

## 2 Towards comprehensive wastewater and sanitation strategies

1 Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water stress causes deterioration of fresh water resources in terms of quantity (aquifer over-exploitation, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.). Source: European Environment Agency, EEA glossary, 2006

2 World Commission on Water 1997

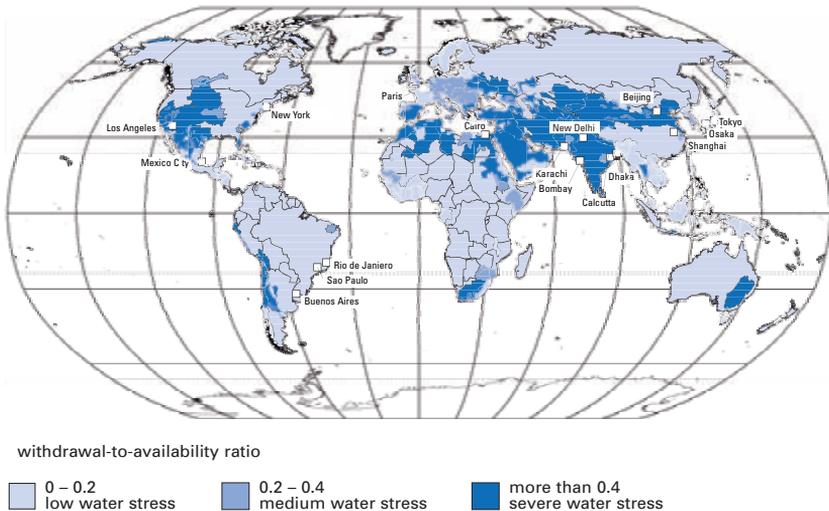
### 2.1 World water resources under threat

Water is the essential basis for all forms of life. Water is of utmost importance for human health and dignity. Water is crucial for sustainable social and economic development. However, world water resources are under threat. In the past 250 years the world has seen a tremendous increase both in population and economic activities. This development process has resulted in extensive social transformation and a rapidly increasing demand for natural resources. Urbanisation, industrial development and the extension of agricultural production have a significant impact on the quantity and quality of water resources. Overexploitation of water bodies and deterioration of water quality are global trends.

Today one-third of the world's population lives in countries suffering from moderate to high water stress.<sup>1</sup> Since the mid-1990s, some 80 countries, representing 40 per cent of the world's population, have been suffering from serious water shortages in urban and rural areas – in a lot of cases, the result of the socio-economic development over the recent decades.

The increasing demand for freshwater sources and rapidly changing production and consumption patterns are directly linked with the pollution of ground and surface waters. "More than half of the world's major rivers are seriously depleted and polluted, degrading and poisoning the surrounding ecosystems, threatening the health and livelihoods of those who depend on them."<sup>2</sup>

Picture 2\_1:  
Water stress (2000) in regions around megacities. This map is based on estimated water withdrawals for the year 2000, and water availability during the 'climate normal' period (1961–1990). Results shown in this map were calculated on river basin scale. Source: WaterGAP2.1e by CESR, Kassel, Germany

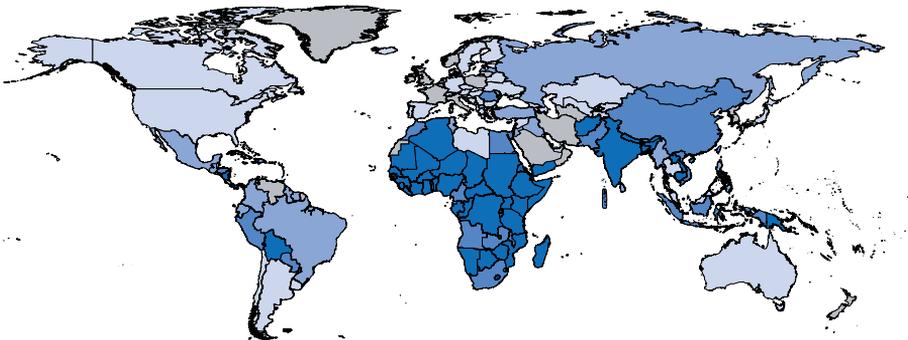




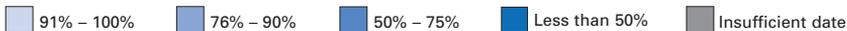
Picture 2\_2:  
More than half of the world's major rivers are seriously depleted and polluted

Although the threat to water resources is not only a phenomenon in developing countries, it is particularly the world's poor that are most affected: worldwide, 0.9 billion people still lack access to safe drinking water and 2.5 billion lack access to adequate sanitation. While improvements are monitored on the drinking water side, the challenge on the sanitation side obviously is much bigger than it was thought to be. Estimates indicate that approximately half the population of the developing world is exposed to polluted water resources, which increase disease incidence; most of these people live in Africa and Asia.<sup>3</sup>

3 JMP-WHO/  
Unicef 2008



Percentage of population using improved sanitation



Picture 2\_3:  
Half the developing world are still without improved sanitation;  
Source: JMP-WHO/  
UNICEF, 2008

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The challenges ahead are obvious: the urban population of the less-developed world is expected to nearly double in size between 2000 and 2030 from just under 2 billion to nearly 4 billion people, with the greatest urban growth occurring in Asia. By that time, 58 per cent of the world's population will live in urban or semi-urban areas. Pessimistic scenarios forecast that nearly 7 billion people in 60 countries will live in water-scarcity by 2050, whereas even rather optimistic projections estimate that just under 2 billion people in 48 countries will be affected.

Over the last 30 years, a multitude of national and multi-national initiatives have addressed the emerging water crisis. In 1980 the International Water Supply and Sanitation Decade (IWSSD) was launched. At the so-called Rio Conference in 1992 "water" was identified as one of the key elements for sustainable development:

"The general objective is to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases."<sup>4</sup>

4 Agenda 21,  
Chapter 18

In September 2000, 189 UN member states adopted the so-called Millennium Development Goals, setting well-defined targets for the world's most pressing development issues. The seventh goal is to sustain the human environment. Its target number 10 is related to water supply and sanitation. Access to sanitation has been added at the Johannesburg Sustainable Development Summit. Target 10 is:

"To halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation."<sup>5</sup>

5 Johannesburg Plan  
of Implementation,  
Paragraph 8

In order to meet this sanitation target, an additional 1 billion urban dwellers and almost 900 million people in rural communities have to be served with adequate facilities by 2015; this equates to approximately half a million extra people to be serviced each day.

## 2.2 The protection of water resources – achievements and challenges

A number of encouraging results have been achieved by various initiatives launched on very different levels since the Eighties. While in 1990, only 77 per cent of the world's population used improved drinking-water sources, in 2002 a global coverage of 83 per cent was achieved. The deterioration of water-supply infrastructure in many developing countries – the per capita water-supplies had decreased by a third between 1970 and 1990 – was stopped in most places.

In the past few years, governments have developed more efficient approaches to halt the increasingly urgent water crisis:

- more efficient legal frameworks are being developed and, in many places, law enforcement has been improved
- water policy is increasingly recognised as a cross-cutting task for socio-economic development
- water resources are more comprehensively assessed through the application of new planning methods and technologies
- the conservation and sustainable use of water for food production and other economic activities receives more emphasis
- institutional and human capacity to assess and manage water resources are being created

Nonetheless, considering the number of people who are still without a safe water supply, the tasks required to meet the Millennium Development Goals are enormous.

In the fields of sanitation and wastewater treatment, the challenges are even greater. Although global sanitation coverage increased from 54 per cent in 1990 to 62 per cent in 2006, 2.5 billion humans still live without improved sanitation.<sup>3</sup>



Picture 2\_4:  
Slow progress in water and sanitation will hold back advances in other areas

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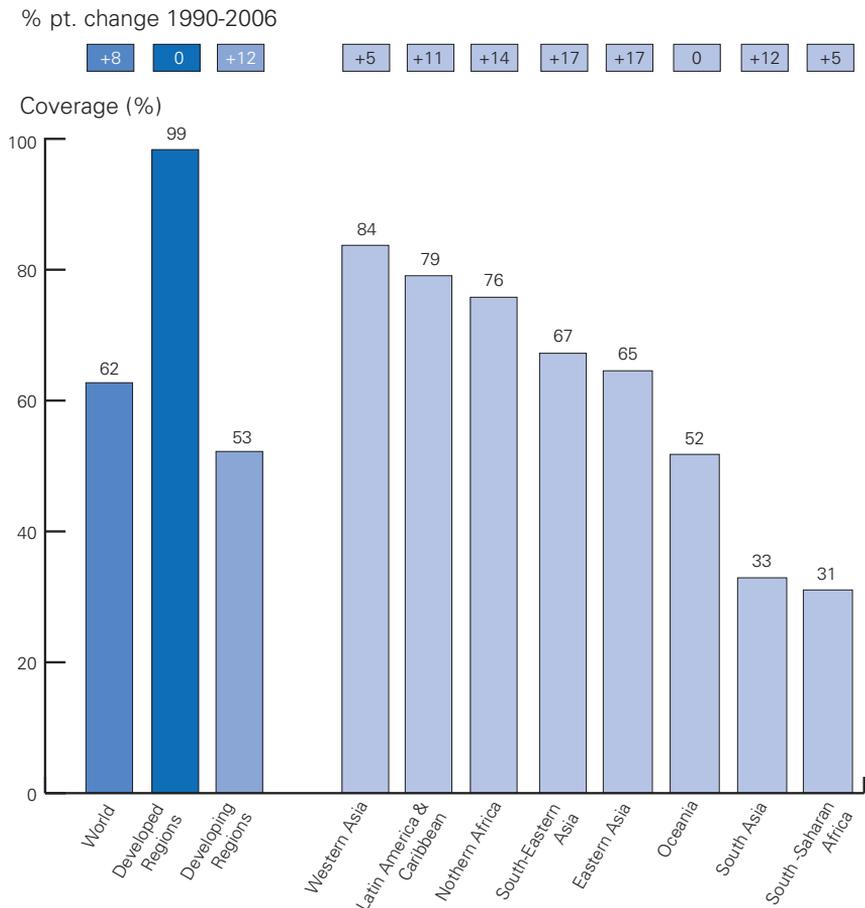
In India and China alone, nearly 1.3 billion people live without adequate facilities; in Sub-Saharan Africa, coverage extends to only 31 per cent of the population, and in Latin America and the Caribbean about 121 million people have no access – a critical situation.<sup>3</sup>

6 DALY is a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health (WHO)

The impact of poor sanitation and water pollution is obvious:

In fact, some 1.5 million children die each year from preventable diarrhoeal diseases.<sup>3</sup>

In terms of disability adjusted life years (DALY), some 44 per cent of the annual global burden attributable to water, sanitation and hygiene are caused by diarrhoeal diseases. In other words, every year more than 52 million years of healthy life are lost (UN-WWDR3, 2009).<sup>6</sup>



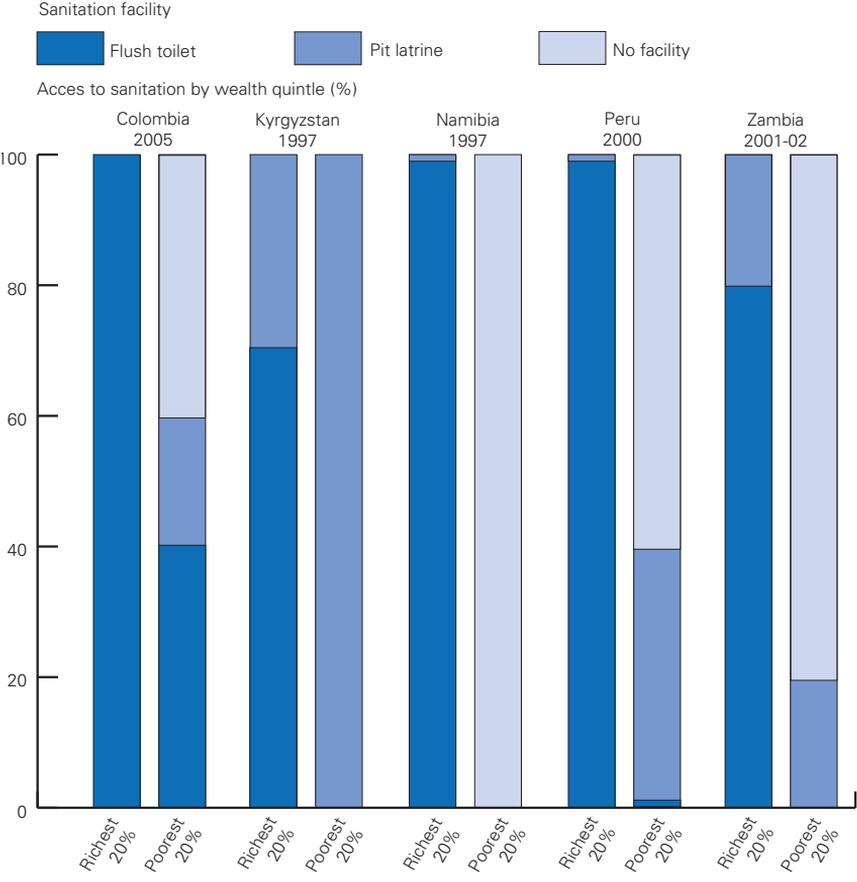
Picture 2\_5: Sanitation coverage is lowest in sub-Saharan Africa and South Asia. JMP-WHO/UNICEF, 2008

It is the poor sections of these populations who are most affected by the increase of water-borne diseases. Many live in a vicious cycle of unhealthy living conditions, faecal-oral disease, illness and poverty.

The statistics on water borne disease underline the scale of the challenges that lie ahead:

- 443 million school days get lost each year from water-related illness
- one third of the world population (2 billion infections) affected by intestinal parasitic worms
- 6 million are blind from trachoma
- 200 million people are affected with schistosomiasis<sup>7</sup>

7 UNDP, HDR 2006



Picture 2\_6:  
Access to sanitation  
by wealth quintile in  
selected countries;  
Source: UNDP, HDR  
2006

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### 2.3 A short assessment of the sanitation and wastewater sectors in developing countries

Poor sanitation should be perceived as an element of an overall process of inadequate use of water. Poorly treated wastewater has negative effects on public health. Furthermore, its high oxygen demand damages eco-systems, causing eutrophication in open water bodies, due to excessive nutrient supply; aquatic life is destroyed. Toxic substances also reach the groundwater, which approximately 2 billion people – about one-third of the world's population – depend on for water supply.

The three main sources of water pollution in developing countries are domestic, industrial and agricultural. The volume and characteristics of each type of wastewater differ by source and location (urban, rural). In total, domestic wastewater generally contributes the greatest organic load. In the Philippines, for instance, municipal (domestic) wastewater generates 48% of the national BOD (biochemical oxygen demand) (Industry 15%, Agriculture 37%); in Thailand, municipal wastewater generates about 54% of the total BOD.<sup>8</sup>

8 World Bank, 2005

9 CERNA, 2003

10 World Bank, Philippines Environment Monitor, 2003

11 World Bank, Indonesia Environment Monitor, 2003

Water pollution from domestic, agricultural and industrial sectors results in tremendous public and private economic losses. Calculations of external costs indicate that in China about 2.6%, in Mexico about 3.3%, in India about 4.53%, in Eastern Europe up to 5% and in industrial countries between one and two per cent of the GDP is lost due to water pollution.<sup>9</sup> The World Bank estimates the annual losses to the Philippines' national economy to be about PhP 67 billion (US\$ 1.3 billion); this can be broken down into PhP 3 billion for the health sector, PhP 17 billion for fishery production, and PhP 47 for tourism.<sup>10</sup> In Indonesia, economic losses are conservatively estimated at US\$ 4.7 billion per year, which is roughly equivalent to US\$ 12 per household per month.<sup>11</sup>

Comprehensive sanitation strategies must therefore protect public health and the environment; they should include the collection, the treatment, the disposal, the recycling and, especially, the avoidance of waste. Wastewater strategies must address an array of different wastes:

- human excreta (urine + faeces = blackwater)
- household wastewater (shower + washwater = greywater)
- stormwater
- waste from industrial production
- hazardous waste, as from hospitals
- solid waste



Picture 2.7:  
Water pollution  
causes tremendous  
public and private  
economic losses

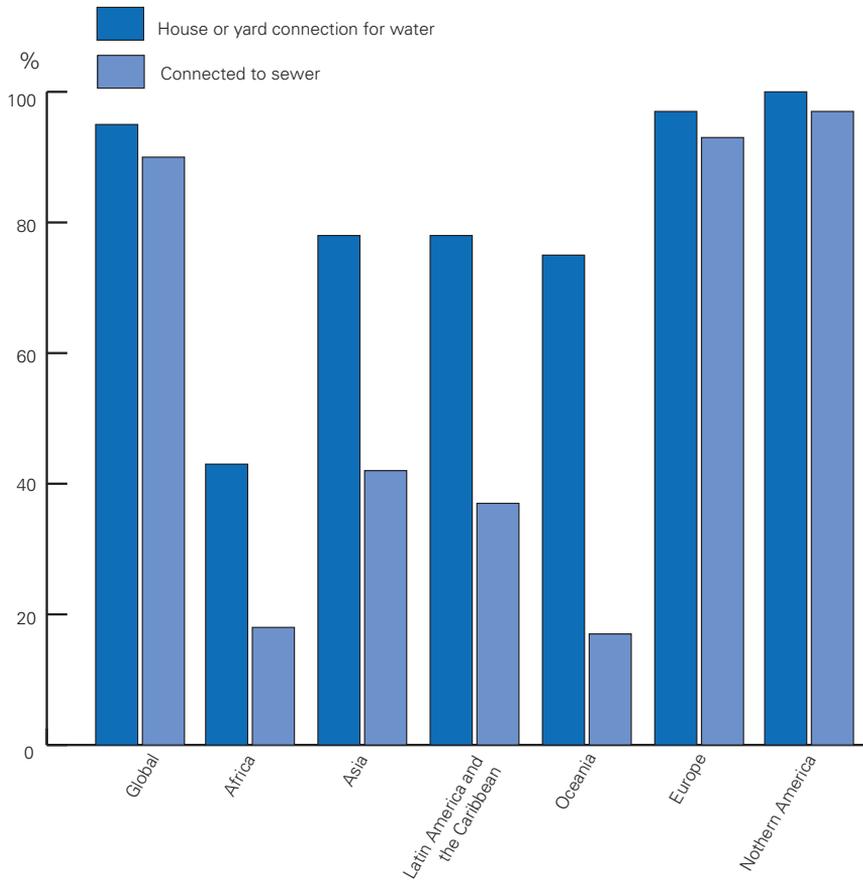
Picture 2.8:  
Open drainage of  
untreated wastewater  
is a prime source of  
serious disease

For a long time, wastewater treatment systems in the “developed world” were seen as the ideal solution, which should also be applied in the “developing world”. Wastewater treatment was perceived as a highly technical engineering task; flush toilets were used to transport the human excreta through big sewer systems to rather technically sophisticated wastewater-treatment plants.

However, a study carried out in 116 cities worldwide indicated a low connection of households to sewers in Africa, Asia, Latin America, the Caribbean and Oceania. Surveys show the rather weak efficiency of centralised wastewater-treatment systems.<sup>12</sup>

12 UN-WWDR1, 2003

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Picture 2\_9:  
The proportion of households in 116 major cities connected to piped water and sewers  
Source: UN-WWDR1, 2003

Most of the sewage in developing countries is discharged to nature without adequate treatment. An assessment published by the Central Pollution Control Board in New Delhi indicates that only a small quantity of sewage flows to treatment plants in India. While in so-called "Class I cities" 33% of the collected and 24% of the total wastewater is treated, only 5.6% of the collected and 3.7% of the total wastewater is treated in smaller "Class II cities".

Class I cities are urban agglomerations with a population of 100,000 or more, followed by: Class II (50,000 to 99,999), Class III (20,000 to 49,999), Class IV (10,000 to 19,999) and Class V (5,000 to 9,999).

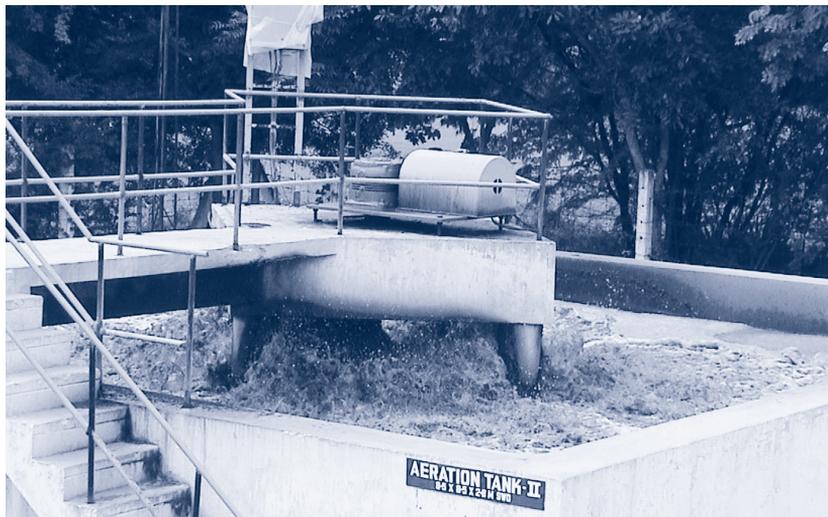
Type	Number of cities/towns	wastewater generated (MLD)	wastewater collected		wastewater treated		
			MLD	% (of generated)	MLD	% (of generated)	% (of total)
Class I Cities	299	16,662.5	11,938.2	72	4,037.2	33.8	24.0
Class II Towns	345	1,649.6	1,090.3	66	61.5	5.6	3.7
Total	644	18,312.1	13,028.5	71	4,098.7	31.5	22.4

**Table 1:**  
Sanitation coverage in India, Central Pollution Control Board, Delhi, 2005  
1MLD = 1 million liters per day

These figures correlate with experiences in other countries. In the Philippines, only 7% of the total population is connected to sewers and more than 90% of the sewage generated in the Philippines is not disposed of or treated in an environmentally acceptable manner. Figures from Latin America and the Caribbean show that only 14% of the effluent is treated.<sup>13</sup>

13 Global Water Partnership, 2004

A closer look at the performance of existing wastewater-treatment systems reveals further reasons for the rapid deterioration of coastal waters and the dead waterbodies found in many countries. Technical and maintenance problems result in low treatment efficiency and a discharge of still highly contaminated effluent.

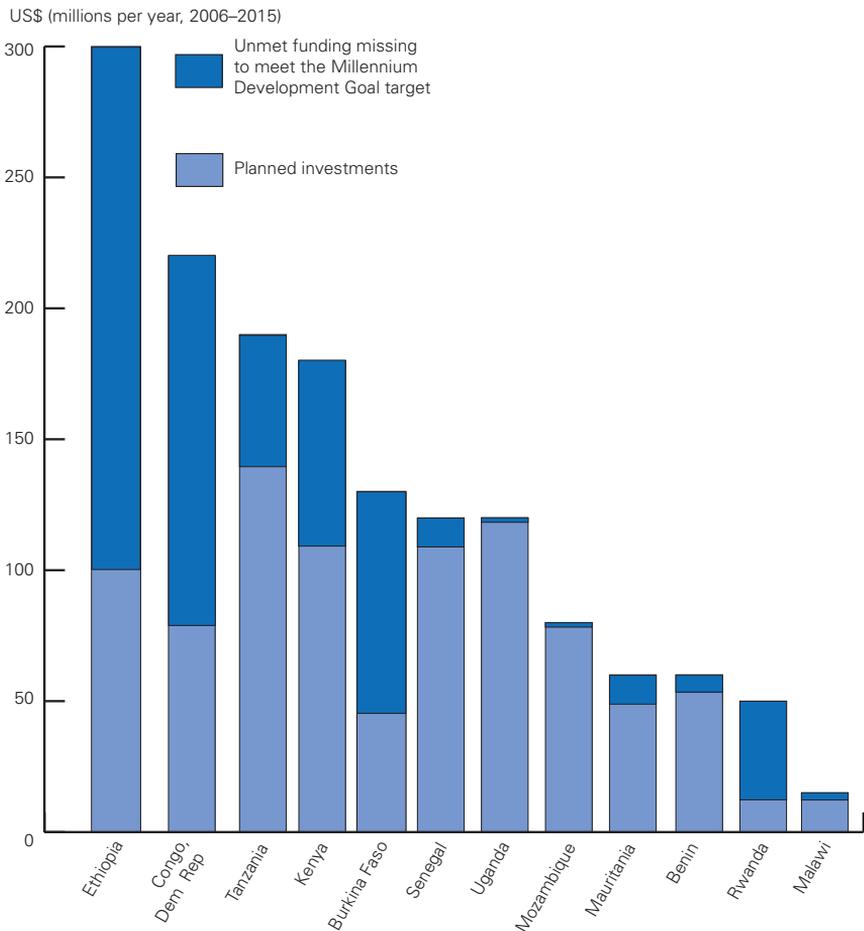


**Picture 2\_10:**  
Power cuts and maintenance problems are frequently encountered at conventional and decentralised wastewater-treatment units

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Poor performance is also observed in many so-called decentralised wastewater-treatment solutions, such as the:

- rotating disk reactor
- the trickling filter
- the activated sludge process
- the fluidised bed reactor and
- the sequencing batch reactor



Picture 2\_11:  
The gap between planned investments and funding required to meet Millennium Development Goal in Sanitation;  
Source: UNDP HDR 2006

The main causes for these treatment failures are insufficient operation and maintenance, lack of spare parts and frequent power-supply cuts. A survey, carried out in 1999, showed that one-third of the centralised wastewater treatment plants in Thailand were malfunctioning or did not operate at all. Most of the facilities suffered from equipment failure or damage, as well as deficiencies in staff-skills levels. Performance data showed that – due to poor maintenance – the collection systems collected only 55% of the wastewater that the treatment plants were designed to treat.



Picture 2\_12:  
Conventional centralised systems frequently suffer from poor performance

The increase of sanitation coverage has been slow because the extension of existing centralised systems has to be more complex than anticipated. In China, for instance, where increasing emphasis is placed on the treatment of the rapidly growing wastewater volumes, official reports state that the construction of about 700 – or half of the major wastewater-treatment projects planned by central government for the period 2001-2005 – had not yet been launched by the end of 2004<sup>14</sup>.

The drive for such high sanitation standards is the result of a complex development process at local, regional and national levels. It includes elements such as:

- public awareness-raising and stakeholder involvement of civil society groups at all levels
- human and institutional capacity-building in engineering, private companies, science and public services
- application of relevant techniques and standards
- development of adequate legal frameworks and efficient law enforcement and
- availability and efficient allocation of financial resources.

14 State Environmental Protection Agency Administration of China (SEPA) ref. SINA 2005

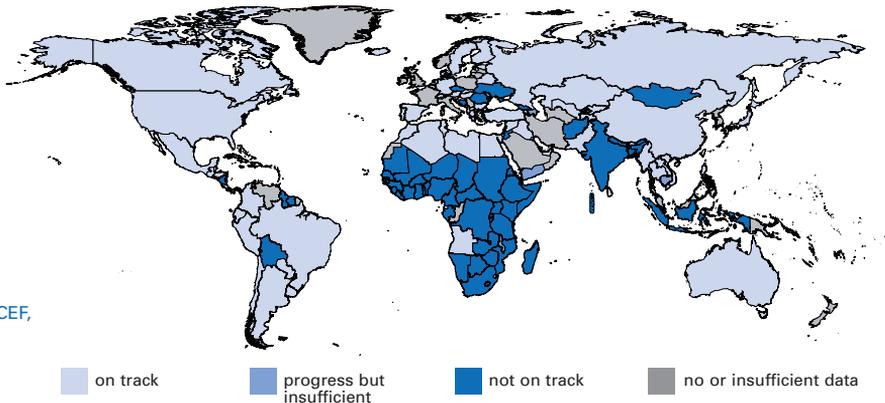
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Due to the technological, institutional and organisational requirements, such complex wastewater projects are unthinkable in many parts of the world. There is not the availability of sufficient funds. Moreover, the high water demand for flushing toilets (30–50% of domestic water consumption) further increases water stress, particularly in arid and semi-arid regions.

The desperate need for the establishment and implementation of efficient sanitation programmes becomes even more apparent on viewing the slow progress between 1990 and 2006. The term “sanitation” frequently only refers to the collection, removal or disposal of human excreta. “Improved sanitation” facilities ensure hygienic separation of human excreta from human contact. Technical solutions are:

- flush or pour-flush toilet / latrine to:
  - piped sewer system
  - septic tank
  - pit latrine
- ventilated improved pit (VIP) latrine
- pit latrine with slab
- composting toilet

Although these technologies are fairly simple to implement and maintain, progress in implementing them remains rather slow in many countries.



Picture 2\_13:  
Progress in  
sanitation,  
1990–2006  
Source:  
JMP-WHO/UNICEF,  
2008

WHO estimates that meeting the target of the United Nations Millennium Development Goal for improved sanitation requires annual funds of approximately US\$14 billion from the beginning of 2005 until the end of 2014<sup>15</sup>.

<sup>15</sup> WHO, Geneva 2008

## 2.4 Signs of change – elements of efficient and sustainable sanitation programmes

The reasons for slow progress in the sanitation sector are manifold. Performance both at the policy and implementation levels has been unquestionably weak in the past, resulting in unclear, contradictory or non-existent sanitation policies.

Typical political and administrative deficiencies are:

- lack of political will
- low prestige and recognition of the sector
- poor policy at all levels
- weak institutional framework
- inadequate and poorly used resources
- inappropriate approaches
- failure to recognise defects of current excreta-management systems
- neglect of consumer preferences
- ineffective promotion and low public awareness
- women and children considered last<sup>16</sup>

16 WHO, 1998

Within projects, considered at the implementation level, the following deficiencies have been observed:

- isolated character of the activities
- poor coordination between initiatives
- insufficient construction quality
- poor adaptation of designs to local conditions
- hardware-driven approaches
- insufficient involvement of users and other relevant local and regional stakeholders for implementation (top-down approach)

Recently, the situation has begun to change; national and international discussions are beginning to show results. In 2001, for instance, the Government of South Africa published a white paper on “Basic Household Sanitation”. At that time, about 18 million citizens had no access to adequate sanitation. Within the strategic paper, the government underlined its constitutional responsibility to ensure sanitation access to all South Africans.

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The purpose of the paper was to:

- spell out government policies on sanitation
- provide a basis for the formulation of local, provincial and national sanitation-improvement strategies
- provide a framework for municipal sanitation programmes
- ensure that sanitation-improvement programmes are adequately funded, and
- install mechanisms for monitoring the implementation of the policy and sanitation-improvement programmes<sup>17</sup>

17 Government of South Africa, 2001



Picture 2\_14:  
On the outskirts of major South African cities, people face poor sanitation

In 2002, the Government of Indonesia published a similar document, addressing the country's requirements for more efficient and sustainable implementation of safe water supply and sanitation. Within the paper, the government drew conclusions from problems faced in earlier programmes within the Water Supply and Environmental Sanitation (WSES) sector – and defined essential principles for future programmes:

- the role of all stakeholders involved in a programme must be clearly defined and their commitment ensured
- programmes must meet community's demand
- participatory management – involving all segments of the user community, especially women – is essential for successful long-term operation and maintenance
- the approach for environmental sanitation should be distinguished from that for clean water
- high quality of services is essential for meeting the expectations of the users and ensuring their willingness to pay for the services<sup>18</sup>

18 Ministry of Settlement and Regional Infrastructure, Ministry of Health, Ministry of Home Affairs, Ministry of Finance, National Development Planning Agency/ Bappenas, 2002

## 2.5 Towards service orientation – the conceptual framework of basic needs sanitation programmes

Although the documents discussed in the previous section were developed in a specific country context, both papers reflect ongoing, worldwide discussions concerning the development and implementation of successful sanitation programmes. Based on a broad range of position papers and experiences, the crucial importance of the definition of roles and tasks of different stakeholders involved in the process are outlined in the following:

- The elaboration of an efficient, adequate legal and regularity framework and the provision of budget lines are basic tasks of the central and regional governments, respectively
- Since sanitation programmes are far more than just hardware dissemination, the definition of the procedure for the institutionalisation process within public bodies (horizontal and vertical level) must be defined within the regularity framework. Special emphasis should be given to the definition of responsibilities and co-operation between different ministries and departments (public works, environment, health, etc); as well as how they are broken down at the national and local level
- Regional and local governments should be aware of the important role that sanitation programmes play within regional integral development. Sanitation goals and corresponding timelines should be established; these should comply with national legislation, norms and standards. Regional and municipal levels should monitor and ensure efficient co-ordination between concerned public entities.
- In most cases, the provision of sanitation facilities is the responsibility of local government, which must carry out the following tasks during implementation: awareness building within communities, decision-making in close collaboration with concerned communities, developing implementation schemes, budget allocation, monitoring implementation, setting up sludge-treatment systems and ensuring sustainability of the programmes
- Sanitation schemes must be developed in close co-operation with the communities. Since hygiene starts with the awareness and sanitation practices of each individual, sanitation programmes usually fail without the active involvement of the households. Community involvement is essential for ensuring regular use, continuous maintenance and financing of the sanitation facilities

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- Private-sector companies must not only deliver good-quality hardware, but also ensure long-term operation and maintenance as service providers. Public-private partnership models can ensure large-scale implementation and operation of sanitation facilities
- In many countries, non-governmental organisations (NGOs) initiate and facilitate the development and implementation of sanitation programmes. They launch awareness raising-campaigns, facilitate decision-making within communities, establish communication between communities and local governments, and even work as implementing agencies or service providers. Their roles depend on the profile and institutional competencies of each respective organisation, as well as the local conditions of the project area

Picture 2\_15:  
Multi-stakeholder involvement is vital to successful sanitation programmes



Picture 2\_16  
“Demand-responsive approaches” have been developed in order to ensure the efficiency and sustainability of sanitation programmes



The concepts of “multi-stakeholder involvement” and “result-driven programme portfolio” correlate with a new perception of basic-needs infrastructural development:

- The “demand-responsive approach” should be a main feature of any sanitation programme; the users are perceived as “clients”, who express a need and create a demand for sanitation services. Since public entities and other stakeholders respond to the demand of the communities, the approach is referred to as “Community-Based Sanitation”
- The active involvement of “users”, “clients” or communities is crucial for the sustainability of the programme. “Willingness to pay” is not only a strong indicator that the community is actually interested in the programme, but also the basis for professional, long-term operation and maintenance of the sanitation system<sup>19</sup>

19 The demand responsive approach and the main principles of community-based sanitation are discussed in chapters 5 and 6 of this handbook

## 2.6 The increasing demand for efficient and reliable decentralised wastewater-treatment solutions

Sanitation programmes should be an integral part of comprehensive wastewater strategies and vice-versa. Connecting sanitation facilities to sewerage or to septic tanks alone, however, does not ensure the adequate treatment of domestic wastewater. In order to meet legal effluent standards, solutions for secondary and tertiary treatment must be found.

In recent years, improved legislation and growing public awareness have led to a rapidly growing demand for suitable wastewater solutions. Water quality and discharge standards are defined on the basis of legislation, such as the Philippines “Clean Water Act” (2002), the Vietnamese “Law on Water Resources” (1999), or the “Water Act” in India. These standards are subject to law enforcement, court cases and public debate.



Picture 2\_17  
Improved legislation and law enforcement are the main driving forces behind the rapidly growing demand for new wastewater treatment solutions