Contribution for the evolution in water supply and sanitation systems in peri-urban areas of the Portuguese-Speaking African Countries

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Abstract

Worldwide, 884 million people do not have access to improved sources of drinking-water and 2.6 billion people do not use improved sanitation (WHO and UNICEF, 2010). This paper focuses on best practices analysis for design, planning, operation and maintenance of water supply and sanitation systems, with a special emphasis on peri-urban informal areas of the Portuguese-Speaking African Countries. Different low-cost technologies are identified, in association with Service Levels. In addition, some key considerations of the process of policy-making, planning and implementation of water and sanitation systems are addressed.

Key-words: water supply, sewage sanitation, peri-urban areas

1. INTRODUCTION

Worldwide, 884 million people do not have access to improved sources of drinking-water and 2.6 billion people do not use improved sanitation (WHO and UNICEF, 2010). Water and sanitation-related diseases are among the most common causes of illness, affecting mainly the poor in developing countries. Where adequate water and sanitation facilities are present, rates of illness drop, productivity increases, malnutrition in children is reduced, more children attend school and women dignity is improved (UNDP, 2006; WSSCC, 2006).

The Millennium Declaration established the Millennium Development Goals (MDG) of halving the proportion of people without access to safe water and basic sanitation by 2015, compared to 1990 (UN, 2010). Expanding access to domestic water supply and sanitation services will help in reaching a number of other MDG, due to their inter-relation. At the current rate of progress, the world is expected to exceed the MDG target regarding access to safe drinking-water. Nevertheless, the scale of the problem is far greater for sanitation, and that target remains elusive (WHO and UNICEF, 2010). One of the main constraints for expanding water supply and sanitation coverage is the lack of political will and government commitment in allocating sufficient resources to the sectors. Moreover, inadequate legislation, insufficient institutional and financing mechanisms, as well as lack of coordination among stakeholders are factors which contribute to the lack of effective results (WaterAid and Tearfund, 2003). Another constraint is the lack of technological support, especially after the project is completed and facilities are in use. Furthermore the lack of community participation and general dissatisfaction of the community with the projects' outcome has proved to contribute to the failure of the latter (Muyibi, 1992).

This paper gives special attention to urban informal settlements because they are facing enormous challenges, economic pressure and limited financial resources due to the rapid pace of rural-to-urban migration and the unplanned growth of slum areas around cities. Other reasons for the sharp growth of slums include the fact that the rate of economic growth does

not suffice to absorb the work force that enters the work market, as well as the lack of legislation and enforcement related to the land-use (WUP, 2003).

Given the historically relations between Portugal and the Portuguese-Speaking African Countries (PSAC), it is important to analyse their water and sanitation status, summarized in Table 1 and Table 2. PSAC include Angola, Cape Verde, Guinea-Bissau, Mozambique and São Tomé and Príncipe.

		Total			Urban		
		Unimproved	Improved	Piped	Unimproved	Improved	Piped
Angola	1990	64	36	0	70	30	1
	2008	50	50	20	40	60	34
Cape Verde	1990	-	-	-	-	-	-
	2008	16	84	38	15	85	46
Guinea-Bissau	1990	-	-	2	-	-	6
	2008	39	61	9	17	83	27
Mozambique	1990	64	36	5	27	73	22
	2008	53	47	8	23	77	20
São Tomé and Príncipe	1990	-	-	-	-	-	-
	2008	11	89	26	11	89	32

Table 1 Use of drinking-water sources (percentage of population) (adaptated from de WHO and UNICEF, 2010)

Although the levels of adequate access to water have increased between 1990 and 2008, they are still very low, particularly in Angola (50%) and Mozambique (47%). Levels of piped water are also low, with a focus in Guinea and Mozambique where less than 10% of the population has access to the most convenient and safe way to obtain water (WHO and UNICEF, 2010). Concerning the technologies used in the urban areas of the PSAC, the tap connection is the most popular option, usually made through a connection in the yard (WHO, 2010).

		Total				Urban			
		Improved	Open defecation	Unimproved	Shared	Improved	Open defecation	Unimproved	Shared
Angola	1990	25	61	14	-	58	35	7	-
	2008	57	23	20	-	86	1	13	-
Cape Verde	1990	-	-	-	-	-	-	-	-
	2008	54	42	4	-	65	33	2	-
Guinea-Bissau	1990	-	-	-	-	-	-	-	-
	2008	21	31	46	2	49	2	41	8
Mozambique	1990	11	65	22	2	36	32	25	7
	2008	17	42	38	3	38	14	41	7
São Tomé and Príncipe	1990	-	-	-	-	-	-	-	-
	2008	26	55	15	4	30	49	17	4

Table 2 Use of sanitation facilities (percentage of population) (adapted from WHO and UNICEF, 2010)

The level of improved sanitation is clearly low in Guinea, Mozambique and São Tomé and Príncipe, where less than 50% of the population has adequate access to sanitation. A lot of people still defecates in open land or has inadequate sanitation systems which are proved to be more dangerous for the public health, than their absence. The community system is not too common in the PSAC (WHO and UNICEF, 2010).

2. LOW-COST TECNOLOGIES AND SERVICE LEVELS

It is not adequate to impose a single technological option for water supply and sanitation systems. Instead, several options, which can be adjusted to the local conditions and needs, should be considered. The scope of this chapter aims at categorizing the most common options, or the ones which have greater potential in the urban areas of the countries under analysis. Options are subdivided in different *Service Levels (SLs)*. As the SL increases, so does public health protection and the level of quality of life. Figure 1 and Figure 2 represent SLs defined in this paper for water and sanitation systems, respectively:

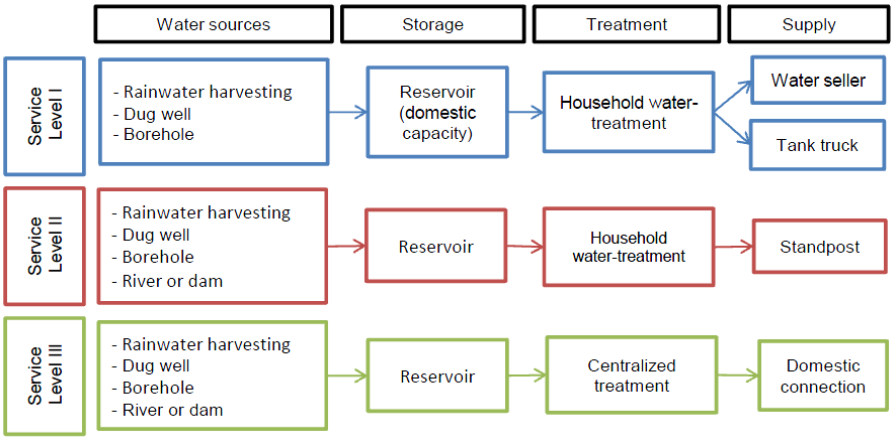

Figure 1 Service levels of water supply systems

The main distinctions between the different water supply SLs are the water distribution method and the level of water consumption. The water sources include rainwater harvesting dug wells, boreholes and river or dams catchments. In SL I, water is distributed through water sellers or tank trucks, being usually difficult to guarantee its quality. The water consumption per capita is low - about 5 to 10 l/capita/day, and the water reservoir of small capacity is considered to have a useful volume inferior to $1m^3$.

The SL II is a result of the need to increase the quantity and quality of water. Thus, the service is provided from standposts and corresponds, in average, to a consumption of 20 l/capita/day. For the SL I and II, water treatment is mostly done at the household level. Even in cases where water is obtained from operators which had already treated the water, such practice does not generally prevent the need of treating water immediately before consumption, given its great vulnerability to contamination.

As people improve their life conditions, their expectations towards piped water are raised, leading to SL III. This SL is characterized by a higher consumption (more than 50 l/capita/day), a better water quality control (water is subjected to a more rigorous source treatment), and an improved comfort, as water is distributed through domestic connections.

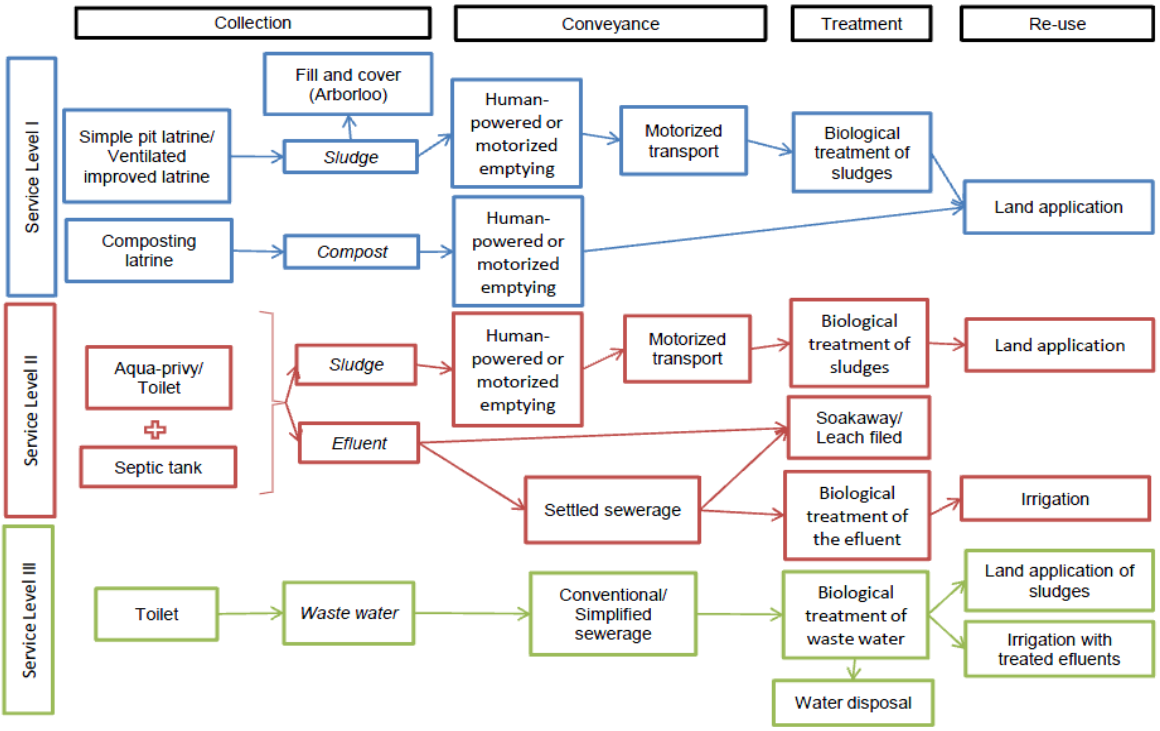

Figure 2 Service levels of sanitation systems

The main difference between sanitation SL lies on the method of disposal, as shown in Figure 2. The SL I is a dry-sanitation system which does not use water but rather cleaning materials such as paper and tree leaves. Simple pit and ventilated improved latrines, once filled, can be covered with soil. If they contain disposal receptors, they can be periodically emptied through human-powered or motorized systems, and sludge can be treated for land application (Faria and Neves, 1989). Composting latrines demand the social acceptance of reutilization of faeces in agriculture, but represents an attractive option, usually considered under the "Ecological Sanitation" concept. SL I is characterized by a lower level of public health protection and by difficulties in pit-emptying services (Bhagwan *et al*., 2008).

SL II relates to methods of wet-sanitation corresponding to "Aqua-Privy" latrines or toilets with a hydraulic siphon, connected to a septic tank. Sludges are subjected to the same procedures as mentioned in SL I. If water sources are not at risk, the effluent from the septic tank may be disposed in the soil (Faria and Neves, 1989). Moreover, this SL has the potential to evolve to a settled sewage system, followed by centralized treatment and the reuse of the effluent in irrigation. In SL II, excreta is better treated and there is a greater health protection level.

SL III corresponds to a wet system which safely carries wastes away from the neighborhood. It involves collectors, with the possibility of applying simplified sewerage systems: small diameter collection mains, usually laid at lower depths when compared to conventional systems. The effluent can then be treated in a centralized installation, and re-utilized. This SL is more adequate for the environmental pollution control and for the privacy and security of the users.

It is now important to analyze the compatibility between water supply SLs and sanitation SLs, which is shown in Table 3. In general, water supply SL I is not compatible with sanitation SLs

II and III, since it is not guarantee that there is sufficient quantity of water. For the same reason, water supply SL II and sanitation SL III are not usually feasible. Finally, water supply SL III should not coexist with sanitation SL I, given the potential public health implications as a result of the water flow not being accommodated by dry excreta disposal systems.

		Water supply		
		SL I	SL II	SL III
Sanitation	SL I			X
	SL II	X		
	SL III	X	X	

	Compatibility
X	Incompatibility

Table 3 Compatibility of water and sanitation Service Levels (SLs)

In conclusion, instead of investing in facilities which are unaffordable, priority should be given to providing an initial minimal level of water and sanitation services to all the community (lower SLs). Subsequently, a planning approach might seek to make progress in a gradual way, always considering the compatibility between water and sanitation SLs.

3. PLANNING AND IMPLEMENTATION

3.1 General considerations

The most appropriate solutions for water and sanitation systems should be chosen considering not only technical, but also institutional, social, political and legislator constrains. For that reason, it is not adequate to define a universal method of planning and implementation of those systems. This chapter includes some reflections related to some of the main question that should be raised. Projects are divided into different stages, as shown in Figure 3, which intends to represent an iterative and dynamic process where it is possible to return to previous stages, whatever it is necessary to reduce uncertainties and correct options. The first stage takes into account the importance of *awareness and capacity building*, taken into account previously to the projects. The second stage refers to *the analysis of the situation,* followed by the *selection* stage, in which actual decisions are taken regarding technologies and general approaches. Afterward, there is the *implementation and management* stage. Finally, the last stage of *monitoring and assessment* contributes to evaluate the adequacy of the functioning and management of the systems.

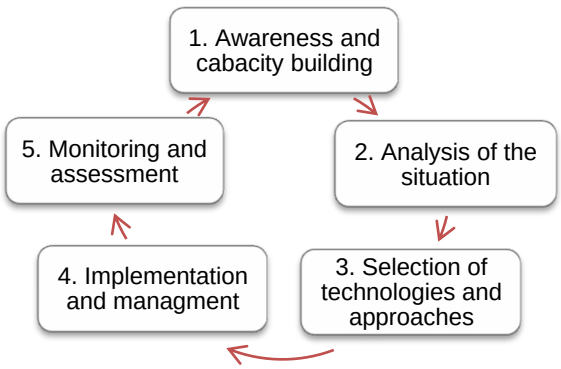

Figure 3 Stages of the planning and implementation cycle of water supply and sanitation systems

3.2 Awareness and capacity building

Numerous studies have shown that resources and time are being spent in projects that do not take into account beneficiaries' needs, preferences, customs, beliefs and socio-economic and political structures. Therefore, water and sanitation projects should rely on a context-specific approach that centers on community mobilization. Behavior change programs can take a number of forms, including the creation of mass media campaigns and the formal integration of water and sanitation education into school curricula (Gomez and Graham, 2004). Hygiene and health education programs are also crucial to increase the beneficial impact of water supplies and sanitation. Participatory methodologies can be used to facilitate the process of empowerment and capacity building of the communities benefited by development interventions, such as the Participatory Hygiene and Sanitation Transformation (PHAST), the Community Led Total Sanitation and the Self-esteem, Associative strength, Resourcefulness, Action planning and Responsibility (SARAR).

Simultaneously, extensive training should take place before the beginning of the project in order to capacitate local authorities and communities. This is especially important in what concerns operation and maintenance activities. Women and children should be an integral part of the training since they are generally in charge of systems maintenance. Furthermore, capacity building will allow all stokeholders to play a more active and decisive role in all the stages of the development projects (Mara *et al*., 2007).

3.3 Analysis of the situation

This stage intends to review the current local situation and to identify potential problems. The diagnosis should address and evaluate the importance of a broad range of factors, namely: technical, environmental, social, political, institutional and economical ones. These factors are interconnected and their analysis should take place collectively.

In terms of environmental aspects, it is important to characterize the water resources (e.g., location, variability, quantity and quality), the geology conditions (e.g., permeability) and the type of soil use (e.g., space availability, housing level and density). It is also important to remember and note the special relation between water systems and sanitation systems, as shown is Table 3. Technical aspects entail the consideration of construction, maintenance and operation aspects including the material and work force availability, as well as the local and available technical knowledge.

Societies are very heterogeneous and are made of different ethnic, age, political and sexual groups, whose preferences in terms of price/quality trade-offs may vary widely. They often have difficulties getting their voices heard by the project planners and usually have opposite ideas about the project design (Avvannavar and Mani, 2007). That justifies the need to consider social factors and to understand the community context, in what relates to health situation, organization and leadership patterns, as well as traditions, religions and beliefs. It is also fundamental to find out what sort of water and sanitation services people want, their preferences and expectations on the projects outputs, as well as their potential to contribute to the project. Understanding the differences between women's and men's roles, the special needs of children, elderly and disable people can also contribute to more effective initiatives.

Developing countries are usually criticized by the lack of leadership and political will to tackle the water and sanitation challenge (UNDP, 2006). In some cases, the existing legal framework is not adequate to the local reality and introduces obstacles to serving peri-urban

populations, as a result of strong requirements, similar to the ones adopted in developed countries, but not adequate to the developing conditions. Urban planning policies are also frequently missing (WUP, 2003). Therefore, it is vital to understand the political context, including the national and local strategies and priorities.

Furthermore, the institutional arrangements should be examined by means of an analysis of the network of actors and their potential contributions. The service provision is usually undertaken by the main operator (MO) and other Small-Scale Independent service Providers (SSIP), especially common in the water sector. In general, the latter are not connected to the main utility network, particularly if connection charges are high or if they cannot obtain access to the service for lack of land tenure (Trémolet e Halpern, 2006). Besides their important role, donor agencies are failing to reach the poorest and transferring the adequate technology. It is therefore crucial to understand their approach in order to maximize their efforts (Ludwig, 2006). Scientific institutions in developing countries also have a significant role to play, which need to be assessed having in mind that their lack of resources and infrastructures constitute a key barrier (Oman et al., 2009). At last, with a tradition of local level community engagement, Non-Government Organizations (NGOs) are well placed to add value to water and sanitation programs. They play a variety of roles and approaches which need to be identified and potentiated (Carrard et. al, 2009).

Compared with rich communities, many poor households pay a much higher proportion of their incomes toward their daily needs for water supply and sanitation services. Furthermore, financial resources are often directed not to poor communities where the needs for access are the greatest, but rather to areas where there is political capture by politicians or where the criteria for donor success are in place (WUP, 2003). This way, it is important not only to consider the economical viability of the project, but also to analyze the economic context, including the user's capacity to pay and the available mechanisms to help them, as well as the stakeholder's capacity to invest in service improvements and expansions.

The broad perspective of the mentioned factors will provide the main insights required in the subsequent stages.

3.4 Selection of appropriate technologies and approaches

In this stage, particular technical solutions and general approaches should be agreed upon. It is advisable that this process is based on previously defined criteria, which will reduce constraints resulting from later opposing views regarding the relative importance of each factor, defended by different stakeholders. Another key factor is to ensure that decisions are coherent with national and regional circumstances.

Coverage targets

The definition of a strategy is often accompanied by the scarcity of information and clarity. Often, the strategy turns out to be not very demanding or too ambitious, if not adequately defined or impossible to enforce because it is not associated with available resources. In the latter case, it is preferable to support a wide range of water and sanitation technologies and service levels that are technically, socially, environmentally, and financially appropriate, instead of a single option (Trémolet e Halpern, 2006). Another difficulty in addressing a strategy is the settlement patterns of many slums, where service provision is often prohibited as a consequence of lack of documentation, information concerning houses limits and the

identification of the owners. More flexibility is needed to address these problems (WSSCC, 2005).

Considerations at the social level

It is crucial to incorporate local and traditional knowledge and local special needs into project processes, to ensure its acceptance and sustainability by the users (WSSCC, 2005). Social and spiritual leaders can be invited to reinforce the importance of water and sanitation systems among their followers and congregations. A particular effort needs to be made in order to ensure that women, elderly and disabled people play an adequate role along the process and that their needs are considered. On the other hand, schools can act as an example to the whole community, as mobilization of teachers, parent associations and school councils can motivate for the best practices (WSSCC, 2006).

Institutional arrangements

A unique institutional structure should not be defined, since the success cases are not necessarily replicable, given the specificities of each site. It is argued, however, that for each situation, the potentials of stakeholders should be identified in order to allow for collaborative efforts with regard to skills and knowledge, but also to avoid institutional gaps (Carrard *et al.*, 2009). For partners to work together, self-interests must be met. Therefore, it is essential to understand how the contribution of stakeholders might be enhanced.

Governments and the public sector, in general, can act on their commitment to water and sanitation service delivery by commissioning a thorough review of policy, legal and regulatory arrangements, making explicit budget allocations for these services, funding, training and capacity building, as well as coordinating efforts, and directly providing the service (UN, 2004 and Carrard *et al.*, 2009). The privatization of the services in analysis is an internationally controversial subject. Besides that, some multinationals have successfully penetrated this market. In particular, the small-scale water providers are a great challenge in many cities, and one possible suggestion is to include them in the regulatory framework, creating conditions for a transparent and fair relationship with the main service provider (Trémolet e Halpern, 2006). Donor organizations can allocate adequate amounts of money to water and sanitation programs and fund micro-credit facilities. Technological transfer and capacity building are other two areas where donor can contribute, for example, through compilation and dissemination of successful programs and good practice, as well as through the training of local expertise (Ludwig, 2006). Non Governmental Organizations (ONG) and Community-based Organizations (CBO) often have the ability to reach remote places or illegal settlements and have been shown to be adept at taking an integrated and longer-term programmatic approach to meeting community needs. Other ONG potential is the research and innovation, including demonstration and piloting of innovative and locally adapted approaches and technologies (Carrard et al., 2009). Finally, research should be performed by researchers in the countries most affected, on topics identified by them and in their own environment. In order to achieve it, the strengthening of local scientific capacities is needed, including: training courses on scientific methodology, literature review, fundraising, sampling, laboratory practices, statistical methods, experimental designs, participatory approaches, oral presentation, as well as help on how to purchase and maintaining scientific equipment (Oman et al., 2009).

Regulation

Regulatory arrangements can have a decisive influence on providing service providers with strong incentives to serve poor people of the peri-urban areas, ensuring that water service providers comply with existing rules with respect to price, service quality, competition regulation and consumer protection. A regulatory institutional model can include an autonomous regulatory agency, a ministry, an asset-holding company, a customer group, and independent experts, among other options as self-regulation. Quality standards are sometimes set at to high levels, using norms that have been adopted from other countries or regions without sufficient adaptation for local conditions. While desirable in the longer term, such standards may be prohibitively technically or costly for immediate use. Therefore, relaxing such standards could allow increasing the service coverage. On the other hand, economic regulation is required for tariff-setting, while ensuring that the interests of both operators and users are protected. In particular, connection subsidies are preferred to consumption ones. One of the solutions for the tariff structures includes “social blocks”, i.e. initial consumption blocks for which the tariff is set below cost, usually subsidized. If metering is not adequate to implement, it is important to examine the most efficient way to charge for consumption. The billing and payment options have also to be considered, especially in peri-urban areas, where salaries are usually irregular (Trémolet e Halpern, 2006).

Financing

Some households can not afford the costs of improved services. As a result, conditions should be created to help people make the needed investments (WSSCC, 2005). Experience shows that using subsidies to finance water and sanitation infrastructures is a viable next step. However, grants initially regarded as temporary, often result in a level of dependency that imposes obstacles to the continuation of the service (Schutte, 2001). Additionally, subsidies have to be adequately targeted to reach poor people. Access to micro-credit for household improvements, can also act as community drivers for change (WUP, 2003).

3.5 Implementation and management

In the *implementation* stage, the execution of plans faces typical problems of developing countries: lack of payments, change of the circumstances, poor information, low infrastructure, vandalism, among others (Schutte, 2001). New measures should be gradually introduced, in different phases over time. In some cases, policy options may need to be tested through the use of pilot programs (UN, 2004). Additionally, operators should focus on transmitting an image of credibility and imposing a culture of cost control. In parallel, it is essential to involve the community (Schutte, 2001). Operation and maintenance activities are crucial for the success of the projects. In this regard, the unaccounted-for-water solutions deserve special attention because of the magnitude of the problem.

3.6 Monitoring and assessment

Implementation needs to be continuously monitored and evaluated. After a reasonable period it will be necessary to review the functioning of the water and sanitation infra-structures. To do so effectively, goals and performance standards should be defined so that actual service delivery can be compared with them. These performance criteria are often seen as a threat, especially in developing countries, since the entities under evaluation fear punishment. Accordingly, these entities must be motivated for the opportunity the indicators present to ensure that the project meets its objectives and operate on a sustainable basis.

Ideally, indicators should be easily calculated and understood by experts and by the general community (Pybus and Schoeman, 2001).

4. CONCLUTIONS

Water and sanitation are essential to the well-being of humankind and a vital input to economic and health development. However, the lack of access to those services has been increasing with population growth and urbanization, especially in peri-urban areas, hampering the achieve of the MDGs.

This paper identified solutions that are not unique to the peri-urban areas, neither apply only to PSAC. However, the focus on the peri-urban areas is justified because they include the majority of the population without access to water and sanitation. Literature usually refers to water supply and sanitation in urban areas and / or rural settlements, but not specifically in peri-urban areas. Therefore, it is urgent to study and give priority to the study of informal peri-urban areas, even though they might sometimes share some common characteristics with planned and formalized urban areas. Although the analysis is far from being exhaustive, the attention that this paper had given to the Portuguese-Speaking African Countries results from the special historical responsibilities and commitments that Portugal has towards these countries.

This paper also does not define solutions for water supply or sanitation that are universally applicable to all situations. Actually, it is considered that to be effective, interventions, approaches and financing mechanisms must be highly context-specific. It is crucial that projects fit their local context and so, it is impossible to tailor strategies for water and sanitation without considering specific local circumstances.

In conclusion, from the technological point of view, it is clear that there is a need for guidance on technology selection. The best way to deal with it is to start with immediate, simple and low-cost technological solutions, and then move gradually toward more complex options. In that way, it will be easier to make progress where it would otherwise have taken much longer to move toward the top of the water and sanitation ladder. The consideration of the compatibility between water systems and the sanitation ones is crucial.

Efforts to reach the water and sanitation target must focus on sustainable service delivery, rather than technical aspects alone. Therefore, projects should ensure a policy cycle as an ongoing dynamic process, which calls for continuous dialogue and the sharing of experiences among stakeholders. Without a clear consideration of specific conditions in the definition of coverage targets, social context, institutional arrangements, regulation and financing, additional resources may bring only a few benefits to low income groups and little improvement in overall.

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