southern Sudan did have large-scale farms (rice, sugarcane) in the past but these were destroyed during the war (UNEP 2007). Several scenarios are possible, yet a mix of both scales of operation is most likely: first, a larger share

of the existing 2.7m ha of land that is cultivated periodically by smallholder farmers would be brought under continuous cultivation with improved access to markets, lower transport costs and access to inputs such as fertilizer and herbicides, use of out-grower models, and so on (see e.g. IRIN 17/02/2011). Second, a substantial investment would also be made in cultivation of new land by medium- and large-scale commercial farming operations, many of which would operate with out-grower models that would allow nearby existing or new smallholder farms to supply fresh foods and agricultural raw materials for processing by the commercial operation. Opponents of the latter strategy fear that opportunistic investors will ‘grab land’ at the expense of the local communities. The Norwegian People’s Aid organization, the largest international NGO active in South Sudan, raised a warning that several opportunistic deals were planned and underway. In just four years, between the start of 2007 and the end of 2010, foreign (mostly western and middle east) interests sought or acquired a total of 2.64 million hectares of land (26,400 km²) in the agriculture, forestry and biofuel sectors alone (Deng 2011a). It drafted a number of recommendations to address the risks and opportunities of large scale land investments; linking with local communities, transparency in contracts, a temporary moratorium etc. Other organizations such as the Oakland Institute, have characterized the land deals in South Sudan as unfair to local communities and urged the government to support smallholder farming as the best way forward (see e.g. Deng 2011b). [UNEP \(2007\)](#) does not oppose large-scale farming but warns for potential environmental problems (pesticides, water pollution, canal siltation, soil salinization) and yield reduction especially if irrigation schemes are started in the wrong location.

Figure 20 Locations for potential commercial investment in South Sudan

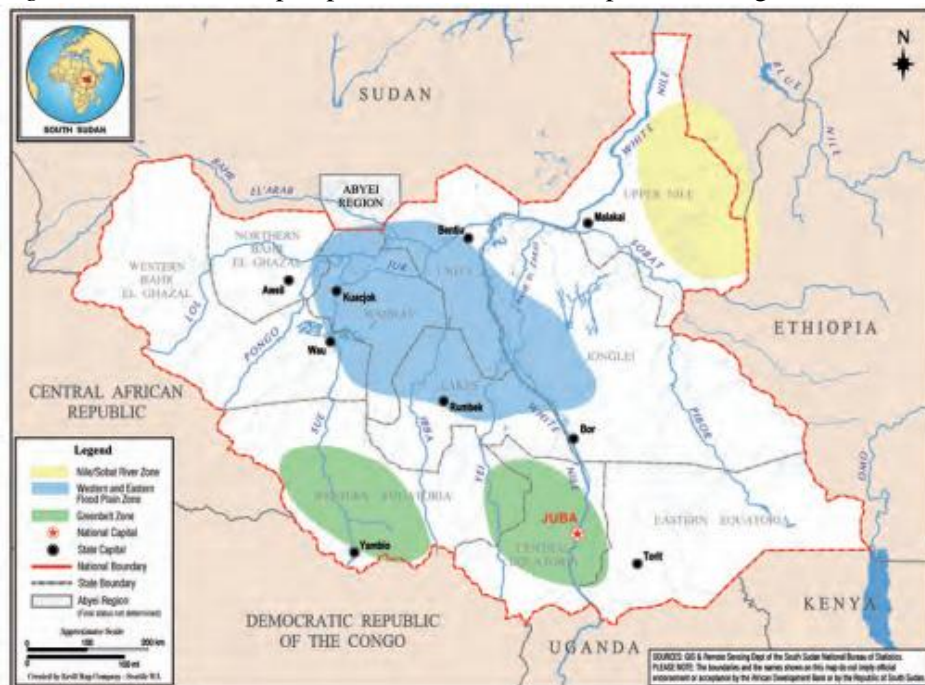


Source: AfDB 2013

Expanding cultivated areas will come at considerable financial costs. The mobilization of these levels of investment for agriculture represents another major challenge for the decade ahead. Several large-scale investors seem not to have moved to a production stage.

Another sensitive issue will be that promoting irrigated agriculture might affect the downstream Nile basin countries of Sudan and Egypt. The 2007 South Sudan water policy claims that given adequate water supply, most tropical crops can be grown and realize its label of potential 'bread basket' for the region as the country did 25 years ago. A range of irrigation techniques (traditional and modern) can be observed in different parts of Southern Sudan. Areas have been earmarked for the expansion of irrigated agriculture, whether small or large scale.

Figure 21 Location of prospective areas for development of irrigation schemes



Source: AfDB 2013

Part of the planned irrigated scheme area is in the Jonglei State. In the later 1970s this area saw the start of the construction of the 360 km long Jonglei canal linking Bor with Malakal (Mohamed 2005; UNEP 2007; Howell *et al.* 2009; Lamberts 2009). The idea, already launched in 1907, was to bypass the Sudd wetlands of South Sudan so as to deliver some 5 to 7% more water (appr 4.8 Gm3/year) downstream to (North) Sudan and Egypt for use in agriculture. The reasoning was that too much water was lost in the Sudd due to evapotranspiration. Warnings that major environmental and economic negative impacts were to be expected on the livelihoods of local communities in the South, in particular

the pastoralist groups such as the Nuer, Dinka and Shilluk, were ignored by the authorities in Khartoum. The canal was never completed because when 240 km out of a total of 360 km of the canal had been excavated, the infrastructure was bombed by the SPLA in 1984. Its construction was never resumed (Salman 2008; Cascão 2013).

Figure 22 The Jonglei canal



Source: www.chappart.co.uk/pdfs/Sudan.pdf

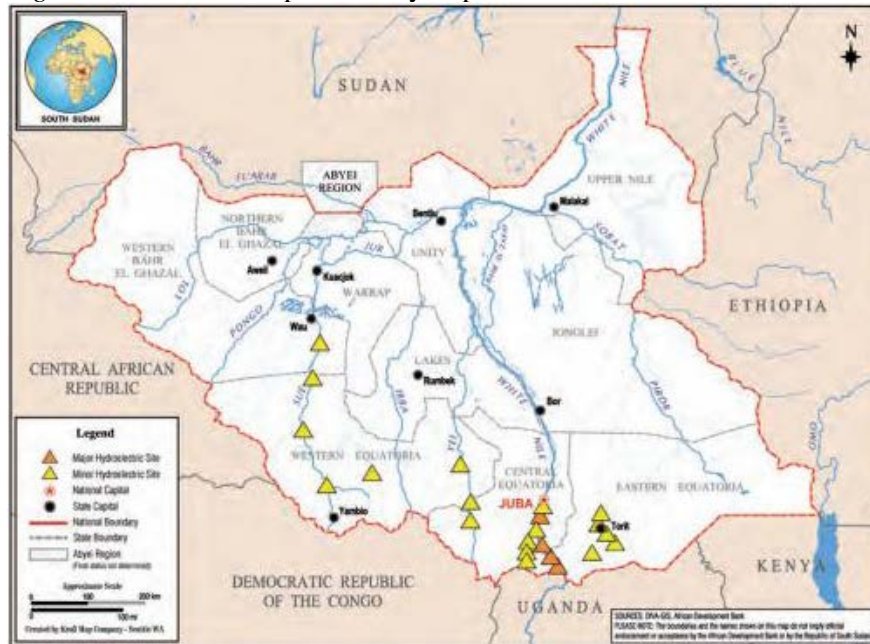
Energy dynamics

Energy consumption in South Sudan is over 80% by way of biomass (firewood, charcoal, grass), especially in the rural areas. But rapid urbanization is also having profound effects on forests. Many urban poor rely on firewood collection and charcoal burning and this is a driving factor of deforestation around Juba (USAID 2007). About 14% of the population is using petroleum products and close to 4% of the population is using electricity. The supply is limited to a few towns. The installed generation capacity is around 24 MW or about 3 MW per million people. This is a tenth of what has been installed in the Eastern African region (AfDB 2013). Moreover, frequent breakdowns are undermining the power network. For example, Juba is sustained by eight massive generators owned by South Sudan Electricity Corporation, with a capacity of up to 11 MW, about half of the 2012 demand for power. But in February 2014 seven generators were down due to lack of spare parts (Jacomella 2014).

To promote rural electrification and industrialization the Water Policy of 2007 suggested the rehabilitation of a small-scale hydro power station in Eastern Equatoria State and the development of new hydropower stations focussing on small-scale rapids such as Aga Falls (GoSS 2007). The 2011-13 Development Plan stressed the need for reliable power supply and proposed besides minor hydroelectricity sites a number of major ones notably south of Juba along the White Nile (see figure 1). The following five mega hydropower sites with a cumulative capacity of 2,590 MW have been identified: Bedden (720 MW), Fula (1,080

MW), Lekki (420 MW), Shukoli (250 MW) and Juba barrage (120 MW) (SSDP 2011-13). Small hydropower plants have also been identified. None of the hydropower sites has been developed as yet. Fula Small Hydropower Plant (40-60 MW) is intended to supply Juba by 2016 (AfDB 2013; Jacomella 2014).

Figure 23 Location of potential hydropower sites



Source: AfDB 2013

Diesel units will be put up outside Juba and Malakal while the electricity grids of cities will be linked with the Ethiopia-South Sudan and Uganda-South Sudan Interconnectors commissioned by the end of 2019 and 2020, respectively. Beyond 2025 the formation of a national grid will be managed by the proposed Transmission and Distribution Master Plan. Other policies that have been drafted to guide the energy sector are the South Sudan National Electricity Policy Paper and National Petroleum Policy. UNDP (2012) commented that wind and solar energy did not seem to have a prominent place, but in August 2014 the Government announced the Energy Sector Technical Assistance Project that aims to boost off-grid solutions including the distribution of solar devices.

Climate change

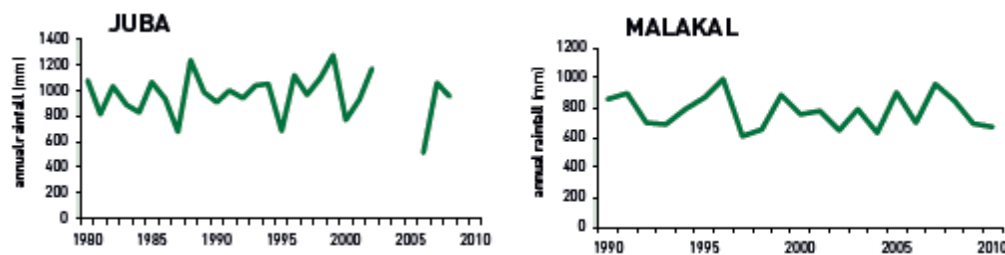
The National Adaptation Plan of Action, which was prepared for the entire Sudan before South Sudan became independent, predicts rising temperatures and a decrease in rainfall having significant consequences for agriculture, water and

health (UNDP 2012). The Sudan Post-Conflict Environmental Assessment by UNEP (2007) also identified climate change as one of the most important threats to development. However, the report foremost refers to northern parts of Sudan. A Ministry of Environment/UNDP report (2012) focussing on South Sudan states that rainfall data for South Sudan are scarcely available and no specific climate change scenario models have been found, but generally expectations are based on regional trends. According to various ministries climate change in South Sudan is manifested through:

- (1) Duration and timing of rain becoming erratic, rainy season delayed and shorter;
- (2) Some areas receiving generally less rain, water tables dropping;
- (3) The desert expanding southward.

The FAO SISFIA project managed to collect data from 1980 onwards but does not show a clear change in annual rainfall (Figure 24).

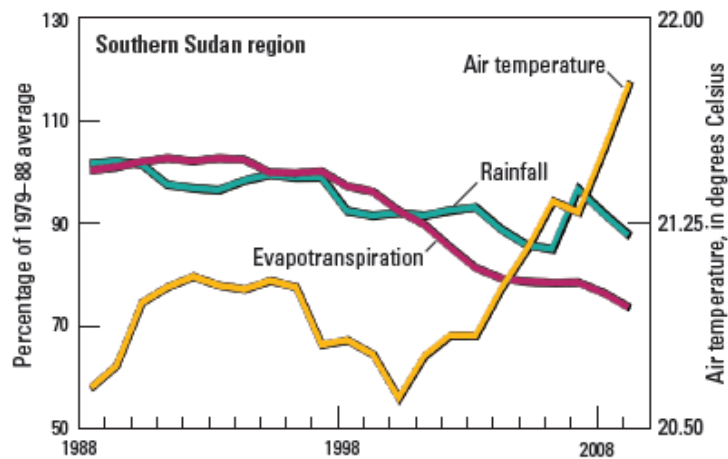
Figure 24 Annual rainfall in Juba and Malakal



Source: UNDP 2012

By contrast Famine Early Warning researchers of USAID, studying both South and North Sudan, claim that rainfall is down by 10-20 percent and temperatures up by more than 1 degree Celsius since the mid-1970s (Funk *et al.* 2011). The observed warming is equivalent to another 10-20 percent reduction in rainfall for crops. The warming and drying have impacted areas around Juba which threaten southern Sudan's future food production prospects.

Figure 25 Smoothed time series of June through September rainfall, actual evapotranspiration, and average air temperature for the southern Sudan region



Source: Funk *et al.* (2011)

Figure 26 Climate change in Sudan

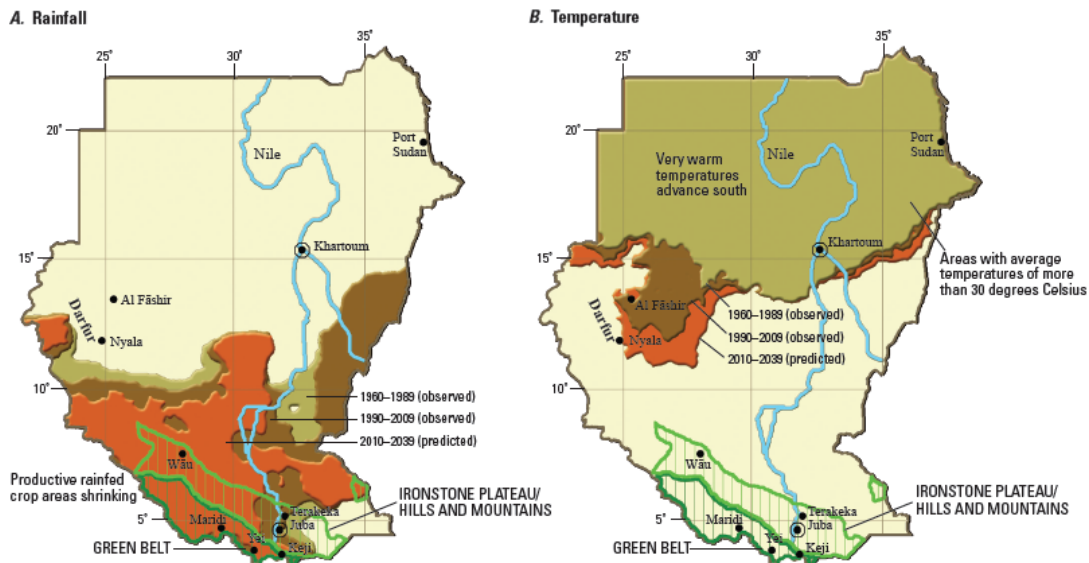


Figure 26. Climate change in Sudan. A) Average location of the 500-millimeter rainfall isohyets for the years 1960-1989 (light brown), 1990-2009 (dark brown), and 2010-2039 (predicted, orange). The green polygons in the foreground show the main crop surplus region (the Green Belt livelihood zone) and the agro-pastoral Ironstone Plateau and Hills and Mountains livelihood zones. B) Similar changes for the 30 Celsius isotherm. Areas north of this line are very hot; this intense heat makes plant growth and pastoral livelihoods difficult.

Source: Funk *et al.* 2011.

In the 2011-2013 Development Plan climate change hardly features. Also in the State specific priority setting attention is foremost directed towards the need for security and basic infrastructure, education, health and food security. Only Eastern Equatorial State mentions that food security is hampered due to droughts and floods, besides diseases and a lack of inputs, skills, irrigation and markets.

Pressing Needs

** Measures to deal with population movements*

South Sudan is among the least populated countries in Africa. However, the huge influx of returnees as well as the large numbers of IDPs due to conflicts within the country puts severe pressures on water resources in certain areas, notably in the fast growing urban centres. Likewise during periods of drought, which might increase in the years ahead due to rising temperatures and dropping rain quantities, especially pastoralists face problems over access to water for their herds, leading to additional local resource conflicts. These conflicts could sometimes be prevented through provision of water sources. Yet care has to be taken as new water sources may also trigger battles over newly opened grazing areas. Decent studies and thorough consultations by all potentially involved groups should be done ahead of providing new water schemes in these settings.

As long as Nile waters stream into South Sudan at current rates the country is not water stressed or water scarce. However, without the Nile waters South Sudan would be water stressed from 2015 onwards (see tables 3 and 4).

Table 3 Sudan (Medium variant) 2015-2025

Year	Population (’000)	Population density (pop/km2)	Period	Population growth rate%
2015	12 152	19	2005-2010	4.25
2020	13 853	20	2010-2015	4.02
2025	15571	24	2015-2020	2.62
			2020-2025	2.34

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

Table 4 Availability of water in South Sudan 2012-2025

South Sudan	2012	2015	2025
Total renewable water (10 ⁹ m3/yr)	49.5		
Total renewable per capita (m3/cap/yr)	4567	4073	3166

Source: http://www.unep.org/pdf/africa_water_atlas.pdf; FAO Aquastat author’s calculation

** Maintaining water as a government priority (in competition with other needs)*

Several government and donor groups have been soliciting views and ideas among communities and professionals which actions should be given priority to improve the well-being of the people of South Sudan. A World Food Programme survey among local communities gave seven top priorities: health services/assistance (31 percent), food assistance (24 percent), water provision (10 percent), education services (8 percent), security and peace (8 percent), agricultural inputs (6 percent) and road construction (5 percent).

By contrast, a 2013 World Bank survey among individuals working in government and non-government circles in South Sudan enquired about the most pressing needs the country was facing. Some bias existed towards the background of the respondents (mostly in education) and location (Equatorial states), but the outcome revealed that for specific themes such as poverty reduction, economic growth, general development as well as the sector the World Bank should work in, education was among the top three in each case. Other priorities mentioned were foremost agriculture, security, transport and health (World Bank 2013b). Water and sanitation scored from place 13 up to 20. However, professionals with a background in water were mostly lacking. It seems that the abundance of (Nile) water and reasonable precipitation is sufficient (for the moment and in most places). However, the government has earmarked the water and sanitation sector as one of its six priority areas in the 2011-2013 development plan. In the next 5 to 10 years an annual doubling of new rural water supply schemes (from 300 to 600) through hand-dug wells (5%), boreholes with hand pumps (75%), water yards (10%) and surface sources (e.g, ponds) (10%) is aimed for (AfDB 2013). In addition, rehabilitation of existing schemes and reducing non-functionality of schemes is a priority.

** Smart operation and maintenance*

There is an urgent need to build local capacity. Selection of smart technologies will be crucial. It is estimated that about 11,000 new rural water supply schemes will be constructed to attain access levels of 65% by 2020 (AfDB 2013). A major challenge will be to come up with sustainable formats of both operation and maintenance. The AfDB doubts whether this can be done by local communities though, and it calls for the private sector to step in.

In the urban setting, a mix of surface and ground water will be used to supply the state capitals. In another group of at least 50 small towns the use of water yards is suggested. This should improve water access from 15 to 70% by 2020. Lack of investment funds (needed: US\$ 2 bn), and internal or external conflicts will undermine development of the water and sanitation situation in the country.

** Knowledge and data gathering on climate change and wetlands management*
 Given i) the growing demand by upstream countries as well as by South Sudan itself for expansion of water use in agriculture (irrigation), ii) the Jonglei canal question and iii) other uncertainties linked to the Nile Basin Treaty, knowledge gathering of the impacts of these water demanding developments is crucial. For a better understanding of climate change in South Sudan it is also essential to improve data gathering.

** Other pressing needs South Sudan:*

- Water for arid zones to overcome conflicts over water resources
- Need for proper understanding of the issues at stake as water development could open up new grazing areas and cause more problems over the long run
- Water/sanitation especially for fast growing urban centres and for IDPs (smart technologies)

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