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Water Issues in the Democratic Republic of the Congo

Challenges and Opportunities

Technical Report

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Water Issues in the Democratic Republic of the Congo: Challenges and Opportunities

This technical report is part of the overall Post-Conflict Environmental Assessment of the Democratic Republic of the Congo

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Executive summary

Africa's most "water-rich" country, the Democratic Republic of the Congo (DRC), is facing an acute drinking water supply crisis. Only an estimated 26 per cent of its population has access to safe drinking water, well below the approximately 60 per cent average for Sub-Saharan Africa. Due to the deteriorated state of its water infrastructure – undermined by years of underinvestment and conflict – and a rapidly growing population, the trend in water supply coverage was until recently in regression. Social and public health consequences of water service breakdown have been considerable. The poorest sections of society have been disproportionately impacted by the decline in service delivery and rising water costs, both in rural areas but increasingly in rapidly urbanizing cities.

Notwithstanding the complex post-conflict context, high-level political commitment and international assistance have generated a positive dynamic in the water sector today. As a result, the DRC has since 2004 succeeded in arresting and indeed slowly reversing the negative downturn in water accessibility. This in itself is an important achievement which should be acclaimed and supported. Despite this encouraging turnaround, current projections – even in the best-case scenario – indicate that the DRC will not be able to meet its water targets under the Millennium Development Goals (MDG) and its Poverty Reduction Strategy Paper (PRSP). To meet national development goals, which are significantly below the MDG water target, the country faces the enormous challenge of supplying an additional 20.3 million people with safe drinking water by 2015.

A draft Water Code was recently validated and will soon be submitted to Parliament for adoption. Based on an Integrated Water Resources Management (IWRM) approach, the Water Code represents a major step forward in water governance and institutional reform. As envisioned in the Water Code, preparation of a water resources management strategy, as well as a public water services strategy should be carried out as a matter of priority, to provide a common vision for the sector's development and establish a decentralised institutional framework for the water sector. Statutory regulations and guidelines to support the effective implementation of the Water Code also need to be developed and promoted extensively.

In the DRC's administratively fragile context, uncontrolled land development activities pose a fundamental threat to strategic drinking water sources. Weak land-use planning and inadequate protection of critical water sources – at all levels from village springs to the intakes of water treatment plants – represent a direct risk to ongoing efforts to achieve MDG and PRSP water targets. The long-term sustainability of water infrastructure investments are frequently jeopardised by the resultant environmental degradation, exemplified by the Lukunga water treatment plant in Kinshasa. Given the urgency of the situation, interim priority measures need to be taken, namely securing the land area surrounding drinking water sources and implementing source-management plans at the microwatershed level. More broadly, increasing deforestation and degradation of forest ecosystem services represents a direct threat to local community water supply and attainment of national and MDG water targets. This is particularly the case in rural areas, where over 90 percent of the population depends on springs located in dense forests (both gallery and rainforest).

With the gradual unravelling of state capacity and ensuing post-conflict vacuum, provision of water services in rural and peri-urban areas has become almost completely informalised and consequently is not subject to independent oversight. Due to the generally low technical expertise of the diverse actors active in rural and peri-urban areas, construction quality and maintenance of water supply structures has been compromised, with serious public health implications. UNEP spot-check analysis of drinking water quality showed a high incidence of bacteriological contamination. Strengthening the capacity of national water authorities to coordinate activities and ensure compliance with minimum standards is therefore a priority issue. Similarly, humanitarian actors need to establish a mechanism through the WASH Cluster to monitor and evaluate their own interventions. It should be pointed out that urban centres are generally not facing this problem, where UNEP spot-check analysis of REGIDESO water supply indicated that it is of good quality overall. The ability of REGIDESO to provide good quality drinking water under difficult circumstances attests to the institution's resilience and professionalism of its staff.

In line with decentralisation and public enterprise reform laws, wide-ranging institutional restructuring is foreseen in the draft Water Code. Implementation of these reforms needs to be realistic and carefully timed given the acute financial and human resource capacity gap in post-conflict DRC. Although decentralised governance is widely embraced as an underlying principle of water reform, it is critical that institutional transition is carried out in a disciplined manner. For many provinces, decentralised water institutions may not be feasible in the short to medium term. Enhancing the capacity of provincial and local authorities is a clear priority in this critical interim phase to avert the risk of a "governance vacuum". Special measures may also need to be taken to avoid potential regional inequities in water services.

While major water infrastructure development is important, implementation of small-scale projects in the DRC often reach a larger beneficiary population and provide greater returns per investment unit made. Innovative strategies such as autonomous community-based water supply systems and low-cost technical solutions (public standposts, spring boxes, hand pumps) promoted by various development partners (BTC, KfW, UNICEF) offer promising solutions. On the other hand, the World Bank's support to the public water utility (REGIDESO) should help revitalize large scale water infrastructure in urban centers. With respect to water governance, the GTZ supported water reform project and the draft Water Code should help create the "enabling conditions" for the participation of private enterprises and social economy organizations and help mobilise much needed resources. What is now needed is a broad vision drawing on a mixture of both macro and micro solutions to develop and upscale the aforementioned positive initiatives into large-scale national programmes. At the same time, establishment of a comprehensive national water information system is equally essential, particularly given its importance for the development of key economic sectors.

The DRC's abundant water resources are a major asset for national development. Despite the great challenges constraining the water sector, these are not intractable problems and can be solved by effectively implementing astute investments and governance reforms. Over $500 million of donor financial commitments have been successfully mobilised, but disbursement rates have been low and project implementation has consequently trailed behind schedule. In addition, to the estimated $2 billion required for infrastructure projects to achieve the MDG water target, this assessment recommends an investment envelope of approximately $69 million focusing on policy and regulatory instruments, data collection, capacity building and microlevel technological solutions over the next five years. The strategic interventions proposed should help strengthen the water sector to fulfil its critical role in speeding up the DRC's economic recovery and fund long-term development.

Key drinking water challenges by sub-sector	
Urban and peri-urban	• Derelict water supply infrastructure. One third of treatment plants not operational. • Rapid urban population growth rate (4.6 per cent). • High water prices. • Weak cost recovery and financial viability of public water utility. • Informalisation of water service provision in peri-urban areas. • Degradation of water source catchments increase treatment costs.
Rural	• Low access to improved water sources. • 60 per cent of rural water systems not operational. • Informalisation of water service provision (inadequate quality control and maintenance). • High incidence of bacteriological contamination. • Low investment allocations (15 per cent of total). • Physical degradation of drinking water sources.

1 Introduction

Despite its immense freshwater resources, the overriding challenge for the Democratic Republic of the Congo's (DRC) water sector is to improve its rapidly growing population's low access to safe drinking water. At least two decades of underinvestment, aggravated by conflict-related destruction of facilities, have left the country's water infrastructure and services in a serious state of deterioration. Consequently, water access rates have undergone a dramatic decline from pre-conflict 1990 levels; the DRC's current rate of around 26 per cent[1] is one of the lowest in Sub-Saharan Africa. It is also significant that the enormous death toll from the "Congo wars" is mainly attributable to indirect public health effects, including *inter alia* those linked with the collapse of water and sanitation services.[2]

In this complex post-conflict context and based on current trends, the DRC will unfortunately miss the water target under Millennium Development Goal (MDG) Seven[3] to halve by 2015 the proportion of its population without sustainable access to safe drinking water. Nevertheless, rehabilitation of the water sector is one of the highest priorities in the country's Poverty Reduction Strategy Paper (PRSP) and receives considerable international assistance. As part of the ongoing drive to reconstruct the water sector, this report highlights the need for a better understanding of the critical role of ecosystem services in securing national and MDG targets of providing people with safe and sustainable sources of water. Enhancing environmental management and protection of drinking water sources (wellhead and spring protection zones, intake zones, recharge areas, microwatersheds) therefore needs to be valued for its contribution to safeguarding public health and strengthening the sustainability of water sector investments.

Demining the Bangoka water treatment plant, located within the perimeters of Kisangani airport. Contaminated by mines and unexploded ordinance during the 1997-2000 war, the site has now been almost cleared

Tshopo hydroelectric plant in Kisangani, Orientale Province, is one of the DRC's many run-of-the river schemes having a limited environmental footprint

Commitment to ongoing water sector reform, including development of a draft Water Code in which an Integrated Water Resources Management (IWRM) approach is well embedded, represents an important step forward in establishing overall water governance and institutional frameworks. In order to sustainably develop and manage the country's water resources and kick start growth in such related sectors as transport, energy, ecotourism and agriculture, major investments in water resource inventory and information management systems are necessary but which are acutely lacking at present.

1.1 Scope and methodology

This technical report comprises an integral part of the broader United Nations Environment Programme (UNEP) post-conflict environmental assessment (PCEA) of the DRC. The UNEP PCEA aims to evaluate the key environmental problems and threats facing the DRC and propose strategic options and practical recommendations to address them in the short term. It is prepared in close collaboration with the Ministry of Environment, Nature Conservation and Tourism (MENCT) and various national and international partners.

In line with the abovementioned PCEA approach, this study does not intend to provide a comprehensive evaluation of water resources management. It focuses on the key challenges in the water sector, which in the case of the DRC are strongly centred on drinking water supply. Several water-related issues have purposely not been examined in this study and are taken up in other reporting outputs emanating from the PCEA process. The subject of international waters is covered in a technical report on transboundary natural resources management. Water pollution from large-scale industrial mining is addressed in the Katanga mining environmental assessment, which includes a detailed water quality survey. Environmental impacts of large dams are addressed in the full PCEA study, but this is not considered a priority issue, as large dam projects remain in the early planning stages, and are unlikely to materialise in the short term. Moreover, most of the proposed dam projects are run-of-the-river hydroelectric schemes with relatively limited environmental impact (with the exception of the proposed Inga III and Grand Inga schemes). The effects of climate change on the country's precipitation patterns and hydrological regime is an emerging concern, but as the available information base is weak it is not possible at this stage to analyze this issue in sufficient detail.

In undertaking this technical assessment, a desk-based literature review was initially carried out to scope the key issues. The core of the assessment derives from a series of field missions conducted between October 2009 and September 2010. It included extensive discussions with various government authorities at the national, provincial and local levels. The key technical departments consulted were the public water utility (REGIDESO), national rural waterworks service (SNHR), the National Water and Sanitation Committee (CNAEA), MENCT, the Ministry of Health and the Ministry of Energy. Meetings were also held with a wide range of development partners, UN agencies, regional organizations, non-governmental organizations (NGOs) and civil society representatives.

Field missions were carried out across in the country's 11 provinces: Bandundu, Bas Congo, Equateur, Kasaï Oriental, Kasaï Occidental, Katanga, Kinshasa, Maniema, North Kivu, South Kivu, and Orientale. These were generally conducted as transect surveys from the provincial capitals and secondary urban centres and included visits to villages and remote areas. All field visits were accompanied by representatives from the MENCT at the national and provincial levels, as well as technical staff from relevant government agencies and departments.

In view of the underlying drinking water supply problem and to better understand the challenges on the ground, the assessment approach sought to examine the largest possible range of water supply sources developed by diverse actors, including both state and non-governmental agencies. Fieldwork comprised site visits to 21 REGIDESO water treatment stations in Kinshasa, provincial capitals and secondary urban centres. It included water plants that were both fully and partially operational as well as several which had been abandoned or destroyed during the conflict. Both unimproved and improved drinking water sources in rural and peri-urban areas were inspected. This covered many types of water engineering designs (spring boxes, wells, boreholes, small reticulated supply systems operating by gravity or motor pumps) constructed by various actors, including government services, development agencies, national and international NGOs and faith-based organizations.

UNEP conducted selective on-site measurements of key water quality parameters using portable field equipment. This included both physicochemical (turbidity, pH, conductivity, dissolved oxygen, temperature) as well as bacteriological analysis. Where there was concern that drinking water sources may be contaminated by surrounding activities, samples were collected and sent for more detailed analysis (heavy metals, nutrients) at Spiez Laboratory in Switzerland. The sampling results are presented in Annex 3. The internationally accepted World Health Organization (WHO) Guidelines for Drinking Water Quality were used as a reference standard for measuring the safety of drinking water.

The field missions were carried out with logistical and administrative assistance from MENCT, United Nations Development Programme (UNDP), Food and Agricultural Organization (FAO) and the United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO).

2 Overview of freshwater resources

Possessing an estimated 52 per cent of Africa's surface water reserves (rivers, lakes and wetlands), the DRC is the most water-rich country in Africa.[4] Furthermore, the DRC alone accounts for an estimated 23 percent of Africa's internal renewable water resources. Endowed with an average annual precipitation of around 6,000 billion m^3, rainfall is regular and abundant (average 1,545 mm/year) but varies in space and time (800-1,800 mm). The DRC also enjoys considerable water autonomy, with 70 per cent (900 km^3/yr) of its total actual renewable water resources (estimated at 1,283 km^3/year) generated internally from rainfall.[5] The country's bountiful water resources are intrinsically linked to its vast forests, which extend over 155.5 million ha.[6] Indeed, the vast majority of the population depends on springs located in dense forests (both gallery and rainforest), highlighting the importance of forest ecosystem services to local community water supplies. While overall national deforestation rates remain relatively low (estimated at 0.2 per cent per annum[7]), in some parts of the country, notably in savanna and gallery forests and especially around urban centers, it is reaching high levels and posing a direct threat to drinking water sources.

Under growing pressure, gallery forest ecosystems in savanna landscapes sustain critical sources of drinking water for the local population (above and top right)

2.1 Surface water resources

With a mean flow of 41,000 m^3/s, the Congo River boasts the largest discharge volume in Africa (1,260 km^3), equivalent to 15 times the mean annual runoff of the Nile River and second in the world after the Amazon River. The Congo's catchment area of 3.7 million km^2 is the largest in Africa and its length of 4,700 kilometres is second only to the Nile. While it drains nine countries, 62 per cent of the river basin lies within the DRC.[8] A fairly stable year-round flow regime (ranging from 57,200 m^3/s in December to 32,800 m^3/s in August at Kinshasa[9]), is ensured by the relatively uniform equatorial climate, characterized by the lack of a true dry season coupled with the buffering role of the extensive rainforest swamps of the low-lying Cuvette Centrale. Only in the tropical savanna environment of Katanga and the Kasaï plateau in the centre and south of the country does a prolonged dry season exist, rendering these areas prone to drought spells.[10]

The overwhelming dominance of the Congo River basin is evident in that it covers 98 per cent of the DRC's surface area. Only 2 per cent of the country lies within the Nile basin.[11] This region is drained by the Semliki River in the northeastern Albertine Rift along the Uganda border, and includes lakes Edward and Albert. Despite its relatively small size, the Semliki watershed is a hydrostrategic region as it contributes up to 4.6 km^3 or 20 per cent of White Nile flows.[12] The DRC has one of the most extensively dense river networks in the world, totaling more than 20,000 kilometres of riverbanks.[13] Covering approximately 86,080 km^2, lakes and rivers account for 3.5 per cent of the country's land area. The DRC has an extensive system of lakes and wetlands, which are well described in the literature.[14]

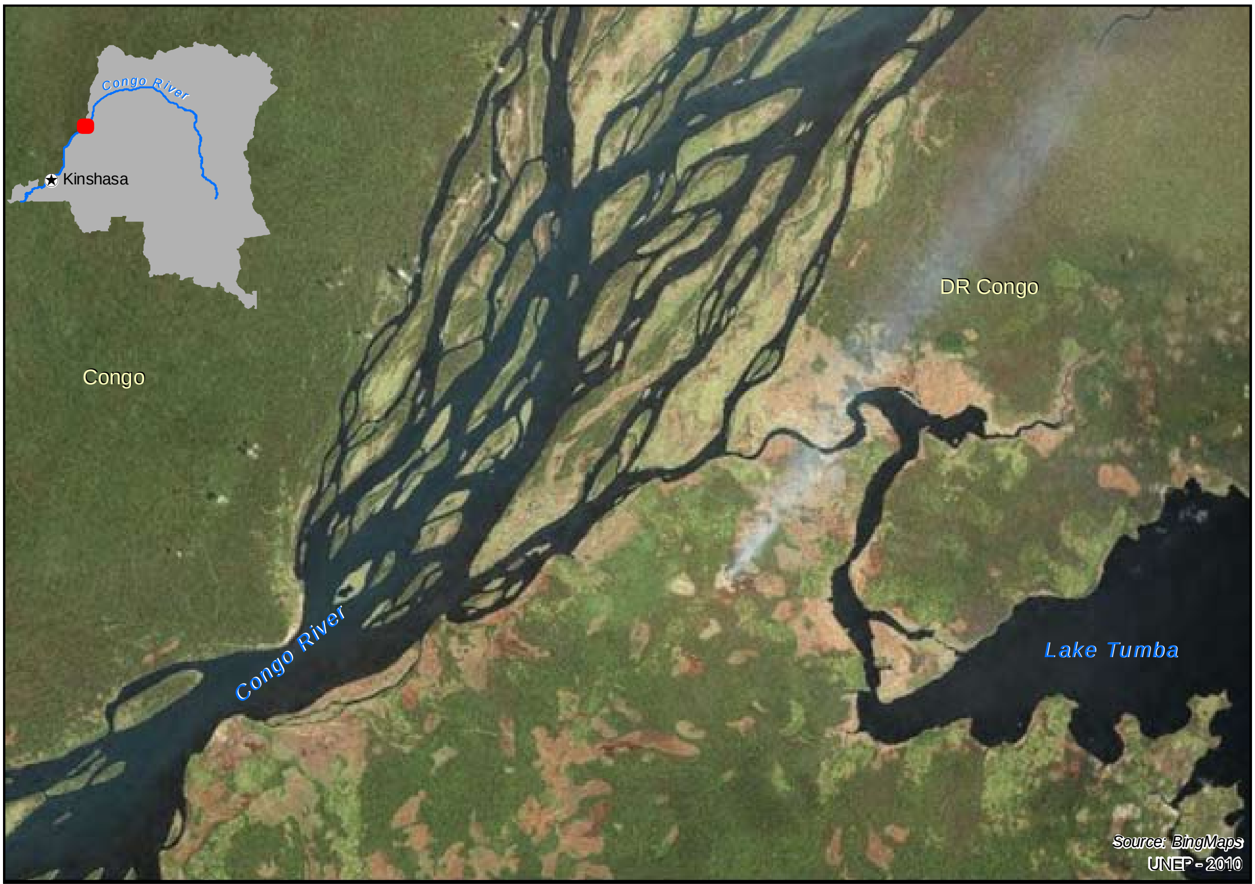
Over half of Africa's surface waters flow through the DR Congo. The Congo River north of Mbandaka, Equateur Province

Mbuti Pygmies draw drinking water directly from natural springs in Ituri forest

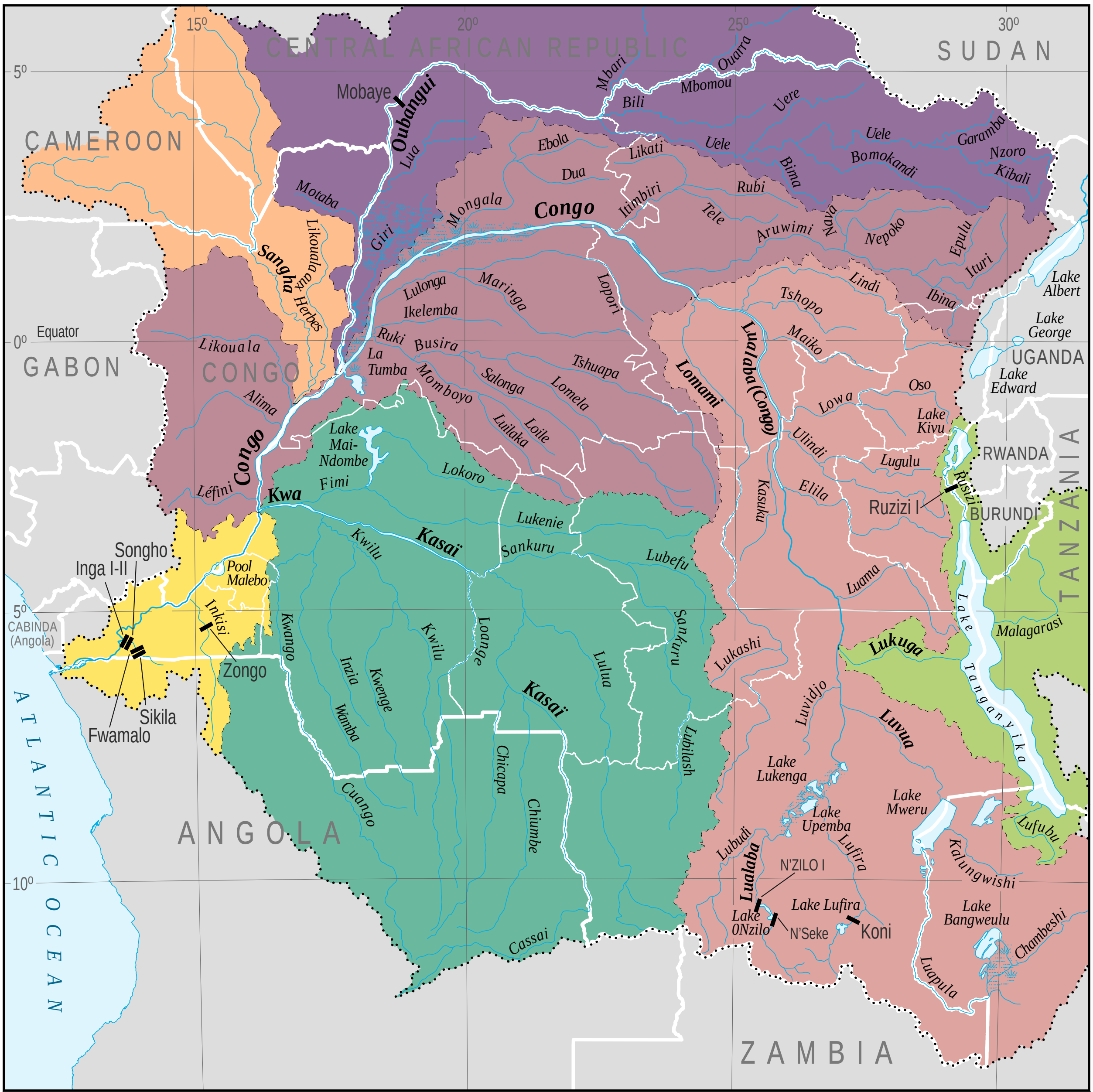
The Congo drainage basin

Given the scale and complexity of the Congo basin, understanding and managing it requires examination of its physiographic structure at the sub-watershed level. Within the DRC, the Congo basin encompasses over 20 major tributaries comprising four main sub-catchments: (i) the Lualaba/Tanganyika, (ii) the Kwa-Kasaï, (iii) the Oubangui and (iv) the main Congo. The Lualaba is the main headwater source of the Congo River rising in the savanna highland plateau of southeastern DRC (Katanga Province). Lake Tanganyika, despite being a semi-enclosed system with a relatively small discharge via the Lukuga River, holds an estimated one sixth of the earth's surface freshwater and is part of the Lualaba watershed. The largest contributor to the Congo River is the Kwa-Kasaï, originating from Angola's Lunda Plateau in the south and discharging an average of 10,000 m^3/s; almost equivalent to the flow of the main Congo River at its intersection. The Oubangui drains the northern plateaus of the Central African Republic (CAR), adding a mean runoff of 5,000 m^3/s.[15] The main Congo (Lualaba) flows through the down-warped depression of the Cuvette Centrale penetrating a dense tropical rainforest and continues until its outlet in the Atlantic Ocean. The Cuvette Centrale formed part of a large, ancient lake whose remnants are visible in the two major lakes of Tumba and Mai-Ndombe. It consists today of an immense flood zone that is equivalent to an inland delta. About 70 per cent of the Congo's water volume accumulates in the Cuvette, and its gradual release plays a critical role in regulating ecosystem dynamics and downstream flows.[16]

Satellite image 1. Braided channel of the Congo River, north of Lake Tumba



Map 1. Congo drainage basin



DEMOCRATIC REPUBLIC OF THE CONGO

- Lualaba - 870'000 km²
- Lake Tanganyika-Lukuga - 265'000 km²
- Middle Congo (Cuvette Centrale) - 705'000 km²
- Oubangui - 644'000 km²
- Sangha - 213'000 km²
- Kwa-Kasaï - 890'000 km²
- Lower Congo - 102'000 km²
- Congo basin - 3'689'000 km²

- International boundary
- Province boundary
- Lake and reservoir
- Marsh
- River
- Dam

Kilometres
0 100 200 300 400 500
Azimuthal Equidistant Projection

Sources:
International Boundaries, UNCS;
Hole-filled seamless SRTM data V4, CIAT;
rdc-humanitaire.net, OCHA/RDC;
VMAP0, NGA;
HydroSHEDS, WWF;
HYDRO1k, USGS;
Hydrology and water resources of Africa;
AQUASTAT, FAO;
various maps and atlases.

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Another approach to organizing the Congo River, typically applied for navigational purposes, is to divide it into three main segments: the upper Congo, the middle Congo and the lower Congo. From its source in the savanna environment of the Katanga Plateau and Lake Mweru to its junction with the Lomami River near Boyoma Falls, the upper course of the Congo River, called Lualaba, is broken by several rapids, most notably those known as the "Portes d'enfer." The middle Congo, encompassing the Cuvette Centrale, runs downstream from Kisangani through the dense equatorial rainforest to Pool Malebo, where the capital Kinshasa lies. As it is devoid of any waterfalls, the middle Congo's 1,700 kilometres is mostly navigable. Below Lisala, near the mouth of the Mongala River, the Congo's flow slows considerably as it expands into a wide, shallow, braided course reaching 10-16 kilometres across. [17] A mosaic of islands, estimated in total at over 4,000, as well as sandbanks subdivides the river at this point into a series of minor channels. Approximately 50 of these islands are over 50 kilometers in length [18] In this section, the Congo is surrounded on either side by vast areas of swampland.

Downstream from its intersection with the Kwai-Kasaï, the channel of the Congo River narrows down again into a deep "corridor" less than 1-2 kilometres wide, generating a tremendous increase in its discharge and velocity. Finally, the lower Congo is made up of a section of waterfalls and a maritime zone. Traversing the Crystal Mountains (Mbangu Mountains) between Kinshasa and Matadi, the Congo River has carved a deep gorge, creating one of the longest sections of waterfalls and rapids in the world. Plunging over a series of 32 cataracts, the most impressive of which is Inga, the river drops 280 metres in altitude over a distance of 250 kilometres.[19] This abrupt fall in river gradient is illustrated by its average slope of less than 7 cm/km between Kisangani and Kinshasa, increasing to 70 cm/km below Kinshasa. Near Boma the river expands to form a deep estuary that is about 80 kilometres long and widens to 10-15 kilometres at its mangrove-bordered mouth. Below the surface of the Atlantic, the estuary cuts down the continental shelf, producing one of the largest submarine canyons on Earth. Due to its high discharge and great energy, the lower Congo discharges an 80 kilometre plume offshore, estimated to carry a sediment load of 70 million tons annually into the Atlantic Ocean.[20] The isolating role of physical barriers including waterfalls and semi-enclosed domains is an important factor in the high levels of diversity and endemism observed in the DRC's fisheries and other aquatic fauna.[21]

The DRC is quintessentially a 'hydrographic state' defined by the drainage basin of the vast Congo River. The Lualaba at Kindu

As vegetation decays in water, acidic tannins leach out giving rise to a darkly stained appearance - Mfimi River, Bandundu Province

Surface water quality

Although poorly studied and despite the existence of localized pollution hotspots around urban centres and mining operations, in the larger picture surface waters in the DRC exhibit almost pristine quality conditions. This is largely due to the high dilution capacity of large volume flows through an extensive river and wetlands network, the fact that vast areas have low population densities and human activities generally being of a low-input subsistence type. The waters of the Congo River have been classified into two broad types: (i) whitewater rivers of the Batékés Plateau and the savanna mosaic of the Oubangui basin and Katanga Plateau, and (ii) blackwater rivers of the Cuvette Centrale. Whitewater rivers hold very low levels of dissolved minerals due to excessive leaching of underlying bedrock.[22] The blackwater swamps and streams of the Cuvette Centrale carry humic acids originating from the surplus of decaying rainforest vegetation, and have low oxygen and nutrient levels. The whitewater upper reaches of the Congo River (Lualaba, Lomami and Oubangui) and Rift Valley lakes are relatively more alkaline, with variable quantities of bicarbonates and moderate to high levels of dissolved oxygen.[23]

Slow-moving blackwaters flowing through the rainforests of the Cuvette Centrale

2.2 Groundwater and springs

Despite the abundance of surface waters, the vast majority of the DRC's population is dependent on groundwater and springs as sources of safe drinking water. Groundwater is estimated to comprise almost 47 per cent (421 km^3/yr) of the DRC's internal renewable water resources.[24] Information on the extent and quality of groundwater resources and springs in the DRC is scarce, and where available is often outdated and of limited geographic coverage.

The key large-scale hydrogeological units of the DRC include:

1. Highly productive Cuvette Centrale and Oubangui continuous aquifers composed of coarse alluvial sediments reaching up to 120 metres thick. Recharge is direct from rainfall as well as the river system. High-potential areas include Libenge and the alluvial plain between the N'Djili River and Ngaliema Bay in Kinshasa.

2. Low-potential tertiary-quaternary aquifer underlying the Batékés Plateau and southeast Kasaï. It consists mainly of semi-continuous sandy loam and soft sandstone, whose thickness can reach 100 metres in certain areas. The aquifer sustains many streams and is mainly replenished by direct rainfall, as indirect recharge from watercourses is relatively small.

3. Mesozoic (Karroo) sandstone and calcareous aquifers surrounding large parts of the Cuvette Centrale, including around Gemena, Kisingani and northern Kasaï. This region is characterized by rapid recharge and is of low to moderate productivity. In certain areas, fracturing has led to the development of karstic systems.

4. High yielding calcario-dolomitico sedimentary complex constituting a major carbonate aquifer in southern Katanga (Lubumbashi dolomites). This system is characterised by faulted heterogeneous aquifers.

5. Fractured Precambrian crystalline basement rocks (including basalt and granite) cropping out in the mountainous terrain along the Albertine Rift from Lake Tanganyika to Lake Edward, as well as in the lower Congo south of Kinshasa, hold major but discontinuous aquifers with high potential.[25]

Some 90 per cent of the DRC's rural population is dependent on groundwater and springs for drinking water. (Tomoti village, Bandundu Province)

Map 2. Groundwater resources

Groundwater resources

Major aquifers

- I — Highly productive Cuvette Centrale and Oubangui continuous aquifers; and other alluvial plains.
- II — Low-potential tertiary-quaternary aquifer
- III — Mesozoic (Karroo) sandstone and calcareous aquifers (low to moderate potential)
- IV — High yielding calcario-dolomitico sedimentary complex
- V — Fractured Precambrian crystalline basement rocks (discontinuous, high potential)

Kilometres
0 100 200 300 400 500

GCS: WGS 84

Sources:
Administrative: RGC, ESRI, Geonames.
Groundwater: Adapated from REGIDESO, 2004 and UNESCO, 2004.

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

UNEP - 2010

Groundwater generally has an acidic pH requiring an equilibrium treatment. Karstic and carbonated aquifers such as those of the Lubumbashi dolomites, however, produce alkaline groundwater. Soft sandstone, quartz and sand aquifers are generally very low in dissolved solids and minerals. On the other hand, thermal waters of volcanic and tectonic origin in the Albertine Rift, and dissolution from sulphide-bearing host rock (schist formations of gypsum, calcite, etc.) as found in Katanga and the littoral zone, generate highly mineralized groundwater. As these may also include heavy metals, detailed investigations are required to ensure that water is suitable for human consumption.[26]

Importance of springs and groundwater in drinking water supply

Springs comprise the main source of drinking water, estimated to supply up to 90 per cent of DRC's rural population. No inventory of springs exists at the national and provincial levels.[27] For the most part, these comprise simple, capped springheads that are widely used in dispersed villages, and also in the rapidly growing peri-urban areas. Large-scale water production from springs through distribution networks is also an important water source for many cities, including Mbuji-Mayi, Lubumbashi, Kisingani, Bunia, Beni, Gemena and Lisala.

There are only an estimated 1,000 deep-drilled wells in the DRC, providing service coverage for a small proportion of the population.[28] Most of these wells were constructed between the 1960s and 1980s, especially during the International Decade for Water Supply and Sanitation. Their yield typically ranges between 15 and 80 m^3/h, in some cases registering as high as 300 m^3/h.[29] Since the 1990s, limited well drilling has been carried out, though in the past several years it has been rapidly developing with international assistance. Most of the groundwater is otherwise exploited using dug wells in addition to hand and mechanical pump wells, which is estimated to account for approximately 10 per cent of the drinking water supply.[30]

A preliminary estimate for six provinces indicated that raising water access to 60 per cent by 2020 would require inter alia the development of 11,875 springs including 716 reticulated supply systems, 13,056 hand and pump wells and 707 electrically pumped deep boreholes.[31] This emphasizes the critical role of springs and groundwater in achieving MDG and PRSP drinking water targets. It also underlines the importance of data collection systems and hydrogeological studies in providing adequate information to plan efficient and sustainable use of groundwater resources.

2.3 Water Use

Up to date and accurate information on water use in the DRC is not available. In 2000, total water withdrawal was estimated by FAO Aquastat at 356 million m^3 for that year, which represents merely 0.04 per cent of DRC's internal renewable water resources. This clearly illustrates the minor level of water resource mobilization at the national level. Per capita water availability, estimated at 19,967 m^3 in 2008, is well above the internationally recognized water sufficiency benchmark of 1,700 m^3.[32] Water abundance sharply contrasts, however, with effective supply, estimated in 2000 at only 7 m^3 per capita per year. In fact, water use per inhabitant in the DRC is considerably lower than that of many arid Sahel countries experiencing a *physical water scarcity* problem.[33] This clearly reveals the extent to which *economic water scarcity* is hindering development in the DRC.

Despite its abundant water resources, water use per inhabitant in the DRC is considerably lower than that of many arid Sahel countries. Population lining to purchase water from a REGIDESO public standpost in Kikwit, Bandundu Province

Domestic water consumption accounts for over half of water use in the DRC. Collecting water from a public standpost in Likasi (Katanga - above) and Beni (North Kivu - bottom right)

At the same time, there are also several regions in the DRC that are susceptible to experiencing physical water shortages in the near future. Paradoxically, this includes critical recharge zones such as the steeply sloping regions along the Congo-Nile watershed divide in eastern DRC. Emerging hot spots include Beni and Butembo, where increasing demand from the dense and rapidly growing population is placing major pressure on water resources. Drought-prone regions in the savanna environment of the Katanga and the Kasaï plateau are also prone to seasonal water shortages.

The defining characteristic of water use in the DRC is the dominance of domestic water consumption, accounting for 52 per cent of total withdrawal. This contrasts with most African countries, where agricultural usage is normally the leading water consumer. Given the reliance on rain-fed agriculture and negligible irrigation, the agricultural sector accounts for 32 per cent of water withdrawals, followed by industry with 16 per cent.[34] Hydropower generation, fisheries and navigation are not typically included in water use accounting due to negligible physical abstraction. Nevertheless, the needs of these three

Given the extensive river network, fluvial navigation is a critical means of transportation and trade.
A pirogue carries sacks of rice along the Congo River near Bumba, Equateur Province

sectors should be taken into consideration given (i) the DRC's reliance on hydropower for its electricity needs as well as its immense untapped generation potential, (ii) the importance of fisheries for livelihoods and as a source of protein in the population's diet and (iii) the critical role of fluvial navigation as a means of transportation.

Given current trends, water withdrawal is projected to grow significantly by 2025. Based on the year 2000 baseline, domestic water consumption is expected to expand by 470 per cent, agriculture by 375 per cent and industry by 225 per cent (Table 1). In absolute terms, however, these estimates remain negligible since by 2025 total water consumption would still only represent 0.16 per cent of DRC's internal renewable water resources.[35]

Table 1. Evolution of water withdrawal by sector in DRC (million m^3)

Year	Domestic	Agriculture	Industry	Total
1990	80.8	70	34.9	185.7
2000	186	112	58	356
2025	874	420	130.5	1424.5

Source: adapted from CICOS, 2007.

3 Water sector governance

Water sector governance is structurally weak, characterised by a multiplicity of laws and institutions with often overlapping and conflicting mandates. The DRC lacks a clear water policy, a framework water law and a dedicated water ministry to guide and lead sustainable development of the sector. While legal and institutional inadequacies have long been recognised since at least the 1980s,[36] political turmoil and conflict have precluded these deficiencies from being effectively addressed. This situation, however, is about to change with ongoing reorganization of the water sector under a government reform initiative begun in 2006 with the support of development partners, particularly the German Technical Cooperation's (GTZ) water reform project (RESE). It is also noteworthy that the new 2006 constitution recognises access to water as a basic human right.

3.1 Legislation

Around a dozen ordinances and decrees regulate the water sector, several of which date from the pre-independence period. Based on a partial subsector approach, these largely outdated by-laws focus mainly on protection of water sources from contamination, drinking water supply and the management of user rights. As such, they do not provide a coherent legal framework for organizing a multi-stakeholder water sector.

Under the ongoing water reform sector initiative (RESE) supported by GTZ, a draft comprehensive Water Code has been prepared in 2010, which provides an overarching legislative framework for the rational and sustainable management of water resources. A fundamental principle defining the water law is Integrated Water Resources Management (IWRM), which aims to create a structured process for reconciling the divergent needs of multiple stakeholders, including ensuring the sustainability of aquatic ecosystems. One of the key environmental protection tools envisaged in the law is a land zoning system to safeguard strategic drinking water supply sources and their watersheds.[37] Other key tenets of the Water Code include the user pays principle, the polluter pays principle, the precautionary principle, the subsidiary principle (i.e., decentralisation of decision-making) and public dialogue and consultations.

The Water Code creates a new institutional architecture for the organization and management of the sector. In line with the decentralisation provisions of the 2006 constitution, it lays down the basis for the devolution and transfer of water supply services to provincial and local administration. It also removes state monopoly over the water supply subsector and opens the way for the engagement of community-based organizations and investment from the private sector through public-private partnerships (PPP).[38]

The Water Code has been developed in a complex context primarily due to the lack of a clear water policy. As a result, the law has in effect laid down the guiding principles for the development of a suite of policy instruments to plan and manage the efficient use of water resources. These include a national water policy that takes into account the objectives of all subsectors, national and provincial water action plans prioritising interventions and implementation modalities, as well as drainage basin and area based development plans.[39] It is important to note that the Water Code does not envisage the development of one single national water strategy. Instead the Code mandates the elaboration of a broad water resources management strategy (led by MENCT) as well as subsector strategies, most notably a national public water services strategy that would *inter alia* define the sector's decentralised institutional framework.

The draft Water Code has been the subject of an extensive consultation process at the inter-ministerial level as well as by civil society and provincial authorities. It was recently validated in a national workshop in Kinshasa and should be submitted to Parliament for discussion and adoption in late 2010.

3.2 Institutional Arrangements

Management of the water sector is fragmented among seven ministries and several organizations.

Rural health centers play a key role in the national *Village Assaini* programme, which seeks to mobilize communities to develop drinking water sources (Mushie Pentane, Bandundu Province)

Areas of responsibility are not clearly defined. Overlapping competencies and conflicting mandates have led to institutional competition, while incentives for effective coordination are lacking. Notwithstanding its obvious priority status, the almost exclusive bias towards drinking water supply has led to the neglect of other important activity areas. Moreover, the generally weak administrative capacities of water institutions have thwarted progress and development of the sector.[40]

The two main ministries heading the water sector are the Ministry of Environment, Nature Conservation and Tourism (MENCT) and the Ministry of Energy (MoE). Management of water as a natural resource falls under MENCT's Water Resources Directorate. Its regulatory duties include protecting aquatic ecosystems from all types of polluting activities, development of watershed management plans and handling international and regional water cooperation. Under the National Sanitation Programme (PNA), MENCT also has an executive responsibility to provide urban sanitation services, including wastewater treatment and solid waste management, two important sources of water pollution. MoE's Department of Water and Hydrology (DEH) has supervisory authority over REGIDESO, the state-owned corporation providing urban drinking water supply services, as well as SNEL, the public electricity utility in charge of hydropower development.

Other key ministries include the Ministry of Rural Development, whose national rural waterworks service (SNHR) is in charge of developing rural and peri-urban drinking water supply services. The Ministry of Public Health is responsible for supervising the potability of drinking water, but its capacity to monitor water quality is seriously deficient. For operational purposes, the Ministry of Public Health has divided the country into 515 rural health centres. Despite their limited capacity and resources, the health centres represent one of the few remaining state structures with an active presence at the local level throughout the DRC. Under the country wide programme to promote Sanitized Villages (*Village Assaini*), supported by UNICEF, health centres are mobilising communities to develop improved drinking water sources, particularly in dispersed villages.[41]

At the operational level, REGIDESO and SNHR are the two key water agencies in the DRC, respectively in charge of urban and rural water supply. Both organizations, however, are in a precarious situation today and do not have the capacity and financial resources to carry out their duties in a cost-efficient manner. Lack of rehabilitation and maintenance, coupled with looting during the conflict period, has rendered most of their facilities and equipment obsolete. Furthermore, they suffer from a serious shortage of qualified personnel, many of whom have either sought alternative employment or are approaching retirement age.

Other organizations involved in water management include METTELSAT and the fluvial and maritime transport agencies (RVF and RVM), all under the Ministry of Transportation. They perform a critical role in hydrological and meteorological data collection, but are under-capacitated and seriously lacking in resources. The Ministry of Agriculture is responsible for fisheries management and minor irrigation schemes.

Water sector coordination

As there is no central water ministry (even though the MENCT holds a generic mandate for the water sector), the sector as a whole is in effect led by the National Committee for Water and Sanitation (CNAEA). Operating under the auspices of the Ministry of Planning, the CNAEA provides a high-level inter-ministerial coordination mechanism and acts as a gateway for development partners. The CNAEA is specifically focused on programming and monitoring of the drinking water supply and sanitation subsectors and does not address water resources management in an integrated way. Operating at a policy and strategic level, the CNAEA sets planning goals and is in charge of resource mobilisation and donor facilitation. With limited resources, however, the CNAEA has functioned largely in a spontaneous and ad hoc manner and has not been able to effectively coordinate the sector. Moreover, its activities have been largely restricted to the national level, as most of its provincial committees are no longer operational. Nevertheless, in 2007 the CNAEA was accredited with legal status and accorded autonomous administrative and financial authority.[42]

Institutional reform

Under the ongoing reform process and the draft Water Code, the institutional framework of the water sector is set to undergo a far-reaching structural transformation. Firstly, to reconcile the needs of multiple stakeholders, the CNAEA will be replaced by a National Water Council whose scope of work will be broadened to handle the whole water sector based on an IWRM approach. Secondly, in line with the decentralisation process, Provincial Water Councils will be created as well as local Water Committees and Water User Associations. Thirdly, agencies will be established to manage water resources at the drainage basin and sub-basin levels, including aquifer systems.[43] In addition, organizational reform will also open a window of opportunity for private enterprise and social economy organizations (i.e. mainly cooperatives and entrepreneurial / user associations) participation in the water sector. Decentralisation and the creation of new bodies will require a drawn-out transitional process to take effect. Substantial resources will therefore need to be mobilised to build the embryonic capacities of the provinces and local authorities in water resources management.[44]

As part of the reform process REGIDESO's legal monopoly over the urban water supply sector will come to an end. REGIDESO, however, will continue to operate, but as a commercial corporation with the state as sole shareholder. SNHR's institutional status remains uncertain, hampering it from formulating a long-term action plan and mobilising resources. A recent government-commissioned study has proposed transforming SNHR from an implementing agency into a coordinating and regulatory body for water supply in rural areas.[45] However, the SNHR is likely to retain some executing capacity, particularly for borehole drilling operations[46] and has reportedly recently received around 38 borehole drilling rigs.[47]

An SNHR engineer operating from OXFAM's office in Kindu, Maniema Province, provides technical advice to NGOs and international organizations

Up until the early 1990s, the REGIDESO was reputed to be one of the most successful public water utilities in Africa. REGIDESO headquarters on the Boulevard du 30 Juin in Kinshasa

The role of NGOs

During the conflict years, a plethora of international and national NGOs moved to fill the shortfall in drinking water services as part of the overall humanitarian and emergency relief effort. Poorly coordinated and typically comprising targeted one-off activities, the performance of NGO projects has generally been wanting. As a result, NGO interventions have not succeeded in generating a sustainable improvement in water coverage. Nevertheless given the scale of drinking water needs and the weakness of government services, NGOs have a vital role to play in reaching otherwise inaccessible areas. Strengthening the technical and resource mobilization capacity of NGOs is therefore a critical strategy to maximize and improve water service delivery.

International Assistance

International development partners have historically played a critical role in the development of the DRC's water sector. Following a decade-long suspension of donor assistance starting in the early 1990s, many development partners had by 2005 re-engaged in the water sector. Today, international aid accounts for almost 95 per cent of total investments in the water sector, equivalent to around $62 million per annum. Donor financial commitments are significantly higher, estimated at $171 million per annum over the period 2007-2008. Project implementation, however, has trailed behind with only 38 per cent disbursement rate. The resultant delay in project delivery is largely due to limited technical capacity, logistical constraints and complex project application procedures.[48] Despite significant donor support, the financial gap to meet the PRSP's revised water goals is nevertheless estimated at $102 million per annum[49] (Figure 2, page 28).

Most donor projects and programmes are focused on reaching MDG and PRSP water targets. International assistance is almost equally divided between the rural ($34-40 million) and urban water sectors

($30 million). In the rural and peri-urban water sector, international assistance accounts for the quasi-totality of all spending. It includes an important humanitarian and emergency component, but this is more difficult to quantify. Rural water sector assistance is essentially channelled through two programmes: (i) "support for autonomous community-based water supply systems" that is financed by four main donors, namely Belgium Directorate General for Development Cooperation (DGCD), UK Department for International development (DFID) , the European Union (EU) and French Development Agency (AFD), and (ii) the "Sanitised Villages" programme with support from the United Nations Children's Fund (UNICEF), Japanese International Cooperation Agency (JICA), United States Agency for International Development (USAID) and UK-DFID (Table 2).[50]

Major infrastructure investments in the urban water supply sector are led by the World Bank, the African Development Bank (AfDB), JICA, the German Development Bank (KfW) and more recently by the national public water utility REGIDESO. As indicated in Table 3, substantial resources have been successfully mobilized for the urban water sector amounting to $500 million. The World Bank is spearheading the restructuring of REGIDESO and the urban water management subsector as a whole.[51] GTZ is providing lead technical assistance for the overall water reform process. In addition, the Chinese Cooperation is reportedly developing urban water projects. India recently delivered 33 borehole drilling rigs and is training SNHR personnel, while China has provided 5 borehole drilling stations. Discussions are also reportedly underway with South Korean companies to construct water supply infrastructure in return for mining concessions in Katanga.[52]

The Management Platform for Aid and Investments (PGAI) coordinated by the Ministry of Planning brings together 10 major donors, of whom 7 accounted for around 95 per cent of all external financial commitments for the water sector (including the World Bank, AfDB, Belgium, EU, Japan, Germany and the United Kingdom). According to the PGAI, 5 per cent of total donor assistance ($6.9 billion) over the period 2007-2008 was allotted to the water sector, placing it in sixth place in relation to other sectors. In terms of actual spending, the water sector, with 3 per cent of expended donor assistance, ranked eighth over the same period.

The government-led *Thematic Group 13* on water and sanitation provides a platform for coordinating the activities of government agencies and development partners. It meets on a regular basis and serves as a mechanism for dialogue and information exchange. Donor fragmentation is less of an issue in the water sector. Nevertheless, as it is expected to experience substantial investment growth in the short term, the role of Thematic Group 13 and CNAEA's coordinating capacity will require reinforcement.

Table 2. Major funding sources for the rural and peri-urban water and sanitation sector

Programmes / donors	Sum disbursed (USD Million)	Beneficiary population	Period
Sanitised Villages programme (UNICEF, DFID, JICA, USAID)	40	800,000	2008-2009
Autonomous community-based water supply systems (Belgium-DGCD, DFID, EU, AFD)	11	100,000	2007-2009
Pooled Fund	9	225,000	2008-2009
International Committee of the Red Cross (ICRC)	n.a	1,475,795	2002-2009
OXFAM-Quebec	2.5	200,000	2004-2009
GoDRC Unit for Programme Coordination (UCOP/World Bank)	0.72	111,286	2008-2009
GoDRC Central Coordination Bureau (BCECO)	0.542	15,000	2003-2009
GoDRC Social Fund	0.998	221,148	2008-2009
Total	**64.8**	**3,148,229**	

Source: CNAEA/WSP (2010).

Table 3. Current financial commitments for the urban water supply sector by donor

Rank	Donor	Amount (USD Million)	Percentage
1.	World Bank	219	43.8%
2.	African Development Bank (AfDB)	113.6	22.7%
3.	Japan International Cooperation Agency (JICA)	62	12.4%
4.	German Development Bank (KfW)	58.6	11.7%
5.	GoDRC/REGIDESO	19.4	3.9%
6.	Arab Bank for Economic Development in Africa (BADEA)	15	3.0%
7.	European Union	8.2	1.6%
8.	French Development Agency (AFD)	2.6	0.5%
9.	International Committee of the Red Cross (ICRC/UNDP)	1.1	0.2%
10.	Belgian Development Cooperation (DGDC)	1	0.2%
	Total	**500.5**	**100%**

Source: CNAEA/WSP (2010).

4 Key issues in the water sector

4.1 Drinking water crisis

Based on the most recent estimates (2010), only around 26 per cent[53] of the DRC's population of 67.8 million – equivalent to 17.6 million people – have access to safe drinking water, well below the approximately 60 per cent average for Sub-Saharan Africa. This means that almost 51 million people do not have access to potable water in the country today. Until recently, the deteriorated state of the country's water infrastructure and rapidly growing population (estimated at 3 per cent) had meant that water coverage was on a negative and declining trend. (Figure 1) The DRC, however, has succeeded in arresting and indeed reversing this downturn by achieving for the first time since 1990 an increase in water accessibility, from 22 per cent in 2004 to 26 per cent in 2010.[54] Although this 4 per cent addition is relatively small, it nevertheless represents a 20 per cent increase. This significant turn-around is due to high-level political commitment prioritising the water sector in the country's post-conflict reconstruction agenda and the successful mobilisation of substantial international development assistance.

Nevertheless, the country remains off-track in achieving the MDG target for water, which under normal circumstances would have required an expansion of coverage to 71 per cent of its population, equivalent to almost 55 million people by 2015. Based on population growth projections (Table 4), if the MDG target were to be realized by 2030, when the DRC's population is expected to reach 108.5 million, an additional 60 million people would need to gain access to a safe water supply. This is equivalent to supplying an additional 3 million people per annum over the next 20 years.[56]

Given this enormous challenge, the PRSP justifiably revised its benchmark below the MDG water target and set an objective of providing water coverage to 49 per cent of its population by 2015. Even with this adjustment, the goal remains ambitious as it requires providing an additional 20.3 million people (equivalent to 3.4 million people per annum) with safe drinking water between 2010 and 2015. Achieving the PRSP's water coverage target is estimated to require an annual public investment of $171 million per annum over a 12-year period from 2004 until 2015. Progress, however, has been constrained by a major funding gap of approximately 60 per cent.[57] (Figure 2) Based on the latest WSP-commissioned assessment in 2010, the DRC will also not be able to attain its PRSP water target.

Consequently, drinking water objectives have been further scaled down in the PRSP's Programme of Priority Actions (PAP). In a best-case scenario, the DRC will only be able to raise water access from the current 26 per cent in 2010 to 38 per cent in 2015. This projection is based on current experiences with the implementation of water supply projects and the financial resources already mobilised includ-

Table 4. Population growth and prospects for the DRC (thousands).[55]

Year	Total Population	Rural population	Urban population	Rural (%)	Urban (%)
1980	27 170	19 367	7 803	71.3	28.7
1985	31 402	22 617	8 786	72.0	28.0
1990	37 016	26 717	10 299	72.2	27.8
1995	44 921	32 148	12 773	71.6	28.4
2000	50 829	35 662	15 168	70.2	29.8
2005	59 077	40 109	18 967	67.9	32.1
2010	67 827	43 940	23 887	64.8	35.2
2015	77 419	47 560	29 858	61.4	38.6
2020	87 640	50 806	36 834	58.0	42.0
2025	98 123	53 408	44 715	54.4	45.6
2030	108 594	55 212	53 382	50.8	49.2

Source: UN DESA/Population Fund.

ing the medium-term outlook, as well as progress with on-going water reform and capacity-building programmes. On the other hand, based on current trends, the status quo scenario is that water service provision is only likely to increase by 5 per cent, from 26 per cent in 2010 to 31 per cent in 2015.[58] This is significantly below both the MDG and PRSP targets, but nevertheless would represent a 40 per cent increase from 2004 levels.

It is important to recognize the geographic discrepancy in drinking water availability, which is skewed towards urban centres. Of the 17.6 million people with access to safe drinking water, roughly 70 per cent are urban residents and 30 per cent live in rural and peri-urban areas.[60] While national drinking water coverage is estimated at 26 per cent, this ratio ranges from 38 per cent in urban centres and 17 per cent in rural areas[61] (Table 5). In other terms, more than 1 in 3 urban residents has access to safe drinking water, while the ratio in rural areas is almost 1 in 6. In reality, even these figures do not reflect the geographic disparity in drinking water access, which in many areas is below 5 per cent.[62] For example, access to safe drinking water was less than 5 per cent in Mbandaka and Mbuji-Mayi,[63] capital of Equateur and Kasaï Oriental provinces respectively, 1 per cent in Tshikapa in Kasaï Occidental[64] and 3 per cent in Banalia Health Zone in Orientale Province.[65]

Figure 1. Evolution and prospects for safe drinking water coverage in the DRC.[59]

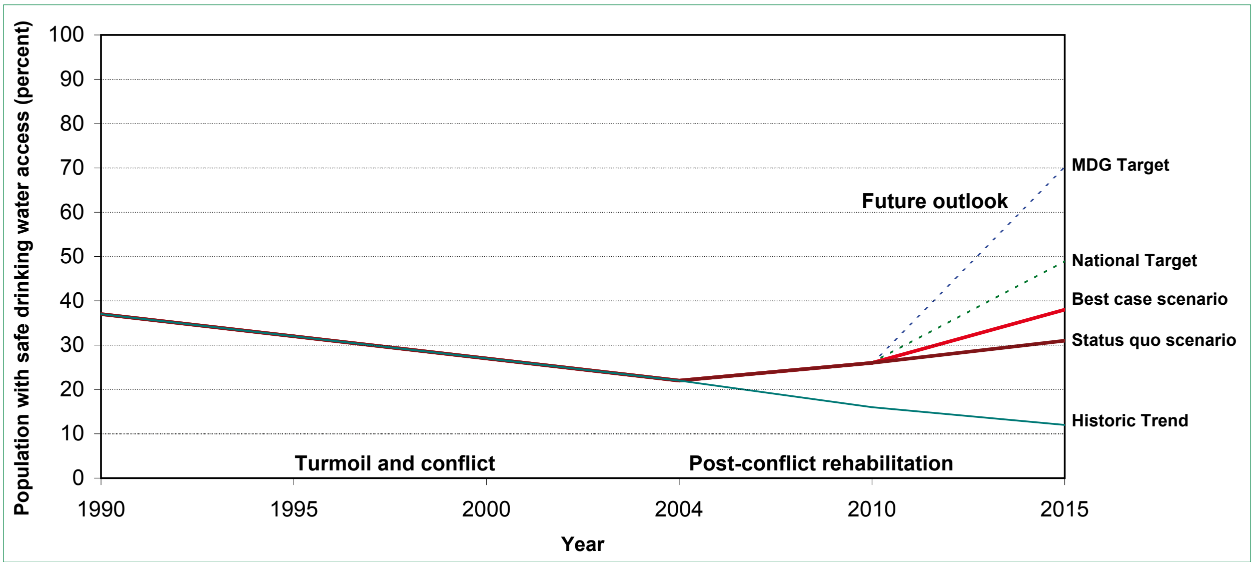
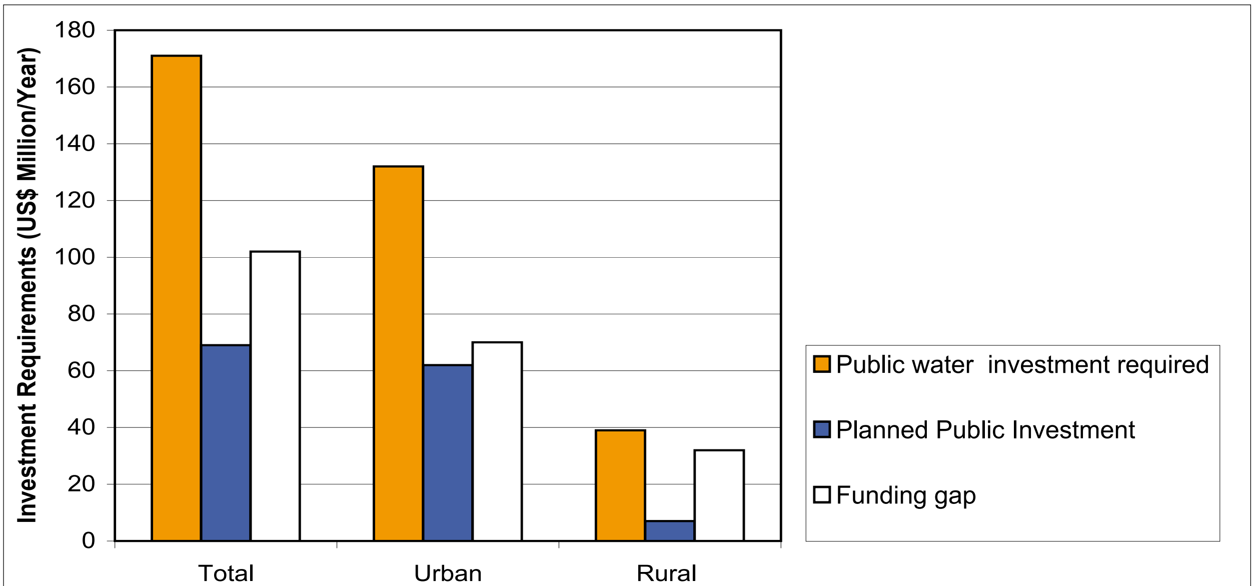
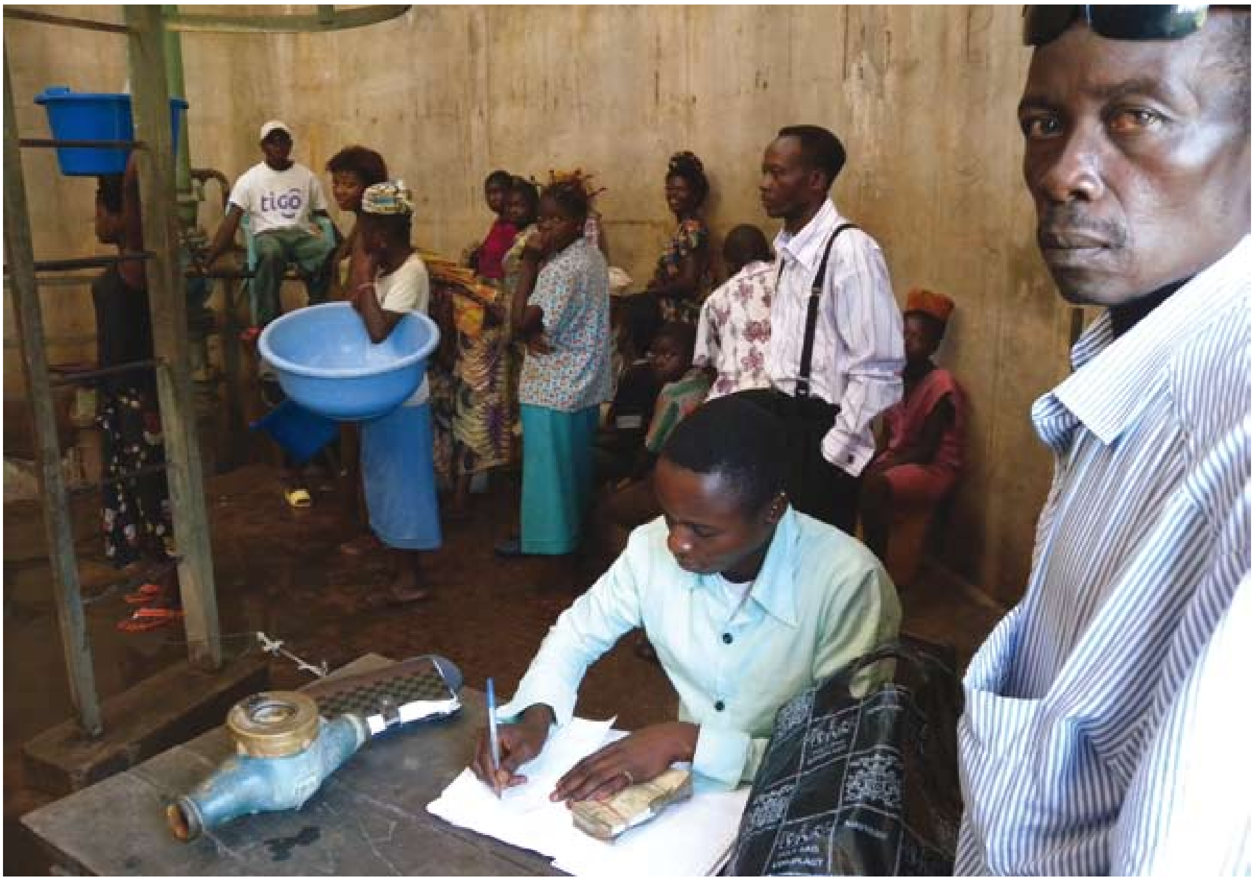


Figure 2. Water sector investment requirements.[66]





The water distribution system in Kananga, capital of Kasai Occidental Province, has ceased to function in this city of nearly one million. Water is sold at REGIDESO's main water tower

Table 5. Percentage of the population with access to water.

Year	Urban	Rural	Total
1990	68	21	34
2004/05	37	12	22
2008	38	17	24

Source: CNAEA/WSP (2010).

The disparity between urban and rural areas is not only limited to water coverage rates. In terms of financial investments, there is also a strong urban bias, with 85 per cent of total allocations designated for urban centres. Under the PAP II (2009-2010), \$413 million has been earmarked for water supply investments, of which approximately \$353 million has been assigned to urban centres, compared to \$60 million for rural areas.[67] At the regional level, most of the financial commitments for the period 2010-2015 are targeted at Kinshasa, which with \$141 million accounts for 40 per cent of city- or province-specific obligations. The two Kasaïs, Bas Congo and Katanga account for 7-10 per cent of total planned expenditure, while the other provinces account for less than 5 per cent[68] (Table 6).

Table 6. Financial commitments for the national and urban water sector by province (2010-2015).

Provincial Rank	Province	USD Million	Percentage
1.	Kinshasa	141.4	28.5
2.	Kasaï Occidental	49.1	9.9
3.	Bas Congo	42.5	8.6
4.	Katanga	38.7	7.8
5.	Kasaï Oriental	31.9	6.2
6.	Equateur	27.8	5.56
7.	Bandundu	20.7	4.16
8.	North Kivu	4.5	0.9
9.	South Kivu	1.1	0.2
10.	Maniema	0.8	0.2
11.	Province Oriental	0.14	0.03
	National water sector (reform, institutional development, equipment)	141.9	28.6
	Total	**500.5**	**100**

Source: CNAEA/WSP (2010).

Urban and peri-urban water supply: the demographic challenge

Although water access rates are significantly lower in rural areas, the actual number of people without access to drinking water is growing at a considerably faster rate in urban centres. Compared to other African countries, the DRC has a relatively high proportion of its population residing in urban areas, estimated currently at 35 per cent and projected to increase to almost 40 per cent by 2015. Over the period 2005-2010, the urban annual growth rate in the DRC stood at 4.6 per cent, significantly higher than both the rural and total annual growth rates of 1.8 and 2.8 per cent respectively (Table 7). Closely associated with urban population growth, the spatial expansion of urban sprawl across the DRC is having major adverse impacts on the prospects of installing adequate water infrastructure.

Urbanisation is largely driven by rural migration that has been significantly accelerated by conflict induced population displacement. REGIDESO has not only been unable to cope with this rapid population influx, but the population it is servicing has declined in real terms due to the degradation of its infrastructure. Moreover, impoverished secondary urban centres with very limited water supply infrastructure have experienced massive growth. A growing number of these urban centres are hosting populations of over 1 million inhabitants. This is evidenced by the slow progress in urban water access rates from 37 to 38 per cent between 2004 and 2008.[69] Rapid growth of the urban population in a context of increasing poverty and declining water service coverage therefore represents a paramount challenge for the urban water supply sector.

Table 7. Urban and rural population growth rates and prospects for the DRC.

Year	Urban annual growth rate (%)	Rural annual growth rate (%)	Total annual growth rate (%)
1980-1985	2.37	3.10	2.90
1985-1990	3.18	3.33	3.29
1990-1995	4.31	3.70	3.87
1995-2000	3.44	2.07	2.47
2000-2005	4.47	2.35	3.01
2005-2010	4.61	1.82	2.76
2010-2015	4.46	1.58	2.65
2015-2020	4.20	1.32	2.48
2020-2025	3.88	1.00	2.26
2025-2030	3.54	0.66	2.03

Source: UN DESA/Population Fund.

In November 2009, the head of the REGIDESO center in Gemena - a city of around 275,000 inhabitants – turns on the taps for the first time in 13 years. Fuel shortages and ransacking of water installations during the conflict has left this city without running water since 1996

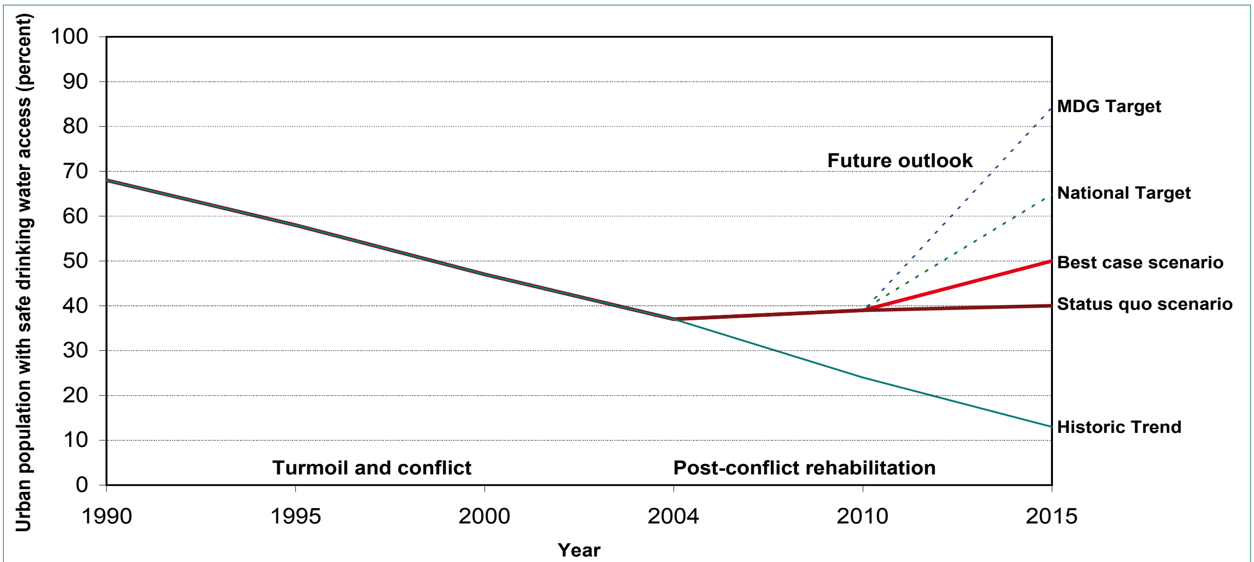
Following considerable investment under the International Drinking Water Supply and Sanitation Decade (1981-1990), the DRC succeeded in doubling its water access rate and almost reached the 70 per cent coverage target in urban areas. With the withdrawal of international partners and ensuing turmoil in the early 1990s, water supply coverage in urban areas underwent a major decline by almost one half – from 68 per cent in 1990 to 35 per cent in 2006. (Figure 3) This means that out of an urban population of 21.3 million, only 7.36 million people currently have access to drinking water. It should be further noted that of the aforementioned 35 per cent ratio, the majority (63 per cent) is indirectly served by accessing water from neighbours. Considering only active connections from the public water utility REGIDESO, the urban water access rate in DRC would be revised to 13 per cent.[70]

Prior to the early 1990s, REGIDESO was considered to be one of the country's most effective government institutions and was one of the best regarded water utilities in Sub-Saharan Africa. Today, however, most of its production centres are in a precarious state, either functioning under capacity or not at all. This predicament is the cumulative result of a lack of maintenance and investment, suspension of donor aid from 1992-2001 and the impacts of prolonged conflict. As of the end of 2006, out of REGIDESO's 94 centres, only 60 were operational. Of the 34 dysfunctional centres, at least 11 or one third of the installations were looted and completely destroyed during the war.[71] It is also noteworthy that only nine cities have operational water distribution networks.[72]

Geographically, urban water coverage is disproportionately concentrated in a few centres. Most urban water connections (> 85 per cent) are found in four provinces: Kinshasa, Bas Congo, Katanga and war-torn South Kivu. REGIDESO's three most important centres – Kinshasa, Lubumbashi and Matadi – account for 62 per cent of the utility's production capacity, 72 per cent of its revenue and 79 per cent of its active customer base. Conversely, three provinces – Equateur, Kasaï Occidental and Maniema – have urban water coverage of less than 5 per cent.[74]

A substantial part of REGIDESO's infrastructure dates from the colonial period as well as from infrastructure investments carried out from 1970-1990. For example, Kinshasa's water supply system installed in 1950 was initially destined to service 500,000 people[75] but the city which now ranks as the third largest in Africa has a population estimated at 8.75 million inhabitants in 2010[76]. Limited investment has been made to cope with the increasing water demand and inadequate maintenance has left the distribution in a dilapidated state. Moreover, most REGIDESO centres in secondary cities were out of reach during the crisis years and do not function properly today due to lack of maintenance and rehabilitation. Their continued makeshift operation has been largely driven by staff initiative and creativity. While the relationship with REGIDESO

Figure 3. Evolution and prospects for safe drinking water coverage in urban centers.[73]



headquarters in Kinshasa has been gradually revitalised, active reconstruction of secondary centres remains for the most part on hold. With World Bank support, a phased approach is currently underway for REGIDESO reform, focusing initially on upgrading its abovementioned three most important operational centres. Depending on the results, the aim is to extend this initiative to help restitute other secondary centres.[77] In addition, the creation with World Bank support of a new institutional structure, known as the Remise en Service des Centres en Arrêt et Création des Nouveaux (RESCA-CN), to help the REGIDESO recover its public water bills should enable it to rehabilitate and build new water treatment plants[78].

As individual water connections are unattainable for most households,[79] one of the key strategies to develop basic services aims to service low-income peri-urban areas not currently covered by REGIDESO by establishing public standposts fed by small, piped water networks. On the one hand, development partners such as the World Bank and the African Development Bank aim to deliver such systems by working with and through REGIDESO and enhancing its capacity through public-private partnerships. Other partners such as the Belgian Development Agency (BTC) are establishing private, community-managed standpost systems as an alternative solution for peri-urban areas not serviced by REGIDESO. Despite the difference in delivery approach, this pragmatic strategy has the clear advantage of rapidly maximising coverage in the vast and impoverished outlying settlements that have grown around DRC's urban centres. In this respect, one of the key actions required is to regulate and formalise community-level water service provision.

During the conflict, many REGIDESO centers, such as the above Ndjongobono station in Lisala, Equateur Province, were pillaged

Local residents queuing in the Cité Musonoie in Kolwezi to draw water from breaches in the water pipeline (Katanga Province)

Abandoned in the early 1990s, the REGIDESO center in Libenge is overtaken by the forest. A lamp post relic points to the installation

Box 4.1 A glance at REGIDESO's challenges in Equateur Province

With only five per cent of its urban population, estimated at one million in 2006, having access to drinking water, Equateur Province illustrates the urban water supply crisis facing many of DRC's secondary cities. Given their dire financial situation, provincial REGIDESO centres are wrestling to cover their basic operational costs, particularly for fuel and chemical inputs. Only two of Equateur's 12 provincial centres are currently operational, even if only on a partial basis.

The number of individually connected subscribers in the provincial capital of Mbandaka, a city of approximately 700,000 inhabitants, declined by an estimated 83 per cent – from 9,000 in the early 1990s to 1,500 in 2009.[80] One of the main constraints facing REGIDESO-Mbandaka is the decrepit state of its 215 kilometre water supply network, which reportedly experiences 30-40 leakage incidents per month and has never benefited from any rehabilitation since it was constructed in the 1950s and 1960s. With respect to cost recovery, it was reported that whereas the price to produce one cubic metre of water was FC 579, domestic users were charged only FC 139, or 24 per cent of production cost. Furthermore, the sales collection rate was only 30 per cent. The head of REGIDESO in Mbandaka reported that if it were not for the local brewery, whose payments cover 40 per cent of its budget and 80 per cent of salaries, operations would have been forced to close long ago. The net result is that REGIDESO-Mbandaka is only able to provide a water supply service for five hours per day every other day of the week to less than 5 per cent of the city's population.[81]

With the collapse of public water services, some households in Mbandaka had developed their own water sources, mostly dug out wells, or simply tapped water from unimproved water sources such as local springs and streams. In some cases several families had joined to develop a common water source, but rarely had this been organized at the neighbourhood or community level. One of the problems associated with the unregulated proliferation of private water sources is that it is difficult to adapt to seasonal variability and to monitor water quality problems, especially given the risks of contamination from pit latrines in densely populated urban areas. Substantial public education and technical assistance is therefore required to ensure the water safety of private sources. Nevertheless, most households rely on private suppliers, making them liable to paying for water at inflated prices. Meanwhile, the international NGO SNV (Netherlands Development Organization) is assisting REGIDESO to address the problem of water shortages by setting up 121 public standposts in Mbandaka and its environs.

Rural water supply: a historically weak and neglected sector

The drinking water crisis has a strong rural dimension, where the majority of the population without access to potable water resides. Indeed, the Minister of Planning recently stated that "it is here that the DRC's water battle will take place."[82] Drinking water coverage has historically been low in rural areas, attaining a high of 21 per cent in 1990. In the war's aftermath, rural water access rates had fallen to 12 per cent in 2004 (Figure 4). Since then and in the wake of post-conflict reconstruction, the rural water sector has been undergoing noticeable transformation, registering an appreciable rise in water coverage by 5 points to reach 17 per cent in 2008. In addition to the SNHR, key players in the rural water sector include UNICEF, BTC, OXFAM and CICR.

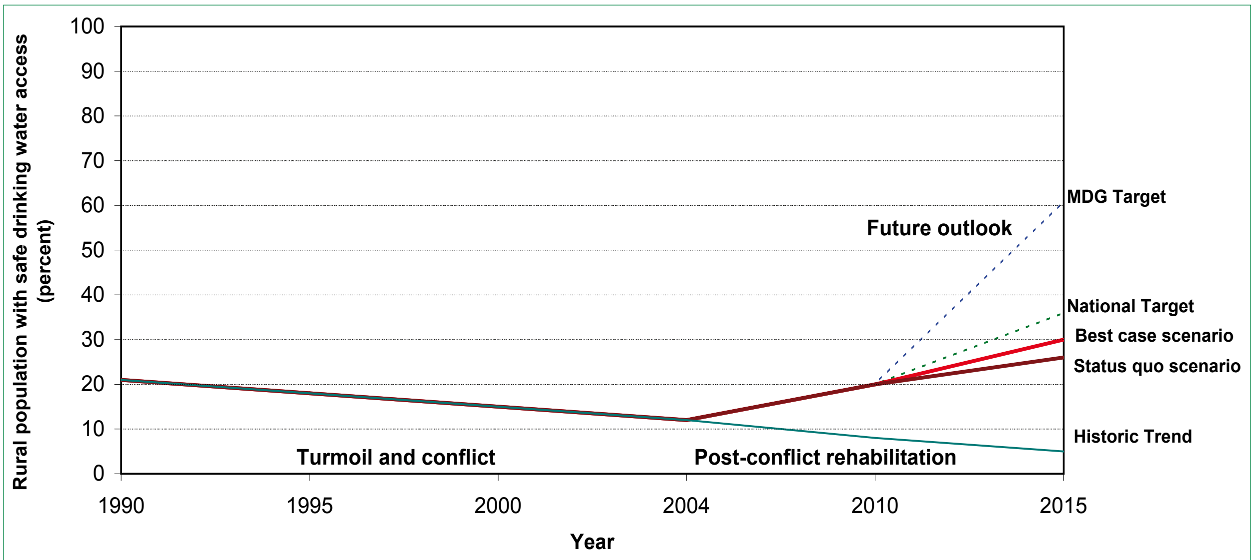
Despite a reversal of the declining trend, the rural water supply sector remains marginalised, receiving only 15 per cent of overall water supply investments.[83] Despite the aforementioned progress, of the DRC's approximately 44 million rural inhabitants in 2010, approximately 7.5 million people had access to safe drinking water. Under the PRSP, the objective to raise rural water supply to 36 per cent would require a substantial addition of approximately 1.4 million people annually between 2010 and 2015.

A key feature of the rural water sector is the poor and derelict state of its infrastructure. An estimated 60 per cent of existing rural water works is no longer operational due to lack of maintenance and spare parts.[85] It should be further noted that most rural water systems were constructed between 1983 and 1990 as part of the International Drinking Water and Sanitation Decade. Between 1991 and 2003 there was minimal investment in the sector and most interventions undertaken as part of emergency and humanitarian operations.[86] Due to the poor quality of its construction, most of this "humanitarian infrastructure" has fallen into disrepair.

Springs are the main source for rural water supply in the DRC and typically require minimal investment to develop and maintain. It is estimated that on average 90 per cent of the rural population uses springs for their water supply, particularly in dispersed villages of fewer than 500 persons. For the most part, springs are exploited without adequate development and protection. Moreover, where developed, the quality of spring protective structures was observed by UNEP to be of generally poor standard and inadequate maintenance. The remainder of the rural population mainly relies on shallow wells, using both hand and machine pumps. Small, piped distribution systems, boreholes and rainwater harvesting structures account for an insignificant proportion of overall rural water supply.[87]

For large village settlements as well as peri-urban areas, current investments aim to expand borehole drilling and small piped networks that would typically serve a population of between 2,000 and 5,000 persons.[88] The strategy is to have these small water supply networks managed by autonomous

Figure 4. Evolution and prospects for safe drinking water coverage in rural areas.[84]



The *Village Assaini* programme implemented by the Ministry of Public Health with support from UNICEF, aims to improve drinking water sources in the DRC's dispersed villages

community-based associations as well as local private firms. Successful experiences have been developed by BTC and others in both rural and peri-urban communities in Bas Congo, Kasaï Oriental, Kinshasa and South Kivu, which need to be replicated and scaled up (Case study 4.1).

For small, dispersed villages with typically 500-1,000 inhabitants, the national programming strategy is centred on the "Village Assaini" ("Sanitized Villages") model launched in 2006 and implemented by the Ministry of Public Health with support from UNICEF and other development partners. The programme marks a critical turning point from emergency and ad hoc rehabilitation interventions to systematic development of the rural water sector. One of the key elements in this integrated concept is to improve the quality of drinking water sources by tapping springs and constructing shallow wells through community mobilisation and capacity-building.[89] The programme, which has an annual budget of approximately $20 million per annum, aims to reach a population of 9 million people in 15,200 villages by 2012. By mid-2010, however, only 1,300 villages (1.6 million people) were declared to have reached "sanitized village" status. Key challenges facing this critical programme are lack of technical know-how as well as multiple logistical and institutional constraints.[90]

Villages of fewer than 100 persons, estimated in 1990 to comprise up to 37 per cent of the rural population,[91] are considered not viable and are therefore not typically targeted under current programmes to expand water coverage. While the proportion of these small population clusters is likely to have declined in recent years due to migration and urbanisation, they nonetheless constitute a significant part of the rural population. The marginalization of the smallest villages in water development plans represents a gap for which a solution is required in line with the PRSP focus on the poorest and most vulnerable sections of society.

In comparison with urban water supply, governance of the rural water subsector is made even more challenging by unclear institutional mandates and a wide range of actors. In addition to SNHR and the Ministry of Public Health, a variety of international agencies, development partners and numerous NGOs, as well as private contractors, are actively engaged. The lack of a structured institutional framework, however, has created serious gaps in coordination, engineering quality control and maintenance of rural water systems.

SNHR, which has the general mandate over the rural water supply subsector, is seriously lacking in personnel, capacity and financial resources to exercise effective leadership. Its physical presence in the provinces is thin and virtually absent over large rural areas. Its geographic scope of operation is patchy and limited to a small radius around its 17 hydraulic stations, which are moreover only partially operational due to obsolete equipment requiring replacement. Where it is represented, SNHR lacks practical means and functions largely on an ad hoc basis, mainly providing advisory services to humanitarian interventions and NGO projects. Moreover, most of SNHR's employees are not registered civil servants, but are instead on short-term contract. It is therefore perhaps not surprising that a significant number of SNHR's staff have opted to work for NGOs and the private sector. The resulting shortfall in SNHR's human expertise poses an important challenge as new recruits have limited experience.[92] It is nevertheless noteworthy that the SNHR recently received borehole drilling rigs from India and China, which should significantly enhance its implementing capacity.

SNHR's operational budget in 2002 was merely $61,000 (excluding salaries), highlighting an enormous financial discrepancy given the scale of expenditure required. A recent study proposed a $274 million programme targeting 60 per cent rural water coverage (approximately 10 million people) in six provinces by 2020, including $36 million for strengthening and equipping SNHR.[93] In comparison with the urban water subsector and other major infrastructure, this is a relatively modest investment given the significant benefits that would be derived by way of improved water access. In sum, while the basic structure of SNHR exists, due to lack of operational means it is hardly a functional and effective entity. As a result the rural water supply subsector is currently suffering from a serious governance gap.

Social impacts: gender, water pricing and the poor

The most vulnerable sections of society have been disproportionately impacted by the drinking water crisis. This is particularly true of residents in poor, unplanned neighbourhoods mushrooming around the DRC's cities that today comprise the majority of its urban population. Rural consumers typically resort to unimproved water sources such as springs, which while posing serious public health risks, are free of charge. In crowded urban contexts, however, households often have no choice other than to purchase their water. As REGIDESO has generally not been able to expand its coverage beyond the limited historic perimeters of planned urban centres that often date from the colonial era, low-income families in rapidly growing urban outskirts are bearing the full burden of not being able to connect to a central water distribution system.

The quest for drinking water is amongst the foremost daily struggles for women and children who have assumed the main responsibility of securing supplies for their families. As with most domestic chores, family water supply is a highly gendered activity. Although men are increasingly implicated, this is most evident where opportunities for water commercialization have arisen for example through transport delivery or as standpost agents. Typically and when available, water from an improved source is used for drinking and cooking, while that obtained from rivers and lakes, dugout wells and rainwater is used for bathing and household tasks.

During the dry season in Lisala, Equateur Province, the price per 25 liter container increases by up to 10 times reaching CF 250; even though water is collected from unimproved springs

High water demand combined with supply scarcity has forced households in outlying poor neighbourhoods to pay excessive water rates. The World Bank estimates that poor households pay more than seven times the price for a litre of water than they would have done had they received their water supply from REGIDESO.[94] During its field visits, UNEP encountered a typical price range of CF 50-75 for the standard 25 litre containers sold at public standposts. This is equivalent to CF 2,000-3,000 ($2.30-3.40) per cubic metre of water, which is three to five fold the REGIDESO rate and significantly above the unit cost in developed countries.[95] Prices can also significantly increase during the dry season and if transport costs are added. In places with steep terrain such as Lisala and Kikwit, home delivery of a 25 litre water container typically costs CF 250. In Mbuji-Mayi, the capital of Kasaï Oriental, an informal bicycle trade has grown up to supply households with water. Ferrying water over distances of 10-15 kilometres, the price of a 25 litre water container can reach over 1,200 CF during periods of water shortages. This is 80-90 times the full cost of providing water from a mains water supply. Low-income households therefore not only buy water at considerably higher cost than relatively better off households connected to REGIDESO, but are also vulnerable to overcharging by private vendors. Consequently, they also tend to spend a larger proportion of their limited income on water.

Despite delivering water to a large number of the local population, water from public standposts is sold at a significantly higher rate than that supplied by private household connections. Buying water in Kikwit (Bandundu Province) and Kananga (Kasai Occidental)

REGIDESO's financial difficulties undermines service provision

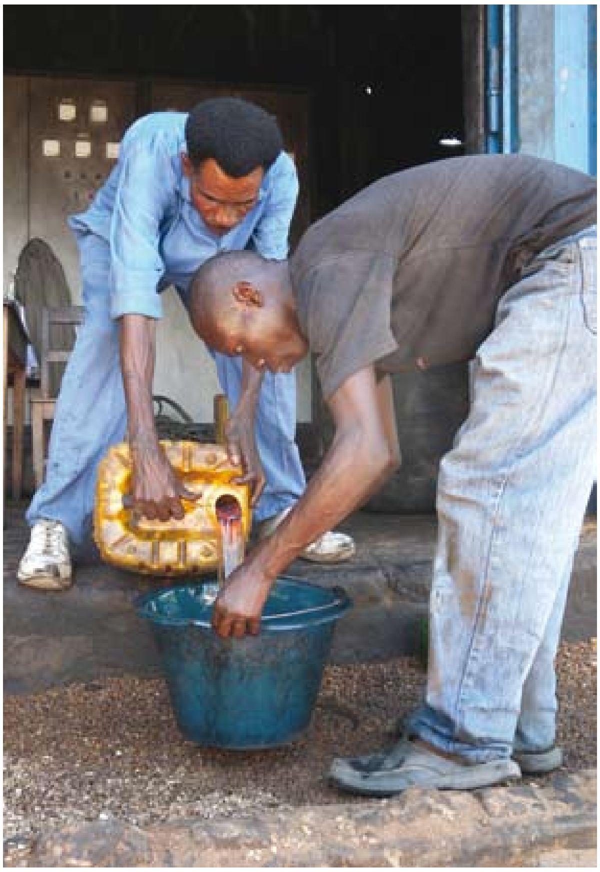
A fundamental constraint in REGIDESO's inability to extend its service coverage is its fragile financial viability. The two main issues relate to production cost and revenue collection. REGIDESO's current water tariff structure is such that the billing price is below the cost price. On average the sale fee is estimated to be 80 per cent of production cost. Non-payment of water bills is another reason why REGIDESO is currently operating at a significant loss and burdened with heavy debt. According to the World Bank, REGIDESO reportedly has the worst collection rate in Sub-Saharan Africa with only 49 per cent recovery of water billing. Non-payment by public institutions accounted for 81 per cent of these arrears.[96] In effect, water sales to public institutions represent around 35 per cent of REGIDESO's water bill, which on average amounted to $30 million per annum for the period 2006-2008.[97]

At the same time, less than one third of active connections are equipped with a meter. Even where installed, most meters do not work properly, which may seriously disadvantage consumers as they are charged a fixed rate. This normally should not be a problem, but given the very high water loss rate from REGIDESO's distribution system, estimated nationally at almost 40 per cent,[98] consumers risk having to foot the leakage bill as well. Discussions with households in Kisangani's peri-urban areas, for example, revealed that they were being invoiced for relatively high water volumes of between 30-50 m^3 per month, significantly higher than household consumption rates in developed countries. Similar problems have been reported in the Kinshasa communes of Limete and Lemba.

Yard taps are typically shared by several households - Kisingani, Orientale Province

Less than one third of active connections in the DRC are equipped with a meter

Faced with a chronic financial deficit, unable to conduct basic maintenance and rehabilitation, handicapped by fuel and input shortages and the declining purchasing power of its customer base, it is clear that REGIDESO will not be able to reach rapidly growing urban outskirts in the short term. A key step in moving forward is to assure a minimum level of cost recovery to meet basic operation and maintenance costs. This is clearly a politically sensitive issue and notwithstanding the need to ensure that the poorest households are connected to a secure water supply, it is a question that needs to be addressed to ensure the long-term financial sustainability of water services.



Fossil fuels are a major financial burden on water treatment plants, particularly in geographically isolated cities such as Kananga and Mbuji-Mayi, accounting for over 25 percent of overall operational costs

Mindful of the need to eliminate the perverse drain on its budget, the government is currently studying the revision of REGIDESO's water tariff structure. At a practical level, one promising approach to easing water shortages in peri-urban areas is the development of public standposts fed by local systems that are managed by community organizations on a cost recovery basis (Case study 4.1). In Bunia, Gemena, Kananga, Kikwit, Mbandaka and many other towns, REGIDESO is also experimenting with this model with reportedly good results.

4.2 Degradation of drinking water sources from land use changes

During the course of UNEP's fieldwork, one of the striking observations was the adverse impacts of uncontrolled land development on drinking water sources. In the DRC's administratively fragile post-conflict context, unregulated rapid growth of urban centres and rural communities poses a serious threat to the highly sensitive areas surrounding the sources of drinking water supply. Confusion over land tenure, conflicting jurisdictional mandates and institutional weakness in applying an organized system of land use planning and management are underlying causes of the problem. This complex situation is further exacerbated by an inadequate broad level vision and strategy on regional and watershed development planning. Lack of a coherent land use plan that protects critical water sources represents a direct risk not only to ongoing efforts to achieve MDG and PRSP drinking water targets, but also to the long-term sustainability of major infrastructure investments in the water sector.

The immediate challenge on the ground is the non-application of basic zoning principles and land delineation procedures for drinking water source protection. Nonexistence of demarcated protection zones was observed in all water source categories from village springs and wellhead areas to the water intakes of REGIDESO's treatment plants. Ensuing sprawl and encroachment exposes vulnerable source areas to contamination and land degradation, creating a significant risk to drinking water quality and public health. While water professionals generally recognise the threats of poor land use practices on drinking water sources, there is limited planning and effective tangible measures to reduce these risks.

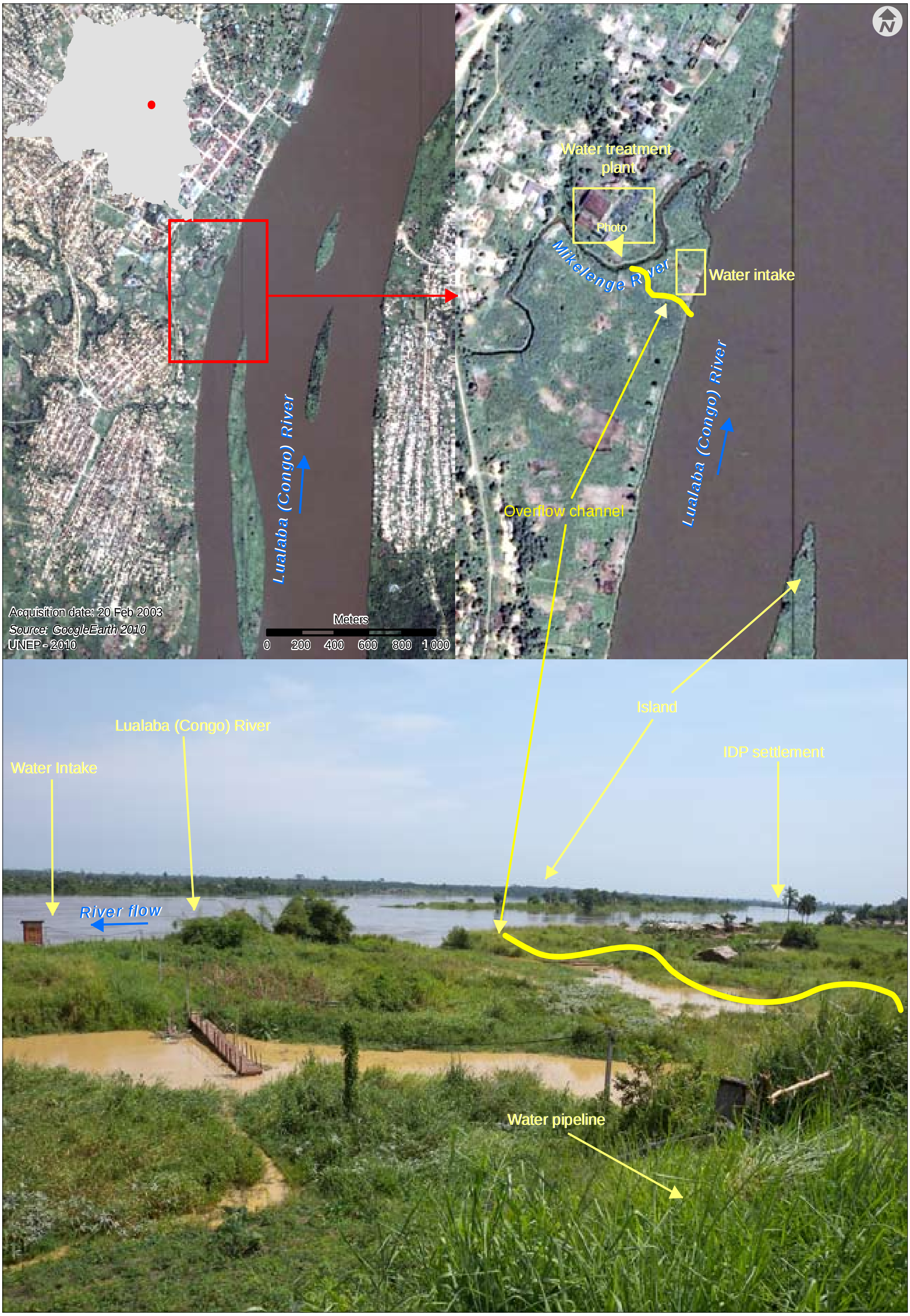
The most endangered water source areas include springs, wellheads, river intake zones, priority lake and reservoir segments and aquifer recharge areas. These critical sources typically lack any form of identifiable demarcation, fencing enclosure or adequate natural buffering strips to deter and mitigate the environmental impacts of potential land use encroachment, as well as wanton sabotage. While it is difficult to quantify the scale of the problem as no inventory of drinking water sources exists, based on UNEP's field reconnaissance this was found to be a generalised nationwide challenge.

The greatest threats to water supply sources were observed during site inspections to include modification of runoff patterns, accelerated erosion and landscape degradation. These problems are mainly caused by agricultural encroachment and deforestation, disorderly housing development and poor road construction including that of pedestrian pathways in rural areas. Pit latrines and septic systems and mining activities and tailings also present important contamination sources. For example, water production sites in Bukavu are exposed to sewage infiltration from uphill latrines, constructed in some cases merely five metres from supply springs. Mining activities in Katanga and the Kasaïs has caused a land surface loss in drinking water sources and generated groundwater and surface water pollution.[99] In urban centres, small and medium scale enterprises, fuel stations, garages, abattoirs and storm water runoff generate additional pollution hazards. A prominent case in point is Kinshasa's main water treatment plant at N'Djili, which is threatened by solid waste disposal from households and surrounding activities upstream of the water intake.

Major water infrastructure investments are seriously jeopardised by environmental degradation. Most notably, several REGIDESO centres are operating under capacity or have been abandoned as a result. The list of impacted water plants is long. The following is a brief account of some of the cases encountered during UNEP site inspections and stakeholder consultations. Urbanisation induced catchment destabilisation has led to excessive soil erosion rates, causing major operational difficulties including frequent stoppages in REGIDESO's Lukunga plant in Kinshasa[100] (Case study 4.2). In Kindu, the Mikelenge River, which discharges immediately upstream of REGIDESO's intake zone, often records very high turbidity levels during the rainy season, forcing recurrent cessation of its operations. The marked increase in turbid conditions is attributed mainly to ad hoc housing constructions by internally dispersed persons that have recently sprung up on its river banks. Moreover, sedimentation of the riverbed has increased the flood risk, thereby threatening the plant's conveyance structure.[101] Tree cutting and encroachment by an army camp as well as local inhabitants within the boundaries of REGIDESO's Arma

Satellite image 2. N'Djili water intake is threatened by pathogenic and chemical pollution from the intensification of surrounding activities.

Satellite image 3. In Kindu, the muddy waters of the Mikelenge River discharges immediately upstream of REGIDESO's water intake forcing recurrent cessation of its operations.



The head of the REGIDESO center in Lisala looks over the collapsed Ebabo water treatment plant. Formerly located within a protected forest, agricultural encroachment and housing settlement has led to the silting-up of the stream supplying the plant

REGIDESO's main transmission pipeline in Mbuji-Mayi is exposed to a high risk of structural deterioration. This occurred in February 2010 when a catastrophic failure caused the sudden loss of millions of liters of water and damage to surrounding property. Water delivery was cut-off for several weeks in this city of over one million residents (above and below)

site in Kisangani has caused flow reductions in the 25 springs supplying the water system.[102] In Kalima, a water production unit constructed in 2006-2007 with World Bank funding was reportedly destroyed by soil erosion only eight months following its commissioning.[103] In Lisala, REGIDESO's Ebabo station was formerly located within a protected forest that has since been replaced by agricultural fields. Ensuing land degradation caused subsidence of the treatment plant, which has long been deserted.[104] Gully erosion and storm runoff recently swept away part of REGIDESO's distribution network in Kananga, and a landslide in February 2010 damaged its main water supply pipeline in Mbuji-Mayi.

Gully erosion has damaged Kananga's water pipelines

Protection of drinking water sources

Legislation exists on the protection of water sources, namely the Ordinance of 1 July 1914, which provides for the demarcation and protection of drinking water sources, and the Decree of 6 May 1952, on the award of concessions and water administration and use. While these by-laws provide a legal basis for land use restrictions to protect water sources, they are outdated and enforcement is virtually non-existent.

The draft Water Code establishes a comprehensive approach for the protection of drinking water sources and accords it priority over all other competing types of land use. It is based on a tiered zoning concept that distinguishes three separate protection sectors where different restrictions on land use are to be applied based on hydrogeological studies.[105] Adoption of the draft Water Code will therefore provide legal sanction to implement a robust system for drinking water source management and protection. It will nevertheless need to be complemented with subsidiary legislation establishing operating standards and guidance on the demarcation of water source protection zones.

Adoption and implementation of the draft Water Code and subsidiary legislation is a slow and protracted process. Given the urgency of the situation and rather than waiting for legislative instruments and institutional structures to be in place, interim priority measures should be taken immediately to address significant risks to water sources. A direct step will be to secure the land area surrounding drinking water sources as a first line of defence. This will involve land demarcation and enclosure, land title acquisition or purchase and the potential transfer of residential and development activities to other, less sensitive parcels. Establishing green buffers to protect sensitive water sources and engineering structures to control runoff are other practical options.

Photo 26: The head of the Lukunga water treatment plant in Kinshasa holds a recently obtained land title of the installation. Formal demarcation provides a basis for creating a protection zone around critical water installations threatened by uncontrolled development activities.

At the same time, it is also important to recognise that safeguarding water sources cannot rely solely on zoning ordinances and formal approaches. A proactive collaborative process involving concerned stakeholders in the management of water sources as well as public education activities need to be initiated. This should help delineate the responsibilities and roles of provincial and local authorities, municipalities, communities, MENCT and other relevant agencies including REGIDESO and SNHR. Gradually, drinking water source protection plans will need to be broadened to the microcatchment level and eventually across the larger watershed.

4.3 Poor construction and maintenance of rural water systems

As government capacity to provide water services deteriorated, its functions were progressively assumed by other actors. This trend is particularly manifest in rural and peri-urban areas, as REGIDESO – despite serious constraints – maintained its command over urban water supply within city centres. In rural and peri-urban areas, however, a wide range of international and national NGOs, civil society and faith-based organizations, private sector enterprises, UN and development agencies gradually took over the role of the state in providing water services. This gradual "outsourcing" of the state's responsibility in the water sector has been largely sanctioned by donor support, who started channelling their assistance through non-state actors following the suspension of international cooperation with Congo's government from 1992-2001.

SNHR, mandated to service rural and peri-urban populations, was particularly impacted by the discontinuation of international cooperation, as its operations relied heavily on donor funding. Whereas REGIDESO started to receive external assistance in 2002, most notably in the form of several megaprojects from the World Bank and African Development Bank (AfDB), SNHR has benefited from minimal international assistance. Consequently, SNHR's capacity has been seriously undermined to the point where it has become almost a negligible player on the ground. Although there have been some attempts to revitalize SNHR, notably with the support of the AfDB, its future role remains unclear.

Within the ensuing rural water supply governance vacuum, a multitude of actors from national and

The Djokojo spring, which has now almost run dry, was originally developed to meet the water needs of displaced and local communities on the outskirts of Bunia, Ituri District

international NGOs to religious organizations and private contractors expanded their scope of work to include drinking water provision. While these actions are well intentioned and provide essential services during humanitarian emergencies, ensuring the quality and sustainability of water supply structures is of critical importance given its potential impacts on public health. The importance of strengthening NGO technical capacity can not be overemphasized as they have a crucial role to play in improving water service delivery, particularly in remote areas.

Simple point source structures

As previously mentioned, an estimated 90 per cent of the rural population relies on springs for its drinking water supply. Most of the springs are located in dense forests (both gallery and equatorial), highlighting the importance of forest ecosystem services to local community water supply. For small, dispersed communities of fewer than 1,000 people, spring development and protection is essentially based on various spring box designs. While spring box technology is simple and inexpensive, a minimum level of technical engineering expertise is nevertheless required to ensure that they provide safe and adequate water. Unfortunately, UNEP observed that many of the actors involved lack the expertise and competence to build robust spring protection structures.

The UNEP team visited 27 spring structures in seven provinces (Bandundu, Equateur, Maniema, Kasaï Occidental, Kasaï Oriental, North Kivu and Orientale). Site visits were typically accompanied *inter alia* by representatives from SNHR, local health centres, NGOs and local community representatives as well as the provincial and national MENCT. All the spring protection structures examined were either spring boxes or simply headwalls, constructed by a wide variety of actors.[106] Based on the site visitations, the overall conclusion is that the majority of the spring structures were of substandard quality.

In several cases, spring boxes constructed in the previous one or two years or as recently as several months were found to be completely dysfunctional. Stagnant water pools, sedimentation and low yield rates were common telltale signs of poorly built structures. The main environment-related problems encountered were: (i) inadequate protection of the immediate area surrounding the spring, including demarcation and fencing, as well as of the larger spring microcatchment, (ii) lack of surface water diversion drainage ditches to prevent runoff from polluting the source, (iii) up-gradient erosion due to vegetation removal, agricultural activity and footpaths and (iv) poor site selection for spring development due to inadequate knowledge of hydrogeological conditions. In addition, animal trespassing on drinking water sites, particularly pigs and goats, is a common occurence.

Work in progress: construction of a retaining headwall in the village of Kandate in Ituri District

Work in progress: construction of a spring box in Kindu, Maniema Province

Stagnant water pools and low flow rates are indicative of poorly built spring boxes.
Moubaka spring in Kikwit, Bandundu Province

The protective cover of this spring box is partially exposed rendering contamination inevitable.
Note also the lack of any diversion ditch and fence around the site to protect from pollution.
(Denge spring, Libenge, Equateur Province)

Constructed in July 2006, the Vala spring box in Libenge, Equateur Province, fell into disrepair by 2008, forcing local communities to tap seepage around the spring box or travel longer distances in search for water

Retaining walls are simple alternatives to spring boxes, but even such basic structures require a minimum level of maintenance and site protection. As the headwall is not properly positioned, back-pressure has caused the spring eye to move and re-emerge to the right

In Kalima, Mainema Province, the Baganda spring box combines several features of poor construction and maintenance including: reduced flow rate, damaged spring box cover, sediment build-up and clogging of the drainage ditch, lack of fence enclosure and upslope footpaths increasing erosion and contamination risks

Constructed as recently as February 2009, SNHR advised that this poorly designed spring box in Boka village (Bandundu Province) be demolished as it posed a health risk to the local population

Without a drainage canal to remove excess water produced from hand-pumps, resulting stagnant pools may become breeding grounds for infectious diseases. (Bilundu Village, Maniema Province)

Another important shortfall is the almost total lack of water quality testing. While spring water is generally safe, the risk of contamination, particularly given the poor quality of construction, is an issue of concern. UNEP carried out spot check water tests of 15 spring boxes for bacteriological contamination. All samples showed the presence of total coliforms signifying a strong likelihood of pollution by surface runoff. Pathogenic *Escherichia coli* bacteria were found in slightly over 50 per cent of the water samples, indicating fecal infection (Annex 3, Table 4). It is therefore important to systematically control for bacteriological contamination using simple field kits, which can be carried out by the local health centres. Laboratory testing should be carried out on a semi-annual or annual basis for more detailed analysis of key parameters including bacteria, nitrates, turbidity and conductivity. In addition, operators should be trained to regularly observe any changes in turbidity, particularly following rainstorms as this would indicate that runoff is reaching the spring.

Physical access to the water points is another major constraint in improving the quality of rural water service. The generally accepted standard is that the distance to the consumer in rural areas should be within 500 metres. Although the distance to the springs is in many cases within 1 kilometre, it was observed that a large proportion were located in steep valleys, particularly in deep gallery forests in the savanna belts and sharp hillsides in the eastern part of the country. Water transport, almost exclusively done by women and children, is as a result a highly laborious and time-consuming chore. In some locations, the access slope is so steep that the risk of falls and injuries is high. It is important that the selection of these sites carefully consider site accessibility issues. Moreover, there is a risk that water points in steep terrain develop erosion problems that compromise the integrity of the water source.

Even though spring boxes and simple headwalls need only limited attention, they are not maintenance free. Community sensitisation and engagement is therefore critical for the successful operation and maintenance of spring structures. It is also equally important that operation and maintenance not be limited to infrastructure and that source protection and microcatchment management is incorporated as an integral component. As spring boxes are low-cost structures, the common development approach promoted by many NGOs is to mobilise community work, known as *salongo*, for their construction. While this voluntary approach may work in the initial set-up phase, it is inadequate to assure periodic maintenance and rehabilitation. In reality, community ownership was observed to be low and furthermore they generally lacked the technical skills to ensure proper upkeep. On the other hand, communities typically expected maintenance and rehabilitation to be carried out by the organization that installed the structure, the government or a potential donor. A voluntary community caretaker approach to maintain spring protection structures is therefore unlikely to be a sustainable strategy over the long term.

Even where designated water committees had been established, it was found that these often subsequently unravelled or were subsumed under broader local development committees. While one of the key components of the "Village Assaini" programme is the establishment of local water committees, social mobilisation to promote community ownership and responsibility for the maintenance and operation of spring structures was often cited to be a major challenge. Although the construction of spring protection structures can be completed in a matter of days or weeks, community participation is a long-term process that requires consistent advocacy, awareness raising, training and follow-up. It t is difficult, however, to have an effective social mobilisation component under the short-term donor funding cycle associated with small water supply projects. Even though the economic base of rural communities is fragile, communities should be empowered to become self-reliant by convincing users that they would be better off making even minimal payments (both in cash or in kind) to ensure sustainable operation and maintenance of water supply structures.

To improve the quality of spring development structures, UNICEF recently initiated collaboration with SNHR to provide technical supervision and inspection of installations. This is a positive step that needs to be promoted and expanded. In the meantime, SNHR participation remains on a selective and project basis and its role is essentially that of a technical consultant. Other actors generally bypass SNHR and operate beyond any form of official oversight. As a result, not only are there no common standards, construction supervision and accountability, but even an inventory of existing structures is lacking. The resulting informalisation of water service provision in rural and peri-urban areas represents a major challenge for effective coordination and investment planning in the sector.

UNICEF recognises that the lack of systematic monitoring and follow-up of water supply structures is an important shortcoming.[107] It is therefore important that international organizations establish a more structured cooperation with SNHR and strengthen its capacity to coordinate activities and enforce compliance with minimum standards. In emergency situations where SNHR may not be active, it is important that the UN Office for the Coordination of Humanitarian Affairs (UN-OCHA) and the Water Sanitation and Hygiene (WASH) Cluster set up a mechanism and dedicate resources to supervise construction standards and ensure regular follow-up of drinking water structures as an integral part of rapid humanitarian response.

Rural and peri-urban autonomous water supply systems

Although of a different technology type and scale, the problems of construction quality and maintenance also applies to autonomous rural water supply systems. These comprise either gravity flow or borehole systems that service a beneficiary population ranging from 3,000 to over 30,000 persons. A survey commissioned by the World Bank and Water and Sanitation Programme (WSP) in 2005 found that most of the DRC's rural water systems were of poor construction quality. It also decried the fact that water supply systems were being built by a profusion of non-specialized actors who had limited or no professional experience in the water sector. Donors were partly held responsible for this disarray by funding interventions from unqualified intermediaries.[108]

The WSP survey found that around 50 per cent of water supply systems had broken down due to poor quality construction. Most of these systems were constructed in the last 10 years and date from after the year 2000. Only rarely was water system failure attributable to aging infrastructure or poor maintenance. The WSP assessment also emphasized the need to shift from a "charitable" and "voluntary" management approach of water systems to one that is based on cost recovery. In addition, the study highlights the need to train and professionalise water committees to ensure adequate maintenance and sustainability of water systems.[109] The example of user-managed water associations promoted by the BTC presents a resourceful and flexible approach for establishing a durable drinking water service based on participatory operation and maintenance (Case study 4.1).

Toiling for water: women and children labour through gallery forest valleys in the daily collection for water. (Idiofa and Kikwit, Bandundu Province), (above and top of the next page)

Young boy transporting a container that is heavier than his own weight in Bobala, Equateur Province

Newly constructed office of the Lubilanji Water User Association in Mbuji-Mayi, Kasai Orientale. Following a breakage in REGIDESO's pipeline in February 2010, this was one of the few sources of potable water in the DRC's third largest city

Case study 4.1 Improving drinking water accessibility through community action

A promising approach for sustainable water service delivery is the Belgian Development Agency's (BTC) water programme[110] in peri-urban and rural areas. This innovative project is based on the establishment of Water User Associations (WUAs) to manage small piped networks. BTC plans to construct 65 reticulated systems in the informal settlements of Kinshasa, Mbuji-Mayi and Kindu, and in rural communities in South Kivu and Bas Congo. Each water supply network is managed by an autonomous WUA and serves around 20,000 persons. This should add up to around 1.4 million people gaining access to safe water. As of early 2010, seven water supply networks were fully operational.

In principle, all beneficiaries in the project area are by default WUA members. The WUA's organizational structure includes a general assembly comprised of elected officials, which in turn appoints an administrative council. The latter's duties include inter alia representing and negotiating stakeholder interests with local authorities and fixing water pricing. Daily operations are undertaken by a management office that is controlled by and accountable to its members through the administrative council.

The WUA approach is distinctive from other community-based management initiatives in that it functions essentially as a small-scale enterprise with fulltime employees and a separate bank account. Its operating principle is ensuring at least full cost recovery. The management office includes an administrator, accountant, secretary and technicians. Some WUAs have also appointed lawyers to represent their interests. Sales agents, almost all women, manage the WUA's public standposts and collect payments on site for water sold in plastic containers. Standposts are all equipped with meters to gauge water volume withdrawals, which are matched with incoming financial receipts.

The community based water management committee is a formal structure that includes full-time employees

Case study 4.1 Improving drinking water accessibility through community action (continued)

The average final turnover for a WUA ranges typically from $70,000-120,000 per annum. The considerable income generated from water sales has not only sufficed to pay salaries and maintain infrastructure, but has also unlocked various opportunities to undertake additional development investments. For example, one of the WUAs, based in Mbuji-Mayi procured back-up generators and is planning to extend its piped network and build additional stand-posts. By becoming financially self-sustaining, the WUA has a better chance of achieving an enduring water service over the long term.

The WUA also provides an interesting entry point for strengthening water resources management. For example, several WUAs working within the same subcatchment can explore ways to improve resource management and ensure that the activities of one association do not impact another. One of the important first steps undertaken by WUAs is to secure the project area by obtaining a land title. Nevertheless, uncontrolled developments around sensitive water sources continue to pose a threat in certain cases, as was observed at one site in Kindu. By integrating their activities at a catchment level, WUAs can exercise greater leverage in managing and protecting their respective watersheds. Furthermore, WUAs can be a vehicle for implementing catchment management programmes and strategies as envisaged under the draft Water Code.

One of the areas that requires strengthening is water quality monitoring, which is currently only being done on an ad hoc basis. To ensure the safety of drinking water services it is important that regular and frequent bacteriological analysis is carried out. As laboratory analysis can be costly, one possibility is for WUAs to undertake their own bacteriological testing with user-friendly field kits. A comprehensive control of other parameters should be conducted by professional laboratories on a periodic basis. The BTC is considering providing simple field kits and training to enable partner WUAs to carryout basic water quality testing.

While it is recommended that at least during its formative years WUA investments are restricted to its own operations, in the future members may decide to invest in other areas not related to water. Within this context, the WUA has the potential of helping generate a “virtuous circle” of development and supporting related poverty alleviation activities. It is equally important to recognise that by bringing community members together under a participatory management structure with a shared vision, the WUA goes beyond the confines of water management and contributes to social cohesion in a broader sense. From this angle, cooperative governance through WUAs also provides a practical vehicle for the social reconstruction of vulnerable communities fragmented during the conflict years.

4.4 Water Pollution

As the DRC lacks a national water quality monitoring programme it is difficult to empirically evaluate the nature and magnitude of potential water pollution. In addition, there are no functional monitoring stations from which it would be possible to extrapolate general water quality status and trends. Water quality studies, both of surface and groundwater, are for the most part undertaken on an ad hoc basis and conducted as part of targeted research and academic projects.

At the macro level, the quality of the DRC's inland waters may be considered to be in a relatively good state. Large swaths of territory are remote and inaccessible and consequently water quality has not been significantly impaired by human activities. Furthermore, a small and declining industrial base and negligible use of agrochemicals means there is limited release of industrial effluents and synthetic chemicals into the environment. Finally, high rainfall levels and the country's dense hydrological network signify extensive dilution of most pollutants. While water pollution is predominantly of biological origin and mostly concentrated in urban "hot spots," it nonetheless has major health consequences on the wider population.

The abovementioned portrait is held up by UNEP's initial analysis of drinking water quality in Kinshasa. Twenty samples from the four main water treatment stations (Ngaliema, N'djili, Lukunga, and Lukaya) in Kinshasa were tested for 13 heavy metals as well as ammonium and phosphates. (Annex 3) The results showed concentrations of all elements to be significantly below WHO drinking water quality guidelines, confirming the water to be of good quality. Nevertheless, it should be noted that this snapshot analysis was carried out in the rainy season and therefore pollutant concentrations would have been diluted. Systematic monitoring, both in the rainy and dry seasons, as well as for a wider range of parameters including persistent organic chemicals, is necessary to obtain a reliable overview of water quality. It should also be highlighted that post-treatment contamination is a potential problem given the debilitated state and extensive leakages in the water supply network. Indeed, UNEP analysis revealed widespread bacteriological contamination of drinking water supplies, both in urban and rural areas. Moreover, the Pool Malebo on which Kinshasa is situated is the receiving basin for municipal, agricultural and industrial effluents as well as urban surface runoff exposing this ecosystem to potential contamination. More detailed pollution studies are required on this section of the Congo River, particularly on bioaccumulation risks.

Water quality deterioration from heavy metal pollution is a major issue of concern in the Katanga Copperbelt, particularly given the considerable environmental legacy from 100 years of intensive industrial-scale mining. Although UNEP laboratory analysis of REGIDESO water supply in Lubumbashi revealed it to be within WHO guidelines for drinking-water quality, long-term monitoring is required to ensure that there are no water quality problems. Elevated levels of mercury, arsenic and cyanide in both surface and groundwater are reported around the main gold mining centers in Ituri.[111] Moreover, widespread use of mercury in gold processing by artisanal miners, estimated at 15 tons per annum, is an important source of water pollution.[112] The impacts of mining activities on water quality is addressed in greater detail in the mining section of the DRC PCEA report as well as in the technical report on the environmental impacts of mining in Katanga.

The two main sources of water pollution are: (i) biological contamination from uncontrolled sewage and solid waste disposal and (ii) elevated suspended sediment loads from poor land use practices and management.

Biological water pollution

The principal source of biological pollution in the DRC is the direct release of raw sewage in water courses or indirectly via seepage into groundwater. Only 10 per cent of the population has access to sanitation services.[113] As there are no functioning sewage treatment plants, including in Kinshasa, untreated sewage is released through the main drains directly into rivers and lakes. Waste from septic tanks and pit latrines are typically openly dumped in the environment including in canals and water bodies. Random open defecation in peri-urban and rural areas is common, thereby exposing water sources to potential contamination.

Where it exists, the sewer system consists of a single drain system that collects both untreated sewage


Release of untreated effluent from a copper smelting plant into Luilu River in Kolwezi, Katanga Province


Major physical disturbance from artisanal tin mining along the Kakaleka stream in Kalima, Maniema Province

Artisanal diamond miners digging close to a water treatment plant near Mbuji-Mayi, Kasai Orientale

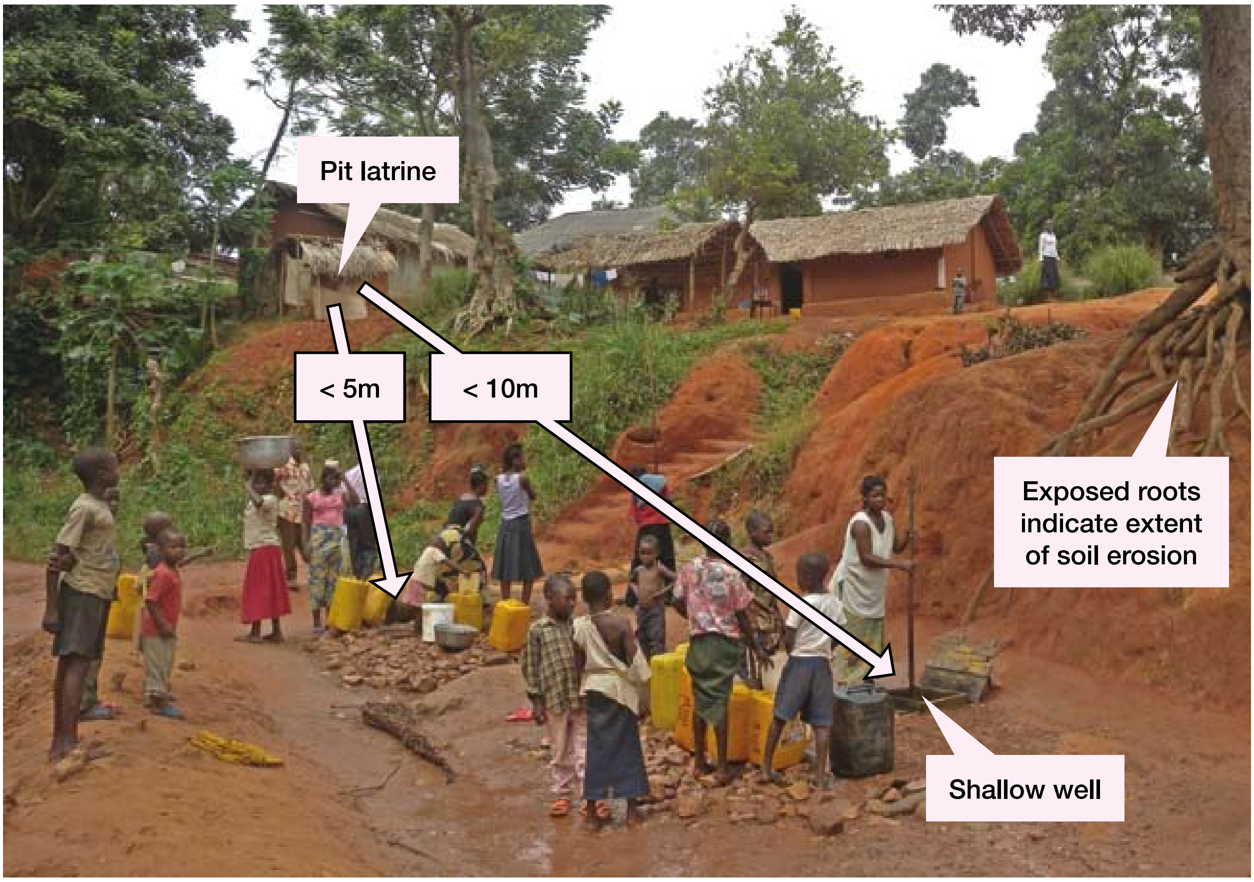
Along the Chibungu River in Kasai Occidental, alluvial diamond mining involves vegetation and soil removal and subsequent washing of the gravel, resulting in increased river turbidity and siltation

Water-pumps used by artisanal gold miners to wash down the soil releases large amounts of sediment-laden runoff into watercourses and lakes. Mongbwalu, Ituri District

and rainstorm water flows. Moreover, such combined sewer systems are typically only found in old city centres and are both undersized to handle wastewater flows and lay in a derelict state. Consequently, the extent of biological contamination is therefore spread over a wide area. This is readily visible in Kinshasa, where some of the city's major water courses, such as the Gombe and N'Djili, are effectively little more than open sewers. Moreover, sedimentation and dumping of solid waste adds to the pollution burden by blocking drainage streams and canals. Flooding of households including sanitary installations is a frequent occurrence in the rainy season, which further compounds the problem.

The net result of untreated sewage disposal and lack of sanitation infrastructure is endemic prevalence of infectious waterborne diseases. In addition, outbreak of cholera and typhoid fever epidemics is a frequent occurrence. Both the human and economic cost of water related sickness is therefore substantial. UNEP spot check testing of 50 urban and rural drinking water supply sources found widespread (76 per cent) incidence of bacteriological contamination, including pathogenic microbes of faecal origin in nearly one third of samples tested. (Annex 3) Other studies, for example, an environmental impact assessment of Tenke and Fungurme in Katanga Province, revealed widespread contamination by *E. coli* and total coliform bacteria in both groundwater and surface water.[114]

While biological contamination represents a large-scale risk to human health in the DRC, it is one that is readily reversible and can be remediated through investment in standard water and sanitation infrastructure. Nevertheless, it will not be possible to implement a centralised wastewater treatment system in most of the DRC due to the dispersal of the population in unplanned peri-urban areas and the inability of the general population to pay for such a service. Alternative options focusing on community-level wastewater systems need to be developed, including approaches based on ecological sanitation technologies as well as traditional septic tanks.



In Gemena, latrines uphill of water wells pose a pollution risk

Kinshasa watercourses, such as Gombe River, are effectively little more than open sewers

A dump site spilling over into the N'Djili River, directly opposite the intake of Kinshasa's main water treatment plant

Biological contamination of exposed shallow wells in Kananga is evident

Sediment pollution

Suspended sediments represent an important and growing pollution load in many of the DRC's rivers. Despite high levels of natural turbidity (cloudiness), particularly in the mountainous east of the country, the problem has been considerably worsened by watershed degradation. Extensive land cover and land use changes have led to excessive rates of soil erosion within many catchments. Specifically, the principal activities responsible for elevated suspended solid concentrations include ad hoc agricultural expansion, informal settlements including refugee and displaced persons camps, deforestation and vegetation clearance and mining. As sediment particles may include dangerous bacteria, viruses, heavy metals and toxic organic compounds, water quality is not only aesthetically compromised by its murky appearance but also importantly carries a pollution risk to human health and aquatic life.

High levels of suspended sediment pollution have caused considerable economic losses, particularly by disrupting the operation of water utilities and dams. A case in point is that of the Lukunga water treatment plant in Kinshasa, where there is a direct relationship between sediment contamination and the chemical cost of water treatment (Case study 4.2). Dam operations have also been hampered by siltation, including the country's most important hydropower plant at Inga and the Ruzizi dam in South Kivu. In Maniema, the Lutshurukuru dam's hydropower production capacity was reduced by increased sedimentation of its reservoir and offtake canal. Consequently, the SAKIMA mining company, which manages the dam, banned agricultural activity along the reservoir's edge and established a three kilometer buffer strip to protect it. While the government has made provisions restricting agricultural cultivation and other human development activities along riverbanks and lakeshores, these were observed to be rarely enforced in practice.

Increasing use of imported chemicals to treat sediment-related water quality degradation is a growing financial burden for several water treatment plants in the country

Case study 4.2 Watershed degradation increases water treatment costs

A salient example illustrating the societal cost of sediment water pollution is that of the Lukunga water treatment plant. Constructed in 1939, the Lukunga station supplies western Kinshasa with 48,000 m^3 of drinking water per annum and serves an estimated population of approximately half a million people. Sandy soils and steep topography make the Lukunga catchment highly vulnerable to soil erosion. Until the 1970s the basin was naturally protected with dense forest cover. Land use changes including unplanned agriculture and urban development have exposed the fragile soils to heavy rainstorms, leading to significantly accelerated soil erosion rates.

According to records, turbidity levels of the Lukunga River in the 1940s were typically less than 15 Nephelometric Turbidity Units (NTU), reaching more than 25 NTUs during rainstorms. Today, average suspended sediment concentrations are in the range of 100-120 NTUs. Moreover, turbidity levels of well over 3,000 NTUs and up to 6,000 NTUs have been recorded following heavy rainfall events. Beyond the 1,000 NTU threshold, water plants are generally obliged to stop their operations.

The exponential increase in the Lukunga River’s turbidity levels over the past 70 years is attributed to forest clearance and the haphazard expansion of agriculture and informal settlements. Formerly situated in a protected forest zone, Lukunga’s water intake is today encircled by vegetable gardens and informal housing settlements. Moreover, the Mbinza water intake, which formerly supplied the Lukunga plant, was abandoned in the 1980s as it was destroyed by gully erosion and landslides. Sedimentation of Lukunga’s riverbed is a growing problem requiring the water plant’s management to conduct frequent dredging. The risks of flooding and geomorphologic changes in the river’s watercourse are additional problems facing the water utility.

Excessive turbidity levels have necessitated the utilization of larger quantities of imported chemical coagulants to precipitate the sediment particulate. As the coagulant agent (aluminum sulphate) used is acidic, it significantly lowers the water’s pH. Therefore, lime is applied to adjust the pH, which is also procured from overseas. Increased use of expensive chemicals to treat the degradation of raw water quality represents a significant financial burden on the cost of water production. To help address the problem, REGIDESO recently secured an official land title for the Lukunga water treatment plant, which should support its case in halting surrounding detrimental activities and help prevent further encroachment. In addition, the plant’s management is considering plans to establish a three kilometer protection zone around the site and undertaking catchment reforestation. Nevertheless, the situation remains difficult and REGIDESO expressed concern that it may have to shut down the Lukunga water plant.

The head of the Lukunga water treatment plant in Kinshasa holds a recently obtained land title of the installation. Formal demarcation provides a basis for creating a protection zone around critical water installations threatened by uncontrolled development activities

Case study 4.2 Watershed degradation increases water treatment costs (continued)

The problem of sediment pollution is not unique to Lukunga but was also observed in Kinshasa's other water treatment plants of N'Djili, Ngaliema and Lukaya. Elevated turbidity levels above the 1,000 NTU limit reportedly occur in both the N'Djili and Lukaya rivers during the rainy season. While the Ngaliema station abstracts its water from the relatively clear Congo River, it is negatively impacted by the highly turbid waters of Basoko River, which occasionally backflows into its intake point. Similar problems are also impinging on the operation of REGIDESO's provincial water centres. For example, in Kindu, Maniema Province, the water treatment plant reported frequent stoppages due to elevated turbidity levels (> 1,000 NTU) of the Mikelenge River, which discharges immediately above its water intake. All the aforementioned treatment plants are therefore compelled to use additional coagulants as well as pH adjusters to deal with rising turbidity. Watershed degradation from unplanned agricultural and settlement encroachment was consistently cited as the main cause of elevated sediment pollution.

The increasing cost of drinking water treatment due to diminished water quality is negatively impinging on the operations of many of the DRC's water utilities, both in terms of rising chemical and dredging expenditures. Concurrently, sediment pollution also highlights the role of ecosystem services, particularly of forests and wetlands, in providing good water quality. Empirical studies measuring the effect of increasing turbidity levels on the chemical cost of water treatment would provide hard economic evidence on the importance of ecosystem services in protecting water infrastructure and achieving national and MDG water supply targets. It would also serve as a valuable reference case for the DRC on the role of natural capital in national development.

Satellite image 4. Land use pressures surrounding Lukunga water treatment plant in Kinshasa.

4.5 Governance: the challenges of transitioning to a new water regime

Decentralisation

As previously discussed, water governance in the DRC is set to undergo rapid change with far-reaching structural transformations in administrative arrangements. The main instrument of ongoing water sector reform is the draft Water Code, which was recently validated in a national workshop and is expected to be submitted for review and adoption by Parliament in late 2010. Although decentralised governance is widely embraced as an underpinning principle in water reform, it needs to be carefully designed to address the specific problems of post-conflict DRC, particularly the scarcity of human and financial resources.

In line with the decentralisation laws of 2008, the draft Water Code creates a new institutional architecture based on the devolution and transfer of water services and resource management to provincial and local administrations. Three tiers of governance are envisioned in the draft Water Code. First, at the central level, a National Water Agency will be established to manage the whole water sector based on an IWRM approach. Second, Provincial Water Councils will be created as well as local Water Committees and Water User Associations. And third, basin-based decentralised agencies will be established to manage water resources at the catchment and sub-catchment levels including aquifer systems.

The reorganization of water governance arrangements is intrinsically dependent on progress with the national decentralisation process. While political decentralisation has been achieved at the provincial level, key fiscal and administrative aspects remain unclear and are yet to be resolved. Moreover, as the number of provinces is set to more than double from 11 to 26, considerable human and financial resources will need to be mobilised to create the administrative structures of nascent entities. The scarcity of available provincial resources and embryonic governance capacity, however, raises considerable uncertainty over the operation of decentralised institutions, including those of the water sector.

Within this challenging decentralisation context, it is unlikely that devolved water services will be operational in the short to medium term. Given the limited capacity and severe budgetary constraints and to avoid the risk of a "governance vacuum", caution should be exercised in timing the creation of new water structures. A sequenced approach establishing the prerequisite financial and operational basis of provincial and local water institutions should be followed to ensure that the enabling conditions are in place before the decentralisation process starts. Indeed, in certain cases decentralised water structures may prove to be financially and technically unrealistic to implement at least in the short term.

Recognizing that the capacity of provincial and local authorities is a fundamental constraint, a recent study on the implications of decentralisation on the water sector recommends that responsibilities be gradually transferred as part of a capacity-building process. It proposes that in this transitional phase provincial authorities focus on commissioning and developing water investment plans in the short and medium term.[115] At the same time, it is important to acknowledge that given the disparity in the revenue generating potential and physical accessibility of the DRC's heterogeneous regions, decentralisation may lead to underinvestment in water service delivery in the poorer provinces. Hence, it is important to tailor decentralisation processes to local conditions to preserve a measure of equality and balance in water development across the various regions of the country.

Development of water strategies and subsidiary legislation

While the draft Water Code provides a modern, overarching legislative framework for the rational and sustainable management of water resources, its operationalisation requires the development of water strategies and subordinate statutory guidance. As envisioned in the Water Code, priority should be given to the development of water resources management and national public water services strategies. In terms of subsidiary legislation it is imperative that regulations on water service provision (including construction guidelines), water quality standards, operating standards on the demarcation of drinking water source protection zones, construction guidelines for rural and peri-urban water supply structures, rules on monitoring drinking water quality and directives on water data collection and information sharing are elaborated and promulgated. Development of secondary regulations will need to complemented and followed through with a substantive training and awareness raising programme to promote enforcement.

Institutional and human capacity

The key government ministries and organizations involved in the water sector have insufficient capacity to adequately implement their mandates and ensure rigorous regulatory oversight. While there are highly experienced and competent water experts throughout government ministries and agencies, their individual knowledge and skills are insufficiently institutionalised. An important problem that has plagued public water institutions is overstaffing (particularly of administrative staff) and poor recruitment. Moreover, a large proportion of the government's water professionals are approaching retirement age, although there are no clear policies and measures to ensure adequate replacement. There has also been a noticeable trend of government water experts being recruited by NGOs, development agencies and the private sector as they offer more attractive salary packages. This transfer of skilled water professionals out of the civil service has jeopardised the prospects of rebuilding government capacity in certain provinces.

The overriding constraint on building institutional and human capacity in the water sector is inadequate funding. This has created major deficiencies in exprtise and shortages in professional staff, equipment, office accommodation and operating budgets. The scarcity of financial resources will be particularly challenging for the new provinces, where in many cases completely new decentralised water entities will be starting from scratch. Another key challenge is the uncoordinated and fragmented manner in which capacity development measures are implemented. In response, the government of the DRC with GTZ support is developing a national capacity development strategy for the water sector that is based on a detailed assessment of existing capacity gaps.[116]

With sufficient resources and time, it is entirely feasible to build and reinforce the government's institutional and human capacity in water resources management. Technical assistance and training programmes supported by development partners can play an important role in capacity-building initiatives. The "Sanitised villages and schools university" coordinated by UNICEF is one such initiative that aims to develop local technical know-how to help ensure long-term maintenance of water infrastructure. At the same time, it will also be critical for the government to mobilise internal financial resources for subsequent operational costs and ensure their sustainability in the long run.

Despite difficult conditions, REGIDESO retains qualified staff motivated by what they describe as 'noble work'

Major infrastructure while critical, should not eclipse small-scale investments especially as these benefit a large population

Mobilising financial resources

DRC's post-conflict legacy has created major challenges for stimulating investment in the water sector. Total water sector expenditure is around $165 million per annum, which is equivalent to 1.5 per cent of the gross domestic product (GDP). This total figure includes household, commercial and industrial spending, which amounts to around $100 million or 60 per cent of the sector's economic value. In sum, slightly less than $3 is expended per person per year, while noting that the majority of the DRC's population lacks access to water. Considering that the cost of supplying water to rural and urban inhabitants ranges from $30 to $95 respectively,[117] the low level of current investments reveals the extent to which financial constraints are limiting the sector's development. Nevertheless, successful funding mobilization, particularly for the urban water supply sector ($500 million for the period 2010-2015), represents an important breakthrough but which remains below the $ 2 billion required to attain MDG/PRSP targets.

Policy reforms, namely the elaboration of guiding principles in the draft Water Code, should help create the "enabling conditions" to make water management easier. For example, the draft law removes state monopoly over water supply and opens the way for the engagement of community-level organizations and private sector investment. There is also a clear commitment to phase out distorting subsides and to move towards better cost recovery arrangements. Strengthening administrative capacity to collect charges and recover daily operating costs to enable infrastructure maintenance and ensure adequate returns on capital are also being pursued. The World Bank's project to improve REGIDESO's efficiency through a public-private partnership and the BTC's establishment of Water User Associations provide salient practical examples of water reform. These are all positive steps that need to be vigorously promoted to support sustainable water resources management.

By opening a window of opportunity for private enterprises and social economy organizations to participate in the water sector, additional resources and innovative approaches may be marshalled to address water challenges. Given the severe budgetary constraints, mobilising investments by international partners and private companies will be

Small-scale investments are important as they tend to benefit large populations

critical for the water sector's recovery, particularly in supporting nascent decentralised water institutions at the provincial level. The privileged status that the water sector has so far enjoyed in international aid projects is encouraging. Efforts by the Ministry of Planning and its Agence National Pour la Promotion d'Investissement to promote water infrastructure investments should also be recognised and reinforced. A prominent example is the hosting since 2009 of annual "Open Water Days" that bring together around the same table government agencies, donors and the private sector to explore opportunities for water financing.

Donor investments earmarked for the water sector have reportedly been held up by low disbursement rates attributed to limited technical capacity, logistical constraints and complex project preparation procedures. As a result, the DRC unfortunately risks losing critically needed financing for the water sector. Donors therefore need to simplify project application procedures and expedite their implementation in order to ensure delivery on commitments made.

It is important to emphasize that the need to mobilise financial resources for infrastructure investments should not be biased towards macro-scale projects, such as urban water supply networks and dams. In many cases, greater returns per investment unit can be expected from the construction of small-scale projects, particularly as water infrastructure is run down or non-existent in most of the DRC. Micro-investment strategies such as community-based water service partnerships, improving the construction quality and maintenance of spring boxes or in rainwater harvesting can play a critical role in improving the provision of water supplies for a large proportion of the population. For example, the Water User Associations established under the BTC's project in Mbuji-Mayi are expected to serve more than 310,000 people, which is equivalent to 11 per cent of the city's population. Moreover, cost-efficient microscale infrastructure and the development of local solutions can help make significant headway in areas where the government is reluctant or does not have the capacity to invest. At the same time, it is critical to formalise small-scale community projects by developing the appropriate regulations and ensuring adequate oversight.

A major water data vacuum

The water sector is seriously handicapped by a profound data gap. There is a striking absence of any institutionalised water resources monitoring system both for water quantity and water quality. Baseline studies on the physical characteristics of surface hydrology and hydrogeology are scant and out of date; neither is there an up-to-date inventory of existing hydraulic structures from dams to improved drinking water sources. Collection of meteorological data is relatively better but remains grossly inadequate. While it is expected that in sparsely populated and inaccessible parts of the country it would be difficult to install gauging stations, the density of the observation network is extremely low. Information for certain regions is particularly wanting, including in the war-torn east of the country and the Lake Tanganyika basin.

This unfortunate state of affairs can be traced back to the long decay of state institutions starting in the mid-1970s, which triggered the gradual erosion of data collection systems. The conflict years exposed historical databases (some of which extend back to the early 1900s) and monitoring stations to wholesale looting and wanton sabotage. Two examples from the meteorological (METTELSAT) and river navigation (RVF) organizations illustrate the extent to which hydroclimatological monitoring networks have deteriorated. Prior to the 1970s, there were 127 synoptic weather stations and 700 rainfall stations, while today the METTELSAT operates only 20 stations. Moreover, these stations are almost all located in airports, primarily servicing aviation needs. Weather stations in agricultural zones have been entirely abandoned, which in some cases is due to security reasons. While the RVF had 350 liminographs to measure fluctuations in surface water levels, only 10 stations are functional today and these are largely operated on a voluntary basis. Given the dependence on fluvial navigation as the principal means for evacuation of agricultural produce and the geographic isolation of the county's hinterland, the economic importance of rehabilitating hydrometric stations cannot be overestimated.

Where data exists it is often in a raw state and has not been transformed into usable information products. Most of the data sets are in paper format and are therefore difficult to access and share. Moreover, given the fragility of paper archives and poor storage conditions, they are at high risk of damage and loss. On the positive side, several institutions reported that they are in the process of digitizing their data sets (e.g., METTELSAT, RVF). This, however, is being done on an ad hoc basis and needs to be systematically preformed.

Many of the water laboratories are not working (Mbandaka, Equateur Province)

To rehabilitate its collapsed weather monitoring network, METTELSAT recently installed automated weather stations

Archives at the Meteorological Department in Kisangani are in a deteriorated state

Challenges to restore fluvial navigation include a shortage of hydrographic stations and personnel to record river level fluctuations (above and next page)

Fortunately, there is a positive but slow trend to reinitiate and modernize the collection of hydrological and meteorological data. Several projects are underway to install monitoring stations and inventory hydraulic and water supply works. The African Development Bank is supporting SNHR to implement provincial inventories of improved drinking water sources in peri-urban and rural areas. One of the major investments has been done by METTELSAT, which recently purchased automated weather stations fed by real-time satellite data. UNEP visits to several of the newly installed automated stations in the provincial centres revealed that they were experiencing some difficulties due to lack of adequate training in operation and maintenance. Minor technical issues including lack of spare parts has rendered some of the stations only partially operational.

An important part of ongoing efforts to rebuild the country's hydroclimatological monitoring networks are undertaken as part of wider international initiatives. Implementation of these projects is normally carried out under the auspices of regional organizations. This is partly because some international agencies have withheld direct bilateral support to the DRC pending payment of outstanding membership dues. The principal regional organizations through which international support is being channelled to the DRC are the International Commission for the Congo-Oubangui-Sangha Basin (CICOS) and to a lesser extent the Nile Basin Initiative (NBI). Key programmes include the World Meteorological Organization's (WMO) Hydrological Cycle Observing System for the Congo Basin (Congo-HYCOS) and for the SADC region (SADC-HYCOS), as well as the European Union–supported African Monitoring of Environment for Sustainable Development (AMSED). All these projects have an important hardware component to install modern gauging stations. While these constructive interventions are much needed, given the high density of the DRC's hydrological system they will still need to be significantly augmented. It is also critical that a national hydrological monitoring strategy be developed to ensure coordination and coherence among the various projects.

Numerous national organizations in the DRC are collecting hydrological data, though these are highly variable in terms of their geographic scope, thematic coverage and duration. One of the key constraints to scaling up the benefits from these various activities is the lack of clear modalities to coordinate data collection activities and facilitate access and dissemination of information. To help address this problem, a preliminary inventory of key stakeholders and existing hydrological datasets has been conducted with support from GTZ. In addition, GTZ is also assisting CNAEA in setting up an integrated water information system (SINIEau) for the DRC. A multi-stakeholder working group (involving government agencies, academic and research institutions as well as humanitarian and civil society organizations) has been set up to design a database to centrally store available information, which will be progressively implemented based on available resources. Given the considerable investment required to establish a fully functional SINIEau, additional resources from international partners and the government need to be mobilised.

The huge knowledge gap on the DRC's water resources and climate represents a major obstacle for national economic development. Hydrometeorological data is a critical prerequisite for major investments in key sectors, including water supply, agriculture, hydropower generation and fluvial navigation. In this context, hydrological information services should be viewed as a crucial economic good in their own right. The need therefore to build and reinforce the country's data collection and management capacities and facilitate stakeholder access to timely and adequate information can not be overemphasized.

5 Conclusions and recommendations

The water sector is today on the brink of undergoing fundamental reforms driven by the Water Code and decentralisation laws. High-level political commitment and donor support have also reinvigorated the sector. To alleviate the prevailing water supply crisis, it is critical that planned reforms are carried out in a disciplined manner. While the decentralisation of water institutions is an important guiding principle, it needs to be well planned and be both financially and technically realistic. For many provinces, this may not be feasible in the short to medium term. Capacity-building strategies and programmes to develop and improve existing technical and management skills at the provincial and local levels is a clear priority to avert the risk of a "governance vacuum". In addition, special measures may need to be taken to avoid potential regional inequities in water services and help facilitate institutional transition.

While substantial funding mobilisation is an encouraging development, large-scale infrastructure investments should not overshadow microlevel projects. Based on current experiences in the DRC, small-scale projects such as community-based water systems and low-cost solutions such as public standposts, spring boxes and hand pumps have the potential for reaching a larger beneficiary population and providing greater returns for the investment made. The critical next step is to promote and upscale these successful initiatives into large-scale national programmes. A multipronged investment strategy that is based on a mixture of both macro and micro solutions is therefore needed. Given severe budgetary shortages, enabling conditions that provide incentives for the participation of private enterprises and social economy organizations need to be put in place to help mobilise much needed resources. Securing substantial funding for the establishment of a comprehensive water observation network and information system is equally essential, particularly in light of the importance of water data in the development of key economic sectors.

A major challenge is the informalisation of water delivery services, which are not subject to adequate regulatory controls. As a result the construction quality and sustainability of water supply structures is seriously compromised, with important consequences for human health. Building the capacity of national authorities to ensure effective water sector coordination and independent oversight is therefore a priority issue. Humanitarian actors in the water sector also need to establish a robust mechanism to supervise and follow up on the quality of their interventions.

Finally, the degradation of strategic drinking water sources from unplanned land use changes is a nationwide problem. Immediate steps to secure the land area surrounding drinking water sources should be taken as a first line of defence, and gradually expanded based on catchment management plans. In conclusion, given the abundance of the DRC's water resources, the aforementioned problems are fully surmountable provided that astute investments and governance reforms are effectively implemented.

Recommendations

There are three main themes for the proposed recommendations. These are: (i) support to water sector governance reform; (ii) technical and institutional capacity-building; and (iii) establishing the scientific information base to strengthen water resources management. A preliminary estimate of the investment package required for the water sector over the next five years – excluding major infrastructure projects – is evaluated to be in the range of $169 million. This indicative costing is derived from broad calculations based on similar projects underway in the DRC and/or other developing countries. The final price tag will need to be re-evaluated and refined during the project development phase in consultation with national partners. Implementation of the recommendations involves a wide range of actors including government ministries and state owned corporations, development partners, UN agencies, the private sector, NGOs and social economy organizations.

It should be noted that the bulk of the funds ($100 million) to implement the proposed recommendations is designated for small-scale infrastructure projects (namely autonomous, community-based water supply systems). The balance of $69 million to implement the other recommendations – focusing on strengthening water governance, data collection, capacity-building and innovative technological solutions – represents approximately 3.5 per cent of the overall $2 billion investment package required to achieve the DRC's MDG/PRSP water target.[118]

There are five key interventions that need to be implemented as a matter of priority. These are:

1. **Develop a national water policy, sectoral water strategies and statutory regulations.** Following the adoption by Parliament of the Water Code, elaborate a national water policy defining the guiding principles that would *create* the "enabling conditions" to mobilise investments and ensure strong incentives for improvements in water use. As envisioned in the Water Code, preparation of a water resources management strategy and national public water services strategy should be carried out as a matter of priority. Statutory regulations and guidelines to support the effective implementation of the draft Water Code need to be developed. Priority areas include water service provision (including construction guidelines), water quality standards, operating standards on the demarcation of water source protection zones, rules on monitoring drinking water quality and directives on water data collection and access. A follow-up training component for government officials and other stakeholders on the new water regulations would also be needed.

   Preliminary cost estimate: $2 million

2. **Develop a comprehensive national water information system for the DRC.** This entails investment in both the "hardware" and "software" components of a water information system. The former refers to building a hydrological and climatological station observation network, which was to a large extent, destroyed during the conflict period. It would cover surface and groundwater and monitor both water quantity and water quality. The "software" component is concerned with stakeholder coordination, setting data standards and defining modalities for information sharing and dissemination. Finally, a "human ware" component would provide technical training in data collection and information management. This programme should directly build on the work carried out by GTZ to establish a national water information system (SINIEau). Funding for setting up such a programme would need to be mobilised from a consortium of international partners.

   Preliminary cost estimate: $40 million

3. **Invest in autonomous, community-based management of microscale water infrastructure.** This should be largely based on the successful Water User Association (WUA) model developed by the BTC. A discernible advantage of microscale infrastructure projects is that they can provide greater returns on investment made and reach areas inaccessible to government services. By increasing water supply coverage in peri-urban and rural areas, WUAs would significantly contribute to the achievement of national and MDG-based water targets. The aim would be to raise the proportion of the population accessing water from public standposts from the current 5 per cent to 30 per cent by 2015.[119] The key operating principle for WUAs would emphasize full cost recovery to ensure sustainable infrastructure operation and maintenance. The project would also explore ways of scaling up the activities of WUAs to improve watershed management and protection, and may include such activities as reforestation, gully rehabilitation and solid waste collection. At the same time, the importance of formalising small-scale community projects by developing the appropriate regulations and ensuring adequate oversight cannot be overemphasized.

   Preliminary cost estimate: $100 million

4. **Implement a capacity-building programme for decentralised water institutions.** In view of decentralisation plans, this programme would primarily target building the capacities of provincial water authorities. It would entail significant investment in technical and administrative training in areas such as water law and strategies, development of institutional arrangements and equipment provision. Pilot provinces and catchments from different regions would be selected to ensure that they reflect the country's heterogeneous conditions.

   Preliminary cost estimate: $15 million

5. **Develop and implement watershed-based source protection plans.** This programme would target strategic but degraded watersheds that play a critical role in supplying drinking water to large population centres. Priority catchments include N'Djili and Lukunga in the capital city of Kinshasa. This would entail development of pilot projects based on an Integrated Water Resources Management (IWRM) approach that aim to create a structured process for reconciling the divergent needs of multiple stakeholders within target catchments. It would also provide an opportunity to practically test the IWRM approach promoted in the Water Code and help inform the design of regional and national IWRM programmes.

   Preliminary cost estimate: $1 million

Other important recommended interventions include:

6. **Strengthen national capacity to coordinate and regulate water supply interventions in rural and peri-urban areas.** This project would be undertaken within the framework of the "Village et Ecole Assainis" national programme. It would comprise of two key components: (i) strengthen the capacity of SNHR to coordinate stakeholders and supervise the construction quality of water supply structures and (ii) develop the capacity of health centres (Zone de Santé) to monitor drinking water quality.

   Preliminary cost estimate: $2 million

7. **Establish a field monitoring programme to ensure application of drinking water standards by WASH actors in humanitarian rapid response.** To ensure maximum return on investment and long-term sustainability of humanitarian interventions, it is imperative to set up a follow-up mechanism to supervise the construction standards and the drinking water quality provided by international agencies and NGOs in emergency situations, particularly in the war-torn eastern part of the country. In this regard, donors need to recognise the importance of dedicating resources for field verification, particularly in view of the protracted nature of emergency response in the DRC.

   Preliminary cost estimate: $500,000

8. **Design and implement renewable energy pilot projects for conventional water utilities and autonomous, community-based water supply systems.** Fuel oil costs represent a major financial burden on conventional water treatment plants and community-run supply networks, particularly in geographically isolated areas of the DRC. This pilot programme is divided into two phases: (i) carry out a technical assessment to identify appropriate renewable energy technologies (kinetic energy turbines, microhydro, solar, wind, biofuel) for operating conventional water treatment plants in secondary urban centres and community-level supply networks in peri-urban and rural areas and (ii) based on the technical evaluation, implement the simplest and most appropriate renewable energy solutions selected (in terms of efficiency, maintenance and cost) at three demonstration sites and disseminate and upscale the lessons learned.

   Preliminary cost estimate: $5 Million

9. **Design and implement Ecological Sanitation (Ecosan) pilot projects in strategic urban micro-catchments.** Biological water contamination is the most serious and widespread form of water pollution in the DRC, evidenced by the high incidence of waterborne diseases. The aim of the ecosanitation pilot project is to control pathogenic faecal contamination and improve water quality in priority catchments supplying drinking water to major urban centres. The project will focus on adapting existing ecosan models (e.g., dry toilet systems) to the DRC's specific socio-economic context and prioritize their application in vital segments of water source catchments. As the successful promotion of the ecosan approach requires a change in sanitary culture, priority will be given to public sanitation services (e.g., marketplaces, schools, hospitals, government facilities). In addition, the feasibility of promoting a closed-loop approach and attributing an economic value to human excreta as a valuable source of agricultural nutrients that can help enhance urban food security will be examined. The best-practice ecosan models selected will subsequently be used for demonstration, training and upscaling.

   Preliminary cost estimate: $1.5 Million

10. **Design and implement pilot projects to introduce rainwater harvesting technologies at the household and community levels.** This pilot programme would undertake various trials to assess the potential for rainwater harvesting in the country's diverse regions. The objective is to identify effective rainwater collection techniques – for both rural and urban areas – to help meet domestic water consumption needs, including for irrigation of small household plots. The pilot project would also include training and awareness-raising components to showcase and disseminate information on the country's underutilized rainwater harvesting potential.

Preliminary cost estimate: $2 million

Annex 1. Acronyms

AfDB	African Development Bank
AFD	French Development Agency
AMSED	African Monitoring for Sustainable Development
BADEA	Arab Bank for Development in Africa
BTC	Belgian Development Agency
CICOS	International Commission for the Congo-Oubangui-Sangha Basin
CNAEA	National Water and Sanitation Committee, Ministry of Planning
DEH	Département de l'Eau et de l'Hydrologie, MoE – Department of Water and Hydrology
DRC	Democratic Republic of the Congo
DSCRP	Document de la Strategie de Crossiance et de Reduction de la Pauverté (PRSP)
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GTZ	German Technical Cooperation
HYCOS	Hydrological Cycle Observing System of WMO
IWRM	Integrated Water Resources Management
JICA	Japan International Agency
KfW	German Development Bank
MDG	Millenium Development Goals
MENCT	Ministry of Environment, Nature Conservation and Tourism
METTELSAT	Agence Nationale de Météorologie et de Télédétection par Satellite National Agency for Meteorology and Satellite Remote Sensing, Ministry of Transportation
MoE	Ministry of Energy
NBI	Nile Basin Initiative
NTU	Nephelometric Turbidity Units
NGO	Non-Governmental Organization
PCEA	Post-Conflict Environmental Assessment
PGAI	Platform for the Management of Aid and Investments (Ministry of Planning)
PNA	National Sanitation Programme
PPP	Public-private Partnerships
PRSP	Poverty Reduction Strategy Paper
RESCA-CN	Remise en Service des Centres en Arrêt et Création des Nouveaux (REGIDESO) Starting-up Idle Centers and Establishing New Centres
REGIDESO	Régie de Distribution des Eaux – State water utility company, MoE
RESE	Reforme du Secteur de l'Eau – Water sector reform program supported by GTZ
RVF	Régie de Voie Fluvial – State river navigation company
SADC	Southern African Development Community
SNHR	Service National d'Hydraulique Rural – National Rural Water Service, Ministry of Rural Development
SINIEau	System d'Information National sur l'Eau – National water information system supported by GTZ
SNEL	Société National d'Electricité – State electricity utility company, MoE
SNV	Netherlands Development Organization
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UN-OCHA	United Nations Office for the Coordination of Humanitarian Affairs
WASH	Water Sanitation and Hygiene Cluster (UN)
WMO	World Meteorological Organization
WUA	Water User Associations
WSP	Water and Sanitation Programme

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Annex 3. Sampling Results

Table 1. Heavy metal concentrations in Kinshasa REGIDESO drinking water supply (µg/L)

	Ngaliema water plant / raw water (5/5/10)		Ngaliema water plant / treated water (5/5/10)		N'djili water intake / raw water (5/5/10)		N'djili central reservoir / treated water (5/5/10)		N'djili eastern reservoir / treated water (5/5/10)	
Heavy metal	**diss**	**tot**	**diss**	**tot**	**diss**	**tot**	**diss**	**Tot**	**diss**	**tot**
Mg	1014	1029	1009	995	485	502	420	428	425	417
Al	331	380	596	596	149	171	128	133	246	240
Cr	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Co	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Ni	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1.0	< 1
Cu	1.0	1.2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Zn	6.9	7.5	18.2	17.4	5.9	6.8	7.3	12.9	10.0	11.2
As	1.7	1.9	2.1	1.8	2.0	2.1	1.9	1.6	< 1	< 1
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cd	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sn	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Hg	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Pb	1.3	1.6	< 1	< 1	1.6	1.5	< 1	< 1	< 1	< 1

Diss: filtered water sample
tot: unfiltered water sample
Margin of error ± 20%

Table 1. Heavy metal concentrations in Kinshasa REGIDESO drinking water supply (µg/L) (Continued)

	Lukunga water intake / Congo River (6/5/10)		Lukunga water intake / Lukunga River (6/5/10)		Lukunga water plant / treated water (6/5/10)		Lukaya water intake / raw water (6/5/10)		Lukaya water plant / treated water (6/5/10)	
Heavy metal	**diss**	**tot**	**diss**	**tot**	**diss**	**tot**	**diss**	**tot**	**diss**	**tot**
Mg	1099	1072	521	502	672	686	491	490	445	447
Al	175	214	218	410	169	176	177	204	164	169
Cr	< 1	< 1	< 1	< 1	< 1	< 1	1.3	< 1	< 1	< 1
Co	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Ni	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cu	< 1	< 1	< 1	< 1	< 1	< 1	13.0	12.8	2.6	2.3
Zn	6.5	6.5	8.1	7.4	5.9	11.0	12.2	13.9	19.2	18.9
As	< 1	< 1	< 1	1.2	< 1	1.1	< 1	< 1	< 1	< 1
Se	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cd	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Sn	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Hg	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Pb	< 1	1.2	2.1	2.8	< 1	< 1	3.3	2.3	1.4	1.3

Diss: filtered water sample
tot: unfiltered water sample
Margin of error ± 20%

Table 2. Selected physical and chemical parameters from Kinshasa REGIDESO drinking water supply

Location / Date	Temperature (°C)	pH	DO mg/l	Nephelometric Turbidity Units (NTU)	Electric Conductivity (µS/cm)	NH_4 mg/L	PO_4 mg/L
Ngaliema water plant / raw water (5/5/10)	30.6	6.72	5.92	30	40.8	0.105	< 1.5
Ngaliema water plant / treated water (5/5/10)	30.5	5.41	7.44	1.44	58.1	0.047	< 1.5
N'djili water intake / raw water (5/5/10)	28.8	6.75	7.02	37.3	38.1	0.316	< 1.5
N'djili central reservoir / treated water (5/5/10)	26.2	5.91	8.10	1.98	38	0.039	< 1.5
N'djili eastern reservoir / treated water (5/5/10)	26.8	5.84	8.15	5.03	37.5	0.056	< 1.5
Lukunga water intake / Congo River (6/5/10)	29.2	7.04	6.54	34.9	31.9	0.043	< 1.5
Lukunga water intake / Lukunga River (6/5/10)	28.2	7.2	7.3	118	53	0.197	< 1.5
Lukunga water plant / treated water (6/5/10)	28.9	6.23	7.12	7.99	80.1	0.038	< 1.5
Lukaya water intake / raw water (6/5/10)	27.1	7.26	7.26	56.9	21.73	0.103	< 1.5
Lukaya water plant / treated water (6/5/10)	27.3	6.88	7.99	4.95	29.6	0.044	< 1.5

Table 3. Results of biological water quality testing of REGIDESO water supply

Sample No.	Location/Date (village/town, province)	Water source type	Total Coliforms	*E. Coli*
1.	Kikwit, Bandundu (12/04/10)	Cungu standpost	Positive	Negative
2.	Kikwit, Bandundu (12/04/10)	Pemba standpost	Positive	Positive
3.	Kikwit, Bandundu (12/04/10)	Kikwit-3 standpost	Positive	Negative
4.	Kikwit, Bandundu (12/04/10)	Kikwit-3 Camp Bapemba standpost	Positive	Negative
5.	Kikwit, Bandundu (12/04/10)	Standpost at REGIDESO water plant	Negative	Negative
6.	Idiofa, Bandundu (14/04/10)	Standpost at REGIDESO water plant	Positive	Negative
7.	Idiofa, Bandundu (14/04/10)	Standpost Dia (Boulevard Kabila)	Positive	Negative
8.	Idiofa, Bandundu (14/04/10)	Standpost Ndembi (Boulevard Kabila)	Negative	Negative
9.	Bandundu town (16/04/10)	REGIDESO Bore hole No. 2	Negative	Negative
10.	Bandundu town (16/04/10)	Household yard tap, Quartier Salimenta	Negative	Negative
11.	Bandundu town (16/04/10)	Tap water, Hotel Lenko	Positive	Negative
12.	Kananga, Kasaï Occidental (25/04/10)	Standpost Hygiene, Quartier Malandi	Positive	Negative
13.	Kananga, Kasaï Occidental (25/04/10)	Standpost Omos, Quartier Tshisambi	Positive	Negative
14.	Kananga, Kasaï Occidental (26/04/10)	Water treatment plant, intake from River Chibashi	Positive	Negative
15.	Kananga, Kasaï Occidental (26/04/10)	Standpost Palace	Positive	Negative
16.	Kananga, Kasaï Occidental (26/04/10)	Standpost Ndesha	Positive	Negative
17.	Kinshasa (5/5/10)	N'djili, untreated water at intake	Positive	Positive
18.	Kinshasa (5/5/10)	N'djili, Eastern Reservoir at water plant	Negative	Negative
19.	Kinshasa (5/5/10)	N'djili, Central Reservoir at water plant	Negative	Negative
20.	Kinshasa (5/5/10)	Ngaliema, untreated water at intake	Positive	Positive
21.	Kinshasa (5/5/10)	Ngaliema treated water	Negative	Negative
22.	Kinshasa (5/5/10)	Water tap at SAFRICAS	Negative	Negative
23.	Bunia, Orientale Province (22/08/10)	Standpost, Quartier Limbabo	Negative	Negative
24.	Bunia, Orientale Province (22/08/10)	Household water tap	Negative	Negative

Table 4. Results of biological water quality testing of improved drinking water sources

Sample No.	Location/Date (village/town, province)	Water source type	Total Coliforms	*E. Coli*
1.	Kikwit, Bandundu (12/04/10)	Spring box, Moubaka	Positive	Positive
2.	Idiofa, Bandundu (14/04/10)	Spring Mapela	Positive	Negative
3.	Tomoti, Bandundu (14/04/10)	Traditional spring, Oliob	Positive	Positive
4.	Boka, Bandundu	Spring box, Diem II	Positive	Negative
5.	Mushie Pentane, Bandundu, (17/04/10)	Spring box, Mayi ya Bayansi	Positive	Negative
6.	Mushie Pentane, Bandundu, (17/04/10)	Groundwater, hand pump well at Nsadisa school	Negative	Negative
7.	Mushie Pentane, Bandundu, (17/04/10)	Spring box, Nkulu Mufune	Positive	Negative
8.	Bunkulu, Bandundu (17/04/10)	Spring box, Musul	Positive	Negative
9.	Ito-Mbaya, Bandundu (17/04/10)	Spring box, Mbashia	Positive	Positive
10.	Eliama, Bandundu (17/04/10)	Traditional spring, Djem	Positive	Negative
11.	Monkana, Bandundu (18/04/10)	Groundwater, hand pump well Monkana school	Negative	Negative
12.	Kasasa, Kasaï Occidental (21/04/10)	Spring box, Kantondo	Positive	Negative
13.	Nkonko, Kasaï Occidental (23/04/10)	Spring box, Mukalate	Positive	Negative
14.	Kananga, Kasaï Occidental (25/04/10)	Groundwater, traditional wells at Kelekele (Bayenke)	Positive	Positive
15.	Mbuji-Mayi, Kasaï Oriental (29/04/10)	Groundwater, CTB Standpost at Nyongolo	Positive	Positive
16.	Chitenge, Kasaï Oriental (01/05/10)	Spring Albert, MIBA water plant	Positive	Positive
17.	Mbuji-Mayi, Kasaï Oriental (01/05/10)	MIBA standpost 87, Cite 43	Positive	Positive
18.	Banyakal, Kasaï Oriental (01/05/10)	Spring box, Kangu 1	Positive	Negative
19.	Bunia, Orientale Province (22/08/10)	Groundwater, shallow hand pump well, Quartier Limbabo	Positive	Negative
20.	Djokojo, Orientale Province (22/08/10)	Spring box, Djokojo	Positive	Positive
21.	Talolo, Orientale Province (26/08/10)	Spring box, Talolo	Positive	Positive
22.	Lolwa, Orientale Province (26/08/10)	Spring box, Kondata	Positive	Positive
23.	Komanda, Orientale Province (26/08/10)	Spring box, Katanga	Positive	Positive
24.	Komanda, Orientale Province (26/08/10)	Spring box, Carrière	Positive	Positive
25.	Beni, North Kivu (31/08/10)	Spring box, Butanuka	Positive	Positive
26.	Kasenyi Oriental Province (01/09/10)	Groundwater, hand pump well at Bloc Marche	Positive	Negative

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Annex 6. Endnotes

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Further technical information may be obtained from the UNEP Post-Conflict and Disaster Management Branch website at: **http://www.unep.org/conflictsanddisasters/** or by email: **postconflict@unep.org**

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