

# Questionnaire

## Matrix of Factors

### General information

<b>Region</b>	<b>Sub-Saharan Africa</b>																																																												
<b>Covering countries</b>	<p><b>The sub-Saharan Africa region can be divided into four sub-regions, as follows:</b>            Northern sub-Saharan Africa            Central and Western sub-Saharan Africa            Southern sub-Saharan Africa            Eastern sub-Saharan Africa</p>																																																												
<b>Population</b>	<p><b>The population figures (1995 and estimated for 2025) of the four different sub-Saharan Africa regions are given in the table below:</b></p> <table border="1"> <thead> <tr> <th rowspan="2">Region</th> <th colspan="3">1995 baseline estimates (millions)</th> <th colspan="3">2025 baseline estimates (millions)</th> </tr> <tr> <th>Rural</th> <th>Urban</th> <th>Total</th> <th>Rural</th> <th>Urban</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td colspan="7"><b>Sub-Saharan Africa</b></td> </tr> <tr> <td>Northern Sub-Saharan Africa</td> <td>104</td> <td>29</td> <td>133</td> <td>174</td> <td>114</td> <td>288</td> </tr> <tr> <td>Central and western Sub-Saharan Africa</td> <td>84</td> <td>47</td> <td>131</td> <td>132</td> <td>150</td> <td>282</td> </tr> <tr> <td>Southern Sub-Saharan Africa</td> <td>55</td> <td>24</td> <td>79</td> <td>75</td> <td>80</td> <td>155</td> </tr> <tr> <td>Eastern Sub-Saharan Africa</td> <td>70</td> <td>19</td> <td>89</td> <td>112</td> <td>73</td> <td>185</td> </tr> <tr> <td><b>Total Sub-Saharan Africa</b></td> <td><b>313</b></td> <td><b>119</b></td> <td><b>432</b></td> <td><b>493</b></td> <td><b>417</b></td> <td><b>910</b></td> </tr> </tbody> </table>						Region	1995 baseline estimates (millions)			2025 baseline estimates (millions)			Rural	Urban	Total	Rural	Urban	Total	<b>Sub-Saharan Africa</b>							Northern Sub-Saharan Africa	104	29	133	174	114	288	Central and western Sub-Saharan Africa	84	47	131	132	150	282	Southern Sub-Saharan Africa	55	24	79	75	80	155	Eastern Sub-Saharan Africa	70	19	89	112	73	185	<b>Total Sub-Saharan Africa</b>	<b>313</b>	<b>119</b>	<b>432</b>	<b>493</b>	<b>417</b>	<b>910</b>
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## Socio-cultural factors

<p><b>Willingness to pay for drinking water</b></p>	<p>Source</p>
<p>Is drinking water an important part of the budget in general? How will this change and will this be accepted?</p>	
<p>The 2002 WSSD held in Johannesburg set the ambitious target of halving by 2015 of the 1 200 million people in the world who lack access to clean water and the 2 400 million people who lack improved sanitation – in order to improve services to all by 2025. Some water professionals remark that these targets simply reaffirmed the MDGs already agreed to in 2000. In tracking the history, it seems that the Johannesburg WSSD simply reaffirmed those targets which has not been achieved by previous international water conferences in Dublin (1992), Rio (1992), The Hague (2000), Bonn (2001) and Kyoto (2003). A quote from The Economist "If regulation is difficult for rich countries, it will be desperately hard for poor ones. Part of the problem is cultural: not many developing countries have good antitrust regulation, or are used to the idea of regulating to promote competition rather than to restrain it."</p> <p><u>Provision of a basic human right</u> Utilities should provide at least some minimal quantity of domestic-use water free of charge.</p> <p><u>Social justice</u> Policymakers must be concerned with the income distributional implications of a water rate design, in particular in areas of the world with widespread poverty.</p> <p>Water rates alone can have little overall impact on income distribution.</p> <p><u>Affordability</u> Affordability is a relative and contextual quality of water rates; i.e. water's affordability is a function of a utility's water rate, a customer's income, and the prices of other goods that customer purchases. Rate affordability is meaningful at the level of a customer's ability to pay whereas equity connotes fairness across many customers; the price of a good or service can be affordable but not equitable, or vice-versa.</p> <p><u>Resource efficiency</u> An equitable rate structure charges moderate prices for efficient water use and punitively high prices for wasteful use.</p> <p><u>Cost of service</u> Rates based on cost-of-service principles strive to make each customer pay exactly what it costs to serve him or her. An equitable rate structure by cost-of-service standards levies charges that approximate as closely as possible the costs of serving customers; resource, capital, operating, maintenance, customer service, and other discrete cost pools.</p>	<p>Teodoro, 2005</p>
<p><b>Level of information of the consumer with regard to drinking water</b></p>	
<p>Are people getting more educated or do they lose interest? This aspect is partially coupled with the demographic aspect of level of education</p>	

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<b>The appreciation of drinking water</b>	
For example, water can be a life style product; especially this seems to be the case for bottled water (?)	
<ul style="list-style-type: none"> <li>• Global consumption of bottled water has doubled in five years, consuming huge quantities of energy, producing toxic waste and putting stress on supplies near bottling plants, says the Earth Policy Institute.</li> <li>• The United States consumes most, followed by Mexico, China and Brazil. At two glasses a day, Italians drink most per person. Lebanon and the United Arab Emirates show the fastest growth, while India's consumption has tripled. In 2004, 1.4 million bottles of Finnish tap water were shipped to Saudi Arabia.</li> <li>• The EPI says that bottled water is often no healthier than tap water but can cost 10 000 times more.</li> <li>• Tap water is distributed through energy-efficient pipes while transporting bottles requires massive quantities of fossil fuels. Each year, 2.7 million tons of plastic are used to make water bottles –America alone uses enough oil to fuel 100 000 cars. Discarded bottles take 1 000 years to biodegrade, while incineration produces chlorine and heavy metals.</li> <li>• Consumers associate bottled water with health, but EPI says 40% of bottled water began as tap water.</li> </ul> <p>Related web site: What's in your Water Bottle  <a href="http://www.pbs.org/frontlineworld/stories/bolivia/waterbottle.html">[http://www.pbs.org/frontlineworld/stories/bolivia/waterbottle.html]</a>          Related news: "environmental madness" and often not safe, Source  <a href="http://www.irc.nl/page/14913">[http://www.irc.nl/page/14913]</a>, 23 Nov</p> <p>In South Africa, there has been a widespread increase in the use of bottled water and point-of-use home water purifiers, which is the result of (1) change in life style, and (2) loss of confidence in water supply authorities to produce drinking water of acceptable quality</p> <p>The basis of all life has been taken to lucrative new levels thanks to the power of branding writes Michelle Coetsee (Sunday Times, 3 September 2006). In recent years water, one of the most freely available commodities, has undergone a complete makeover to become one of the most dynamic and competitive items in the packaged-goods categories. Nestlé's international portfolio includes 76 brands, amongst them Perrier. The SA bottled water market has consistently achieved annual value growth in excess of 20% over the past three years. There are over 30 brands in the market, which is acknowledged to have some of the best tap-water in the world.</p>	

<b>Ecological Awareness</b>	
Also awareness regarding emerging pollutants. Are trends visible?	



achieving a growth rate of 6% in GDP over this period. Ngcuka said that the recent growth, though welcome, has been unbalanced in two important respects. Firstly the growth is based on a combination of strong commodity prices, strong capital inflows and strong domestic consumer demand, rooted in anti-poverty measures, growing employment, and rising asset prices. This has had the effect of strengthening the currency making it difficult for exporters outside the commodity sector or those who compete with imports to remain competitive, which led to a trade deficit of nearly 4.5% of GDP in 2005. Secondly although the social grant programme has given some impetus to poverty reduction and income redistribution, there remain about a third of South African households not yet able to benefit directly from our relative economic success. The Minister told the briefing that in order to maintain a sustainable growth at a rate of around 6% would require that the two key imbalances are effectively countered by removing the following six constraints through the ASGISA programme:

- the volatility and level of the currency;
- the cost, efficiency and capacity of the national logistics system (the price of moving goods and conveying services);
- shortage of suitably skilled labour;
- barriers to entry, limits to competition and limited new investment opportunities;
- the regulatory environment and the burden on small and medium businesses;
- deficiencies in state organisation, capacity and leadership.

### **Summary of future social and political scenarios (Offringa, 2006):**

- Increased drive to supply remaining people without water
- Increased drive to provide remaining Free Basic Water
- Pressure on service delivery will increase
- A greater accent on affordability
- The people and their needs will become more important
- Further decentralization of water treatment and supply systems – right into the homes – will take place
- More political pressure to develop and exploit alternative water and energy sources
- Global warming: Water shortages; alternative sources & energy
- Quality water for the immune deficient and vulnerable
- The skills shortage will continue

## Economical factors

<b>Financing models</b>	Source
Privately owned, fully state-owned and different participation models exist. What trends can be observed?	
<p>A Namibian rights NGO has slammed a local government scheme to provide prepaid water, saying it is making the basic commodity "unaffordable for the poor".</p> <p>The revenue generated by the prepaid water system - installed in informal settlements and rural areas by municipalities, including the capital, Windhoek, in early 2000 - is used to recover the cost of providing basic services such as water, streetlights and sanitation.</p> <p>The NGO and political Opposition maintain that the provision of basic water services, including urban and rural supply, should be reincorporated into the public sector as a core function of government, operated on a non-profit and transparent basis, and not by a utility.</p> <p>They suggest that the neighbouring South African system be emulated whereby a free percentage of household water supply is allocated to safeguard the interests of families, children and pensioners, and then staggered tariffs for households and industries.</p>	<p><a href="http://www.IRINnews.org/donors">www.IRINnews.org/donors</a></p>
Sustained interest in and focus on Africa from Europe	Global Research Alliance (2006)
Donor funding from outside Africa: increase or decrease?	
Emphasis on capacity building	
How to integrate PPP effectively	
<p>The African Development Bank Group (ADBG) has provided \$81.8 million to Tanzania, via the Tanzania Rural Water and Sanitation Programme, to support projects that provide safe drinking water and improve sanitation in rural areas. The programme, which will run from 2006 to 2010, aims to provide sustainable safe water supplies and sanitation. The work is underpinned by a theme of management responsibility and user ownership, and will enable an extra 6.5 million people to have access to safe water and 90% of the population to have sustained sanitation by 2010.</p>	

<b>Maintenance / renovation of infrastructure</b>	
E.g. it is claimed sometimes that the renovation of e.g. distribution systems will require huge capital in the future	
The head of Angola's National Department of Water, Elsa Ramos, has reported that 60% of the country's population drinks and uses inappropriate water for domestic needs. She noted at a pan-agency workshop on national water, sanitation and hygiene projects that to improve the situation, the government had to rebuild infrastructure destroyed in the country's decades-long war. The workshop looked at the challenges to developing the water sector, sector programme goals, policy development, institution building and reinforcement,	

<p>service management and development.</p> <p>Australia is to provide \$915 000 for the water and sanitation needs of Ugandans displaced by war. The money will be given to UNICEF's Uganda water &amp; sanitation programme and will be used to help continue the installation of toilets, drilling of boreholes, construction of water tanks and repair of water outlets in displaced persons camps. It is estimated that 1.7 million people are living in over 200 camps in northern Uganda as a result of a 20-year war between the Uganda People's Defence Force and the rebel Lord's Resistance Army (LRA).</p> <p>Management Institute (Sapa-AFP)</p> <p>Investment in appropriate infrastructure</p> <p>Affordable systems</p> <p>Sustained funding for maintenance</p> <p>Availability of capital for infrastructure investment</p> <p>The World Bank's IDA (International Development Association) recently announced the cancellation of IDA debt to 13 of Africa's poorest nations as from July 2006, this date being the start of the World Bank's financial year. This move emerged from the deliberations at the July 2005 G8 Summit in Gleneagles, Scotland, where the G8 leaders pledged to cancel the debt of the world's most indebted countries, most of which are located in Africa – these African countries include:</p> <p>Benin; Burkina Faso; Ethiopia; Ghana; Madagascar; Mali; Mozambique; Niger; Rwanda; Senegal; Tanzania; Uganda and Zambia. The countries outside of Africa, included in the relief fund, are Bolivia; Guyana; Honduras and Nicaragua,</p> <p>The IDA is expected to provide more than US\$37 billion in debt relief over the next 40 years.</p>	<p>Global Research Alliance (2006)</p>
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<p><b>Energy costs and energy consumption</b></p>		
<p>Which trends in energy prices are expected and how will this affect the drinking water situation?</p>		
<p>At the conclusion of the recent four-day African Ministerial Conference on Hydropower and Sustainable Development in Johannesburg, African leaders committed to developing a continent-wide energy vision for 2025 to be monitored by ministers of finance, energy, water and the environment under the auspices of the African Union (AU) and agreed that exploiting the potential of hydropower as renewable energy could help meet the power needs of the continent.</p> <p>The vision includes analysing case studies of hydropower projects in Africa, which will serve as mentoring examples.</p> <p>The ministers also agreed that hydropower development should be underpinned by sound environmental and social impact assessments, mitigation and management of plans, in accordance with national regulatory</p>	<p><a href="http://www.southafrica.info/doingbusiness/economy/infrastructure/971476.htm">www.southafrica.info/doingbusiness/economy/infrastructure/971476.htm</a></p>	

<p>frameworks and international standards of good practice.</p> <p>South African Minister of Minerals and Energy Lindiwe Hendricks emphasised the importance of capacity building in hydropower development and climate change as critical to meeting the set goals.</p> <p>While 75% of South Africans have access to electricity, she noted with concern that over 90% of people in Africa had no such access and emphasised that access to electricity is essential for achieving the objectives of Nepad, the Millennium Development Goals and sustainable development.</p> <p>Hendricks said the conference also noted that less than 70% of hydropower potential in Africa had been developed.</p> <p>As part of the action plan, South Africa and Egypt will help other African countries develop their designated national authorities for clean development mechanisms and provide technical assistance in project development.</p> <p>Recognising the energy deficiency in Africa, ministers will ask the AU and other regional and international institutions to help countries prepare feasibility studies of key Nepad hydropower projects such as Inga Project in the Democratic Republic of Congo, to serve as a regional source of electricity.</p> <p>The ministers will ask the Nepad Secretariat to speed up the establishment of centres of excellence on water, science, technology and renewable energy and called on multilateral and bilateral funding agencies to engage African countries on hydropower development, promote national and regional projects and innovative funding mechanisms.</p> <p>The African Ministerial Council on Water, AFREC and the Forum of Energy Ministers of Africa are to implement the action plan of the conference.</p> <p>Conflicting demand between water use and energy requirements in Africa</p> <p>Research on renewable energy sources</p> <p>Impact on energy intensive water treatment processes, e.g. desalination</p> <p>Impact on industrialisation</p> <p>Availability of fossil fuels</p> <p>The project stalled until recently when the bank agreed to a simultaneous building of two large dams in Uganda.</p> <p>Presently, there is an acute shortage of power in Uganda and we believe that the Karuma project is of great importance to this nation. This shortage will continue in the medium term until at least two large hydro-power stations (Karuma and Bujagali) are constructed.</p> <p>Mozambique's Hydro Cahora Bassa (HCB), which had threatened to suspend electricity supplies to Zimbabwe last week over debt arrears, is believed to</p>	<p>Global Research Alliance (2006)</p>
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<p>have allowed the country's power utility a grace period of one month to settle its arrears.</p> <p>This follows electricity cuts from South Africa which has forced the country to suffer erratic power outages. Zimbabwe, which imports about 34.6 percent of its electricity needs from regional suppliers, receives most of its power imports from HCB, which supplies the country with 3 198.89 GW of electricity an hour. The Mozambican power supplier accounts for more than 26 percent of imported electricity, with the rest coming from ESKOM of South Africa, SNEL of the Democratic Republic of the Congo (DRC) and ZESCO of Zambia. ZESA benefits from the 50 percent of exporters' proceeds that is remitted to the central bank, but hard cash inflows have been low since the introduction of tough new exchange control measures last November.</p> <p>Industry officials have urged the government to support ZESA in concluding a bilateral agreement it is negotiating with SNEL, which would give the Zimbabwean power company the right of first access to DRC electricity. Electricity from the DRC is the cheapest in southern Africa, while HCB 's supplies are the most expensive.</p> <p>Angola, Botswana, DRC, Namibia and South Africa have jointly initiated a massive hydropower plant, that will have the capacity and potential to generate power for the entire African continent, with the possible exportation of the surplus to Europe.</p> <p>The Inga project estimated to cost \$7bn is aimed at addressing the looming energy shortages in the region, but it will also bring huge socio-economic benefits, to the five countries involved, which have already concluded inter-governmental and power utility memoranda. The project is vital to Eskom, which is looking for alternative energy sources, to address the country's growing demands for electricity. Fani Zulu, the Eskom spokesperson, says: "The objective here is to build a power station that would generate some 3 500 megawatts, along with a transmission network that will allow the high voltage transportation of electricity from Inga down to Angola to Botswana, to Namibia and into South Africa. The second phase of this project is to build a plant with a potential to generate some 35 000 to 40 000 megawatts that is equivalent to our current generation capacity in South Africa. That would be massive".</p> <p>Although the five countries have each contributed \$100 000 towards the project, the bulk of the \$7bn required to finance the first phase of the project, will be sourced from potential investors.</p>	
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<p><b>The role of decentralized systems</b></p>	
<p>How will this affect the costs distribution?</p>	

**Summary of future economical scenarios (Offringa, 2006):**

- Greater pressure to produce and supply more affordable water
- Increased pressure on improved water demand management – also on household level
- Greater pressure on low running cost technology (people pay the running costs)
- Technologies should have lower Life Cycle Analysis values – especially lower energy consumption levels
- Pressure to produce and utilize renewable energy sources at a lower cost

## Political factors

Decision making process for innovations / investments	Source
Are trends visible in this process?	
<p>Effect of bad governance</p> <p>No common scientific approach; no standards</p> <p>Regional cooperation</p> <p>Institutional problems</p> <p>S&amp;T community to play a more pro-active role</p> <p>A multi-stakeholder meeting in Lagos, Nigeria, has called for water to be excluded from World Trade Organisation agreements and ongoing General Agreements in Trade and Services (GATS), noting that water is a social good and a social service for the poor, which should not become a commodity to be traded. The water and sanitation round table, held to review issues raised during World Water Week in Stockholm, also voiced fears that the Water Integrity Network, launched during the week, would be stifled by the global institutions that fuelled corruption in the sector.</p> <p>Africa's water systems need annual investments of about US\$ 20bn over the next two decades, a United Nations report has concluded. The report was presented at the World Water Forum in Mexico. The African Development Bank (ADB) says that only 3.8% of the continent's water resources are developed and about 300 million Africans lack access to safe drinking water. It calls for an improvement in governance, as well as finance.</p> <p>The following changes are seen as imperative to promote good practice in water management:</p> <ul style="list-style-type: none"> <li>• guaranteeing stability and democracy in the region;</li> <li>• building an appropriate environment for private investment in water infrastructure(transparent and open; accountable and gender-responsive);</li> <li>• implementing national and regional water policies and strategies adapted to local reality;</li> <li>• making headway in governance as pertained to water through legislative reforms and institutional strengthening;</li> <li>• creating institutional, social, political, financial and technical capacity, and</li> <li>• seeking extensive, in-depth information and analyses for water issues for appropriate decision-making.</li> </ul> <p>The ADB, together with the UN's human settlements agency UN-Habitat, announced a US\$ 550m (EUR 452m) loan programme aimed at developing</p>	<p>Global Research Alliance (2006)</p>

<p>small-scale drinking water projects in urban areas.</p> <p>A UNESCO report due to be released ahead of the Fourth World Water Forum, will warn that corruption, restricted political rights and limited civil liberties are all factors behind the world's growing water crisis. UNESCO has said that the second edition of the UN World Water Development Report will show that the global water crisis is largely a crisis of governing systems that 'determine who gets what water, when and how, and decides who has the right to water and related services'.</p>	
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<p><b>The role of NGO's and lobby organisations</b></p>		
<p>The US is partnering with Case Foundation and the MCJ Foundation, two non-profit organisations, to help bring clean water to sub-Saharan Africa. Announcing the public-private partnership at the annual meeting of the Clinton Global Initiative First Lady Laura Bush called for other partners to join the effort to help up to 10 million people access safe water by 2010 through installing 4000 pumps in schools and communities. The US is providing \$10 million towards a target of \$60 million to fund the PlayPumps Alliance. The idea is to connect playground merry-go-rounds to water pumps and storage tanks so that as children play, they work the pump mechanism and clean water is brought to the surface.</p> <p>Rural and industrial growth demands</p> <p>Re-examine the delivery paradigm for water services</p> <p>Models for multi-stakeholder interest</p> <p>The scope of corruption in water supply and sanitation is multi-faceted and broad, and of significant scale. A study of available data indicates that between 20-40% of water sector finances is lost through corrupt practices. WSP-Africa has developed a conceptual framework to better understand where, how, and how much corruption is happening as well as what needs to be done to tackle corruption in Africa. This was the subject of a keynote paper at the recent World Water Week and is a chapter in a new publication called "The Many Faces of Corruption" which was launched at the World Bank/IMF annual meetings in Singapore in September 2006. WSP-Africa is also a founding member of the Water Integrity Network' (WIN) which was formally launched at World Water Week, attracting about 40 new members.</p>	<p>Global Research Alliance (2006)</p> <p><a href="http://www.waterintegritynetwork.net">www.waterintegritynetwork.net</a></p>	

<p><b>Administrative procedures</b></p>		
<p>E.g. approval of new technologies for application in drinking water</p>		
<p>Holland Minister of Development called for a temporary halt to the implementation of education, environment and water programmes in Kenya, worth EUR 118 million because the Kenyan government has not produced enough proof of success in its fight against corruption. The Netherlands was to have set up a joint drinking water programme with UNICEF and provided a substantial contribution to the education programme being carried out by the UK Department for International Development (DFID). A new bilateral water and environmental programme for Kenya is also being suspended. The Dutch government wants greater clarity in measuring and monitoring corruption, so that progress can be effectively identified.</p>	<p><a href="http://www.tinyurl.com/hffbg">www.tinyurl.com/hffbg</a></p>	

<p>Legal framework to accentuate this</p> <p>Improve management's understanding of water</p> <p>Gap between implementers and policymakers</p>	<p>Global Research Alliance (2006)</p>
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<p><b>The role of political parties</b></p> <p>E.g. the Greens. These situations can change quickly, but are also more general trends visible?</p>	
<p>Political instability</p> <p>Implementation of alternative water supply options, e.g. desalination; water recycling</p>	

<p><b>Changes in water quality standards</b></p> <p>E.g. bathing water standards are prepared in different countries, which will affect the resource water quality. Also effluent quality standards are changing (?) for industry as well as community...</p>	
<p>Ability to meet stringent requirements</p> <p>Effect on the environment</p>	

## Technical factors

Which breakthrough technologies are expected to be introduced in to practice in the time frame of 10-20 years?	Source
Please provide report or reliable sources as a proof of reality of the technologies	
<p><b><u>Membranes:</u></b> low pressure membranes are ineffective for removing dissolved organic matter; thus T&amp;O - and colour-causing materials will pass through. High=pressure membranes remove these and many other low-molecular-weight contaminants including DBPs.</p> <p>Membrane technology, especially in multi-stage units, is widely accepted in the water industry. Research is currently being done on what might be termed “smart membranes”.</p> <p><b><u>Ultraviolet (UV) disinfection:</u></b> remains a very promising technology as these issues are addressed; considerable research and development work is continuing.</p> <p><b><u>Ion exchange (IX):</u></b> treatment technology for contaminants such as arsenic, hexavalent chromium, lead and fluoride, among others, has surged recently.</p> <p><b><u>Advanced oxidation:</u></b> including ozone, ozone with hydrogen peroxide addition, and UV with peroxide addition. Ozone is being considered in the use against pathogens. The effect of rising energy costs on the expanded use of advanced oxidation treatment technologies remains to be seen. Management of organic oxidation by-products of ozone treatment is also a consideration.</p> <p><b><u>Desalination-specific technologies:</u></b> Their use was geographically limited (typically to the Middle East where energy is relatively cheap and water is unavailable) and not cost-effective in other areas. Electrodialysis and RO were in limited use since the 1970’s. Approximately 20 seawater RO plants are in various planning stages along the California coast. Cost issues remain, as do challenges with pre-treatment, permitting of coastal plants and energy requirements. However, as the marginal cost of traditional water sources continues to rise and availability declines, desalination will grow in attractiveness.</p> <p>Artificial intelligence (AI) systems will assist in conversion of data into information. However, it is still the innate intelligence and ability of the human operator that will allow that information to be transformed into useful knowledge. Real-time distribution system monitors will identify problem areas of low flow or residual disinfectant and then provide correctional input to reservoirs and automated pumping stations.</p> <p><b><u>TREATMENT TECHNOLOGY INTRODUCES NEW COSTS AND CHALLENGES</u></b></p> <p><b><i>Capital costs are expected to decrease</i></b></p> <p>Much like Information-technology, costs of emerging technologies continue to decline as additional research and development is conducted.</p> <p><b><i>Operational costs may remain high</i></b></p>	<p>Means, Bernosky and Patrick (2006)</p>

<p>High operating pressures required by NF and RO translate into high electrical energy demands for pumps. Given recent energy price spikes and blackouts, this remains a major operational consideration. Installation of dedicated back-up power generators would mitigate the risk of power outages but add considerably to the overall capital costs of the treatment facility.</p> <p>Membrane systems require careful performance monitoring to assure that the unit is not fouled, and cleaning must be precisely performed to avoid damaging the membranes and to assure optimal efficiencies. UV units require aggressive cleaning to avoid degrading the lamps and reducing their disinfecting capabilities.</p> <p>Finally, the technical skills to properly operate, maintain and repair these advanced monitoring and treatment technologies, may not be present in every water utility. Identifying, hiring and retaining qualified technicians may be difficult and expensive, especially with pending retirements of Baby Boomers and a general reduction in the number of engineering and technical degrees granted by US colleges.</p>	
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<p><b>Which technologies are emerging?</b></p> <p>Some relations with ecological factors may exist - water quality deterioration and emerging pollutants</p>	
<p><b><i>Detection of new contaminants in water is ongoing</i></b></p> <p>Several chemical and microbiological water contaminants have emerged as potential human health risks in recent years; many of these will not be amenable to control by conventional technologies and thus are also proving to be instrumental in driving the development of new treatment technologies such as:</p> <p><b><i>Endocrine disrupting compounds (EDC's)</i></b></p> <p>These compounds are not thought to represent a significant human health risk at the concentrations typically found in drinking water, but research continues in this area.</p> <p><b><i>Perchlorate</i></b></p> <p><b><i>Microbiological contaminants</i></b> e.g. adenoviruses, <i>Aeromonas hydrophylia</i>, caliciviruses, coxsackieviruses, cyanobacteria (and their toxins), echoviruses, <i>Helicobacter pylori</i>, <i>Microsporidia</i>, and <i>Microbacterium avium intracellulare</i>.</p> <p><b><i>Methyl tertiary butyl ether</i></b></p> <p><i>Nitrosodimenthamine (NDMA)</i> – a likely by-product of chloramination of drinking water.</p>	<p>Means, Bernosky and Patrick (2006)</p>

<p><b>Point of use systems</b></p> <p>Current expansion of point-of-use systems (?), trends in their efficiency, quality and control</p>	

<b>Water recycling systems</b>	
Are drinking water application of recycled water likely	
Issue is socio-cultural rather than technical	
Windhoek: good case study for this	

<b>Water saving technologies</b>	
E.g. rainwater harvesting	

<b>Other Technological Aspects</b>	

**Summary of future technical scenarios (Offringa, 2006):**

- Membranes more important in light of increased pollution
- Renewable energy technologies will be required
- Improved and economical water harvesting methods will be required
- Higher demands on treatment plants for removal of increased levels and variety of chemicals and microbiological contaminants
- Newer bio-technologies will play an increasing role in the water sector
- Nanotechnology will take off – presenting opportunities in the water field
- High development costs will further force adaptation of international technologies to South African conditions
- Continued skills shortage will increase automation and telemetric-control of plants

## Ecological factors

<b>Emerging pollutants</b>	Source
Governmental monitoring already exists?	

<p><b>Accumulation of pollutants in the environment</b></p> <p>A new study by the World Health Organization (WHO) reveals that as much as 24% of global disease and 23% of all deaths are caused by environmental exposures, many of which could be prevented by better environmental management. The report estimates that 13 million deaths a year, including those of four million children, are due to preventable environmental causes. The four diseases most influenced by poor environments were diarrhoea, lower respiratory infections, unintentional injuries and malaria. The incidence of all of these could be dramatically reduced by introducing safer household water storage and better hygiene; the use of cleaner and safer fuels; increased safety in the built environment and better water resource management.</p> <p>A World Health Organisation report warns that open waters such as reservoirs, lakes or rivers that have been contaminated by migratory birds carrying the H5N1 flu virus might be able to pass on the disease to humans who drink from or swim in them. There is insufficient data to be sure, the report adds. The report also highlights a possible threat to wastewater treatment works workers from sewage passed by infected humans and other sources. The report also clarifies that properly treated water is likely to pose little threat to humans but calls for more research and suggests that where treatment is not possible, access to reservoirs should be restricted.</p>	
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<b>The effect of more stringent thresholds and pollution control</b>	
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<p><b>General quality / composition changes in water resources, e.g. due to climate changes</b></p> <ul style="list-style-type: none"> <li>• The average temperature of the earth's surface has risen by 0.6°C since the late 1800s. It is expected to increase by another 1.4 to 5.8°C by the year 2100, and the sea level may rise from 9 to 88 cm during the same period.</li> <li>• It is generally agreed that more precipitation can be expected from 30° North and 30° South because of increased evapotranspiration. In contrast, many tropical and subtropical regions are expected to receive lower and more erratic precipitation in the future.</li> <li>• Climate change is having a significant impact on weather patterns, precipitation and the hydrological cycle, affecting surface water availability, as well as soil moisture and groundwater recharge.</li> <li>• Climate change is also likely to lead to increased magnitude and frequency of precipitation-related disasters – floods, droughts, mudslides, typhoons and cyclones.</li> <li>• It has been suggested that the number of environmental refugees could rise to 150 million by 2050 as one of the results of climate change.</li> <li>• If climate change follows the projected scenarios, we can expect more</li> </ul>	<p>Information taken from 1st &amp; 2nd United Nations World Water Development Reports, UN Statistics Division Environmental Glossary and Climate Change Information Sheet 13, UNFCCC</p>
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erratic weather in the future, including increased variability in precipitation, which will threaten crop yields in both developed and developing countries, while placing more than 2.8 billion people at risk of water shortage.

- On a global level, polar and arid systems appear to be the most vulnerable to climate change. Polar systems store the vast majority of freshwater, and most scenarios suggest they are likely to develop a considerably increased discharge of water, driven by higher temperatures in both the polar regions and particularly in the Arctic.
- While global warming may increase productivity in some regions and habitats, the overall predictions are that the impacts of climate change on aquatic ecosystems will be detrimental. Coastal wetlands such as mangroves and coral reefs (Southeast Asia), coastal lagoons (Africa and Europe) and river deltas (the Nile, Niger and Congo in Africa; the Ganges and Mekong in Asia) will be seriously affected by rising water levels, as well as other coastal lowland areas with an elevation of less than 0.5 m.
- A recent study estimates that climate change actually accounts for about 20% of the global increase in water scarcity, the remaining 80% accounted for by population growth and economic development.
- In large parts of eastern Europe, western Russia, central Canada and California, peak stream flows have shifted from spring to winter as more precipitation falls as rain rather than snow, therefore reaching the rivers more rapidly.
- In Africa's large basins of the Niger, Lake Chad and the Senegal river basin, total available water has decreased by 40–60%.

The South African Country Study on climate change, buttressed by the studies on Botswana, Namibia and Zimbabwe identify the key climate change issues in the region to be health, water and biodiversity (Midgley, *et al*, 2005). Taking note of the substantial uncertainties around rainfall projections, there is nonetheless a tendency for the majority of climate models to suggest a decrease in rainfall over the western part of southern Africa in the coming decades. Coupled with warming, this implies net drying, with negative consequences on water supplies and agriculture (Fischer, *et al*, 2002).

In a recently completed WRC project, the School of Bioresources Engineering and Environmental Hydrology of the University of Kwazulu-Natal studied the potential impacts of climate change and mitigation strategies on water resources in Southern Africa (WRC, 2005). The project developed plausible climate change scenarios for Southern Africa, investigated the potential impacts of climate change on hydrological responses and associated water resources and also investigated possible water-related socio-economic impacts in a designated Water Management Area. The report recommends appropriate strategies to cope with water-related impacts of potential climate change.

Many African economies, which largely rely on agricultural revenue, are the least equipped to deal with the devastating impact of regular drought, economists have said.

About 43 percent of Africa's land surface is arid and low rainfall is considered a normal fact of life. However, drought, which used to occur on average every five to six years, has been happening more frequently over

Midgley, et al  
(2005)

[www.alertnet.org/thenews/newsdesk/IRIN/d4375ab](http://www.alertnet.org/thenews/newsdesk/IRIN/d4375ab)

the last 12 years. It is the single most important natural hazard in terms of shattered livelihoods, starvation, deaths and nutrition-related diseases on the continent.

[7c2a32 44be8 215a9 1c008 1144. htm](#)

While drought occurs all over the world, seven out of the 10 most vulnerable countries -- Somalia, Sudan, Ethiopia, Uganda, Chad, Mauritania and Mozambique -- are in Africa. Droughts in the early 1970s, 1980s, the beginning of the 1990s and 2001 affected some 50 million Africans. Between 1980 and 2000, drought killed more than two million people in just three countries: Ethiopia, Sudan and Mozambique. Almost one million of them died in Ethiopia's famine of 1984.

Many climate scientists already predict that less rain will fall annually in parts of Africa within 50 years due to global warming. Now new research suggests that even a small decrease in rainfall on the continent could cause a drastic reduction in river water, the lifeblood for rural populations in Africa. A decrease in water availability could occur across about 25 percent of the continent, according to the new study. Hardest hit would be areas in north-western and southern Africa, with some of the most serious effects striking large areas of Botswana and South Africa. To predict future rainfall, Geologists Maarten de Wit and Jacek Stankiewicz of the University of Cape Town compared 21 of what they consider to be the best climate change models developed by research teams around the world. On average, the models forecast a 10 to 20 percent drop in rainfall in north-western and southern Africa by 2070. The researchers then juxtaposed these rainfall predictions with measurements of Africa's rivers to gauge the future of Africa's water supply. With a 10 percent drop in rainfall, parts of Botswana (map) would be left with just 23 percent of the surface-water flow it has now, their study showed. With a 20 percent decrease, Cape Town would be left with just 42 percent of its river water, and "Botswana would completely dry up," de Wit said. While in parts of northern Africa, river water levels would drop below 50 percent.

[www.inform.kz/txt/showarticle.php?lang=eng&id=140270](http://www.inform.kz/txt/showarticle.php?lang=eng&id=140270)

Africa's rivers face dramatic disruption that will leave a quarter of the continent severely short of water by the end of the century, according to a global warming study published on 3 March 2006.

In the first detailed assessment of climate change on the continent's waterways researchers found that watercourses on the continent are highly sensitive to shifts in rainfall patterns. Even modest decreases in rain in western Africa will see rivers lose as much as 80% of their water, triggering a surge of what the scientists call "water refugees". Maarten de Wit, a climate expert at the University of Cape Town who led the study, said the redrawing of Africa's waterways will pose serious political problems as people displaced by droughts are forced into other countries to be near water.

The study, which appears in the journal Science on Friday, is the first to identify how Africa's rivers will respond to climate change over the century. The extent to which slight changes in rainfall could impact on rivers had never been realised. The researchers used a computer to divide the continent into 1 000km wide squares and worked out the total length of streams and rivers in each block. They used climate change models to calculate the expected changes in rainfall across the continent and the

<p>effect they would have on river levels. The scientists found that in 75% of the countries, those that received between 400mm and 1 000mm of rain a year, shifts in rainfall caused larger than expected rises or falls in river levels. In Harare a 10% drop in rainfall is expected to lead to an 81% drop in fresh water from rivers, a situation the scientists believe will be mirrored in Madagascar, eastern Zambia and Angola. South Africa, which is experiencing a prolonged drought, can expect far less water from the Orange river. A 10% fall in rain over Johannesburg and Bloemfontein will lead to a 70% drop in river levels.</p> <p>A report released last week at the 13th Congress of the African Water Association (AFWA) in the Algeria capital of Algiers has warned that one third of Africa's population have no drinking water and almost half of the continent's population have health problems due to a lack of clean drinking water. If the current situation does not improve, at least 17 African countries will suffer from severe water shortages by 2010.</p>	
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<p><b>Region-specific contaminants?</b></p>	
<p>E.g. Arsenic, Cadmium, Radioactive elements</p>	

<p><b>Influence of water framework directive</b></p>	

<p><b>Other Ecological Aspects</b></p>	
<p>In a report entitled "The Draft National Water Resources Management Strategy, 2005-2007," Kenya's Ministry of Water and Irrigation gives a damning indictment of the management of Kenya's natural environment and its accompanying water resources over the past 30 years. The report blames siltation due to poor management of the lake's catchment area, which is now heavily settled and cultivated. Mismanagement of Kenya's water resources now also poses a security risk to its neighbours as 45% of all the water flowing into Lake Victoria and the Upper Nile comes from Kenya. The situation is now so bad, the report states, that Lake Baringo, one of the main water bodies in the Rift Valley, is a mere 1.8 metres deep, down from an average of 15 metres in 1921.</p>	

## Subfactor: Resources

Trends in resource water	Source
Due to Political factors	
<p>The head of the World Water Council, Loic Fauchon, has warned that Africa desperately needs new water sources, and that most of sub-Saharan Africa is failing to meet its MDG targets. Speaking at the Africities summit in Nairobi, which aimed to find solutions to population growth in African cities, he pointed out that Africa has about <b>24%</b> of the world's land surface but just <b>9%</b> of its water resources. He said the MDG targets had been over-ambitious and that 'a lot more time' was needed to meet them. Obstacles are financial, institutional and knowledge-related.</p> <p>Present population trends and patterns of water use suggest that more African countries will exceed the limits of their economically usable, land-based water resources before 2025.</p> <p>Uganda's Assistant Commissioner in the Water Resources Regulation division of the country's ministry of water and environment has warned that it will experience severe water shortages in future due to pressure on resources and environmental degradation. Callist Tindimugaye told the annual Water and Sanitation Network meeting that the amount of available water would reduce by 20% by 2020, with the population doubling within the same time frame to 54 million.</p>	Ashton (2002)
Due to other factors	
E.g. climate change, river restoration projects	
<p>Reallocation of water from less productive sectors to those that are able to derive greater long-term economic returns.</p> <p>Namibia's water utility, NamWater has dusted off plans to construct desalination plants to serve growing demand in the country's coastal towns. A previous plan some years ago was shelved due to high costs, but during a press visit to a scheme that will supply 1.5M m<sup>3</sup> per year to the new Langer Heinrich uranium mine, senior engineering services manager Andre Genis said that desalination was the only way to secure the water supply for coastal towns. NamWater is already researching the affordability and sustainability of desalination, and discussing upfront funding for plants with investors from six foreign companies that want to open water-intensive uranium mines on the coast.</p>	Ashton (2002)

How does Agricultural use of water influence resources?	
E.g. overexploitation of resources or expansion of bio-technologies?	
<p>To intensify agricultural production, improve rates of agricultural growth and productivity, and ensure food and livelihood security, Africa's rural poor need investment in infrastructure development and capacity building. The Collaborative Program on Agricultural Water Investment Strategies in Sub-Saharan Africa:</p>	<a href="http://www.iwmi.cgiar.org/africanwaterinvestment/">www.iwmi.cgiar.org/africanwaterinvestment/</a>

Trends and Opportunities, seeks to identify the specific areas where investment will support sustainable growth and reduce poverty in the region. IWMI is one of seven partners in this program.	<a href="#">index. asp</a>
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<b>Industry in general: increase / decrease</b>	
E.g. heavy industry moving out of W-Europe	

<b>Wastewater treatment in general: influence on surface water quality</b>	

**Summary of future environmental scenarios (Offringa, 2006):**

- Droughts more of a problem as water resources become overused and global warming starts to have an effect
- Pollution of water resources will become worse as resources become overused
- Management of water-related wastes will become a bigger issue
- Life cycle analysis and associated application of renewable energy will become more important
- Anthropogenic chemicals in the environment will become more of an issue (EDC's, drugs, beauty care products, industrial chemicals)

- **Demographical factors**

<b>Distribution of population (Rural areas / cities)</b>	Source
Trends in rural-urban migration of population: rich people are moving out of the cities, young people - in?	
<p>Major urbanisation trend in Africa</p> <p>In sub-Saharan Africa, 83% of the urban population and 46% of the rural population have access to a water supply.</p> <p>The proportions of households in major cities connected to piped water (house or yard connection) are:</p> <ul style="list-style-type: none"> <li>○ World: 94%</li> <li>○ Africa: 43%</li> <li>○ Asia: 77%</li> <li>○ Europe: 92%</li> <li>○ Latin America &amp; the Caribbean: 77%</li> <li>○ North America: 100%</li> <li>○ Oceania: 73%</li> </ul> <p>A new WHO/UNICEF report warns that large-scale migration to cities in the developing world threatens the MDG targets for clean water and improved sanitation. It calls for a dramatic increase in the pace of work and investment to achieve the UN goals of halving the proportion of people without safe drinking water and basic sanitation by 2015.</p> <p>Experts warned at the start of the World Water in Stockholm that with the world's population forecast set to grow by 2-3 billion by 2050 and water already a scarce resource for some, there has to be a radical transformation in the management of the planet's resources of the life-giving liquid. One in three people is enduring one form or another of water scarcity in the world today, according to a report compiled over a five year period by 700 experts and presented at the event in the Swedish capital, which opened on 21 August 2006. "It is much more widespread than we thought at first," said Frank Rijsberman, Director General of the International Water</p>	<p>Global Research Alliance (2006)</p> <p>Information from the 1st United Nations World Water Development Report 'Water for People, Water for Life' (2003)</p>

<b>Absolute growth of population</b>	
<p>More pronounced in certain areas of Africa</p> <p>Poverty and AIDS plays a major role</p>	Global Research Alliance (2006)

<b>Age distribution / life expectancy</b>	
E.g. older persons are more sensitive to water contaminants	
<p><b>Trends in population demographics in the USA</b></p> <p>Population growth will continue, with the US population expected to increase by</p>	Means,

<p>50% by the year 2050  Population growth appear to be centered in areas that currently have water supply constraints  “Hot-spots” have been identified where water conflicts are expected over the next 25 years  The customer base is ageing  The ethnic make-up will shift (increasing Hispanic population)  Income gap will expand (growing gap between rich and poor), leading to an increasing gap between people who are willing to pay more for water and those who will resist rate increases  Population is becoming more educated, and customers are likely to demand more and better information from their water utilities  Recycling and conservation programs will be a featured aspect of integrated resource plans for water utilities contemplating development of new surface water supplies  Effective communication with consumers will be crucial.</p>	<p>West and Patrick (2005)</p>
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<b>Education level</b>	

<p><b>Health-related issues</b>  Africa accounts for 97% of the world's burden of onchocerciasis (a parasitic infection), 88% of the world's burden of malaria, 78% of its schistosomiasis burden, and 52% of its trachoma burden.</p> <p>Schistosomiasis (bilharziasis)  - More than 200 million people worldwide are infected by schistosomiasis.  - 88 million children under fifteen years are infected each year with schistosomes.  - 80% of transmission takes place in Africa south of the Sahara.</p>	
<p>Increase in immunocompromised persons  AIDS patients in certain regions strongly increasing (e.g. Africa?)</p>	
<p>A survey conducted by the United Nations Children's Fund and the Government revealed that access to safe drinking water and adequate sanitation has been deteriorating in recent years, particularly in rural areas. Only 40 percent of the rural households covered in the current survey used safe sanitary facilities. At the HIV and Aids mainstreaming workshop, organised by Sida, the Zimbabwean Health and Child Welfare Minister stated there is need for the establishment of an effective sanitation programme for rural communities to reduce HIV-related opportunistic infections. The workshop sought to promote best practices on how to handle HIV and Aids and gender issues in water management. Furthermore, a major health crisis is developing in the resettlement areas where as part of President Robert Mugabe's land reform policy, some 400 000 rural families moved to Zimbabwe's mainly white owned commercial farms over the past six years without a corresponding development of health and sanitary structures. Most farms no</p>	<p><a href="http://www.ens-newswire.com/ens/may2006/2006-05-01-01.asp">www.ens-newswire.com/ens/may2006/2006-05-01-01.asp</a></p>

<p>longer have fresh water supplies because pipes are in disrepair and pumps have stopped working for lack of spares. The new settlers cannot afford water purification chemicals, and the main water sources are now streams and dams.</p> <p>The 3rd annual Global Monitoring Report (GMR) on the Millennium Development Goals (MDGs), subtitled 'Strengthening Mutual Accountability - Aid, Trade and Governance', has been just published by the World Bank and the International Monetary Fund. The GMR highlights evidence of reduced child deaths in 9 out of 10 developing countries surveyed, notes rapid gains in primary school enrolment, with 50 countries having achieved universal primary completion, up from 37 in 2000, and cites signs of the first decline in HIV/AIDS infection rates in high-prevalence countries, such as Haiti, Uganda and Zimbabwe.</p>	
Chronic diseases and water quality	

<b>Other Demographical Aspects</b>	

## Organizational factors

Privatization (different models)	Source

Centralization / Regionalization	
<p>A review from the Cochrane collaboration has concluded that treating water in the home is a more effective way of controlling diarrhoea in poor countries than interventions at wells. The authors looked at the outcomes of 35 field trials, which compared the effectiveness of different water treatments. Chlorination, filtration, solar disinfection and improved storage in homes are all suggested as potential actions.</p>	

Other Organisational Aspects	
<p><b>EU-African Union focus on partnership and development</b>            The EC and the Commission of the African Union met at the headquarters of the African Union in Addis Ababa, Ethiopia, on 2 October 2006 to discuss institutional partnership and development. Almost a year after the adoption of the EU Strategy for Africa, both sides reviewed the progress in its implementation and looked at the impact of the EU-Africa Partnership on Infrastructure.            The following four pillars of the African Union Strategic Plan 2004-07 will receive EU funding under the €55 million Support Programme:</p> <ul style="list-style-type: none"> <li>• Institutional strengthening of the AU Commission</li> <li>• Peace</li> <li>• Human security and governance</li> <li>• Regional integration, which also covers science and technology; and enhancing concrete EU-African Union cooperation</li> </ul> <p>It includes fostering regional centres of excellence for research and higher education, and the establishment of the Nyerere student exchange programme across Africa. Complementary support will also be provided within the Erasmus Mundus programme, allowing for more well-qualified African students to come to Europe for post-graduate education.</p>	<p><a href="http://www.africa-union.org/root/AU/Conferences/Past/2006/October/EU-AU/AU-EU-meetingen.htm">www.africa-union.org/ root/AU/Conferences/ Past/2006/October/EU- AU/AU-EU- meetingen.htm</a></p>

## Risk- related factors

<b>Risk of terror attacks</b>	Source
(MEKOROT is also involved in this item within WA-4)	
Formation of regional security complexes (linking together primary security concerns of a number of states so that their national securities cannot be considered apart from one another)	Ashton & Turton (2000)
In sub-Saharan Africa, the balance of evidence suggests that cooperation will be favoured rather than conflict	Ashton & Turton (2000)

<b>Risk of technical failure: one-step versus multi-barrier systems</b>	
Optimisation of (Risk/Cost) factor	

<b>Optimisation of Risk versus Water Quality</b>	
For example, chlorine is added to the distribution net to anticipate to possible microbiological terrorist attacks, which deteriorates water quality..	

<b>Risk of water availability / drought / climate change</b>	
Also changes in water salinity	
“Downstream” countries and communities will always be more vulnerable than “upstream” countries.	Ashton (2002)
It is highly unlikely that “true” water wars will ever occur in Africa.	Ashton (2002)

<b>Other Risk-related Aspects</b>	

# APPENDIX

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## Global Water Supply and Sanitation Assessment 2000 Report

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### 6. Africa

*This chapter presents water supply and sanitation coverage data for Africa. Urban and rural water and sanitation coverage figures are shown by country, area or territory for both 1990 and 2000. Maps of current coverage are also presented. Graphs illustrate the regional changes in coverage over time, as well as coverage targets associated with projected changes in population.*

#### 6.1 Overview

Africa has the lowest total water supply coverage of any region, with only 62% of the population having access to improved water supply. This figure is based on estimates from countries that represent approximately 96% of Africa's total population. The situation is much worse in rural areas, where coverage is only 47%, compared with 85% coverage in urban areas. Sanitation coverage in Africa also is poor, with only Asia having lower coverage levels. Currently, only 60% of the total population in Africa has sanitation coverage, with coverage varying from 84% in urban areas to 45% in rural areas.

In global terms, the continent contains 28% of the world's population without access to improved water supply. It also contains 13% of people without access to improved sanitation worldwide. It is predicted that Africa will face increased population growth over the coming decades, with the greatest increase coming in urban areas. As a result, approximately 210 million people in urban areas will need to be provided with access to water supply services, and 211 million people with sanitation services, if the international coverage targets for 2015 are to be met. A similar number of people in rural areas will also need to gain access. Given the Assessment's findings concerning change in coverage over the 1990s, it appears that future needs for rural services may continue to be the most difficult to meet.

## 6.2 Water supply and sanitation coverage

TABLE 6.1 AFRICA: WATER SUPPLY AND SANITATION COVERAGE BY COUNTRY, AREA OR TERRITORY, 1990 AND 2000

	Year	Total population* (thousands)	Urban population (thousands)	Rural population (thousands)	% urban water supply coverage	% rural water supply coverage	% total water supply coverage	% urban sanitation coverage	% rural sanitation coverage	% total sanitation coverage
Algeria	1990	24 936	13 074	11 862						
	2000	31 471	18 969	12 502	98	88	94	90	47	73
Angola	1990	9 231	2 546	6 685						
	2000	12 878	4 404	8 474	34	40	38	70	30	44
Benin	1990	4 660	1 607	3 053				46	6	20
	2000	6 097	2 577	3 520	74	55	63	46	6	23
Botswana	1990	1 276	530	746	100	91	95	84	44	61
	2000	1 622	815	807	100					
Burkina Faso	1990	9 061	1 229	7 832	74	50	53	88	14	24
	2000	11 937	2 204	9 733	84			88	16	29
Burundi	1990	5 456	342	5 114	94	63	65	67	90	69
	2000	6 695	600	6 095	96			79		
Cameroon	1990	11 472	4 622	6 850	76	36	52	99	79	87
	2000	15 085	7 379	7 706	82	42	62	99	85	92
Cape Verde	1990	342	151	191						
	2000	428	266	162	64	89	74	95	32	71
Central African Republic	1990	2 943	1 103	1 840	80	46	59	43	23	30
	2000	3 615	1 489	2 126	80	46	60	43	23	31
Chad	1990	5 745	1 209	4 536				70	4	18
	2000	7 651	1 820	5 831	31	26	27	81	13	29
Comoros	1990	527	147	380	97	84	88	98	98	98
	2000	695	231	464	98	95	96	98	98	98
Congo	1990	2 219	1 184	1 035						
	2000	2 944	1 841	1 103	71	17	51	14		
Côte d'Ivoire	1990	11 635	4 690	6 945	89	49	65	78	30	49
	2000	14 786	6 854	7 932	90	65	77			
Democratic Republic of the Congo	1990	37 364	10 442	26 922						
	2000	51 655	15 641	36 014	89	26	45	53	6	20
Djibouti	1990	517	415	102						
	2000	637	531	106	100	100	100	99	50	91
Egypt	1990	56 333	24 841	31 492	97	91	94	96	80	87
	2000	68 469	30 954	37 515	96	94	95	98	91	94

**TABLE 6.1 AFRICA: WATER SUPPLY AND SANITATION COVERAGE BY COUNTRY, AREA OR TERRITORY, 1990 AND 2000 (CONT)**

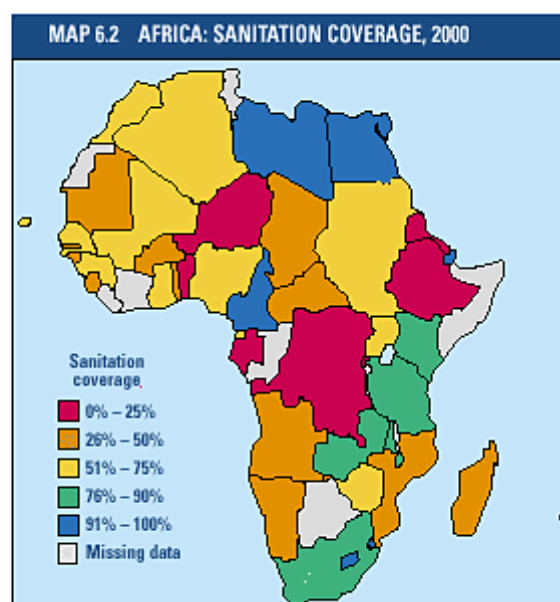
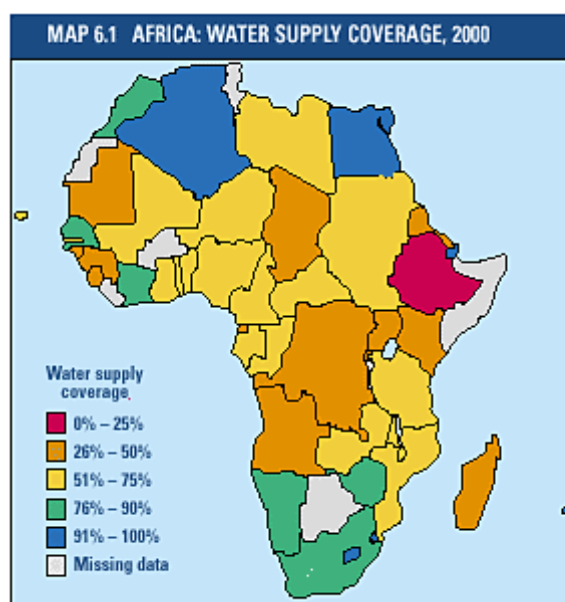
Equatorial Guinea	1990	352	126	226						
	2000	452	218	234	45	42	43	60	46	53
Eritrea	1990	2 888	456	2 432						
	2000	3 851	722	3 129	63	42	46	66	1	13
Ethiopia	1990	48 092	6 461	41 631	77	13	22	58	6	13
	2000	62 565	11 042	51 523	77	13	24	58	6	15
Gabon	1990	935	637	298						
	2000	1 226	998	228	73	55	70	25	4	21
Gambia	1990	921	237	684						
	2000	1 306	424	882	80	53	62	41	35	37
Ghana	1990	15 128	5 124	10 004	83	43	56	59	61	60
	2000	20 213	7 753	12 460	87	49	64	62	64	63
Guinea	1990	5 755	1 477	4 278	72	36	45	94	41	55
	2000	7 430	2 435	4 995	72	36	48	94	41	58
Guinea-Bissau	1990	973	195	778						
	2000	1 213	288	925	29	55	49	88	34	47
Kenya	1990	23 552	5 671	17 881	89	25	40	94	81	84
	2000	30 080	9 957	20 123	87	31	49	96	81	86
Lesotho	1990	1 722	346	1 376						
	2000	2 153	602	1 551	98	88	91	93	92	92
Liberia	1990	2 579	1 083	1 496						
	2000	3 154	1 416	1 738						
Libyan Arab Jamahiriya	1990	4 416	3 614	802	72	68	71	97	96	97
	2000	5 604	4 911	693	72	68	72	97	96	97
Madagascar	1990	11 632	2 735	8 897	85	31	44	70	25	36
	2000	15 942	4 721	11 221	85	31	47	70	30	42
Malawi	1990	9 335	1 242	8 093	90	43	49	96	70	73
	2000	10 925	2 723	8 202	95	44	57	96	70	77
Mali	1990	8 843	2 105	6 738	65	52	55	95	62	70
	2000	11 234	3 375	7 859	74	61	65	93	58	69
Mauritania	1990	2 026	881	1 145	34	40	37	44	19	30
	2000	2 669	1 541	1 128	34	40	37	44	19	33
Mauritius	1990	1 057	428	629	100	100	100	100	100	100
	2000	1 158	478	680	100	100	100	100	99	99
Morocco	1990	23 932	11 543	12 389	94	58	75	95	31	62
	2000	28 350	15 902	12 448	100	58	82	100	42	75
Mozambique	1990	14 198	3 781	10 417						
	2000	19 681	7 917	11 764	86	43	60	69	26	43
Namibia	1990	1 350	359	991	98	63	72	84	14	33
	2000	1 726	533	1 193	100	67	77	96	17	41
Niger	1990	7 732	1 245	6 487	65	51	53	71	4	15
	2000	10 730	2 207	8 523	70	56	59	79	5	20
Nigeria	1990	87 030	30 470	56 560	78	33	49	77	51	60
	2000	111 506	49 050	62 456	81	39	57	85	45	63
Réunion	1990	604	386	218						
	2000	700	496	204						
Rwanda	1990	6 987	372	6 615						
	2000	7 733	476	7 257	60	40	41	12	8	8
Saint Helena	1990	6	3	3						
	2000	6	4	2						
Sao Tome and Principe	1990	119	46	73						
	2000	147	69	78						
Senegal	1990	7 327	2 933	4 394	90	60	72	86	38	57
	2000	9 481	4 498	4 983	92	65	78	94	48	70
Seychelles	1990	69	37	32						
	2000	77	49	28						
Sierra Leone	1990	3 994	1 198	2 796						
	2000	4 855	1 779	3 076	23	31	28	23	31	28
Somalia	1990	7 773	1 882	5 891						
	2000	10 097	2 776	7 321						
South Africa	1990	34 012	16 609	17 403						
	2000	40 377	20 330	20 047	92	80	86	99	73	86
Sudan	1990	24 062	6 405	17 657	86	60	67	87	48	58
	2000	29 490	10 652	18 838	86	69	75	87	48	62
Swaziland	1990	753	179	574						
	2000	1 008	266	742						

**TABLE 6.1 AFRICA: WATER SUPPLY AND SANITATION COVERAGE BY COUNTRY, AREA OR TERRITORY, 1990 AND 2000 (CONT)**

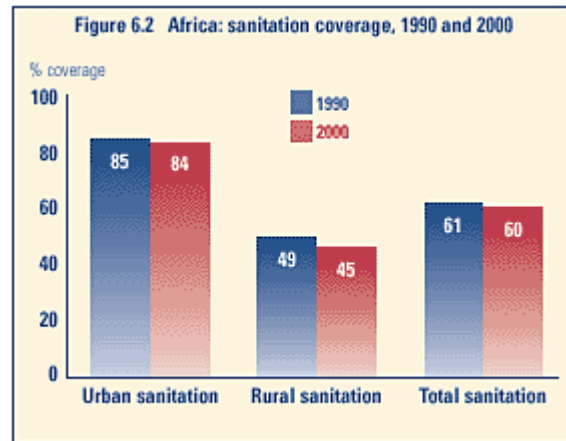
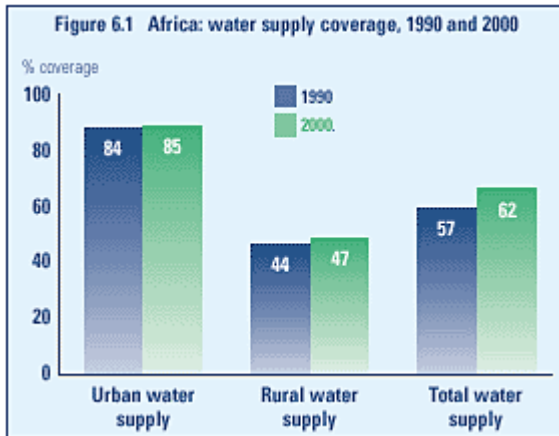
Togo	1990	3 512	999	2 513	82	38	51	71	24	37
	2000	4 629	1 540	3 089	85	38	54	69	17	34
Tunisia	1990	8 156	4 726	3 430	94	61	80	97	48	76
	2000	9 586	6 281	3 305						
Uganda	1990	16 457	1 837	14 620	80	40	44	96	82	84
	2000	21 778	3 083	18 695	72	46	50	96	72	75
United Republic of Tanzania	1990	25 470	5 298	20 172	80	42	50	97	86	88
	2000	33 517	11 021	22 496	80	42	54	98	86	90
Western Sahara	1990	206	181	25	89					
	2000	294	280	14						
Zambia	1990	7 239	2 853	4 386	88	28	52	86	48	63
	2000	9 169	3 632	5 537	88	48	64	99	64	78
Zimbabwe	1990	9 863	2 799	7 064	99	68	77	98	51	64
	2000	11 669	4 121	7 548	100	77	85	99	51	68

\*Source: (10)

Table 6.1 provides data for the years 1990 and 2000, and composite coverage data are presented in Maps 6.1 and 6.2. Figures 6.1 and 6.2 show urban and rural coverage in 1990 and 2000 for water supply and sanitation, respectively.



Maps 6.1 and 6.2, which are based on Table 6.1, show how few countries in Africa have either water supply or sanitation coverage of more than 90%. Indeed, almost half of all the countries for which there are data have less than 50% coverage for sanitation. Even for water supply there are relatively few countries with more than 75% total water coverage.



Ten African countries have less than 50% coverage for both their current national water supply and sanitation coverage. These countries are Angola, Burkina Faso, Chad, the Democratic Republic of the Congo, Eritrea, Ethiopia, Madagascar, Mauritania, Rwanda and Sierra Leone.

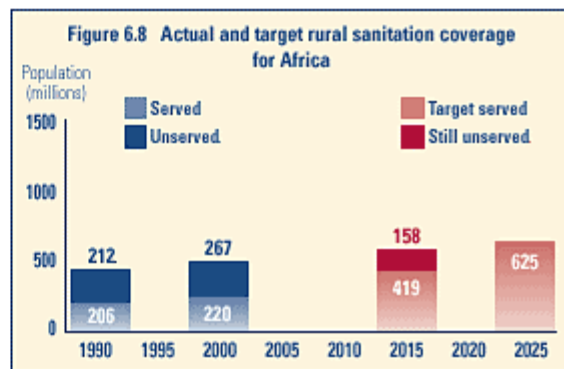
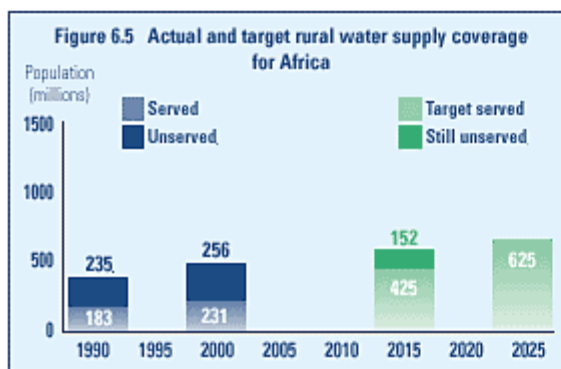
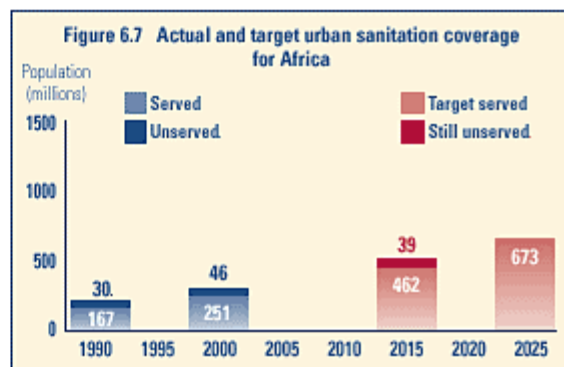
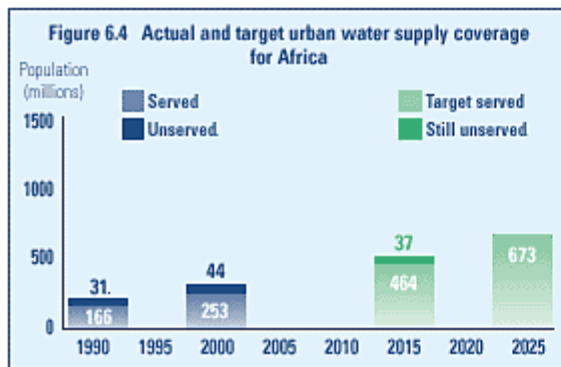
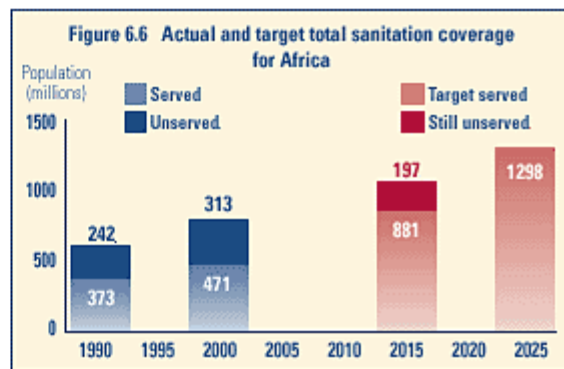
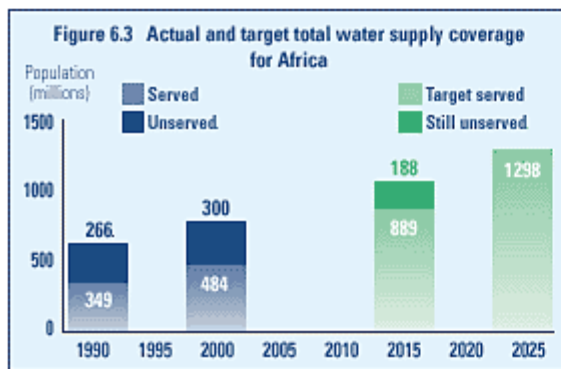
### 6.3 Changes during the 1990s

The changes in water supply and sanitation coverage over the 1990s for urban and rural areas are shown in [Figures 6.1 and 6.2](#). The graphs suggest that urban services have remained more or less the same over the 1990s. Rural services, however, tell a different story. Rural water supply increased slightly while rural sanitation has fallen. Overall, water coverage is moderately higher in the year 2000 than it was in 1990, while sanitation coverage has fallen slightly over the same period. These findings should be considered cautiously, as data for three large countries (Algeria, the Democratic Republic of the Congo and South Africa) are only available for the year 2000 and have an effect on the totals for Africa.

### 6.4 Trends and future needs

In addition to presenting the changes over the 1990s in the number of people with and without access to improved services, Figures 6.3 – 6.8 also show the international development targets applied to population projections. The year 2015 targets are to reduce the proportion of people without access to improved water and sanitation by one-half, and to achieve universal coverage by the year 2025.

The graphs show that the total number of people in the region with access to water supply has increased considerably over the 1990s. For example, the data show that 135 million people in Africa gained access to improved water supply between 1990 – 2000 (Figure 6.3). The majority of these people (87 million) were in urban areas (Figure 6.4). For sanitation, the increase in numbers of people with access has been smaller than that for water coverage. In total, 98 million additional people gained access to improved sanitation services between 1990 – 2000 (Figure 6.6), with the vast majority of these (84 million) living in urban areas (cf. Figures 6.7, 6.8).



Figures 6.3 – 6.8 also indicate population projections and targets. The African population is expected to increase by 65% over the next 25 years. This presents a huge challenge to services in the region. To achieve the year 2015 goal for urban water supply coverage – halving the percentage of those without access – an additional 210 million people over the next 15 years will have to be provided with service. In rural areas, an estimated additional 194 million people will need to have access to meet the target. Therefore, a total of approximately 400 million additional people will need to be provided with access to improved water supply to meet the 2015 target. Given the findings of the Assessment 2000, this will require a tripling of the rate at which additional people have been gaining access between 1990 – 2000. New approaches will be needed to face this challenge. Some of the approaches being taken, as well as the difficulties faced by one country, are given in Box 6.1. Box 6.2 also describes some promising new approaches.