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OVERVIEW

1.1 Introduction

Africa's 29.65 million km² of land area is home to over 1.3 billion people (Worldometers 2019), with this population expected to reach 1.7 billion by 2030 – a huge increase from 480 million in 1980 (United Nations Children's Fund [UNICEF] 2017). Almost 60 per cent of the continent's population lives in rural areas (UNICEF 2017), where sanitation services and access to safe drinking water lag behind those offered in urban areas.

Africa's access to safe drinking water and sanitation provision face water availability challenges. The continent is the second driest in the world after Australia, with only 9 per cent of global renewable water resources (United Nations

Environment Programme [UNEP] 2010). The sanitation and safe drinking water issue is most dire in sub-Saharan Africa, which is wetter than North Africa but suffers from a lack of infrastructure, weak governance systems and low levels of investment in the water sector.

Nearly 750 million people, representing 69 per cent of Africa's population, did not have access to basic sanitation services as at 2017. The majority of the 750 million people lived in sub-Saharan Africa, and had no sanitation facility that was not shared with other households, meaning an improved sanitation facility that is not shared with other households (World Health Organization [WHO]

and UNICEF 2017). This is a challenging baseline for achieving some of the Sustainable Development Goals (SDGs) in Africa, where only a few of its 54 countries met the Millennium Development Goals (MDGs) target for sanitation. Nonetheless, SDG 6 offers renewed hope for not only improved sanitation across Africa, but also improved wastewater management that will promote human health and dignity, minimize the pollution of water resources, and protect the natural environment.

Africa is made up of 54 countries, which the African Union divides into five subregions: North, West, Central, East and South Africa, as shown in Figure 1.2.

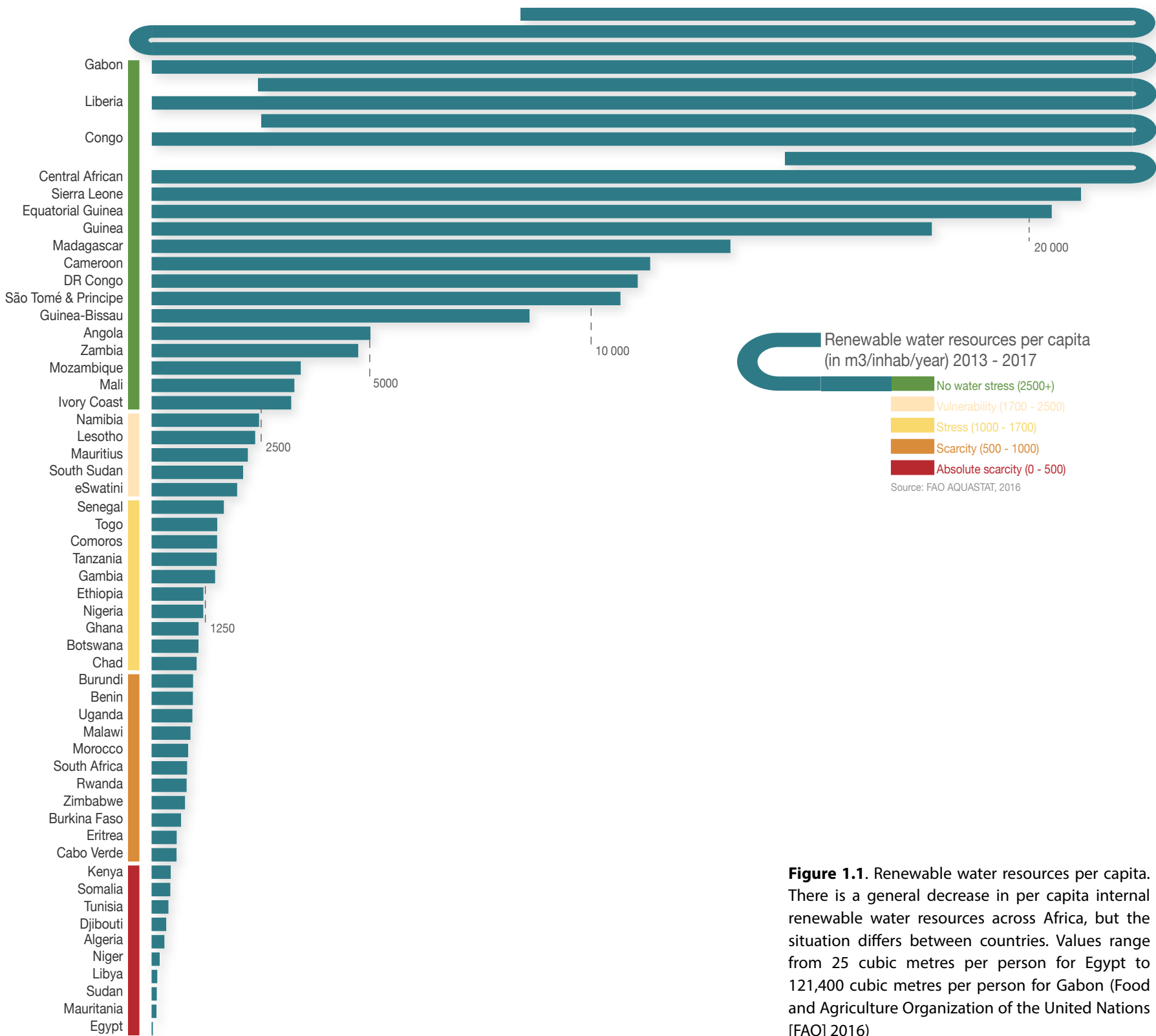


Figure 1.1. Renewable water resources per capita. There is a general decrease in per capita internal renewable water resources across Africa, but the situation differs between countries. Values range from 25 cubic metres per person for Egypt to 121,400 cubic metres per person for Gabon (Food and Agriculture Organization of the United Nations [FAO] 2016)

1.1.1 Africa's population dynamics

According to the Demographic Profile of African Countries (United Nations Economic Commission for Africa [UNECA] 2016), Africa's population has grown at an average annual rate of 2.6 per cent in the last 30 years, compared with the global average rate of 1.5 per cent. The same report further indicates that between 1980 and 2015, Africa's population increased by a total of 708 million, with Nigeria contributing on average an additional 3.1 million people per year to the continent's population. Projections are that Africa's population growth rate will even out at 1.5 per cent in the years up to 2025. Figure 1.2 further shows the 10 biggest contributors to population increase on the African continent, while Figure 1.3 shows population growth trends for the continent.



Africa's population grew at an annual average of 2.6 in the last three decades

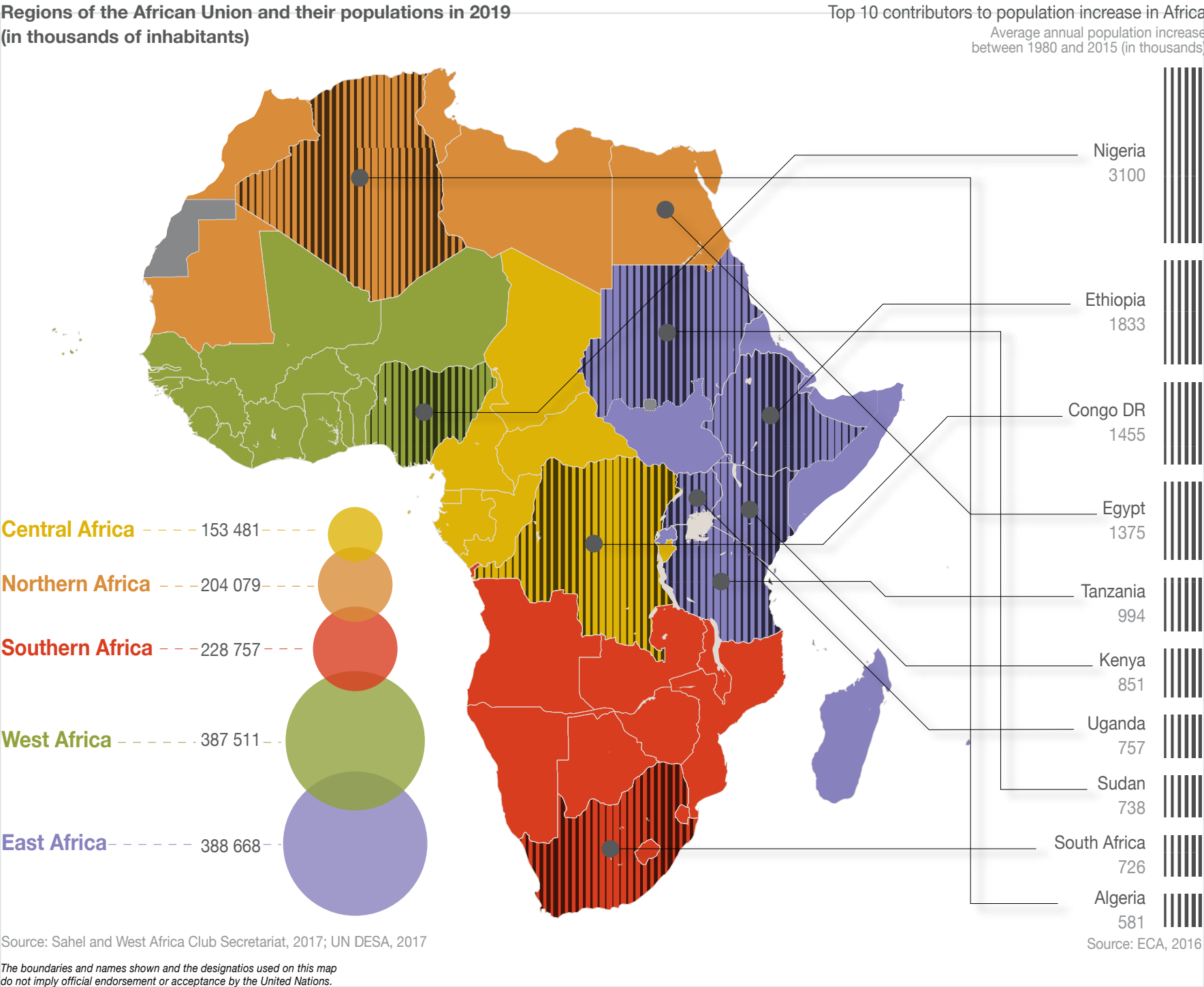


Figure 1.2. Regions of the African Union



Young people are the majority of Africa's population

As Figure 1.4 shows, Africa's population is predominantly youthful (UNECA 2016), with those between the ages of 15 and 24 making up 19.4 per cent of the continent's population (UNECA 2017). If youth are to be involved in sanitation and hygiene activities such as investment and awareness-raising, positive outcomes can be expected. However, if no new investment is made in water, sanitation services and hygiene, the current lack of access will become only more dire for youths, resulting in increased school dropouts and illnesses, among other consequences.

Africa is moderately densely populated, with 43 inhabitants per square kilometre (Worldometers 2019). As Figure 1.5 shows, population density varies across the continent. The island states of Mauritius,

Age and gender structure of African population

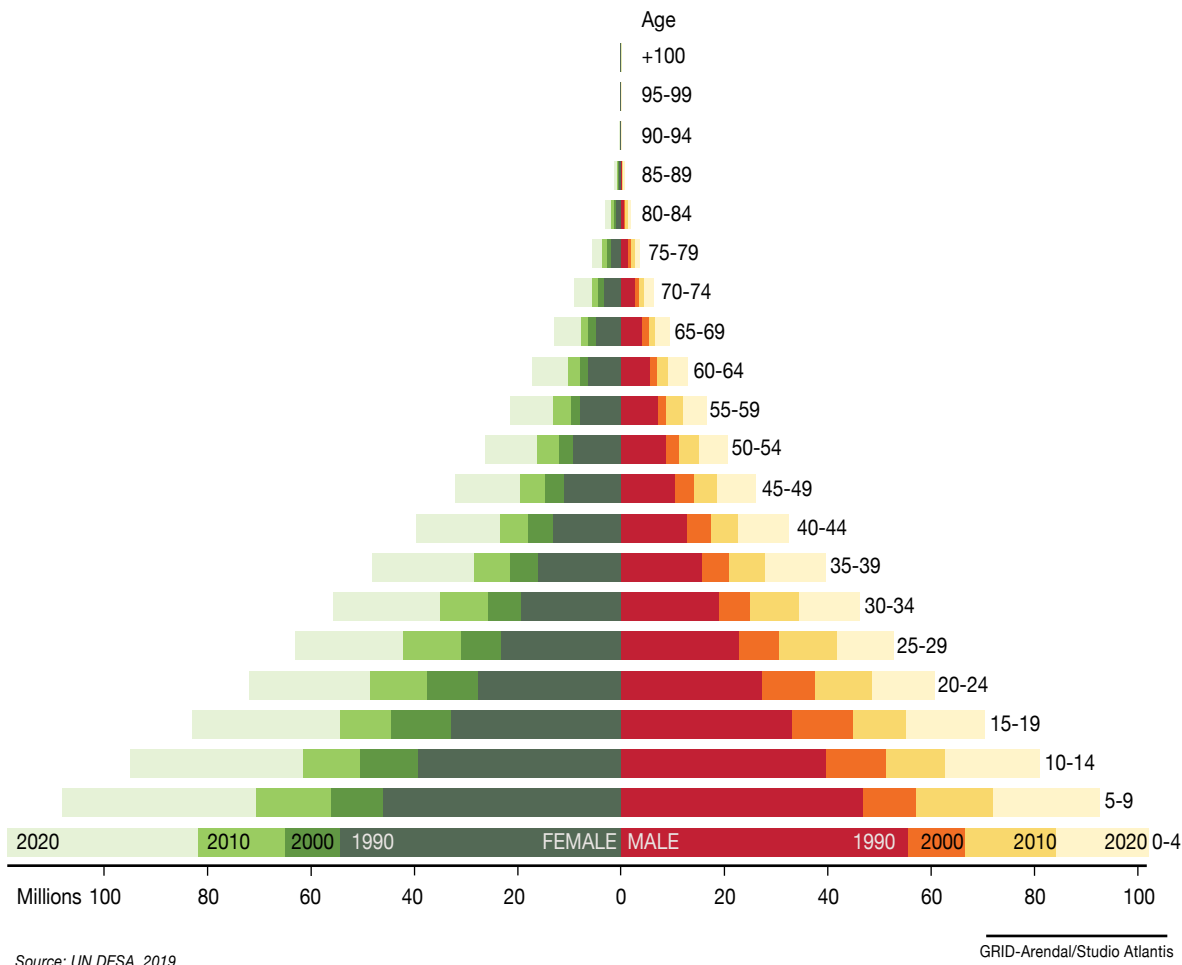


Figure 1.4. Age structure for Africa's population in 2018

Population growth in Africa

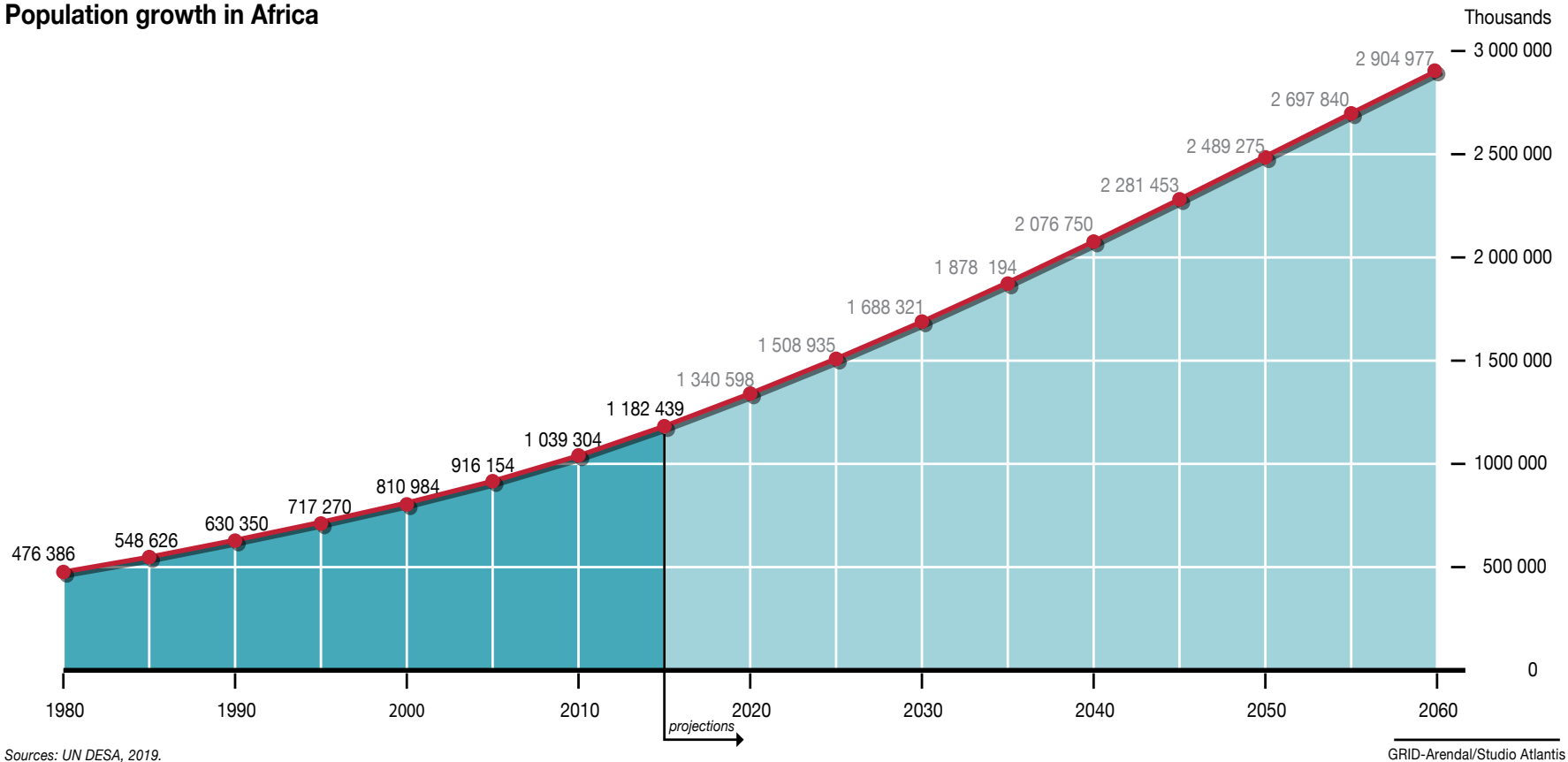


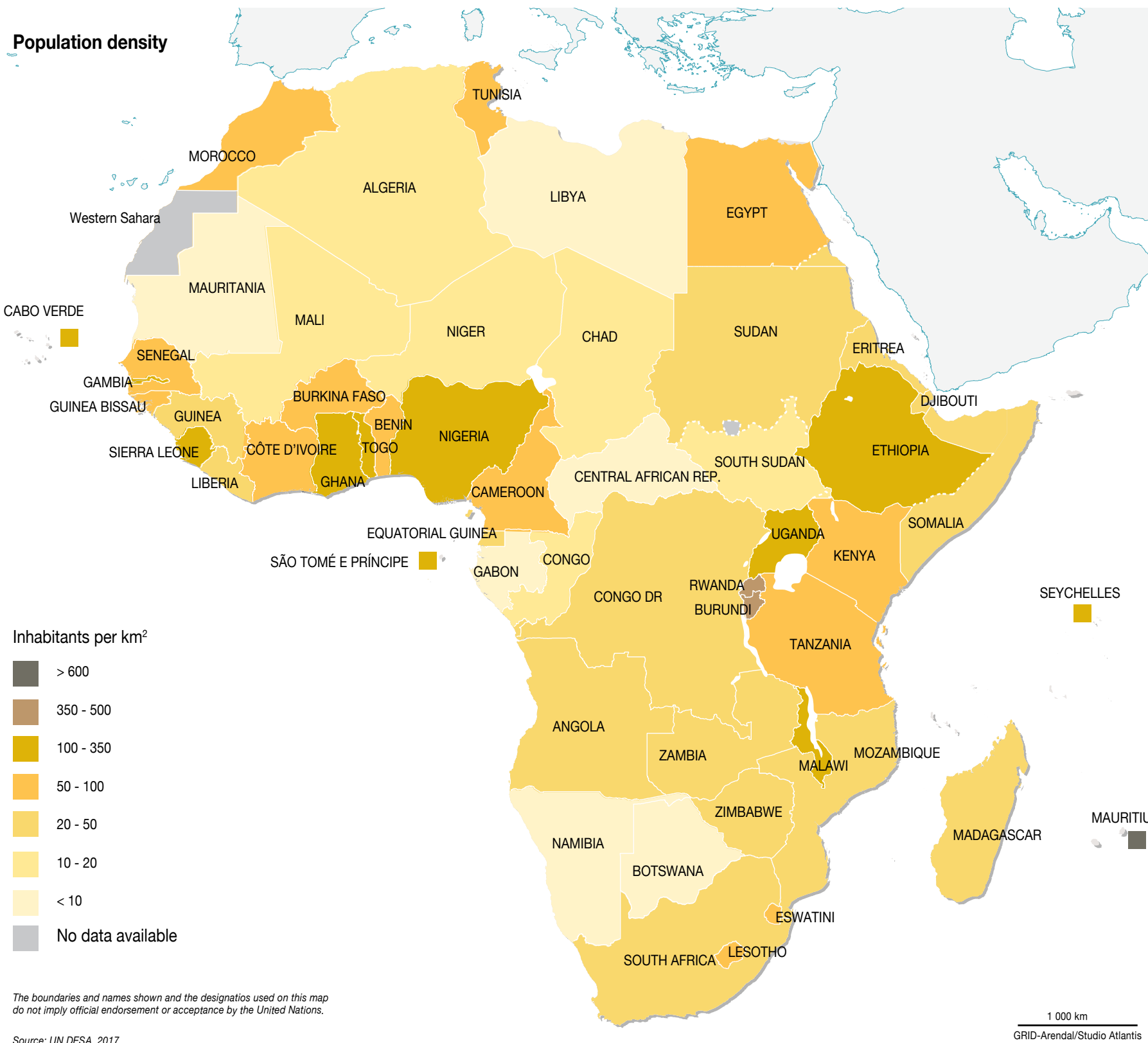
Figure 1.3. Population growth trends and projections in Africa for the period 1980–2065

the Comoros, Seychelles, and the Democratic Republic of Sao Tome and Principe are among the most densely populated countries in Africa. On the mainland, Rwanda, Burundi, Nigeria, The Gambia, Uganda and Malawi have the highest population densities (PopulationPyramid.net 2019).

In 2016, Africa’s urban population was estimated at 40 per cent, having increased from 27 per cent nearly four decades prior (in 1980). The United Nations Economic Commission for Africa (UNECA) reports that the most urbanized countries on the continent are Algeria, Cabo Verde, Democratic Republic of the Congo, Djibouti, Gabon, Libya, Tunisia and South Africa (UNECA 2016). The proportion of the urban population in Africa’s most urbanized countries is shown in Figure 1.6.



Close to 60 per cent of Africa’s population live in rural areas





Nearly 56 per cent of Africa's population will be living in urban areas by 2050

The average growth rate in the urban population in Africa is estimated at 3.7 per cent and is projected to stabilize at 2.6 per cent during the 2025–2050 period, with nearly 56 per cent of the population expected to be living in urban areas by 2050 (UNECA 2016). Some of the fastest urbanizing countries in Africa are among the most populous, and this has significant implications for Africa's wastewater management in the quest for sustainable development, which will in turn impact the availability of freshwater resources. According to the Global Water Partnership, as cities expand they rely on more expensive, further away water sources whose quality can be compromised by upstream activities such as agriculture. Meanwhile, groundwater sources are often polluted by poor sanitation (Jacobsen et al. 2012).

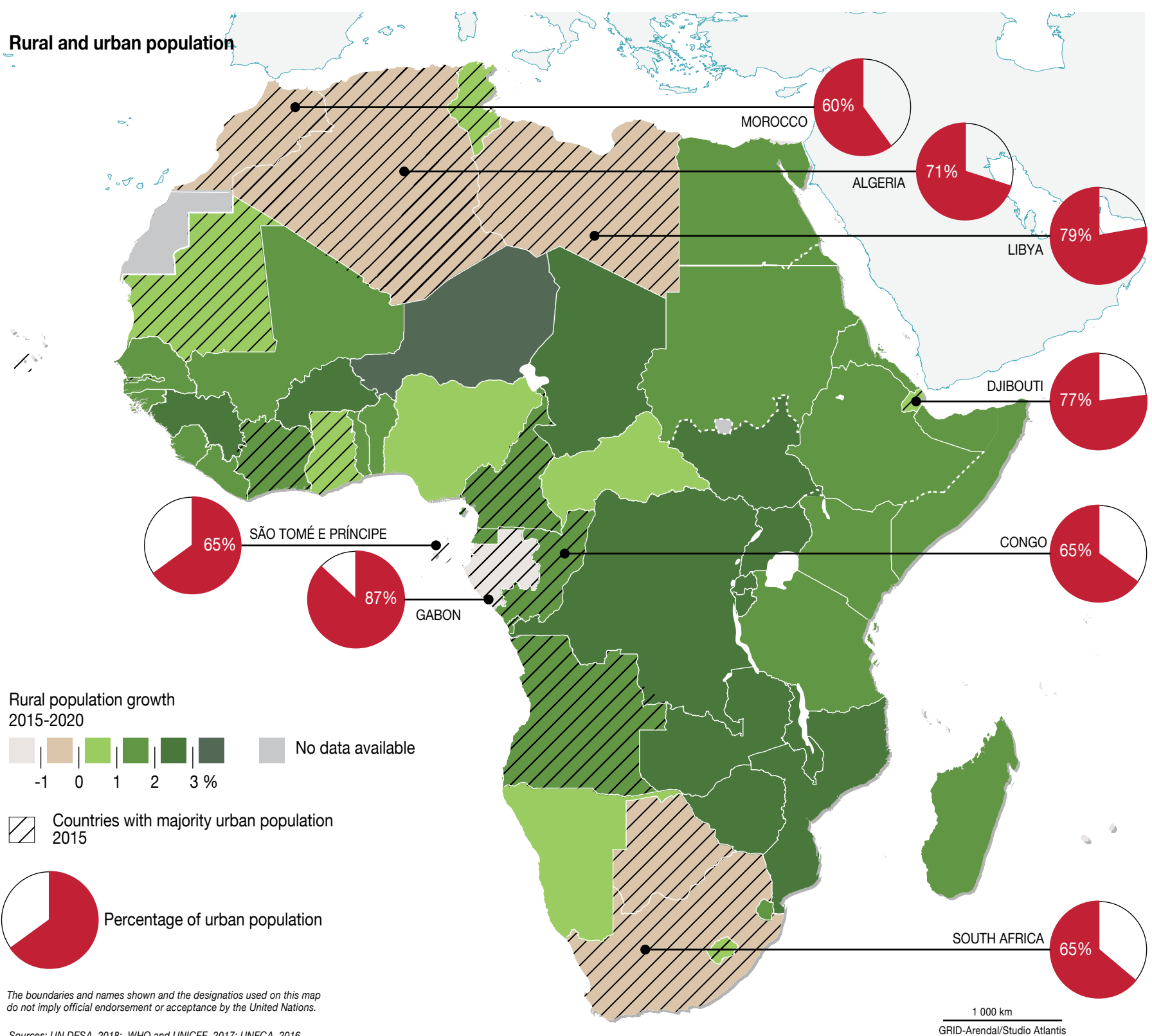


Figure 1.6. 2015 Rural population growth (annual percentage)

Despite high rates of urbanization, Africa still faces high rural population growth rates when compared to the rest of the world (Figure 1.6). Open defecation, lack of handwashing facilities and the poor siting and management of pit latrines – which often results in the contamination of shallow wells that are used for drinking water – are just some of the reasons why rural Africa lags behind urban areas in terms of safely managed sanitation.

1.1.2 Implications of African population trends for sustainable development

Africa's young and rapidly growing population in both the urban and rural contexts calls on the continent to be innovative in its efforts to "reduce poverty, create employment, and provide food, water and energy

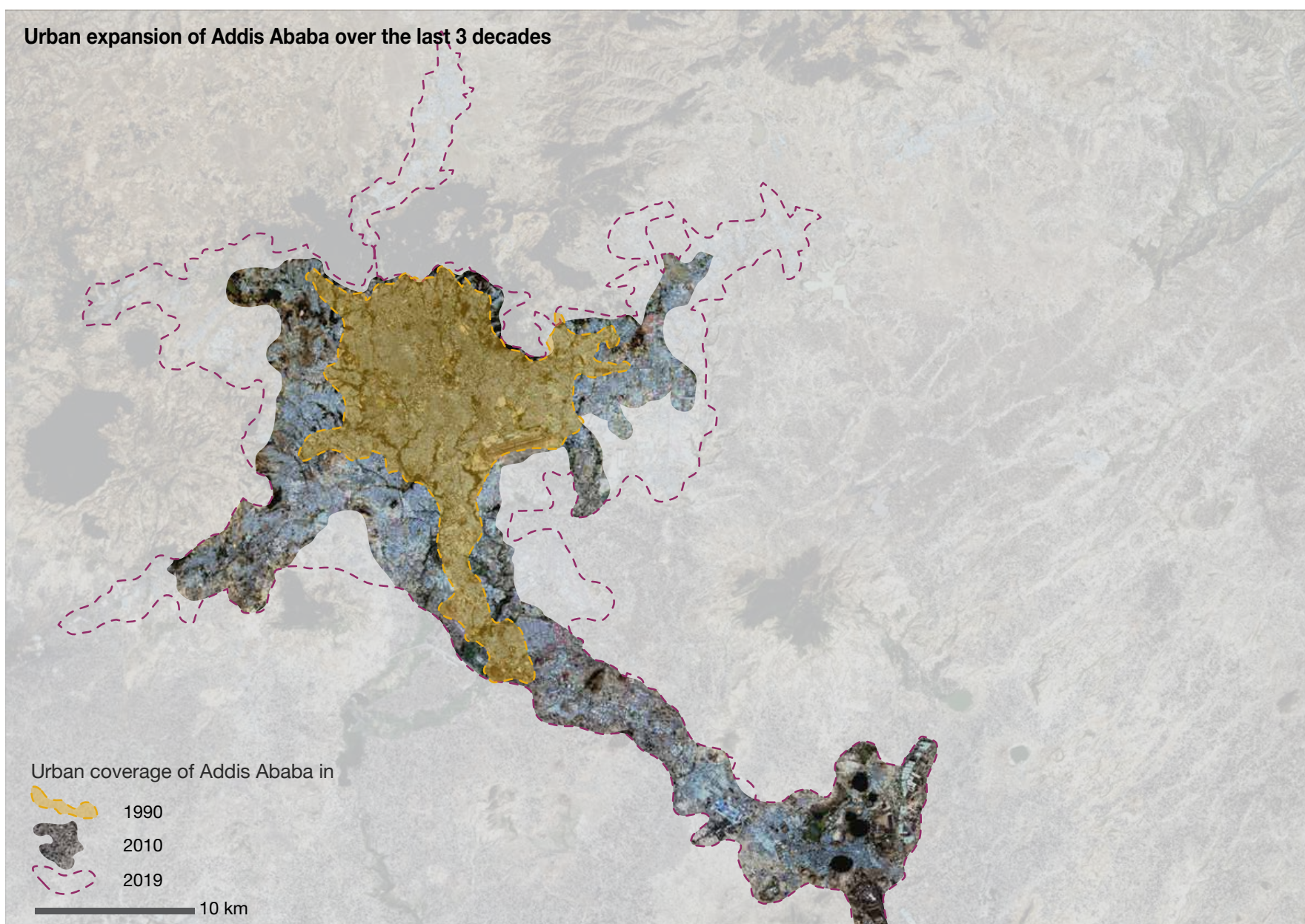
security, while safeguarding the natural environment" (World Economic Forum [WEF] and United Nations Population Fund [UNFPA] 2012). As might be expected, increased population coupled with an increase in consumption patterns is leading to greater pressure on natural resources including water, land and forests (Organisation for Economic Co-operation and Development [OECD] 2012). The challenges of managing water resources and mitigating water allocation conflicts have gained increasing attention among policymakers and researchers, as population growth and changing consumption patterns are intensifying competition for limited freshwater resources (Hurni and Wiesmann eds. 2010). Development policies therefore need to reflect and respond to population dynamics and their relationships with social, economic and environmental factors (OECD 2012).



Many people in Africa lack access to safe drinking water and sanitation



Rural people on average spend a significant amount of time collecting water for household use



Addis Ababa is Ethiopia's capital and largest city. The city's population grew from an estimated 2.11 million in 1994 to 3.3 million in 2010 (UN-Habitat 2017). By 2017, the city's population had approached 4 million, while the area had expanded to 527 sq. km. (World Population Review 2020).

The expansion of Addis Ababa has not been matched with a growth in the infrastructure for sanitation provision and wastewater management. Unregulated urban growth and a proliferation of informal settlements make the assessment of the provision of sanitary conditions for Addis Ababa a difficult task. As a result the available data on the city's state

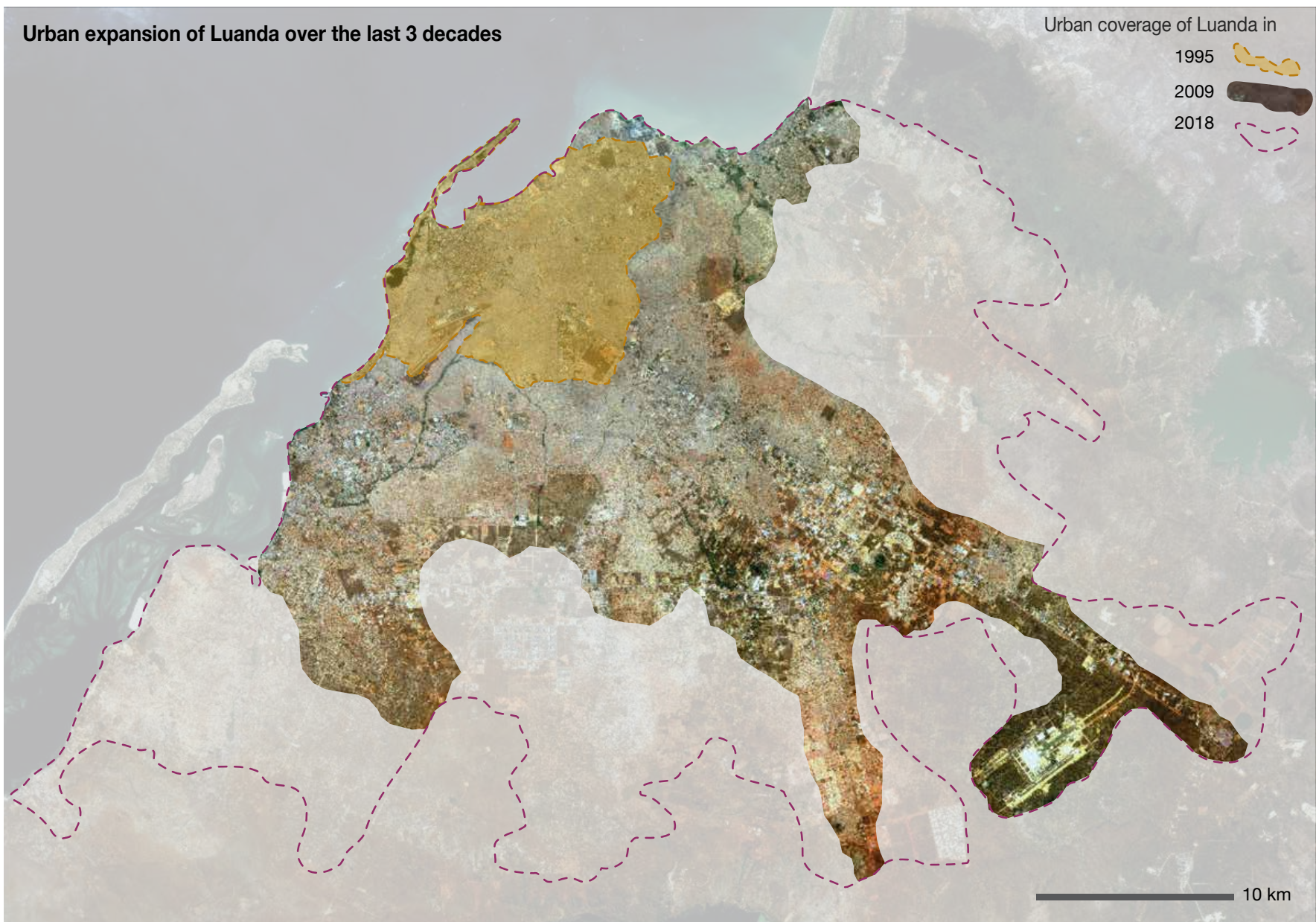
of sanitation tends to be dated, but reflective of the current status. About 10 per cent of the urban area of Addis Ababa is sewered while the greater part of the city is served with pit latrines some of which dispose of their wastewater in the storm water drainage network (AAWSSA 2008).

Until recently, Addis had two sewage treatment plants, one at Kaliti with a designed capacity of 7 600 cu m per day or the capacity to serve a population of 200 000, and the other at Kotebe that only receives sludge from vacuum trucks that empty septic tanks. The Kotebe plant can handle an estimated annual volume of 85 000m³ (NEDECO 2002).

About 75 per cent of households in Addis Ababa make use of pit latrines of which the majority are shared with other households. About 17 per cent depends on water-based flush toilet, while 6 per cent uses the bush (Van Rooijen and G. Taddesse 2008).

However, there are efforts to not only beautify and modernise Addis Ababa, but also to ensure that the city's growth and expansion meet environmental standards for sanitation and cleanliness. The USD 1 billion Sheger project is one such initiative.





Luanda is one of Africa's fastest growing cities, with an annual urbanization rate of 7 per cent. In 2016, the city's population reached 7 million (Cain 2018), and is currently estimated at 8.2 million (World Bank 2020). Half the city's population resides in musseques (informal settlements) (Cain 2018), with limited services, including safe drinking water and sanitation provision. In order to serve the housing needs of the

growing population, Luanda continues to witness rapid expansion in area.

About one third of Luanda's population is not served with adequate sanitation facilities, and the majority of such people reside in informal settlements where open defecation is widely practiced. About 70 per cent of the residents of informal settlements buy

water from vendors, the quality of which is often not good. The situation is compounded by the poor management of solid waste. People's health is greatly affected with outbreaks of cholera being common. For example, in 2006 more than 17,500 residents of Luanda contracted cholera (Médecins Sans Frontières 2006).



1.2 Water, Sanitation and Hygiene in Africa

1.2.1 Water resources

Africa is the world's second driest continent after Australia (United Nations Environment Programme [UNEP] 2010). Freshwater is unevenly distributed across its countries and regions, largely due to the variability of rainfall in different climatic zones (FAO 2003), as shown in Figure 1.7. The continent's renewable water resources average 3,930 cubic kilometres (Figure 1.8), representing less than 9 per cent of the global total (UNEP 2010). The majority of Africa experiences long dry seasons, exceeding five months in some cases (MacDonald and Calow 2009), which result in reliance on groundwater. In addition,

there are over 1,270 dams built across Africa to store and supply water for agriculture and hydropower generation (UNEP 2008). Fifty-three large dams in Africa account for 90 per cent of the total amount of water retained in reservoirs on the continent (UNEP 2008). Much of the dam storage capacity is in South Africa, where there are 589 dams (Tatlock 2006).

Africa has swathes of natural water infrastructure in the form of wetlands, which are important as they contain water resources and provide ecological services to maintain ecosystem integrity. According to UNEP (2008), Africa's wetlands cover approximately 1 per cent of the continent's total

surface area. Anthonj et al. (2017) acknowledge that in parts of sub-Saharan Africa, natural wetlands constitute the only accessible water resources, providing water, agricultural potential and livelihoods in otherwise uninhabitable landscapes, which is why they are being used extensively. The degradation and contamination of water resulting from the use of wetlands has the potential to spread disease-causing micro-organisms and enlarge the breeding habitats for disease vectors.

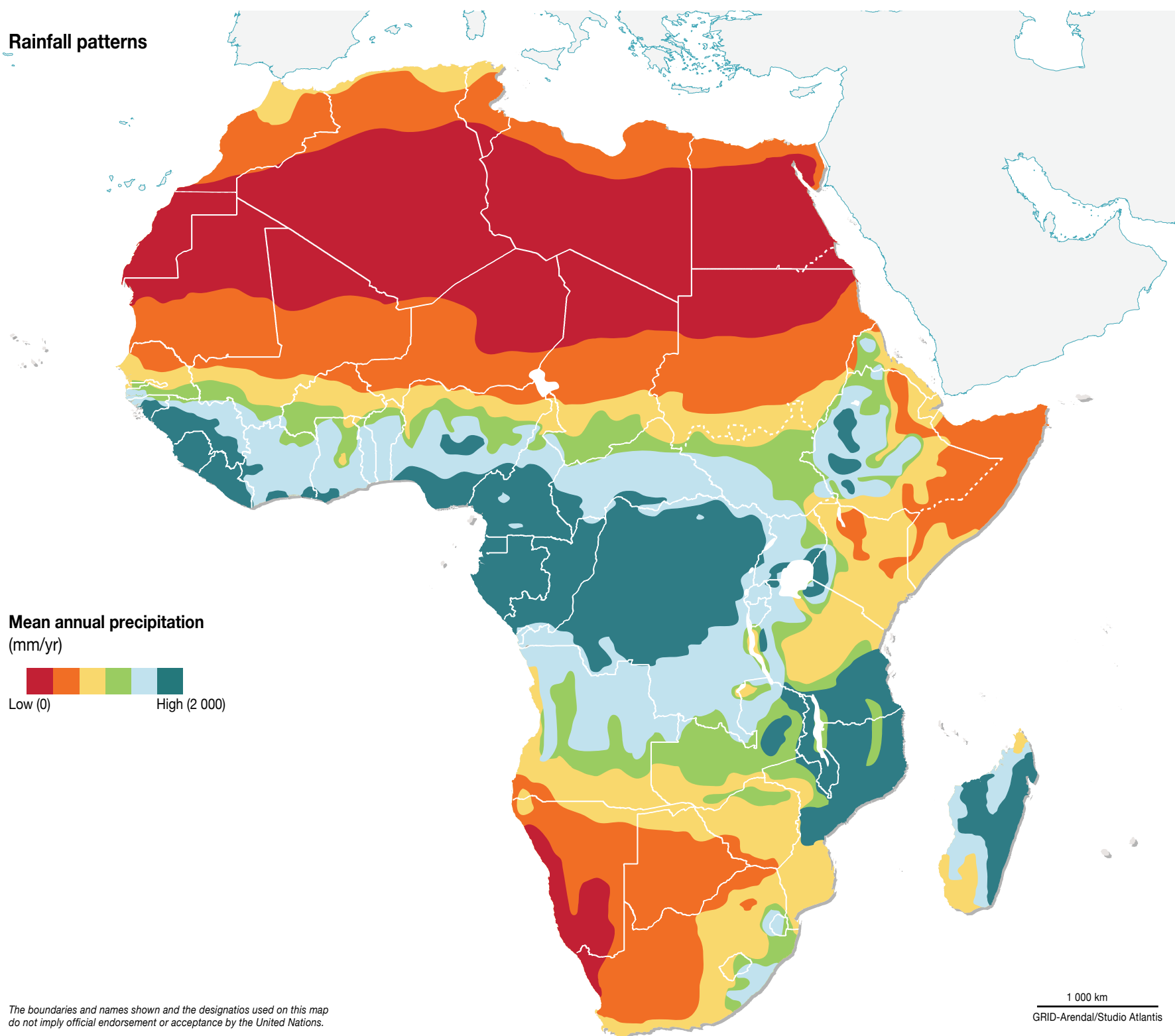


Figure 1.7. Rainfall patterns in Africa



Water can be contaminated in storage containers



Improper disposal of waste degrades the environment, including water bodies

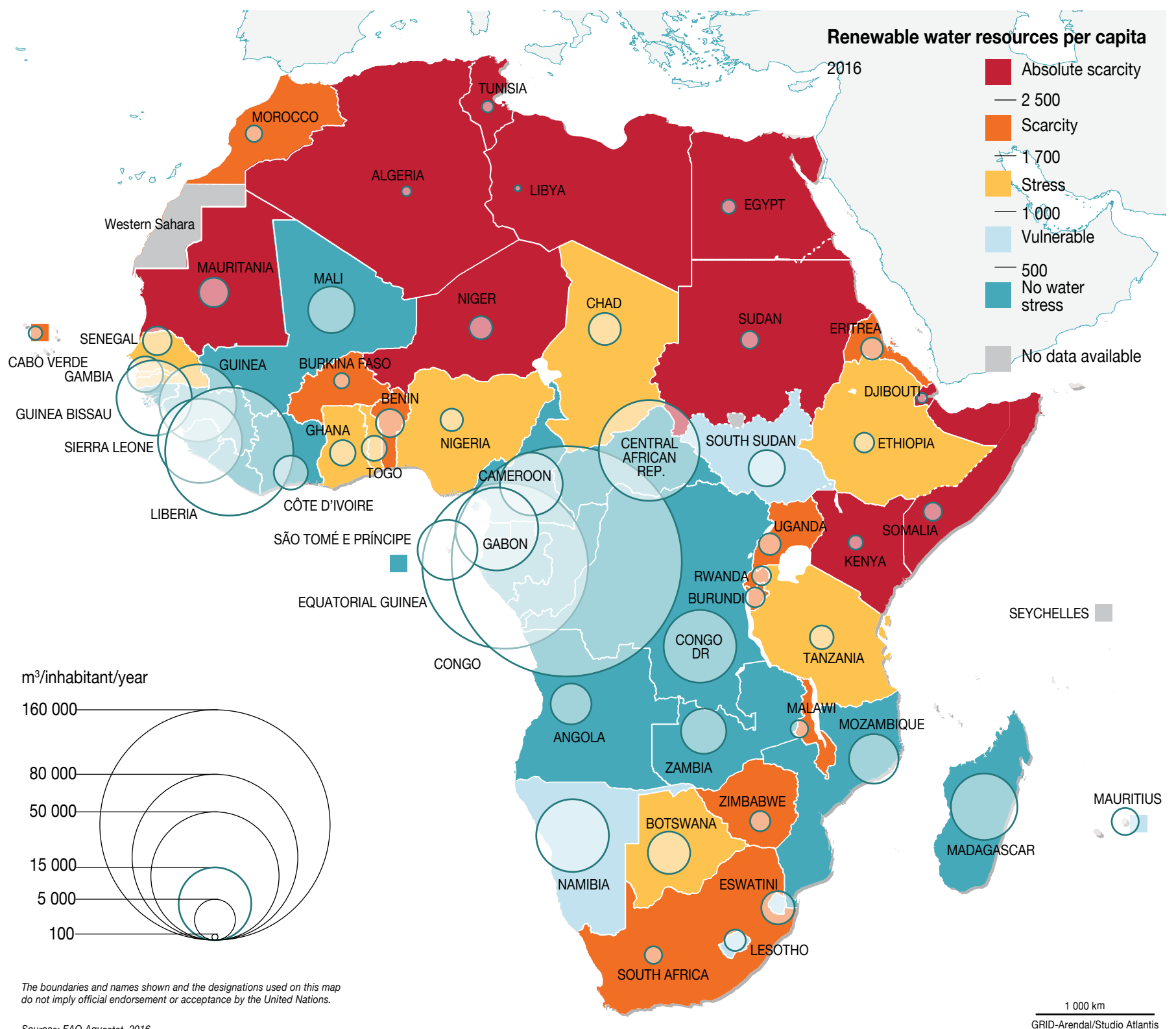


Figure 1.8. Africa's total renewable water resources

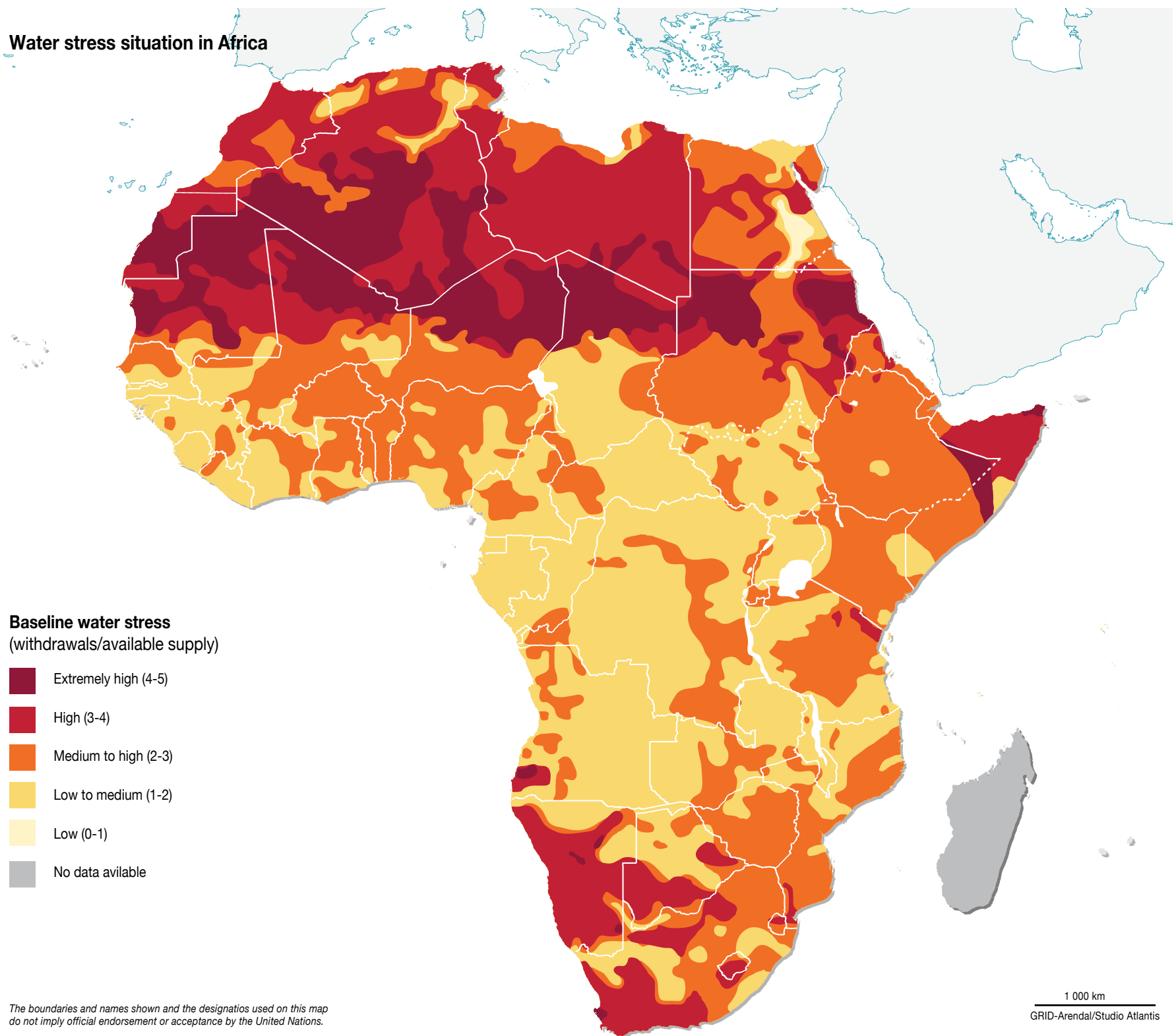


Figure 1.9. A detailed illustration of the water stress situation in Africa



Close to 75 per cent of Africa's population use groundwater sources for drinking

As Figure 1.9 shows, water stress and scarcity issues on the continent are complex and cross national boundaries. For example, the countries that use the most water by volume are Egypt, Sudan, Madagascar, South Africa, Morocco, Nigeria and Mali, but these are not necessarily the most water-rich nations (UNEP n.d). Egypt, for example, is in a climatic zone of low water availability, but is Africa's largest water consumer at 61.7 cubic kilometres per year (UNEP n.d.).

An estimated 75 per cent of the African population relies on groundwater as its major source of drinking water, especially in North and Southern Africa (UNEP 2010). However, groundwater represents only 15 per cent of the continent's total renewable water resources (UN Water 2015). As Figure 1.10 shows, North Africa is much richer in groundwater resources than the rest of the continent.

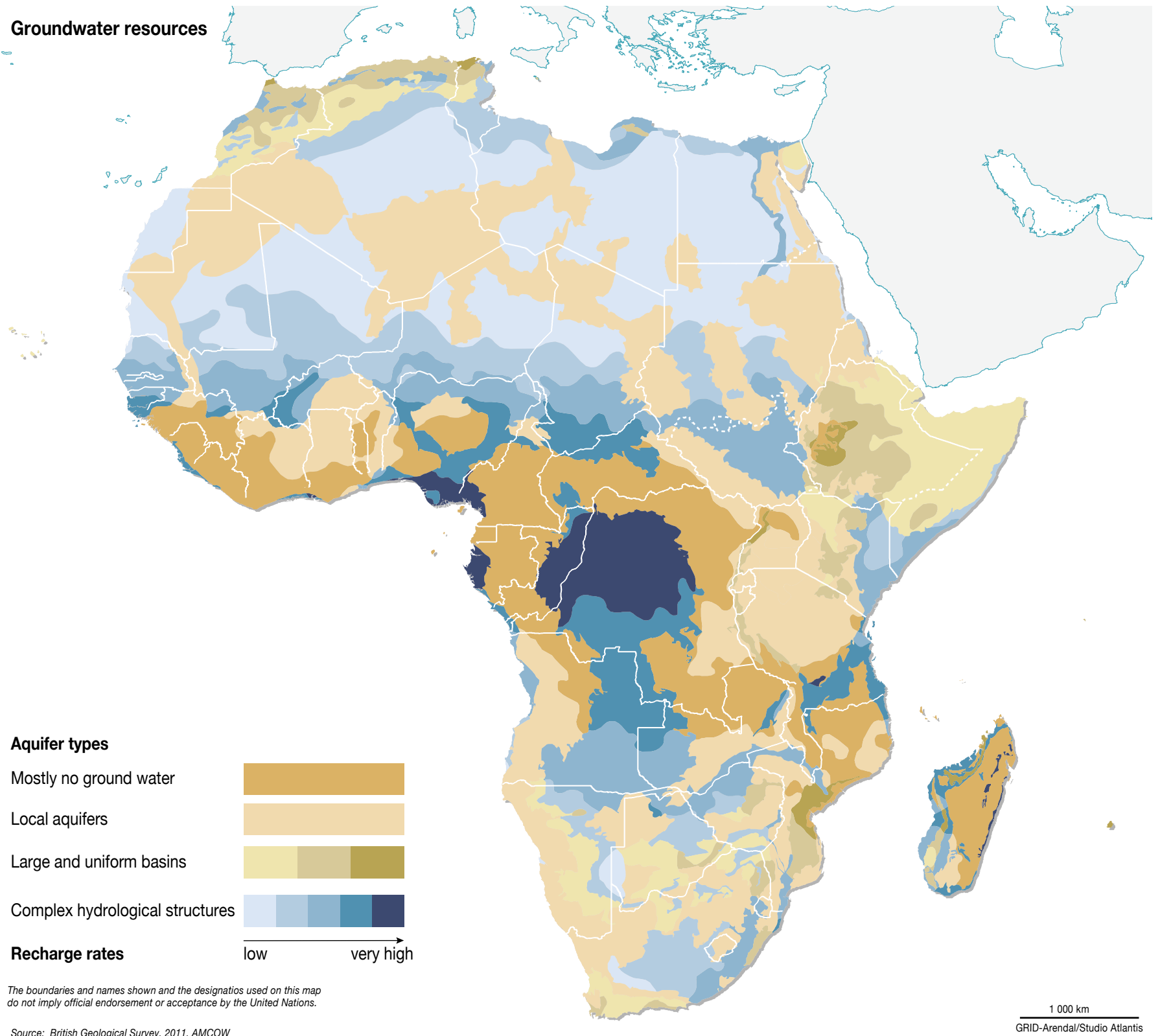


Figure 1.10. Africa's groundwater storage



Droughts are common in many countries in Africa



Wetlands play host to many species, including birds and fish

1.2.2 Sanitation

The World Health Organization (WHO) defines sanitation as “the provision of facilities and services for the safe management of human excreta from the toilet to containment and storage and treatment on-site or conveyance, treatment and eventual safe end use or disposal” (WHO 2018). An improved sanitation facility is one that hygienically separates human excreta from human contact. In addition, improved sanitation provides facilities and services to safely dispose of human urine and faeces, and maintains hygienic conditions through proper collection of garbage and wastewater. In urban areas, improved sanitation also entails the proper management of solid waste and drainage (WHO and UNICEF 2012). WHO acknowledges that given the key role that effective sanitation plays in breaking the cycle of infectious disease, the concept in its broader sense would also include the safe management of solid and animal waste. The post-2015 development agenda (the 2030 Agenda) aptly embraces this holistic view of

sanitation and addresses sanitation as an ecosystem service to be managed sustainably for the benefit of both the natural environment and humanity. The 2030 Agenda and its Sustainable Development Goals (SDGs) employ a ‘ladder’ of definitions that recognizes a progression from access to improved facilities to a sustainably managed service. These are outlined below:

- **Limited sanitation service:** The use of improved sanitation facilities that are shared between two or more households
- **Basic sanitation service:** The use of improved sanitation facilities that are not shared with other households and
- **Safely managed sanitation:** The highest rung on the ladder, whereby excreta are safely disposed of *in situ* or transported and treated off-site.

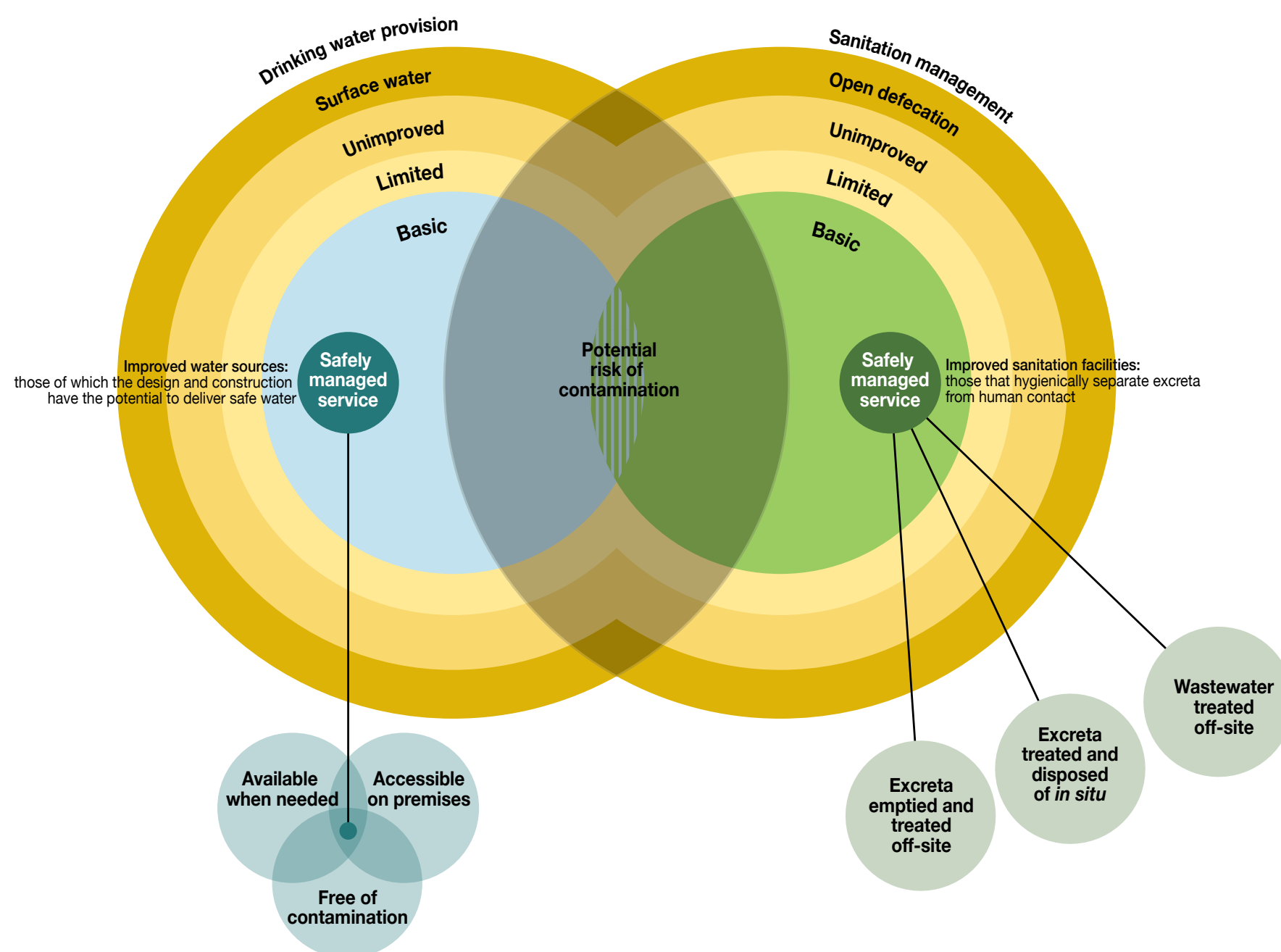
SDG target 6.2 seeks to build on and address the shortcomings of the previous Millennium Development Goal 7C indicator that focused on “sustainable access to ‘basic sanitation’”. It does this by including

aspects of “safely managed sanitation services” and addressing normative criteria of the human right to water including accessibility, acceptability and safety. The safe management of faecal waste in water-based sanitation is key, as discharges of untreated wastewater into the environment create public health hazards and ultimately impact access to safe drinking water by polluting raw water sources. In a safely managed system, excreta are disposed of in a manner that protects human health and the environment to ensure that there is enough freshwater available for potable uses and that the integrity of aquatic ecosystems is not compromised, as illustrated by Figure 1.11.

Millennium Development Goal 7: Ensure environmental sustainability

Target 7C: By 2015, halve the proportion of people without sustainable access to safe drinking water and basic sanitation

SDG GOAL 6. Ensure availability and sustainable management of water and sanitation for all



Sources: JMP Progress on drinking water, sanitation and hygiene – 2017 Update and SDG Baseline.

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Figure 1.11. The excreta management tenets of a safely managed sanitation system

SDG 6: Clean Water and Sanitation

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.b Support and strengthen the participation of local communities in improving water and sanitation management



National targets to improve water quality are difficult to achieve due to dumping and pollution

1.3 Development Goals for the Water Sector

1.3.1 Access to safe drinking water

The Millennium Development Goals (MDGs) set the global development agenda during the period 2000–2015. The 2030 Agenda drew on the lessons and achievements of the MDGs era to frame the Sustainable Development Goals (SDGs), which were officially adopted in 2016. The MDGs served as a cornerstone of development policy around the globe following their adoption in 2000. Taking 1990 as the baseline, just under a quarter (24 per cent) of the African population – the lowest globally – gained access to an improved drinking water source by 2015. Furthermore, only

16 per cent had access to piped drinking water, again the lowest increase in the world (Economic Commission for Africa et al. 2014). There were also wide rural/urban disparities in access to safe drinking water that tended to bring down national aggregate performance figures in some countries. In Africa, the low 1990 baseline conditions combined with rapid population growth relative to the rest of the world exacerbated the challenge in meeting the targets. Apart from North Africa, Africa as a whole ranked lowest in the world on access to improved drinking water sources by 2015 (with only 64 per cent of the population using an improved source).

1.3.2 Access to sanitation

The world is urbanizing rapidly and the number of people living in cities is projected to increase by 50 per cent (from 4 billion to 6 billion) between 2016 and 2045. Much of this growth is occurring in low-income and lower middle-income countries (World Bank 2016), many of which are in Africa. Formal service providers often struggle to meet the demand for housing, infrastructure and services such as sanitation and safe drinking water that is created by rapid urbanization.

The MDG sanitation target called for halving the proportion of the population without basic

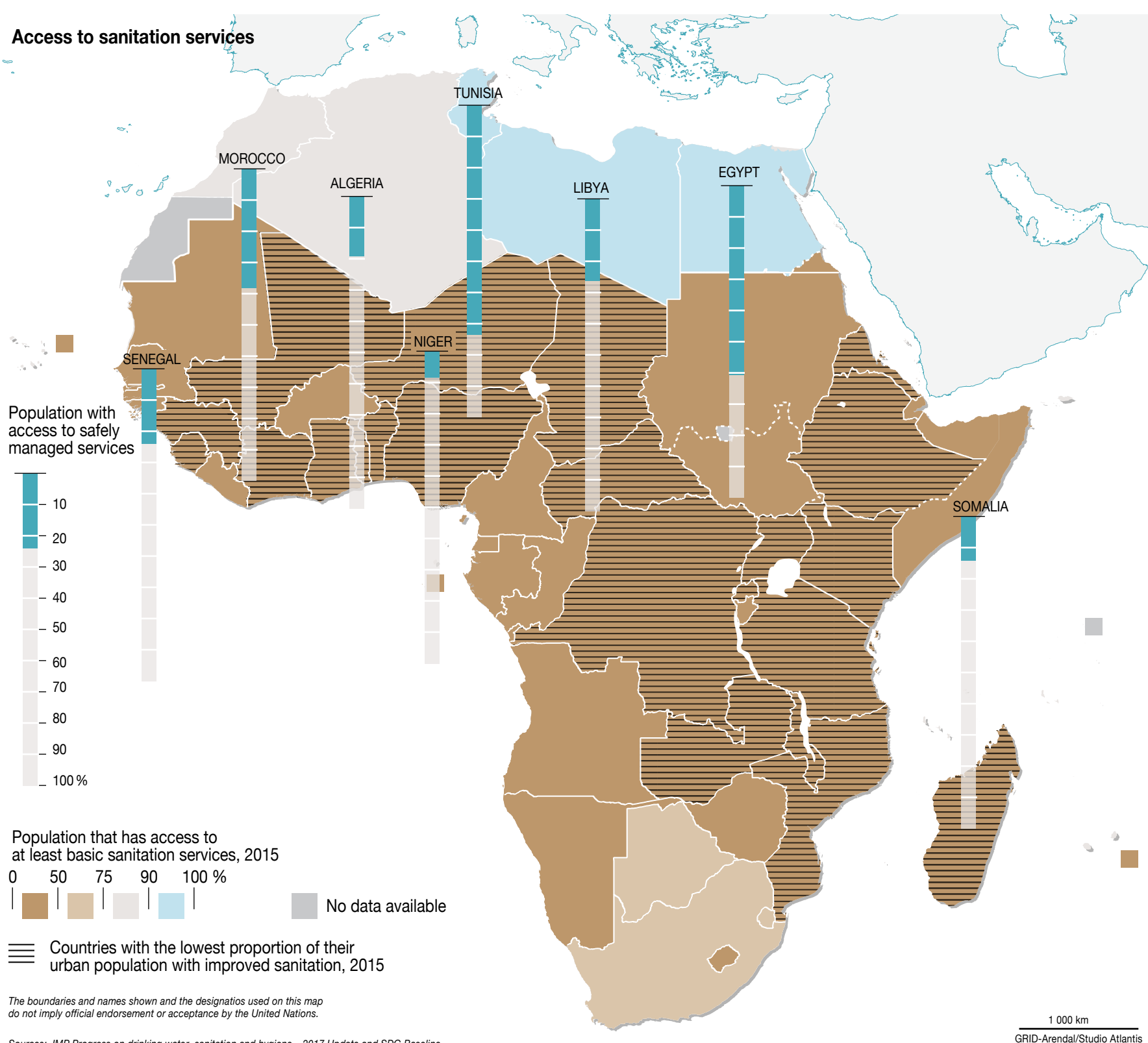


Figure 1.12. Proportion of the population that had achieved at least a basic level of sanitation service by 2015

sanitation. This would have increased access from 54 per cent to 77 per cent for the global population. Though some commendable progress was made, this target was not met across the globe. At the close of the MDGs era, it was estimated that 68 per cent of the global population was using an improved sanitation facility, nine percentage points below the target. The global target for sanitation was missed by almost 700 million people (WHO and UNICEF 2015).

North Africa was the only region in Africa that met the sanitation target, with an additional 41 per cent of the population gaining access since 1990. The subregion started with a good baseline for access to improved sanitation facilities and this increased from 71 per cent to 89 per cent by 2015, surpassing the target set by three percentage points (UNICEF and WHO 2015), and with four countries (Algeria, Cabo Verde, Egypt and Tunisia) meeting the target. On the other hand, in sub-Saharan Africa, minimal progress was made, with less than 17 per cent of its population gaining access by the end of 2012. Due to a combination of population growth and slow progress, the number of people in sub-Saharan Africa without access to improved sanitation at the

end of the MDGs was very high, at 695 million (WHO and UNICEF 2015).

In the post-2015 agenda, the targets focus not only on access to facilities but also to services. When the baselines for the SDG 6 targets were established, improved facilities that did not meet the requirements for the safe disposal and treatment of excreta were considered 'basic', as opposed to 'safely managed'. Using this definition, 5 billion people in the world had access to at least a 'basic' level service, that is, an improved facility not shared with other households, in 2015. However, most of the countries in sub-Saharan Africa had not ensured 50 per cent of their population had access to basic services. Figure 1.12 shows the countries that had achieved access to basic services by 2015 (WHO and UNICEF 2017).

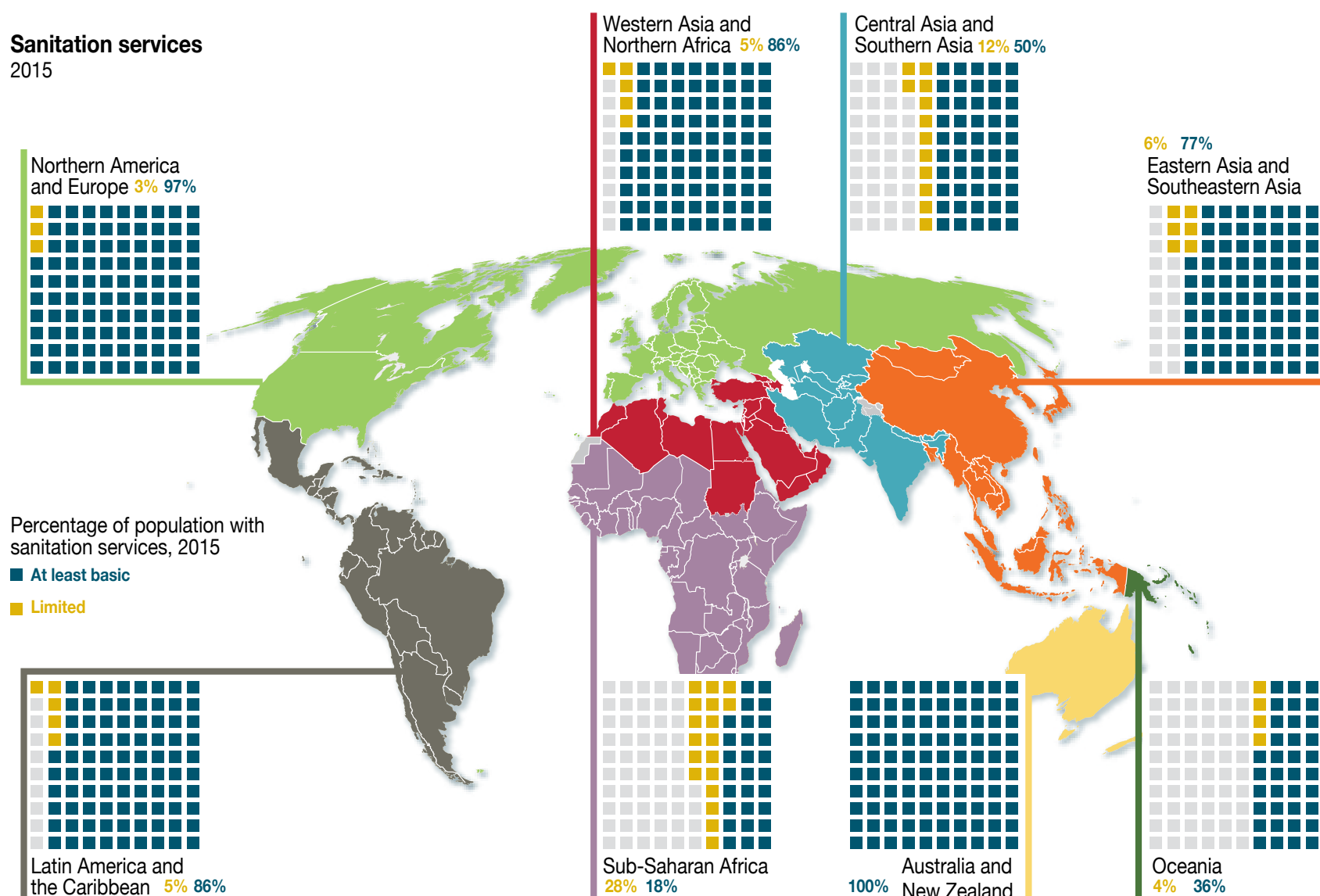
As at 2015, less than a third of sub-Saharan Africa (28 per cent) had access to a basic level of service. A further 18 per cent had access to a limited service, while more than 20 per cent had no service at all and practised open defecation. After Central and Southern Asia, sub-Saharan Africa had the second greatest proportion of people practising open

defecation. Furthermore, it is disturbing that sub-Saharan Africa reported an increase in the number of open defecators from 204 million to 220 million between 2000 and 2015 (WHO and UNICEF 2017). Of those with access to sanitation services, the greatest proportion has access to unimproved sanitation (WHO and UNICEF 2017), as shown in Figure 1.13.

Perhaps in recognition of Africa's poor access to improved sanitation services relative to the rest of the world, the continent's development road map, Agenda 2063, specifically refers to access to sanitation as an indicator of achievement (AU 2015). While this is commendable, it should be noted that the unsafe disposal of human excreta and industrial waste continues to place a huge burden on the continent's freshwater resources. As this threat needs to be addressed, the region must work towards ensuring a safely managed service.

Access to safely managed services, the highest rung on the SDG sanitation ladder, is reportedly rising but remains low, both globally and within Africa (African Union [AU] et al. 2018). Data availability is key to assessing and reporting on countries'

Sanitation services 2015



The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Source: JMP Progress on drinking water, sanitation and hygiene – 2017 Update and SDG Baselines.

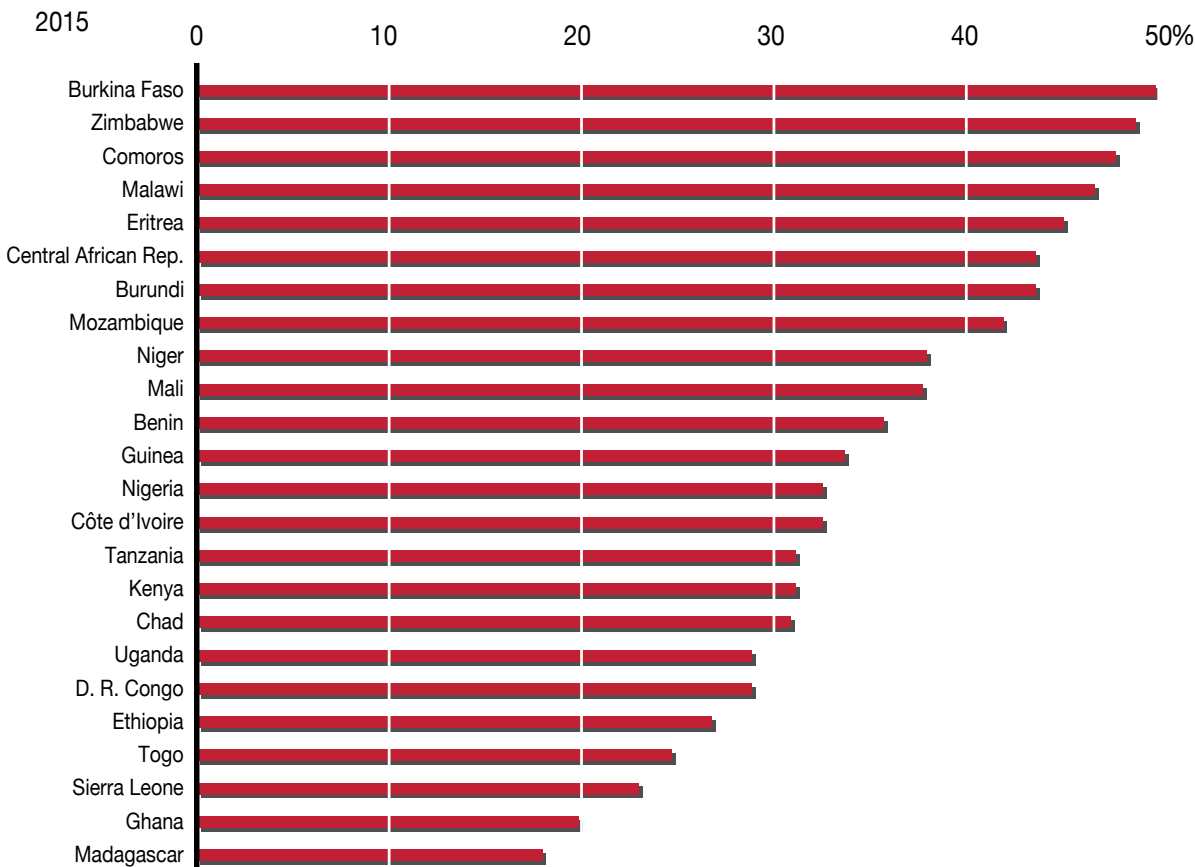
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Figure 1.13. Global sanitation coverage, 2015



Regular hand washing is one way to prevent the spread of germs

Percentage of urban population using improved sanitation



Source: WHO and UNICEF, 2017.

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Figure 1.14. Countries whose urban populations had the lowest proportions of improved sanitation by 2015

progress, particularly when it comes to determining whether or not on-site sanitation services are safely managed. This is clearly demonstrated by the unavailability of baseline figures for sub-Saharan Africa due to the lack of data. In North Africa, where data are available, the proportion of people with access to safely managed sanitation services stood at 25.1 per cent in 2015. This was an increase from 18.1 per cent in 2005.

The 2017 Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) report indicates that 16 of the 24 countries in which at least 20 per cent of the population has limited sanitation services are in sub-Saharan Africa, where the majority of people with such access are found in urban areas (WHO and UNICEF 2017). Figure 1.14 shows which countries' urban populations had the lowest proportions of improved sanitation by the end of 2015, and all but Haiti are in sub-Saharan Africa.

Nevertheless, there are success stories in the region at the country level. Ethiopia achieved the largest decrease in the proportion of the population practising open defecation, which dropped from 92 per cent (44 million people) in 1990 to 29 per cent (28 million people) in 2015 (WHO and UNICEF 2015). Libya and Seychelles stagnated over the period and six countries experienced setbacks (Djibouti, Gambia, Nigeria, Sudan, Togo and Zimbabwe). The

rural/urban divide, lack of adequate infrastructure and the poor situation of slum dwellers compounded the slow progress.

1.3.3 Improved hygiene

The MDGs agenda did not set a specific target on hygiene. However, adequate hygiene practices in water and sanitation have significant health benefits. Therefore, the 2030 Agenda includes a hygiene indicator, defined as access to handwashing facilities with soap and water at home. Other handwashing agents are considered as constituting a limited service due to their reduced effectiveness. JMP data from over 50 countries show low levels of handwashing in many countries. In sub-Saharan Africa, in 34 of the 38 countries for which data are available, access to basic handwashing facilities

is at best 50 per cent (WHO and UNICEF 2017). As with access to water and sanitation, the disparities between North Africa and sub-Saharan Africa are apparent, as shown in Figure 1.15.

1.3.4 Wastewater

The UN-Water Wastewater Management Analytical Brief (UN-Water n.d.) turns to Raschid-Sally and Jayakody's 2008 research report and the 2010 assessment by Corcoran et al. to define wastewater as "a combination of one or more of: domestic effluent consisting of blackwater and greywater; water from commercial establishments and institutions, including hospitals; industrial effluent, storm water and other urban run-off; agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter".

1.3.4.1 The nature and state of Africa's wastewater streams

The World Water Development Report (WWDR) of 2017 acknowledges that the use of surface water as disposal sinks for solid and wastewater has directly resulted in the pollution of downstream water bodies (World Water Assessment Programme [WWAP] 2017). Despite advances in wastewater collection and treatment systems as well as innovations in solid waste management, the discharge of untreated wastewater into the environment continues, with the practice most frequently noted in developing countries. The lack of infrastructure for the collection, transportation, treatment and disposal of solid waste, proper solid waste management planning, insufficient financial resources, technical expertise and public attitude

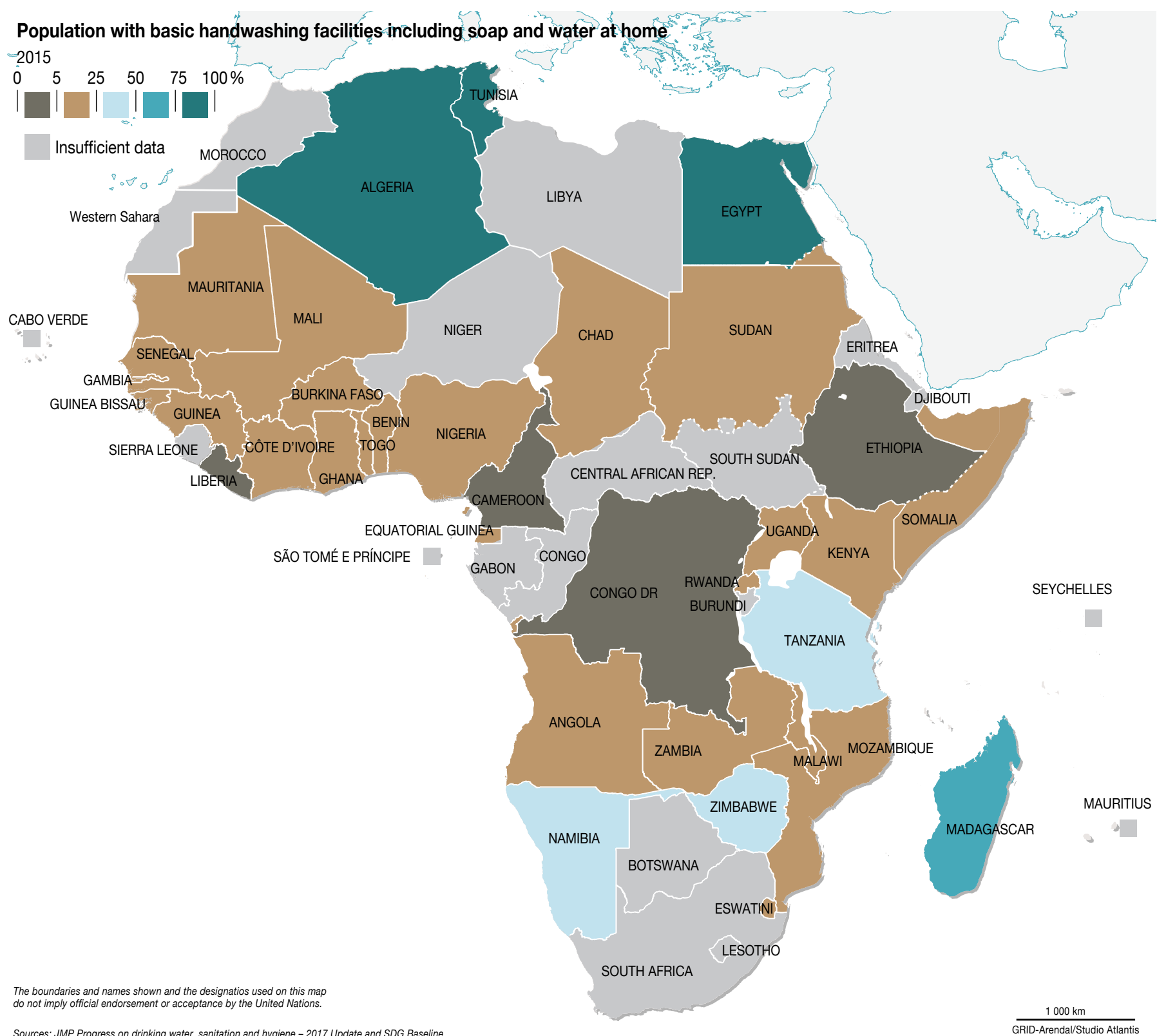


Figure 1.15. Proportion of population with access to handwashing facilities with soap and water at home in Africa, 2015

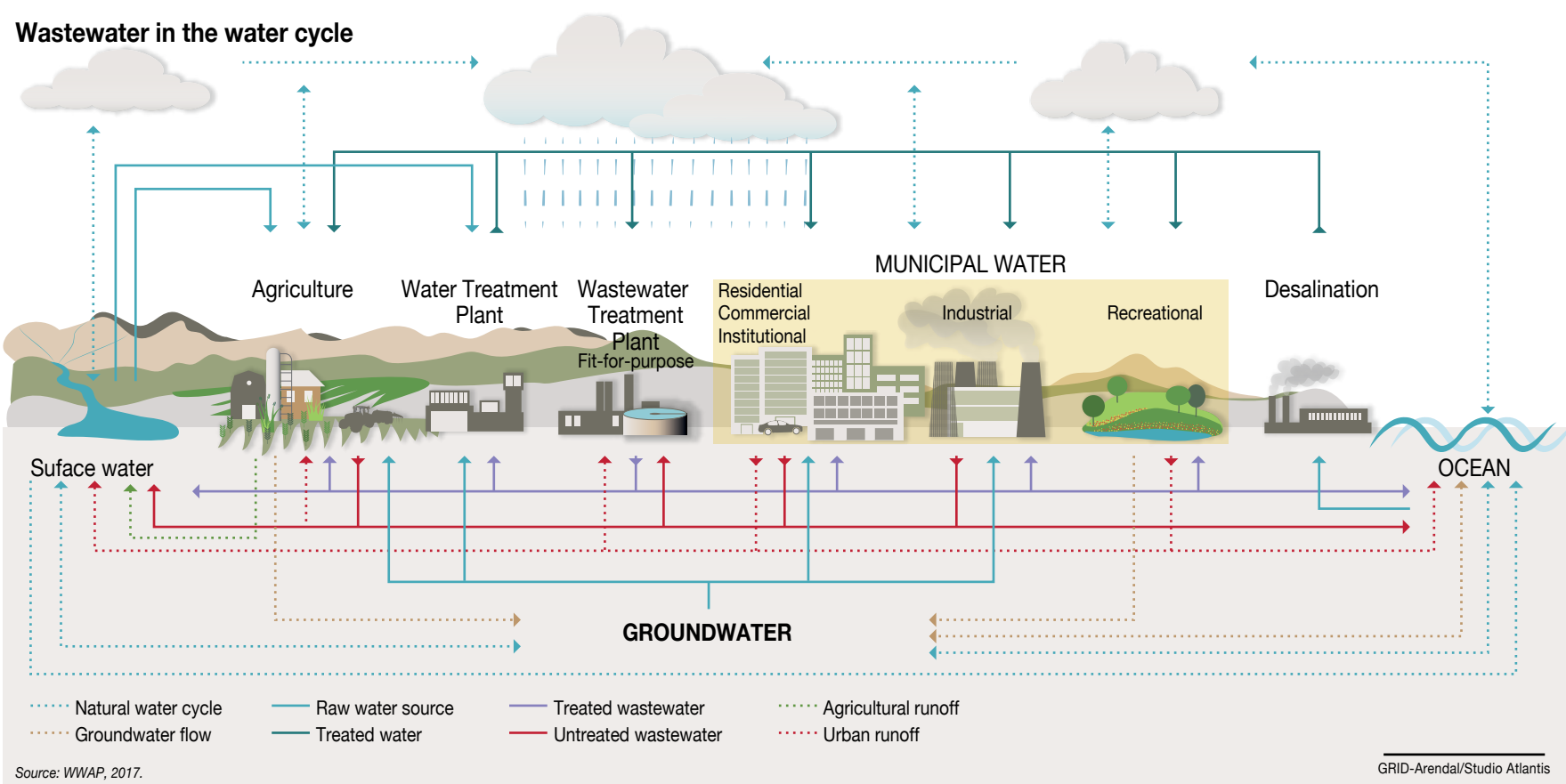


Figure 1.16. Wastewater in the water cycle

worsen the situation, resulting in an increase in environmental and health-related problems.

The WWDR stated that only 20 per cent of globally produced wastewater was receiving adequate treatment in 2012, adding that there seems to be a correlation between the treatment capacity

and the income level of the country (WWAP 2017). Treatment capacity in 2012 was reported to be 70 per cent of the generated wastewater in high-income countries, compared to only 8 per cent in low-income countries (WWAP 2017). The consequence of such practices include increased disease burden as well as significant damage

to key ecosystems. Studies have also revealed that contamination from these streams usually finds its way into freshwater resources, resulting in increased levels of eutrophication and loss of some ecosystem services. Wastewater can also easily pollute groundwater due to the percolation process, as shown by Figure 1.16.



Treated wastewater can be used for irrigation and replenishment of groundwater, among other uses



Sewage leaks and dumping of waste are common urban environmental hygiene problems in Africa

There are four wastewater streams that impact on freshwater and land resources in Africa: domestic, agricultural, industrial and solid waste (Wang et al. 2014).

Some key highlights with respect to these various streams are highlighted below:

Domestic: Domestic wastewater is a challenge from the perspective of an explosive growth of peri-urban informal settlements that lack sewer conveyance systems (Wang et al. 2014). In addition, ageing wastewater treatment plants are failing throughout the continent. In a review of wastewater treatment practices in seven African countries (Algeria, Burkina Faso, Egypt, Ghana, Morocco, Senegal and Tunisia), Nikiema et al. (2013) describe how treatment plants have to contend with high organic loads, uncontrolled input and power cuts, in addition to increasing wastewater flow rates. Other issues raised were poor plant operation and maintenance, high energy costs and lack of re-investments. These challenges culminate in treatment plants that

often deliver insufficient effluent quality, which has negative environmental consequences and leads to poor perceptions of the treated water among stakeholders. In the rural African setting, non-sewered systems are the dominant, but not exclusive, technology. Leakages and poor handling of excreta in these facilities can pollute freshwater systems (United Nations 2018a). The use of on-site and non-waterborne sanitation technologies in rural and urban Africa can, at times, compromise the quality of water resources by contaminating groundwater. This is significant as groundwater is an important component of the drinking supply in water-scarce and stressed Africa.

Agricultural: Agricultural activities – both subsistence rain-fed and commercial – are key components of livelihoods in Africa and are widely recognised to contribute heavily to the pollution of freshwater resources. With a growing population and climate variability, agricultural flows and their impact on wastewater and freshwater resources will continue to be significant.

Industrial: Industrial activity contributes significant levels of chemical pollution to Africa's water flows. Wang et al. (2009) report measuring levels in excess of 2,000 mg/l of chemical oxygen demand in the influent of many pond systems in Africa. This is reportedly five times the levels found in other countries. With Africa on an industrialization drive, the nature, volumes and management of this wastewater stream will be impacted.

Solid waste: The solid waste management challenge in Africa is massive (Bello et al. 2016). Poorly managed solid waste and its decomposing by-products find their way into wastewater and freshwater flows through run-off and other means. Issues such as illegal dumping of waste, failure of municipal systems to act, as well as dumping of faecal matter or 'flying toilets' (plastic bags used to dispose of human waste) are all waste management challenges facing Africa (Wang et al. 2014; Li et al. 2011; Wang et al. 2012). Some entrepreneurs are finding business opportunities by turning some solid and human waste into raw materials for energy and organic fertilizers.

1.4 Galvanising for Action

At the continental level, Agenda 2063 is a “long-term development framework that aims to materialize the vision of: an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the world” (AU et al. 2016). The same report recognizes that Agenda 2063 is anchored by seven aspirations that are supported by corresponding goals, priority areas, targets and strategies. To this end, the Agenda 2063 priority areas address economic, social and environmental sustainability.

Significantly, Agenda 2063 emphasizes that economic transformation on the continent will depend on accelerated industrialization. The social development priorities on the other hand focus on health, education, water and sanitation as well as gender and social inclusion (AU et al. 2016). Environmental priorities focus on measures to address climate change, as well as to preserve and harness marine and terrestrial ecosystems. Specific to sanitation and wastewater, Agenda 2063 calls on Member States to ensure environmentally sustainable and climate-resilient economies and communities. Tied to this goal is the target to ensure at least 90 per cent of wastewater is recycled for agricultural and industrial use.

The SDGs seek to end poverty, protect the planet, and ensure peace and prosperity for all. One of the highlights of the transition from the MDGs to the SDGs was the effort to embrace a holistic approach to the provision of water and sanitation services within the framework of sustainable ecosystem management. This is reflected in the targets for the SDGs that regard access to water and sanitation not only as rights, but also as ecosystem services that must be sustained through generations. SDG 6 thus seeks to “Ensure availability and sustainable management of water and sanitation for all”.

This is reflected in the range of indicators that go from access to improved sanitation facilities, protection of ecosystems, and increasing efficiency through to participatory planning and management at all levels (Figure 1.17).

Some key actions towards the realization of SDG 6 are taking shape throughout the continent, albeit with varying rates of success. The decade from 22 March 2018 to 22 March 2028 has been declared the International Decade for Action on Water for Sustainable Development (Water Action Decade). The decade’s objectives are stated as a greater focus on (UNGA 2015):

- The sustainable development and integrated management of water resources for the achievement of social, economic, and environmental objectives
- The implementation and promotion of related programmes and projects, and
- The furtherance of cooperation and partnership at all levels to help achieve internationally agreed water-related goals and targets, including those contained in the 2030 Agenda.

The High-Level Panel on Water (HLPW) outcome document sets forth a framework of action for accelerated efforts towards the realization of SDG 6. The report outlines practical actions to catalyse change and build partnerships and cooperation, and advocates an integrated and inclusive approach that draws on different sectors and stakeholders to work towards sustainable management of water resources (HLPW 2018).

The reporting mechanisms for progress on the SDGs have evolved to embrace the new focus on an integrated and holistic approach to sanitation and wastewater management as ecosystem services in the context of population growth and climate variability. All the baseline indicators are now available from a number of platforms, but primarily the Global Enhanced Monitoring Initiative (GEMI). GEMI was established in 2014, as an inter-agency initiative whose focus is on integrating and expanding existing efforts on SDG targets 6.3 to 6.6(a) (See Table 1.1). The indicators are new at the global level and require increased awareness-raising and capacity-building at all levels. The GEMI component of SDG 6 monitoring and implementation will be harmonized with the JMP and the Global Analysis and Assessment of Sanitation and Drinking-Water (GLASS) as part of the UN-Water Integrated Monitoring Initiative for SDG 6. The first phase of the initiative focused on the development of monitoring methodologies and other support tools, including pilot testing, a roll-out of capacity-building efforts and the establishment of a global baseline for targets 6.3 to 6.6.

Further recognition of the central role of wastewater treatment is shown in the United Nations Environment Assembly resolution that addresses water pollution. The final resolution (UNEP/EA.3/Res.10) states “support countries in sustainable wastewater management (policies, guidelines, standards, etc) ... and collaborate with private sector to invest and upscale business models for wastewater management, prevention of water pollution, water quality monitoring, and innovative financing mechanisms. In addition, it encourages Member States to implement relevant actions to help attain the indicators for SDG 6 (IISD 2017).

1.4.1 Wastewater treatment and protection of ecosystems

Africa’s wastewater is often inadequately treated and sometimes discharged untreated into



Figure 1.17. The Sustainable Development Goals



Water is central to personal hygiene



Table 1.1. SDG 6 targets and indicators

Target	Indicators
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Proportion of population using safely managed sanitation services, including a handwashing facility with soap and water
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated 6.3.2 Proportion of bodies of water with good ambient water quality
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.1 Change in water use efficiency over time 6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.1 Degree of integrated water resources management implementation (0-100) 6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time
6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan
6.b Support and strengthen the participation of local communities in improving water and sanitation management	6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

Source: United Nations, General Assembly [UNGA] (2015)

freshwater and marine-receiving ecosystems. Many towns and cities on the continent do not have sewerage reticulation and treatment systems and, where these do exist, they are often confined to central business districts and high-income areas. In light of this situation, developers and individual households provide their own sanitation facilities (Strande et al. 2018; Tayler 2018). The inadequate sanitation infrastructure leads to pollution that compromises ecosystem integrity.

In an era of increasing water shortages, projections are already pointing to a dire global situation by 2030, with reduced availability of water resources for human and environmental needs. In addition, it is now increasingly becoming accepted that reuse of water – for various applications in different contexts – is an inevitable component of the world's water future.

The SDG 6 Synthesis Report on Water and Sanitation indicates that a modelling exercise showed that pollution of water resources, measured using the biochemical oxygen demand (BOD), increased between 1990 and 2010 because of growth in wastewater loadings into rivers and lakes (United Nations 2018b). There are limited data on the treatment of wastewater and faecal sludge in developing countries, despite these issues being important at the global level (Strande et al. 2014). Data on on-site treatment of wastewater is yet another area requiring attention. Freshwater quality is reported to be at risk globally and is worsening in Asia, Africa and Latin America (United Nations 2018b).

1.5 Sustainable Sanitation and Wastewater Management

1.5.1 Transitioning to the 2030 Agenda and Agenda 2063

The MDGs to Agenda 2063/SDGs Transition Report of 2016 acknowledges the convergence of Africa's Agenda 2063 and the SDGs (AU et al. 2016). The report argues that the adoption of the 2030 Agenda and Agenda 2063 provides Africa with a unique opportunity to take forward and complete the unfinished business of the MDGs, as both agendas provide the foundation for African countries to develop and strengthen their national long-term development visions (AU et al. 2016). Integrating the two agendas and ensuring that the countries' national development plans are aligned to the two developmental agendas will promote policy coherence and reduce the risk of duplication, as well as the burden of reporting on the two agendas separately (AU et al. 2016).

While cohesion depends on the extent to which African Member States understand the relationship between the global and continental agendas, there is also a need for:

- Enhanced integration and coordination of institutional arrangements for implementation of the two agendas
- Strengthened capacities for data collection and analysis and
- Development of a monitoring and evaluation system that is horizontally (sectoral) and vertically

(national versus subnational) integrated (AU et al. 2016).

The Transition Report states:

Adoption of the two Agendas signals a two-pronged transition: a global-level transition from the MDGs to Agenda 2030 and a continent-level transition from NEPAD [New Partnership for Africa's Development] to Agenda 2063. Both Agendas are comprehensive, underpinned by an extensive consultation process, and share common aspirations of structural transformation and sustainable development. However, the two Agendas are not identical. Implementing them will require effective messaging about their content, coherent integration of both into national planning frameworks and an integrated results framework for follow-up (AU et al. 2016).

1.5.2 The fourth industrial revolution and innovation

More than 30 of the world's 48 least developed countries are in Africa. The continent is on an industrialization drive, with all of its regional economic communities having identified industrial development as an important objective in their founding treaties, and most adopting explicit industrial development strategies. The African Union adopted the Plan of Action for the Accelerated Industrial Development for Africa in

2008, while the United Nations General Assembly adopted a resolution declaring 2016 to 2025 to be the Third Industrial Development Decade for Africa. Despite the importance that African leaders attach to industrial development on the continent, evidence indicates that most African economies do not yet have diversified industrial sectors, and that some of the early industrializing countries are de-industrializing (Stuart 2016).

In light of the environmental pressures that the continent is facing, the need for cleaner and more efficient production technologies has never been greater. There are already growing challenges from emerging contaminants and the impact of industrial flows on ecosystem integrity is well documented (Brooks et al. 2006). Innovation in all its forms and its uptake are therefore needed more than ever before.

The immense possibilities offered by big data and its associated expertise and capabilities, smart systems and artificial intelligence offer possibilities for improving sanitation and wastewater management in Africa. The SDG 6 Synthesis Report (United Nations 2018b) acknowledges the role that smart technologies could play. This calls for cross-sectoral collaboration to capitalize on these possibilities. Furthermore, Africa needs to urgently position itself to take advantage of these emerging opportunities and take its place on the global development platform. While there are many industrialization



Significant efforts are needed to ensure that wastewater is safely treated

and economic opportunities for Africa, lack of infrastructure and water can be a stumbling block. In recent years, the World Economic Forum has identified water as a threat to economic

development. As such, Africa needs to not only secure water supply for all its inhabitants' well-being but also to remain a competitive economic player (WEF 2019).

As shown in Box 1.1, efforts are under way in Africa to embrace information technology in the provision of sanitation services as well as improved wastewater management.

Box 1.1. Using technological applications to support the water and sanitation sector in Africa

Background

Information and communication technologies (ICT), in the form of mobile phones, are readily available in Africa, where mobile network subscriptions surpass those of wired connections (Baelden and Van Audenhove 2015). It has been suggested that ICT has the potential to support “the development strategy of ‘leapfrogging’ some of the processes of accumulation of human capabilities and fixed investment in order to narrow the gaps in productivity and output that separate industrialized and developing countries” (Steinmueller 2001). In particular, ICT can support crowdsourcing (Howe 2006a; Howe 2006b) and crowdsensing (Ganti et al. 2011) approaches, which consist of “taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call” (Howe 2006a).

These approaches have been applied to the development of smart cities (Kumar et al. 2018; Han and Hawken 2018); open and smart governance systems (Millard 2018; Barns 2018; Certomà et al. 2015); urban planning (Shen and Karimi 2016); geospatial data and hydro-geology (Nik-Bakht and El-Diraby 2016); infrastructure management (Ogie et al. 2018); flood monitoring (Wang et al. 2018); transportation planning (Majumdar 2017); wetland management (Sinclair et al. 2018); and energy planning (Bazilian et al. 2012).

For the particular case of water and sanitation services across Africa, “ICTs can be a key enabler for institutional transformation to address the demand for improved services for both rural and urban communities” (Ndaw 2015). ICT tools have been piloted to test their ability to address some of the most pressing challenges that the continent is facing, in particular the collection and storage of good-quality data to enable better decision-making; informing and giving a voice to the people; creating a driving force for safer and more affordable water and sanitation services; and simplifying payments.

Collect and store good-quality data

Data regarding water and sanitation service coverage are rarely readily available and are often gathered through city-wide household surveys that are typically funded by foreign donors – an approach that may not be sustainable in the

long term. Furthermore, the quality of such data is sometimes questionable, given the low capacity and/or engagement of field operators. A permanent solution for gathering good-quality data would therefore greatly serve local decision makers and experts.

One such project is PULA, a VIA Water funded project, which is aiming to completely develop an app in Maputo for desludgers in Mozambique and Zambia that will gather valuable geo-referenced data regarding desludging practices and patterns across cities. These data will include location and type of systems, size of the household, emptying periodicity and emptied volume to support decision makers in improving sanitation planning and regulation and in better designing faecal sludge infrastructure, such as transfer stations and treatment plants. This will make a significant contribution towards achieving universal access to safe sanitation services in both cities.

The developers have identified two user groups: the desludgers and the (government) institutions that will need the data generated by the app.

Operating at a different stage of the service chain to PULA, another sanitation-related project is the Office National de l'Assainissement du Senegal's (National Sanitation Office of Senegal, ONAS) call centre for desludgers in Dakar, Senegal. The plan was for this call centre to boost usage of the more expensive, but more sanitary, mechanized desludging method. Unlike the typical situation whereby a household contacts a desludger directly, under this system households contact ONAS and then the various desludgers that are interested bid for the job. According to ONAS, households appreciate the ease of finding an emptying operator via the call centre, are satisfied with the service monitoring and compliance commitments, and typically recommend the call centre to neighbouring areas. On the other hand, operators (desludgers) appreciate the ease of using the call centre in connecting with customers, and also recognize that they learn more about how to deal with customers (location, timing, etc.).

Inform and give a voice to (urban) populations

The Mozambican company UX introduced MOPA, a Mozambican platform for participatory monitoring of the delivery of public urban services, including solid waste management. Using the platform, any citizen in Maputo can report on outstanding issues,

such as full containers and overflowing garbage via their mobile phone, the app or the project's website. The problems reported in MOPA are passed on to municipal authorities and service providers, who use this information to optimize garbage collection routes and collection infrastructure and plan urgent actions. When the problem is resolved, the citizen receives a confirmation SMS. All problems, including outstanding issues, can be consulted on the project's website.

Similar to PULA, Map Action is an initiative that allows users to report issues related to water and sanitation in the city of Bamako, such as leaking water distribution pipes, non-functional standpipes and clogged or overflowing channels. Reporting is carried out through a mobile application and a preliminary analysis of each problem assesses its impact and severity. The information made available gives stakeholders involved in the water, sanitation and hygiene sector better insight into the current situation in the city.

Accra's increased urbanization has led to very frequent, dangerous flash floods, the effects of which a flash flood forecasting and communication app aims to minimize. Some areas of the city are flooded several times a year during the wet season, often with flash floods that arrive quickly and are dangerous, especially during the night. The aim of this project was to develop a flash flood warning system based on modern rain and hydrological models.

Create a driving force for safer and more affordable water and sanitation services

The PULA initiative also supports entrepreneurs in managing their truck fleets and in offering better and safer desludging services. The app will allow real-time tracking of all trucks in the fleet and direct communication between the owner, the truck driver and the requesting household.

The ONAS call centre has resulted in more affordable desludging services. It puts households in contact with several desludgers, who enter into a bidding process which has been shown to drive down the costs of the service. Furthermore, as expected, the reduced cost of the desludging jobs had led to an increase in terms of both the requests made to formal operators and the amount of faecal sludge treated at the designated treatment plant.



Countries will not meet their sanitation goals if toilets are not accessible to everyone, including children and the disabled

1.5.3 Pan-Africanism, politics and transboundary cooperation

The growing wave of pan-Africanism is an opportunity for shared regional agendas and cross-fertilization of ideas for innovation. The aspirations of the African people as set out in Agenda 2063 offer opportunities for collaboration that will accelerate progress towards the global development indicators, while transboundary platforms provide an opportunity to accelerate the pace in individual countries to work towards shared goals. Such transboundary cooperation requires political stability so that national goals and targets can be realized, and disruption of services such as sanitation and safe drinking water avoided.

Transboundary water resources management plays a key role in tackling pollution. For example, the East African Community Lake Victoria Basin Commission works to prevent the discharge of polluted wastewater into shared Lake Victoria. With the aim of achieving adequate clean water supplies, improving hygiene and environmental sanitation, and improving urban drainage for 15 towns in the lake basin, and financing from the AfDB, this commission has supported the construction of water treatment plants, toilets and water reticulation systems (East African Community Lake Victoria Basin Commission 2016).

1.5.4 Toilet revolution

It was estimated that in 2015, one in three people (2.3 billion) worldwide still used unimproved sanitation facilities, including 892 million people who still practised open defecation (Cheng et al. 2018). According to Cheng et al. (2018), “Even in urban areas, where household and communal toilets are more prevalent, over 2 billion people use toilets connected to septic tanks that are not safely emptied or use other systems that discharge raw sewage into open drains or surface waters.”

There is a growing drive to develop and implement sanitation systems that respond to the environmental and socioeconomic challenges of not only Africa but also the rest of the world, including the need to protect the natural environment. One notable initiative is the Bill & Melinda Gates Foundation's Reinvent the Toilet Challenge, which brought to the fore possibilities for the next-generation sanitation

system. Innovative efforts must also respond to the barriers that have emerged around reuse technologies on the continent, including unlocking the nutrient and energy potential in human excreta.

In setting highly desirable standards for ‘on-site’ sanitation systems, the recently finalized International Standard on ‘Non-Sewered Sanitation Systems – Pre-fabricated integrated treatment units: General safety and performance requirements for design and testing’ (ISO 30500) goes a long way towards addressing a number of challenges associated with contamination from pit latrines, poor management of excreta and the protection of human health.

1.5.5 Energy, food and water nexus

It is clear that Africa needs to produce more food in order to sustain the livelihoods of its growing population. There are opportunities for green design in an urbanizing Africa, where it is becoming increasingly apparent that a new norm is needed – one that invariably capitalizes on the energy, food and water nexus. Smart and resilient urban agriculture, in addition to nature-based solutions in cities and human settlements in general, present opportunities for the continent. Much of today's urban agriculture in Africa is watered with wastewater. A study by Njenga et al. (2011) established that the majority of households in Kenya's Kibera and Maili Saba owned an average of 2,000 square metre plots on which they grew food, used wastewater and also polluted the water with pesticides and chemical fertilizers.



Public toilets need a regular supply of water and their use must be affordable to all

1.6 Conclusion

The baseline metrics that are available for Africa with respect to progress on SDG 6 indicate that there is still an enormous amount of work to be done and resources that need to be invested for Africa to achieve the set targets. With a young and growing population, the effects of missing these targets would be catastrophic for the continent, including damage to its natural environment and

ecosystems. Failure to roll out safely managed sanitation systems would lead to an unchecked increase in the amount of untreated wastewater that is released into the natural environment, making the risk of disease very high.

As a water-poor region, Africa must embrace opportunities for innovation in not only economic

development, but also in the way services such as sanitation and safe drinking water are delivered. The continent must invest in the necessary policies, infrastructure and human skills capacities to operationalize actions towards the achievement of goals and targets in the 2030 Agenda, including those for sustainable sanitation and wastewater management.



Protected wells will ensure water is not contaminated by human and natural activities