Chapter 1: Introduction

1.1. Introduction

1.1.1. Infrastructure Services in Developing Countries

Health problems in developing countries are frequently associated with the lack of basic infrastructure services such as water supply, sanitation, solid waste collection and housing.

One of the major causes of disparities between the health burden in developing and developed countries is the lack of adequate hygienic practices, which may result from both inadequate education and the absence of basic infrastructure. Therefore, the implementation of physical systems that are technically, socioculturally and economically adequate for the recipient users, as well as the promotion of better hygiene practices, are seen as absolutely relevant aspects for those who believe in the prevention of communicable diseases through environmental improvements and hygiene education.

Environmental modifications as a way of health promotion are not a new proposal. In the middle of the 19th century, Chadwick reported to the United Kingdom parliament the precarious life conditions of the urban poor population at that time, and suggested the implementation of water supply and sewage collection systems to improve the health status of those communities (Chadwick, 1842). Additionally, WHO (1995) stated that "…the major factor in the improvement in health in the UK and other developed countries in the 19th and 20th centuries was not advances in medical care and technology, but certain social, environmental and economic changes: limitation in family size, increase in food supplies, a healthier physical environment, and specific preventive and therapeutic measures".

Although in the last decades of the 20th century efforts have been made to promote and support water supply and sanitation programmes in the developing world at both international and local levels (as examples, the International Drinking Water Supply and Sanitation Decades; and Safe Water 2000), billions of people are still suffering from the absence of services. The amplitude of lack of services in this sector in the world can be illustrated by the following data (Kalbermatten & Middleton, 1998):

- One billion people lack safe water;
- Two billion people lack safe sanitation;
- Four billion people lack sewage treatment;

- All of them cannot realise their aspirations for a better life because they lack a healthy environment and, as a result, have only limited economic opportunities; and

- Three million children die from water-related, especially diarrhoeal, diseases each year.

Recent data confirmed the dimension of the above figures, by indicating that at the beginning of 2000 1.1 billion people worldwide were without access to improved water supplies and 2.4 billion without access to improved sanitation (WHO/UNICEF, 2000). This lack of service is, however, concentrated in the less developed regions of the world, as shown in Table 1.1.

Table 1.1. – Population lacking improved water supply and sanitation by regions of the world

Region	Lacking Improved Water Supply		Lacking Improved Sanitation	
	Rural	**Urban**	**Rural**	**Urban**
North America	0 %	0 %	0 %	0 %
Europe	13 %	0 %	26 %	1 %
Oceania	37 %	2 %	19 %	1 %
Latin America and The Caribbean	38 %	7 %	51 %	13 %
Asia	25 %	7 %	69 %	22 %
Africa	29 %	6 %	62 %	14 %

Source: WHO/UNICEF,2000

The above information clearly stresses that consistent actions are still needed to improve the quality of life of the poor in developing countries, which are, in general, currently undergoing a rapid increase in their urban population as discussed below.

1.1.2. The Urban Poor Population

The rapid urban growth evidenced mainly in the second half of the last century and the inability of developing country governments to provide opportunities for improved housing and basic services are intensifying the development of slums in urban centres.

Usually, these urban slums, known as *favelas* in Brazil, are formed suddenly when families invade unoccupied areas and build their homes using any available materials such as cardboard, sticks, mud and plastic sheets. These slums are, therefore, illegal settlements that do not follow any building recommendations, resulting in unsafe and densely occupied areas without any official infrastructure service.

This is certainly a picture of a huge social problem, which is not easy to solve without determination and political commitment. These people have no other place to live, they are illegal and they are poor (which would means *unimportant* for many politicians and officials).

The sanitation solutions (which are the main focus of this study) adopted by poor communities in squatter settlements are nearly always inadequate and promote a poor environment, which favours the transmission of diseases. Therefore, it is not surprising that health indicators, such as the infant mortality rate, are now at higher rates in the urban slums than in rural areas (Figure 1.1).
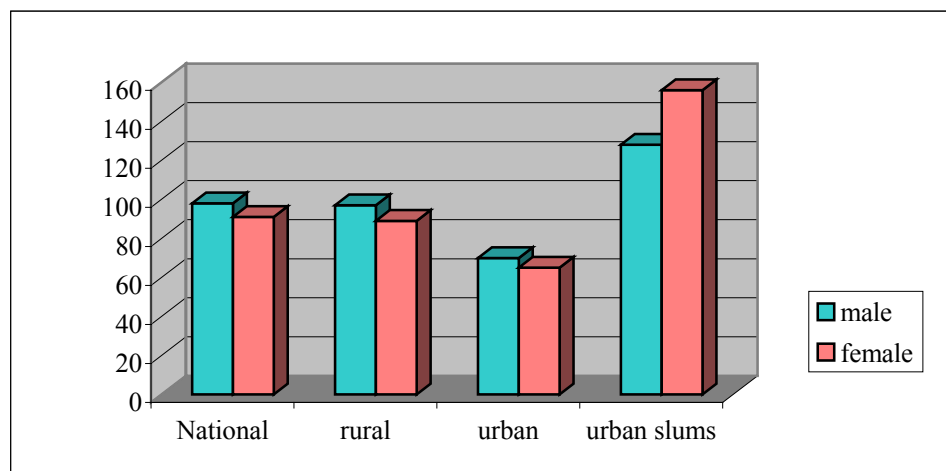

Figure 1.1. - Infant mortality rates in Bangladesh (1991). *Source: Mara (1996)*

Moreover, urban slums have a very high population growth rate. As stated in Choguill & Choguill (1996), "even in cities that are growing by as much as 10% a year, in many instances the percentage of slum dwellers and squatters is growing at twice that rate". The same authors also quoted data from UNCHS (1987) which report that the proportion of people living in informal settlements is making up as much as 32% of the population of São Paulo, 33% of Lima, 34% of Caracas and 59% of Bogota, and even worse, 85% of Addis Ababa, 70% of Luanda and 60% of Dar es Salaam.

1.1.3. Towards Sustainable Services

Sustainability may be interpreted in low-cost sanitation programmes as a pathway to drive systems towards their aims, changing the top-down managerial model of implementation, and designing systems with larger boundaries including social, economical and ecological aspects.

Thus, sustainable development concepts enable the technical (engineering) sanitation systems to be seen as just one part of a lager project, which should be also committed to health and social improvements.

Reed (1995) suggests that, towards sustainability, sanitation systems should be interpreted as *replicable* and *maintainable* systems. The term *replicability* is used to express a technically suitable, socially acceptable and economically affordable system, whilst the term *maintainability* refers to the proper operation of the systems during the totality of its design life.

Throughout the developing world, international agencies are funding programmes under sustainable development perspectives (such as the World Bank funded programmes PROSANEAR in Brazil and PHAST in East Africa), in spite of controversial disagreement for a proper definition for sustainability and sustainable development.

Since the 1980's alternative solutions for sanitation have been put into practice in low-income areas of Brazil. Even before sustainability had become popular, these alternatives systems raised concerns about community participation and responsibilities towards sanitation programmes. Thus, low-cost sanitation programmes developed in Brazil (mainly in the Northeast region) constituted the laboratory for the fieldwork of this study.

1.2. Brazil and Its Northeast Region

1.2.1. General Aspects

The Federative Republic of Brazil is a five hundred year old country which was discovered and colonised by Portugal and obtained its independence in 1822. Brazil has a territorial area of 8.5 million km^2 and is the fifth most populous country in the world with approx. 170 million people, based on the 2000 census (IBGE, URL-15, 2000).

The urban population in Brazil increased from one-third in 1940 to more than two-thirds in 1980 and to five-sixths in 2000 (IBGE, URL-22, 1996; URL-15, 2000). The average annual growth rate of the Brazilian population between 1980 and 1991 was 1.9%, representing a marked decline from the rates of 2.5% and 2.9% registered during the 1970's and 1960's, respectively (PAHO, URL-17, 1995). The increase of the country's population and of its urban population are illustrated in Figure 1.2.
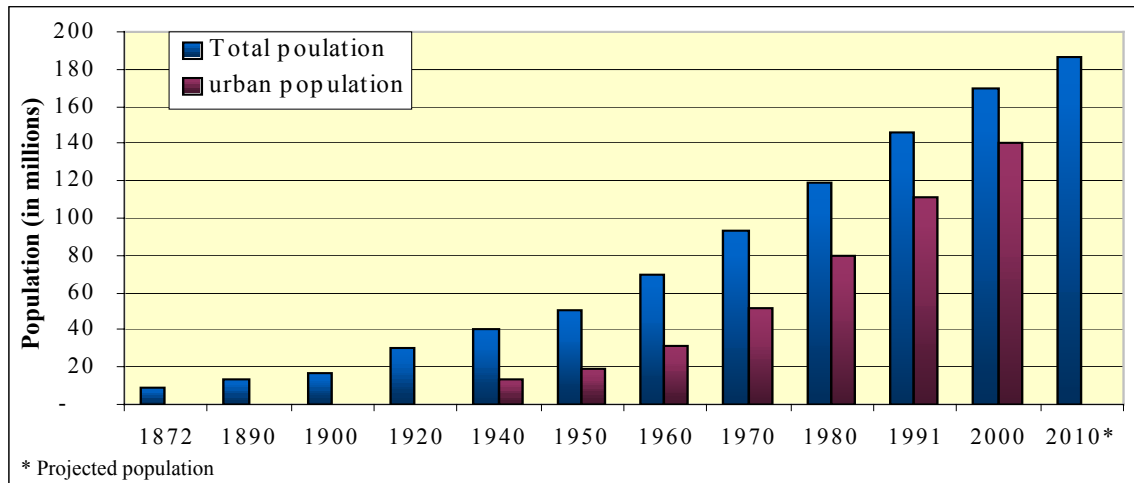
Figure 1.2. - Brazilian population and urban population (in millions).
Sources: IBGE, URL-15 (2000); IBGE, URL-16 (1996);IBGE,URL-22 (1996)

Brazil is divided into five regions: North, Northeast, Central West, Southeast and South. The Northeast region, in which the research for this thesis was mostly developed, is divided into nine states. This region contains approx. 28% of the Brazilian population and occupies 18.2 percent of the national territory (IBGE, URL-23, 2000).

Brazil's geographic regions are considered distinct from each other not only in climate, vegetation and cultural aspects, but also in economic characteristics, health burden and educational profiles. The Northern and Northeastern regions are the less developed, and have the lowest average income as shown in Table 1.2.

Table 1.2. - Total monthly average income in Brazil per working person (above 10 years old) in Reais

Region	Monthly Aver. Income (R$)
North	244.3
Northeast	144.9
Central West	291.3
Southeast	273.4
South	334.4

Source: IBGE, URL-18 (1999)

Health indicators in the North and Northeast are also worse than in the other regions. The risk of death due to intestinal infectious diseases is nearly 6.5 times greater in these regions than in the Southern and Central West regions (Moraes, 1996). Children born in the Northeast are 50 percent more likely to be classified as stunted than those born in the South region. Moraes (1996) also quoted that in urban areas of the Northeast region which are served with water supply and sanitation, the life expectancy at birth

and the infant mortality rate are, respectively, 58.1 years and 96 per thousand, whereas in areas of inadequate services these values are 45.5 years and 146 per thousand. The national average for life expectancy is 68 years and the Brazilian infant mortality rate is 35 per thousand (IBGE, URL-23, 2000).

1.2.2. The Water and Sanitation Sector in Brazil

Water and sanitation services in Brazil may be divided into two main phases: *before* and *after* PLANASA (the National Sanitation Plan), implemented in 1971.

Initially, in the Brazilian colonial period (15th to 18th centuries), the State was nearly absent and sanitation solutions were mainly individual. From the middle of the 19th century to the beginning of the 20th, sanitation services became a responsibility of the State; however, there was insufficient institutional organisation for the provision of these services. This, together with a lack of technological knowledge, led to the regime of private concessions, which were given mainly to English capital companies such as the "Recife Drainage Company", the "Rio de Janeiro City Improvements Company Limited" and others (Costa, 1994).

These companies provided water abstraction and distribution services as well as the first wastewater sewerage system. However, the terms of the contracts were in most cases not accomplished, with long delays occurring in the delivery of the systems. Moreover, the areas covered by these companies were limited to urban centres, reaching just 10-15 percent of the population.

As reported by Costa e Silva (1990), the interests of the English companies in providing infrastructure services had only exploitation purposes and not the promotion of communities' well being. Thus, popular pressure, better institutional organisation of the State and the technological contribution of the engineer Saturnino de Brito contributed to the end of the concessions.

The development of state and municipal sanitation institutions marked the next period (from the end of the 19th century until the 1940's), during which there was nearly a 10-fold increase in water supply services (Costa, 1994).

In the Constitution of 1934, the municipalities were recognised as the primary administrators of local infrastructure services. Following this recognition, the institutional capability of the state agencies increased, resulting in a series of institutions responsible for water supply and sanitation services at both state and municipal levels.

At this time (the late 1950's), a variety of administrative models had already been tested by the sanitation sector and the autonomous service of the municipalities supported by the administration of the states was being consolidated (Costa, 1994).

The second phase started with the delivery of PLANASA by the military government. In financial terms, PLANASA changed the way in which resources were obtained and made municipalities dependent on the state water companies, so losing their participation in decision-making processes. Thus, these state companies were strengthened and they centralised all sanitation programmes.

The specific aims of the PLANASA were to supply 80 percent of the urban population with water systems and to provide sewerage systems for 50 percent of the urban population by 1980, attending all main municipal centres and Brazilian villages with more than 5000 inhabitants by 1985 (Costa, 1994). From 1970 to 1980, water supply services in the country increased from 54 to 76 percent (approx. 40 percent growth); however the increase in sanitation services reached just 36 percent of the population (approx. 60 percent growth - from 22.3 to 36 percent). These large gaps between the percentages of the population served by water supply and sanitation systems indicates how sanitation was being relegated to a second plan and contributed to the unhealthy environments found in the majority of Brazilian large cities.

The absence of municipalities in the decision making processes may have been an important factor in the selection of inappropriate technologies, which is a common criticism against PLANASA (Watson, 1995). Moreover, the services were deliberately concentrated in wealthier neighbourhoods, while the poor areas remained unserved. Therefore, in 1990, the percentage of urban residents served with piped water was 83 percent but only 37 percent of the Brazilian households were provided with sewerage systems (ABES, 1992). In the northeastern region of Brazil specifically, the percentage of households served with sewerage was only 11 percent, much lower than the national average (ABES, 1992).

As part of the attempt to overcome these differences, a World Bank funded programme called PROSANEAR is being experimentally implemented in Brazil with the objective of supplying water to and to collect/treat sewage from poor urban communities (Katakura & Bakalian, 1998). A first pilot programme was implemented connecting one million poor people to sewer systems and 90 percent of them to in-house water. These results were considered very impressive and motivated the implementation

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of a second pilot programme. The PROSANEAR programme is discussed further in Chapter 2.

In conclusion, since the beginning of the national economic crisis in 1983 and the abolition of the BNH (the main financial agency for PLANASA) in 1986, the sanitation sector in Brazil has been suffering from severe undercapitalisation, which limits new investments (Watson, 1995). From the middle of the 1980's the municipalities have been trying to re-assert their position as the primary managers of sanitation in their localities. However, the weak institutional organisation of the majority of the municipalities, associated with factors such as technical incapability and lack of financial resources, does not permit much effective change (Pontes *et al.*, 1996). On the other hand, new programmes are being developed to test more sustainable systems and this should bring a wider range of solutions to the sector.

1.3. Objectives of the Study

During the last two decades of the 20th century, alternative solutions for provision of sanitation systems were implemented in Brazil. These unconventional programmes, which embrace not only innovative technologies but also new social approaches, had as their main objective to reach poor communities, especially the urban poor.

Therefore, the aim of this study was to assess six low-cost sanitation programmes implemented in poor communities in the Northeastern and Central Western regions of Brazil. This assessment focused on the long-term sustainability of the programmes and was based on the study of the following aspects:

- Technical suitability, operation and maintenance of the sanitation systems;
- Institutional arrangements;
- Financial affordability;
- Sociocultural acceptability; and
- Health improvement.

It was expected, therefore, that this study would bring further insight into the conditions necessary for the sustainability of low-cost sanitation programmes.

1.4. **Structure of the Thesis**

As mentioned previously, the study of alternative sanitation systems and their steps towards a sustainable development are the main objective of this thesis, which has the following structure.

Chapter 1, this present chapter, introduces the study reported herein. It provides an overview of the precarious situation of poor communities that lack basic infrastructure services, more specifically sanitation services, emphasising the overcrowded urban squatter settlements and steps toward the implementation of sustainable services. The main profiles of the Northeast of Brazil, where the fieldwork was mainly developed, are also presented in this chapter.

Chapter 2 presents a review of the literature, providing the necessary support for the investigations developed in the fieldwork. Therefore, parallels are drawn between public health, the environment that poor people live in and the benefits provided by sanitation engineering improvements. The low-cost sanitation technologies applied in the case studies investigated are also reviewed. A discussion about sustainability concepts is then presented followed by examples of sustainable sanitation programmes, and ending with recommendations for evaluation procedures and the application of indicators of sustainability.

In Chapter 3, the methodology applied in the fieldwork is described. Chapter 4 presents the six case studies, describing the areas and the respective sanitation programme implemented, as well as the results obtained during the study.

Chapter 5 discusses the results under the perspective of seven aspects likely to influence the sustainability of the low-cost sanitation programmes. Finally, Chapter 6 presents the conclusions of the study and makes recommendations for further work.