7. CONCEPTUAL PROPOSALS

Figure 28 shows the conceptual proposals based on the sustainability framework and the learning and participation processes proposed by CINARA (Duque *et al.*, 1996) (Chapter 3) and field experience (action research) from the full-scale projects (Chapters 5 and 6). The transfer model and the TLPs are both linked to the investment planning model developed by the researcher as part of the programme carried out in Cali (Restrepo, 1995b).

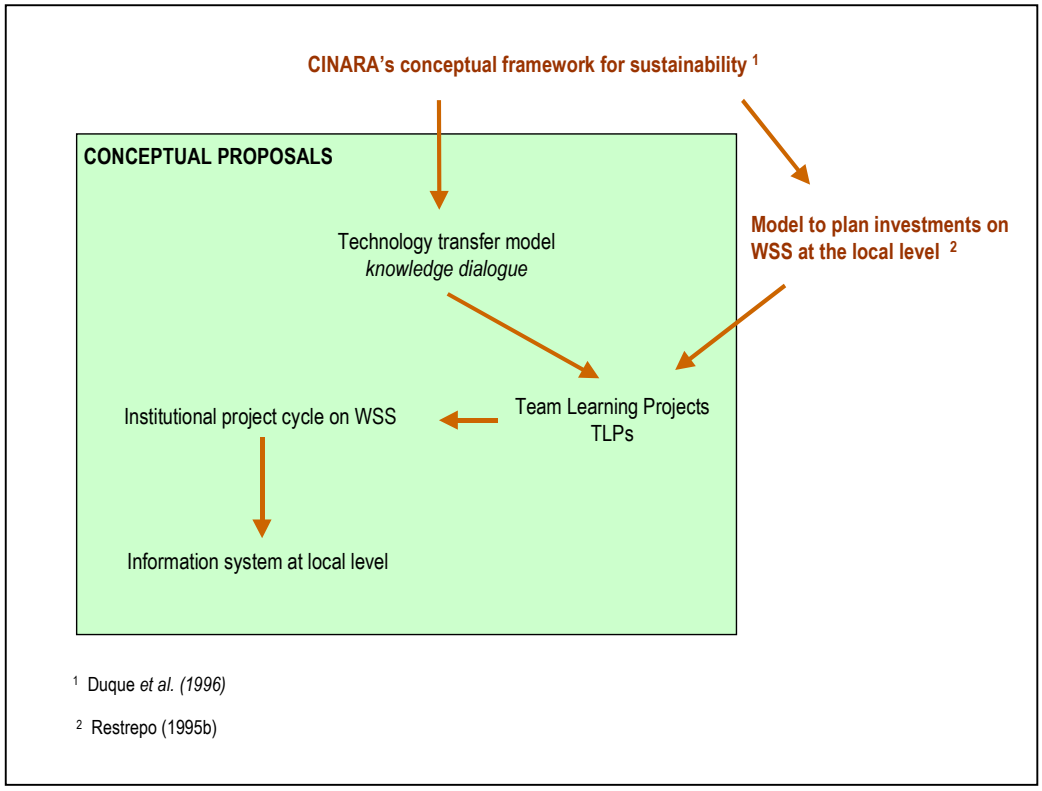


Figure 28 Conceptual proposals

7.1. *KNOWLEDGE DIALOGUE* MODEL FOR TECHNOLOGY TRANSFER

> *It is especially important to understand the kinds of learning experiences that lead to transfer, defined as the ability to extend what has been learned in one context to new contexts.*
>
> *Bransford et al. (2000)*

Ideas about what constitutes technology transfer are not fixed. For instance, the World Bank considers that the project cycle should be re-defined to include phases such as consolidation and expansion in learning environments (Picciotto and Weaving, 1994). According to Prey (1994), participatory technology development helps to solve the problems of technology selection and transfer. Participatory technology development starts by analysing existing technologies and includes "identifying, testing, improving or adapting, and using" technology (Prey, 1994). It is also possible to introduce new technology components through participatory technology development.

Based on field results from the TLPs in Cali, the research presented in this thesis proposed a change from technology transfer to 'knowledge dialogue', which recognises that each actor has useful knowledge. Research and development are also important in the adaptation of technology (CINARA-EMCALI, 1997a; Visscher, 1997). Figure 29 shows the *knowledge dialogue* model as a new approach to the technology transfer process. The *knowledge dialogue* model requires (CINARA-EMCALI, 1997a; Visscher, 1997; Restrepo, 1995b):

- An organisation to play the role of facilitator. The facilitator should not replace any of the project stakeholders, but instead should encourage each institution to contribute its unique view point,

- Scenarios for building consensus and making decisions that will help the stakeholders work together,

- Ways of strengthening skills and capacities in both institutions and communities. This implies that all stakeholders receive training to help them recognise what they can learn from the others,

- A participatory approach to problem-solving, taking into account the different interests of the stakeholders,

- A comprehensive approach that aims to identify every possible approach to the problem, including doing nothing, and

- A system for monitoring and evaluation. This creates feedback that may in turn generate new opportunities for technology transfer.

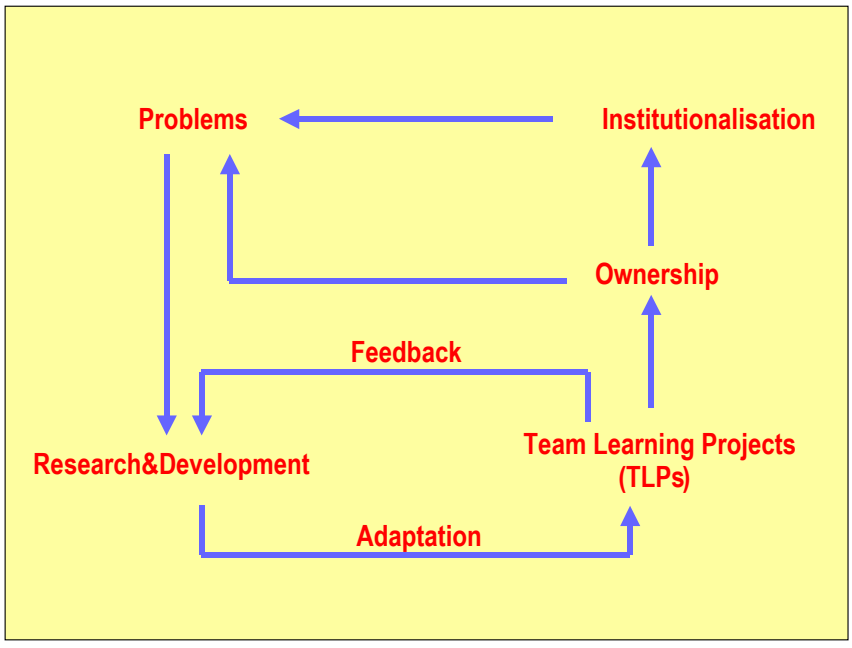


Figure 29 ***Knowledge dialogue*** **model for the transfer process**

The *knowledge dialogue* model also proposes that research and development should be linked to full-scale projects developed in enabling environments, in which communities

participate jointly with inter-sectoral institutions, the private sector and NGOs. This helps the participants develop a sense of ownership of the methodologies, tools, and findings from the TLPs, which they can then use in their everyday projects. The last step is the 'institutionalisation' of the project results –in other words, the incorporation of the results into the policies, contracts and regular activities developed by the stakeholders.

7.2. TEAM LEARNING PROJECTS (TLPS)

> *Technical solutions should be considered not as a starting point but as an end result. They are the products of a process which integrates the social, environmental, cultural, economic, and institutional dimensions of the problems and involves all the actors.*
>
> *Round Table Sophía Antípolis, France, GRET(1994)*

Compared with pilot projects and demonstration projects, which are two of the means for transferring technology, the TLPs (Figure 30) are the best way to build knowledge appropriate to the local context, involving both communities and their support institutions. TLPs are developed in an enabling environment that has its foundation in political commitments, at least at the local level. TLPs, strengthen local capacities (Table 40) because they develop inter-sectoral and inter-institutional work and community participation. Each participant has to reach a minimum common level of knowledge (Figure 31), and this allows participants to discuss problems and solutions on an equal footing. This initial learning is essential in transferring knowledge developed in a WSS context to another context (Bransford *et al.*, 2000). TLPs do this right from the beginning, by collecting existing knowledge and organising it into a conceptual framework. This helps participants understand the "whys" and the "hows", and transfer knowledge between WSS and other projects. TLPs also recognise that conflict is inherent in human interaction. They therefore leave room for conflicts resolution by consensus, taking into account the different interests of the participants. Table 41 shows the activities proposed in a typical WSS TLP. When sustainable projects are the objective of WSS interventions, some of the key factors are (Jimenez *et al.*, 1998):

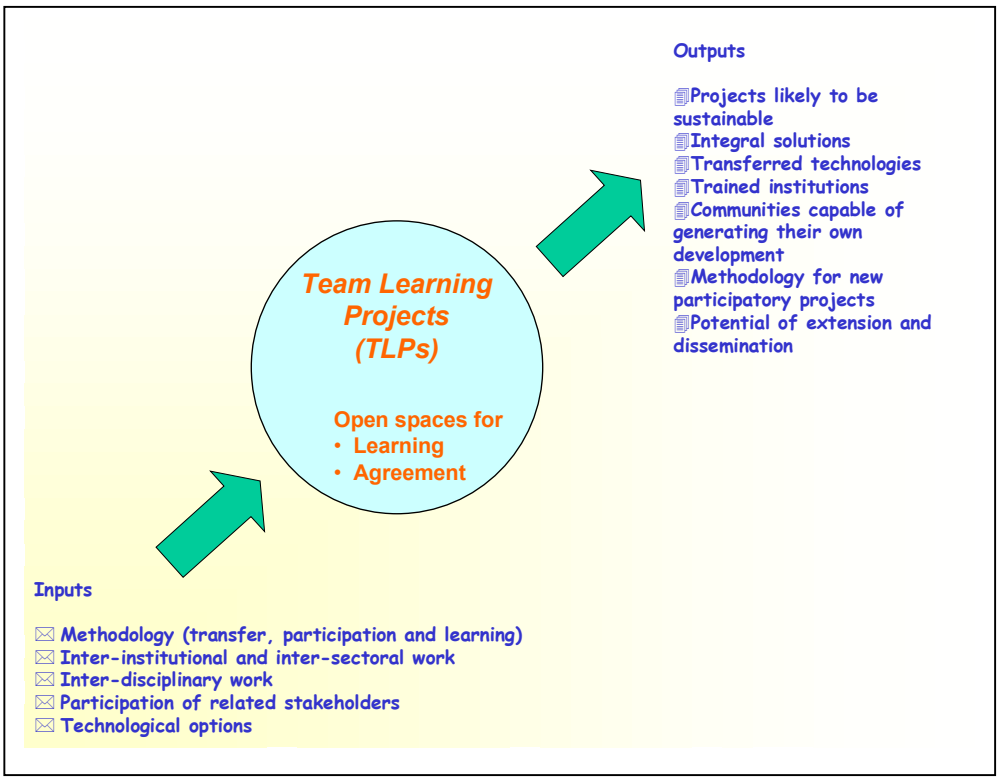


Figure 30 A Team Learning Project as a system

- ✓ Legitimacy of community organisations. WSS community organisations have to be recognised by the community as their own, and this legitimacy is not the same as legality. For institutions, legal existence is enough to justify participation, but for communities, legitimacy is the most important condition (Photograph 32).

- ✓ Leadership strengthening. It is necessary to strengthen existing community leaders and to encourage the emergence of new leaders. In WSS projects, for example, women can make an important contribution to the Administrative Committees. Strengthening their leadership skills allows them to fulfil this potential. It is important for women to participate in the Committees as decision-makers.

Table 40 What TLPs can strengthen

HUMAN NEED	COMMUNITIES	INSTITUTIONS	COMMUNITIES-INSTITUTIONS
Subsistence	Health Self-care Prevention	Quality of services	Water, sanitation, hygiene and health
Participation	Identity Autonomy Decision making Social control	Identity Autonomy Participatory methodologies Ideas and experiences	Participatory methodologies Knowledge dialogue Consensus and negotiation
Affection	Respect Self-confidence	Respect Self-confidence	Respect Solidarity Tolerance
Understanding	Comprehension of social processes Technical knowledge Knowledge of the local WSS systems	Respect for other people's ideas Comprehension of social processes Technical knowledge	Respect for other people's ideas Knowledge dialogue
Creativity	Ability to generate one's own solutions Participation in the selection and design process	Project cycle with community participation Design criteria	Methodologies that help people transfer knowledge to practical problems Jointly search of solutions
Identity	Respect Self-confidence Autonomy Knowledge of the community's history	Respect Self-confidence Definition and performance of missions, functions and roles	Mutual respect Self-confidence Definition and performance of missions, functions and roles
Protection	Self-care Autonomy Solidarity Prevention Leadership	Leadership Autonomy	Leadership Solidarity Prevention
Leisure	Participatory skills and tools Educational games	Participatory skills and tools Educational games	Creation of spaces for recreation
Freedom	Conflict-solving methodologies Promotion of dialogue Definition of priorities Decision making	Conflict-solving methodologies Promotion of dialogue	Conflict-solving methodologies Promotion of dialogue Consensus and negotiation

- ✓ Autonomy and consensus building in decision-making processes. This is necessary because institutions find it very difficult to accept that communities should make decisions about subjects such as technology selection, management issues, tariffs, and conflict management.

- ✓ Responsibility and social commitment. If the transfer process is people-centred, the project will promote values such as equity, honesty, and respect for the people and the

environment. These values are one of the bases for monitoring the quality of WSS services.

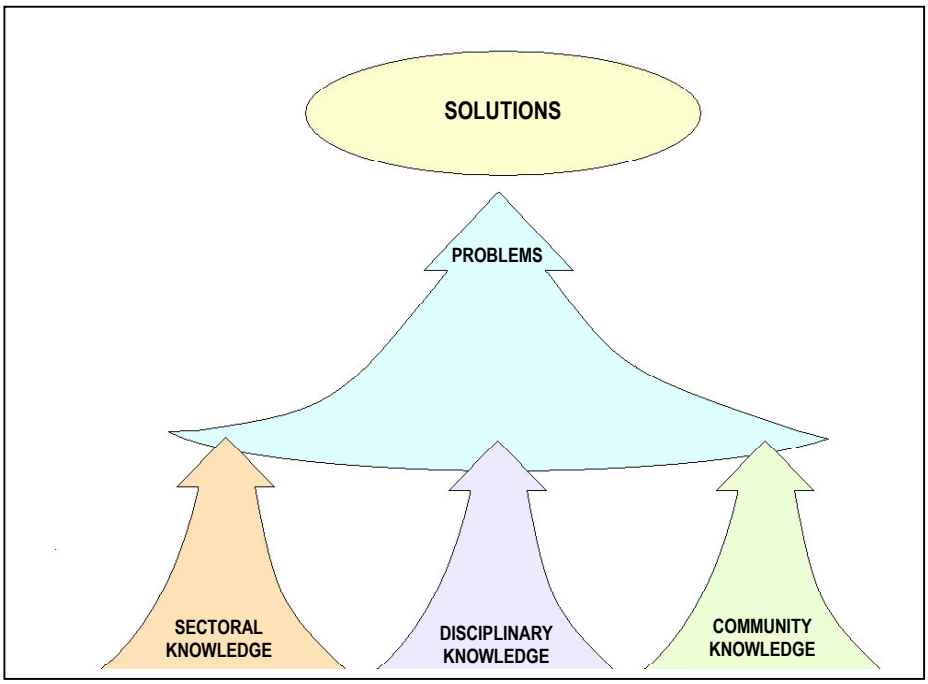


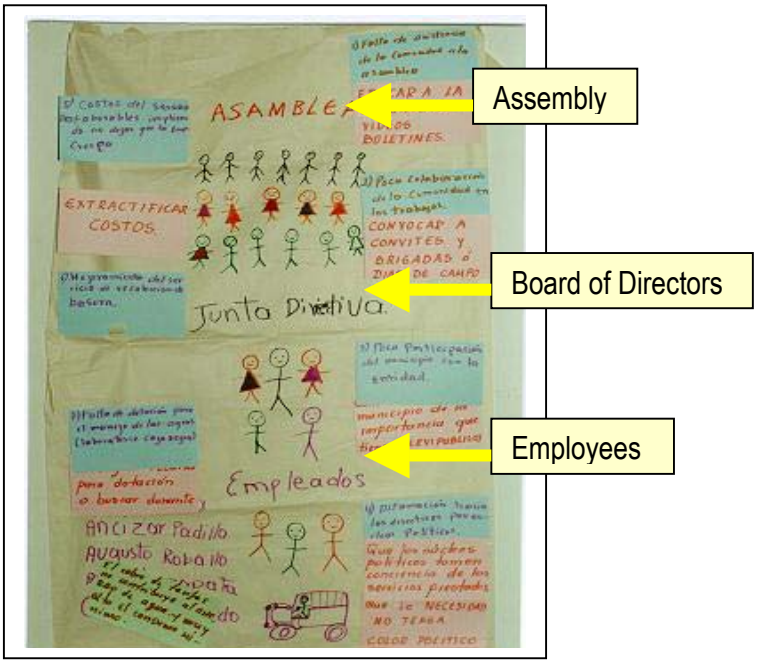
Figure 31 TLP participants must reach a minimum common level of knowledge

- ✓ User education. Education in water issues, hygiene and the use of natural resources helps people understand the significance of technologies such as micro-measurements and design to minimise water consumption. Involving schools in practical educational activities strengthens the sustainability of WSS systems.

- ✓ Community sense of ownership towards the technological solution. Participative decision making ensures that the community chooses technology to suite the local conditions. This in turn helps to 'demystify' the technology and allows people to adapt the technical language to their own level (Photograph 33). Community understanding of "how" and "why" technology functions is one of the keys to sustainability.

Table 41 Activities proposed in a typical WSS TLP

ACTIVITY	INSTITUCIONAL EVENTS	COMMUNITY EVENTS
PLANNING		
Participatory diagnosis	Seminar on concepts and methodologies for community participation	Workshop on participatory diagnosis Workshop on water, sanitation, and health
Review of technological developments	Seminars on WSS technologies	Review of the local technological developments
Participatory formulation of the projects	Seminar on participatory formulation of WSS projects	Workshop on participatory formulation of development projects
FINANCIAL MANAGEMENT		
Project presentation to financial institutions		Workshop on presentation tools
DEVELOPMENT		
Participatory design	Seminar on elements of design	Workshop on participatory design Negotiation of plots and permissions
Contract	Workshop for constructors and Controllers	Establishment of community support groups Establishment of community supervision groups Agreements for community supervision
Construction	Training in construction issues	Training in construction issues
Organisation for administration, operation and maintenance	Seminar on delivery of public services	Workshop on organisation for delivery of public services Workshop on protection of water sources Workshop on control of water wastage Workshop on tariff definition
SERVICES MANAGEMENT		
Commissioning	Workshop on O&M	Training in organisation of administration, O&M Workshop on O&M
Administration, O&M		Continuous training
MONITORING		
Community monitoring of design and construction	Seminar on participatory monitoring and evaluation	Training in community monitoring of services Establishment of Social Control Committees
Community monitoring of the delivery of services		
Diffusion and communication		Workshop on communication tools
EVALUATION		
Participatory evaluation	Participatory evaluation of WSS projects	Participatory evaluation of WSS projects

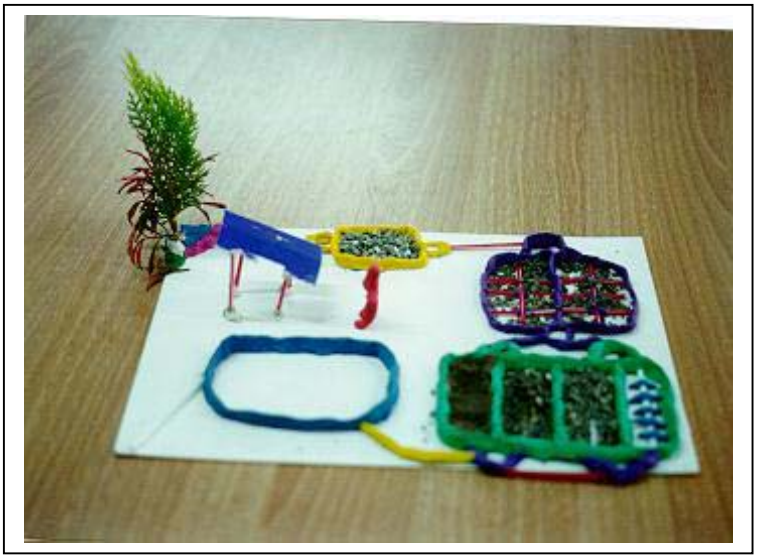


Photograph 32 Community-based organisational structure chosen by a community to provide WSS services

Source: Jimenez *et al.* (1998)

- ✓ Community monitoring of the quality of WSS services. The administrative organisation and the users should monitor the quality of WSS services based on simple indicators measured by community members such as leakages, bad debtors, odour, among others (see Table 33 and Table 44). Monitoring prevents problems, or at least detects them before they can affect sustainability. More complex measurements such as bacterial contamination (measured as Faecal Coliforms) or organics removal (as BOD) can be carried out by local institutions, remembering that the time required for the analyses means these techniques usually detect problems only after the event.

- ✓ An integrated vision of water resources. The project should analyse all water resources from the water source to the receiving basin. Working together communities and institutions can identify problems in the management of water resources and take appropriate action to solve them. Activities involving schools are very important in conserving water resources.



Photograph 33 **Community representation of a technological option in a WSS project**

Source: Jimenez *et al.* (1998)

- ✓ Training of community leaders and community-based organisations. Training in aspects such as administration of WSS services, tariff definition, studies on willingness to pay and so on should be part of institutional development programmes. Training must be made based on local conditions. One problem found in the TLPs, for instance, was difficulty in fulfilling the legal requirements for delivering of WSS services. This was because the legislation took into account only the conditions in large and medium-sized cities.

- ✓ Inter-disciplinary work. If the various professionals involved in a project respect one another, it is possible to break down the barriers that hinder inter-disciplinary work. As a result, the project runs better.

- ✓ Inter-institutional and inter-sectoral work. Individual institutions have separated and often fragmented responsibilities, whereas the needs of communities are less fragmented. As a result, some aspects of WSS services, such as micro-basin protection or hygiene education, come under sectors other than WSS, in this case, the environment and health

sectors respectively. Community-based organisations are likely to need periodic support from institutions in other sectors apart from WSS.

7.3. A NEW PROJECT CYCLE

At the beginning of the 1970s, international agencies organised their investments through sector-based projects that formed part of national development plans. Confining themselves to specific projects with defined resources and objectives helped the agencies control their budgets. Later, the general national plans gave way to sector-based national plans, again based on projects. Whatever the overall development mechanism, all funding is still controlled through projects. It is therefore essential to design the project cycle so that it leads to sustainable projects.

Evaluations of WSS projects in the WSS Decade concluded that these projects focused on infrastructure. Less attention was given to other phases of the project cycle, and monitoring and evaluation were practically neglected. One of the consequences was that most WSS systems did not function once the construction was completed. This situation stems from many cumulative factors, the first of which is problem identification. To improve matters, this work has analysed the project institutional cycle and proposes a new project cycle, which takes into account concepts such as sustainability and response to demand.

7.3.1 Development projects

During the 20th century, the industrialised nations have spent money in efforts to improve the economic growth of other countries, whilst expanding their own markets. The international financial agencies carried out these investments through national development plans focused on economic aspects. These national development plans justified the intervention of industrialised countries in other societies on behalf of “economic development”. Colombia was one of the first countries in Latin America to prepare a national development plan: The *Plan Decenal 1960-1970* was made as a requirement for the Programme *Alianza para el Progreso,* which was supported by the USA government (Sanchez, 1984).

Evaluation of these national plans showed that economic growth by itself does not lead to the "development" of people's welfare. Additionally, many of the actual projects had objectives different from those of the national plans. As a result, the financial agencies began to move towards sector plans and programmes in education, health, and transport. In order words, sectoral development projects within the framework of a national development plan. These sectoral development projects had well-defined objectives, which could be easily quantified, facilitating evaluation by the financial agencies.

In the WSS sector, most development projects originally focused on building infrastructure. This approach was usually clear from the project title such as: "Project for sewerage construction". However, an evaluation of the WSS Decade revealed that infrastructure does not always mean improvement in the WSS conditions. Sometimes, new infrastructure even worsened people's health (Hogrewe *et al.*, 1993). Technology introduced without taking into account the local conditions lead to notable failures. The World Bank considers that technology should be implemented in phases, adapting solutions to the local context through learning projects. The aim is gradually to reach a stage known as "consolidation" in which the technology in question is widely applied (Piccioto and Weaving, 1994). Mogavero and Shane (1982) called this phase "technology institutionalisation".

A different approach, that of "demand-responsive projects", was developed following the 1992 Dublin Conference. Now in use wordwide, this approach has four fundamental characteristics (Sara *et al.*, 1998):

- ✓ The community has to have the necessary information to make decisions throughout the project,
- ✓ Governments and institutions are facilitators, promoting policies and legal frameworks which enable stakeholders to participate and which strengthen local capacities and learning,
- ✓ The project should create a learning environment, and it should promote the participation of all stakeholders involved: community, private sector and NGOs, and

- ✓ The project should provide the information needed by the stakeholders; define the agreement spaces between different stakeholders, and adopt the procedures needed to facilitate decision-making by the community.

The objective of all WSS projects should be to provide a sustainable service. This means delivering a good quality service for a very long time at minimum cost, including environmental costs (Duque *et al.*, 1996). For WSS services be sustainable, it is essential that the definition and management of the project take into account those factors that influence sustainability:

- ☛ Community management and participation in decision-making processes,
- ☛ Integral planning through co-ordinated work by the stakeholders,
- ☛ Technology selection according to local culture, capacities and environmental restrictions,
- ☛ A continuing source of income to fund the service after the initial investment and construction phase,
- ☛ Proper O&M, with resources and responsibilities clearly defined,
- ☛ Integrated water and environmental management, and
- ☛ Continued support from local and regional institutions.

7.3.2 The project cycle

A project is defined as a set of joint activities that have a measurable objective to be reached in a specific time, with defined resources and costs (DNP, 1994). The project answers three questions in a specific context: Where are we? Where do we wish to be? and What do we have to do to pass from where we are to where we wish to be? Usually, development projects try to solve unsatisfactory situations in specific contexts. Figure 32 shows the project cycle used by Colombian institutions. This project cycle is based on Baum's model, which has five stages: identification, formulation, appraisal, implementation, and evaluation (Baum, 1982). In the Colombian project cycle, the first three stages of Baum's

model are known as the “pre-investment” stage, Baum’s implementation stage is called the “investment” stage, and a new “operation” stage is added. The traditional “offer-responsive” project cycle has limitations in WSS projects in which institutions and communities must to work together. Institutions act according to their individual missions and responsibilities, and this limits their support of communities. A striking example of this is the way some institutions consider a project finished once the construction is complete. For communities, on the other hand, a WSS project is an ongoing commitment involving continuous administration, operation, maintenance, monitoring and evaluation.

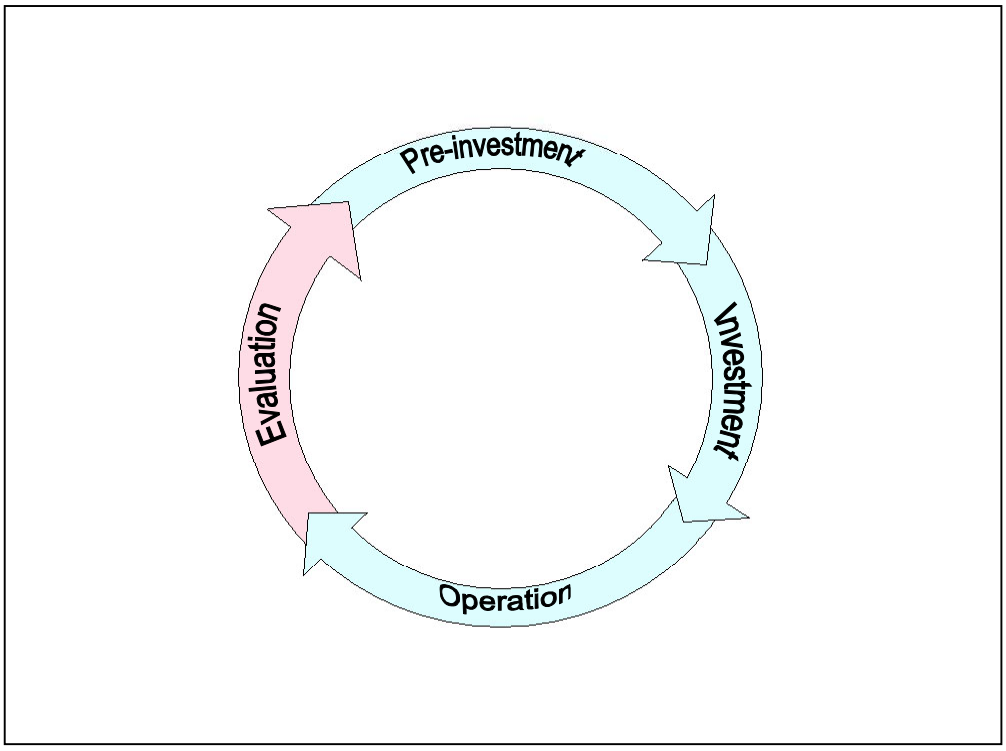


Figure 32 Institutional project cycle

Source: DNP (1994)

Given that sustainability is not a final point but a process, it is necessary to create a new model that considers the continuity of WSS projects. As Franks (1998) suggests, the project path is not a circle but a continuous line that includes day-day operation. Figure 33 shows the project cycle proposed in this research. This proposal was a result of the National

Programme for Sustainability of WSS Systems in Colombia. In this description, the monitoring activity can exist in parallel phases and be carried out in different ways. During the construction stage, for example, community committees could be organised to supervise resources and construction. Additionally, according to Colombian law, the users must organise a Development and Social Control Committee to monitor service quality in the service management phase (administration, operation, and maintenance). The stakeholders have specific roles in each phase of the project. For example, in the financial management phase, community and local institutions look for resources. In the service management phase (administration, operation, and maintenance), one organisation -usually community-based- manages the services while local institutions control their quality.

This proposed project cycle takes on board the demand-responsive approach and extends it to the whole project cycle. Likewise, it meets the requirements of decentralisation policies, which emphasise the role of the local level and the users' role in overseeing the quality of services. The proposed cycle recognises the changing balance between communities and external stakeholders throughout the project lifetime. Local stakeholders can carry out some phases by themselves, but especially in small settlements they are likely need some support from regional institutions. In the end, though, the external stakeholders (NGOs, government institutions at regional and national level, and the private sector) will retire from the project, leaving the local stakeholders with full responsibility. Table 42 shows the activities proposed in each phase. Project sustainability should be encouraged from the very beginning, when the problem is first identified. However, sustainability is tested more severely in the service management phase (administration and O&M). According to Abbott (1996), once people consider that the problem is solved, the conflict, which brought them together in the first place, stops and interest in WSS decreases. Experience has shown that many systems collapse if there is no solid organisation recognised by the users and supported by local institutions (Katz and Sara, 1997). WSS problems are complex and require professionals from several disciplines to work together as well as the co-ordinated work between institutions. Additionally, technological options are most successful if the users participate in the project, but user participation in decision-making is not a common practice in Colombian WSS projects.

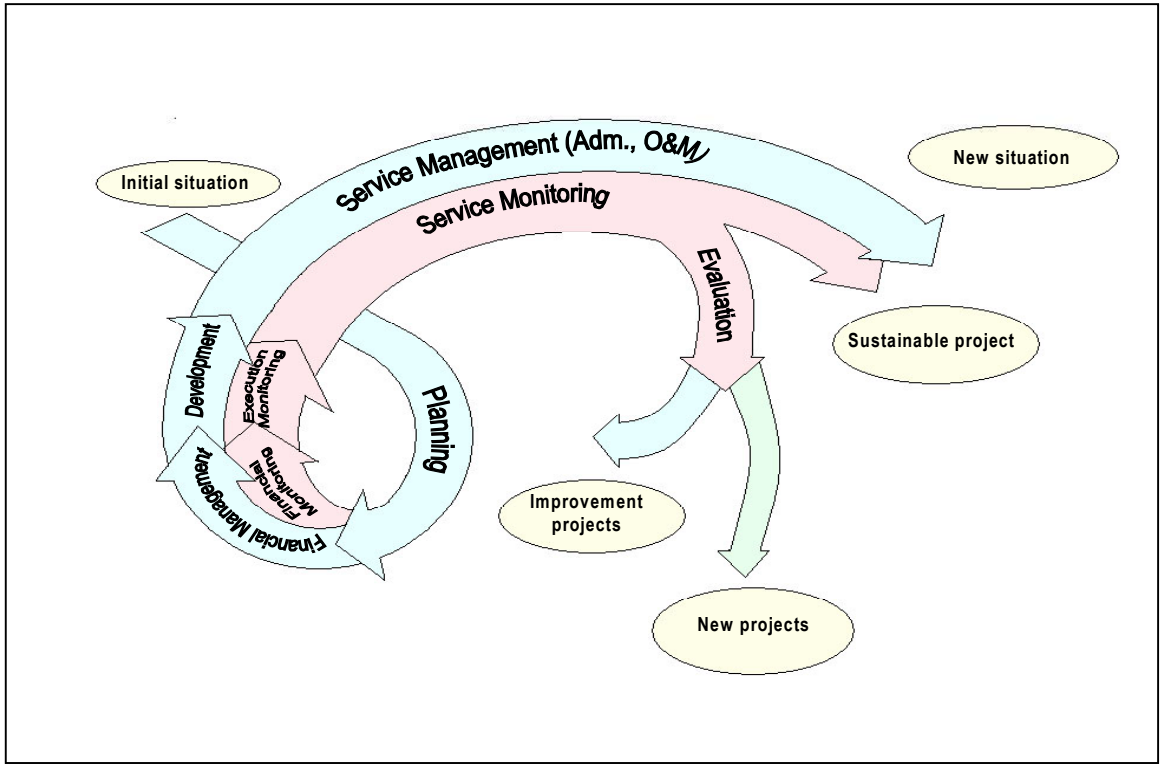


Figure 33 Proposed project cycle

Source: CINARA *et al.* (1998a)

Table 42 Proposed activities in any institutional WSS project

PHASE	ACTIVITIES
PLANNING	♦ Problem identification (pre-diagnosis – diagnosis)
	♦ Recognition of alternatives
	♦ Participatory technology selection
	♦ Project formulation (design, construction, administration, operation, and maintenance, monitoring in each phase, evaluation)
FINANCIAL MANAGEMENT (including community monitoring)	♦ Project presentation to financial institutions (NGOs, development banks, government institutions, etc.)
	♦ Negotiation of resources
	♦ Monitoring the search for resources
DEVELOPMENT (including community monitoring)	♦ Design
	♦ Bidding and contract placement
	♦ Construction
	♦ Institutional control
	♦ Community supervision (monitoring)
	♦ Organisation to administer, operate and maintain
ADMINISTRATION, O&M (including community monitoring)	♦ Commissioning the infrastructure and the administrative organisation
	♦ Administration
	♦ Operation
	♦ Maintenance
	♦ Service quality control (monitoring)
EVALUATION	♦ Efficiency
	♦ Efficacy
	♦ Effectiveness

7.3.3 Conceptual framework for each phase

The following sections present concepts and proposals that can be applied in each phase of the WSS project cycle.

7.3.3.1 Planning

Sustainability starts at the planning phase since it is here that the main decisions are made. Technology, costs, tariffs, and administrative support, all defined in the planning phase, are possible the most important factors affecting the sustainability of the future service. However, many decisions are based on incorrect identification of the problem because users

do not participate in defining the problem. Institutions usually characterise the problem without reference to the community because they follow an “offer-response” approach to projects. Another problem is that institutions fragment the problem according to their respective missions, whereas the community’s reality is an integrated whole. When engineers are evaluation technology, they often do not take into account the fact that technology has both physical (“hardware”) and operational (“software”) components. According to Pickford (1984), software is usually responsible for the success or failure of technology. In addition, WSS systems have other components besides their infrastructure. Any WSS system includes the water source or receiving basin, the administrative organisation in charge of the service, and the users. The centre of the systems is the household, not the treatment plant or the pipelines. Taking the project as a process, technology is a result. The project should therefore be defined not as the building of infrastructure, but as the solving of WSS problems for a human settlement. This vision helps us to identify the relationships between WSS and other sectors such as environment, health, and education.

7.3.3.2 Financial management

Financial management rather than being a single phase, can crop up several times during the project cycle. For instance, the project stakeholders need to find money to develop the design stage, but once the design is finished they may have to seek fresh resources to build the infrastructure. Financial management is often time-consuming and expensive for the community because it is so dependent on politics. The community organisation that leads the project should monitor the search for funds. Some years may pass between design and construction, so the conditions that applied at the time of the original design may have changed by the time the financial resources become available. A further complication is that different aspects of a WSS project may be funded from different sources. For example, money to protect water sources may come from environmental institutions, whereas health institutions typically pay for hygiene education. Applying to multiple sources of funding brings a corresponding penalty in the number of application forms to be filled in. This can be very stressful, and projects may fail when community leaders lack persistence in applying for funds.

7.3.3.3 Development

Development, especially the construction stage, is the most visible phase of the project cycle. In small communities, rural and peri-urban areas, the design stage tends to be as a simple requirement to get funds or justify investment. Bidding and contracting, on the other hand, often delay the project because small communities and municipalities do not have the technical capacity to carry these out. Community monitoring is important in ensuring that the development phase is carried out honestly. In the past, institutions believed that communities take ownership of the technical solution by helping in the construction process or by giving materials or money. People now realise, however, that community participation has more to do with decision-making: communities own projects if they have been able to make decisions right from the start.

According to the World Bank, good-quality construction is fundamental to sustainability (Katz and Sara, 1997). Community monitoring of construction is essential to guarantee good infrastructure, and experience in Colombia has shown how well this can work (CINARA-EMCALI, 1997a: Visscher, 1997: MinDesarrollo *et al.*, 1998a). However, community monitoring is a relatively new issue in the WSS sector and is not completely accepted by institutions and constructors. The process of organising service delivery, otherwise known as institutional development (ID), should be carried out at the same time as the construction phase. In the traditional project cycle, ID is limited to creating an organisation at the end of the project, and any training is usually about administrative rather than operational issues. In contrast to this traditional approach, the ID programme should boost the community's capacities. A WSS project has the potential to generate development as it influences not only basic needs but also other human needs such as creativity, identity, understanding, participation and affection (Max-Neef *et al.*, 1986).

7.3.3.4 Services management

The service management phase starts up the administrative organisation and the infrastructure. Operators, the administrative organisation and some of the community members should be trained in O&M, which are often included in the traditional project cycle as isolated tasks. Figure 34 shows the duties of the administrative organisation. In small

communities, these duties are in the hands of very few people. Institutional stakeholders usually evaluate the project at the point of start-up, because they consider this to be the end of the project cycle. However, this evaluation usually takes into account only the institutional resources spent on the project. Thus, institutions do not know if all the expected products were produced, nor anything about the quality of the products.

Current decentralisation policies dictate that the system is given to a local organisation (whether community-based or governmental) to be administered, operated, and maintained. It is very important to bear in mind that good administration requires a properly-functioning infrastructure; local organisations cannot administer or be responsible for technologies that are not functioning when they are received. Community monitoring of the commissioning stage allows the local organisation to accept handover of the project only if infrastructure is functioning well. Continuous monitoring of the service management phase (administration and O&M) helps to identify threats to the sustainability of the service. Sustainability is not an endpoint but a process, so an essential aspect of sustainability is the identification of variables and indicators through which to monitor the service quality.

7.3.3.5 Evaluation

Evaluation compares the initial situation with the situation at a specific later time. It is a very useful tool in identifying improvements brought about by projects both old and new. The modern trend is for participatory evaluations involving all the project's stakeholders. Evaluation is a feedback mechanism for projects carried out by institutions and communities. Its basis is the information generated in the planning phase, and has three components: efficiency, efficacy, and effectiveness. Efficiency is a measure of how well the expected products were produced with the planned resources. Efficacy determines the project performance: whether it fulfils the objectives generally referred to as coverage, service quality and environmental effects. Effectiveness assesses how well the project has fulfilled its more general objectives. When these general objectives are expressed in terms of health indicators, effectiveness is often not measured because many studies have already proved that WSS projects improve health (Esrey *et al.*, 1990: Esrey, 1994, 1996a, 1996b).

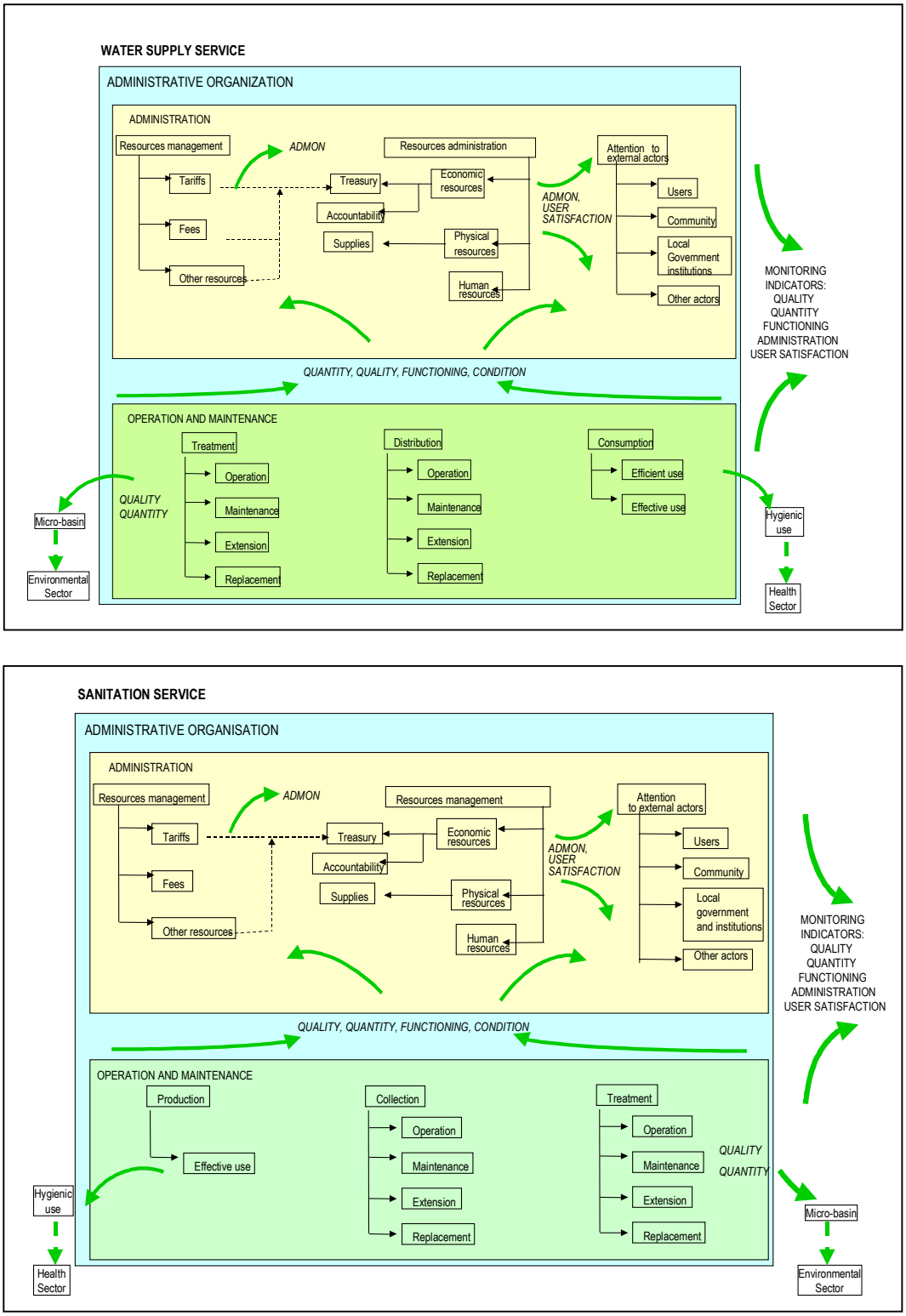


Figure 34 Processes in WSS service organisations

7.4. INFORMATION SYSTEMS FOR MONITORING WSS SERVICES IN SMALL SETTLEMENTS

Information systems (ISs) have traditionally been designed for use at regional or national levels. ISs in the WSS sector are often databases that do not provide decision-makers with good information. With the current emphasis on decentralisation, however, the local level has a more active role in delivering public services, and Colombian users now have more opportunities to monitor service quality. There is therefore a need for ISs to be used at the local level. Project managers are aware of the need for monitoring in some project phases. For instance, the construction stage has a specific monitoring system organised by the works Controller, who registers the progress of the work and the resources spent on construction. Administration and O&M, however, are not a part of the institutional project cycle, so their monitoring is neglected.

The point of an IS is that it should supply information to support decisions made at whatever level the IS is used. At the local level, this means generating information to be used by the administrative organisation, the users, local government, and institutions. Information generated at the local level is essential in identifying deficiencies before they affect the sustainability of WSS services. Based on experience gained in Colombia through the Learning Projects in Cali and the National Programme for Sustainability, this research proposes an information system to monitor the service management phase (administration, operation, and maintenance) of projects involving settlements of between 1,000 and 12,500 inhabitants.

The National Programme for Sustainability of WSS Systems found many problems related to ISs at the local level. Some of them were:

- Variables and indicators not defined,
- Data are not collected,
- Lack of understandable tools,
- Lack of training to collect, present and analyse data,

- Deficiencies in communication channels,
- Lack of feedback, and
- Decision-makers do not have reliable information.

The IS proposed to monitor the WSS quality services is based on the Analysis Unit shown in Figure 35. Any IS has three main components (Cusworth and Franks, 1996):

- Users,
- Communication channels , and
- Content.

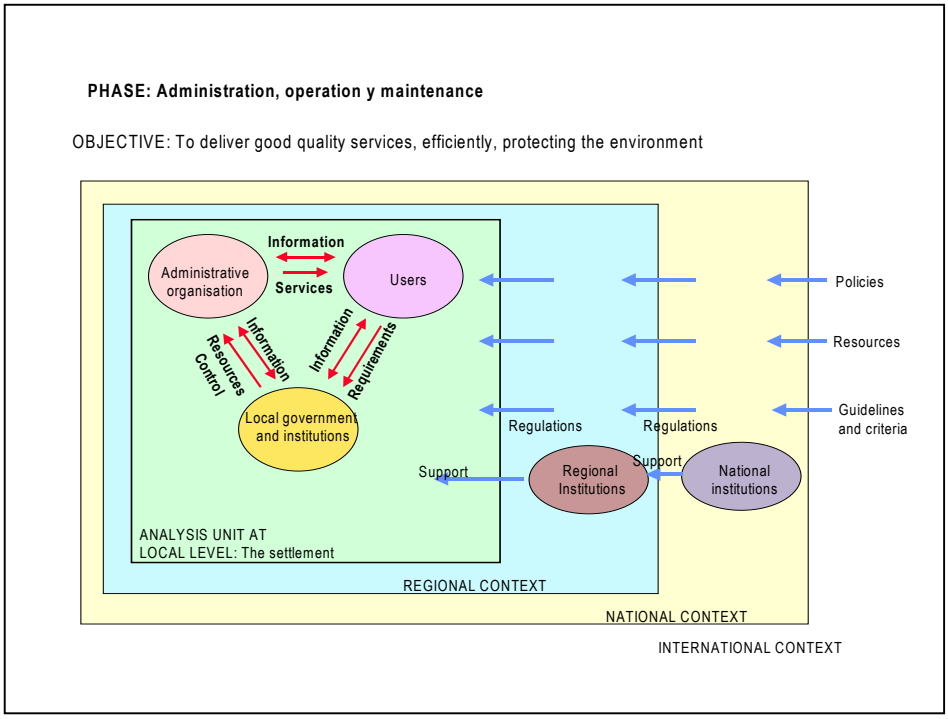


Figure 35 Analysis unit for an IS at the local level

7.4.1 Users

The administrative organisation, users, and local government are the main stakeholders at the local level, and they receive support from regional institutions. At the local level, the Act 142/94 created Social Control Committees, which must be legalised by the Mayor in each municipality. These Committees monitor the quality of in-house services, including WSS. The contact between the Committees and the service organisation is made through the *Vocal de Control*. Likewise, many settlements have organisations of civil society such as NGOs, school associations, elder and youth groups, which usually have relationships with the WSS organisations at the local level. Figure 36 shows the stakeholders in WSS services in Colombia. As Figure 36 shows, the direct users of this information system are:

- ✓ The administrative organisation in charge of delivering WSS services. This organisation can be community-based, a public institution at the local level or even a specific office within the local government or a private enterprise.

- ✓ Local government and institutions. This category includes several sectors, of which the ones most relevant to WSS services are health, environment, education, and planning. The mayor and the town council or JAL (Local Administrative Committee in some urban and rural areas) are important users of the information system because they are responsible for delivering high quality services. Public services are also monitoring by community organisations and supervisory institutions, the latter frequently at the regional level.

- ✓ Service users. This group includes the local population (children, women and men), local leaders (both formal and informal), educational establishments, local industry, public and private institutions, civil society organisations and politicians. In Colombia, the *Vocal de Control* represents users in monitoring WSS services through the Social Control Committee.

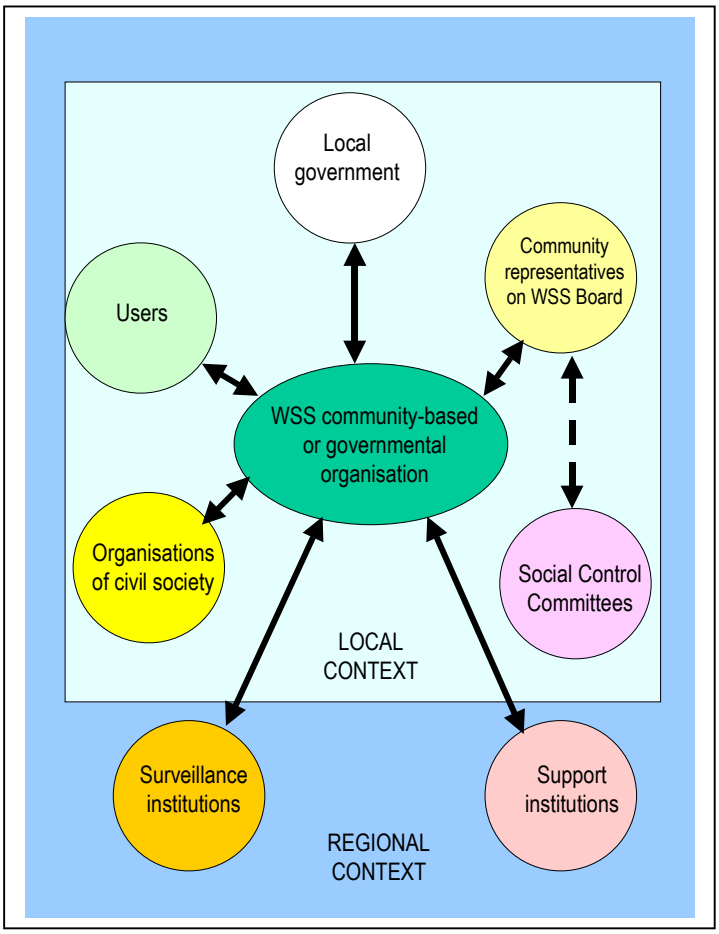


Figure 36 Stakeholders involved in WSS services in Colombia

Source: Adapted from Jimenez *et al.* (1998)

Some of the information produced has to be sent to the support and surveillance institutions at the regional level. Each one of these users has specific information needs according to their own interests. For the information to be useful is very important to identify the users' interests.

7.4.2 Content

The IS was designed to monitor the processes followed in typical WSS systems in communities with in-house water supply and sewerage. Table 43 shows the processes and their components, and Table 44 shows the variables and indicators. Variables and indicators

are applied to the processes and components existing in the WSS systems. This IS can be complemented by other surveillance tools such as sanitary inspection. The objective is that indicators can be measured simply at the local level by the administrative organisation in charge of the WSS services and by user organisations. Some of the goals to be achieved must be defined at the local level, since there are conflicts between legality and legitimacy in the application of the national regulations produced by the central government. The IS displays the indicators in the form of graphs with the targets shown in green, so that community members can easily see if targets are being met, and take corrective measures if necessary. The IS must be capable of being adapted at the local level to suite individual projects. In addition, small communities may require appropriate tools such as collection and processing forms to be developed, and this could be done at the dissemination stage. Public health engineers have suggested suitable values for some of the indicators in Table 44, such as daily water consumption per person. Depending on local conditions, these estimates may have to be revised to suite specific projects.

Table 43 WSS processes and components

WATER SUPPLY		**SANITATION**	
PROCESS	COMPONENTS	PROCESS	COMPONENTS
TREATMENT	Source	PRODUCTION	Educational facilities
	Intake		Health facilities
	Gritsump		Police station
	Treatment plant		Industry
			Houses
			Communal facilities
DISTRIBUTION	Reservoir	COLLECTION	Household connections
	Mains		In-block sewers
	In-block pipes		Main sewers
	Household connections		Manholes
CONSUMPTION	Educational facilities	TREATMENT	Primary unit
	Health facilities		Secondary unit
	Police station		Tertiary unit
	Industry	DISPOSAL	Freshwater streams
	Houses		Underground
	Communal facilities		Water re-use scheme

Table 44 Variables and indicators for monitoring the quality of WSS services

VARIABLE	INDICATOR	GOAL	
		WS	Sanitation
WATER QUALITY	Turbidity (NTU)	≤5*	
	Colour (PCU)	≤15*	
	Odour and taste	Acceptable*	
	Floating material	Absent*	
	Faecal Coliforms (CFU/100ml)	0*	
	Chlorine Residual (mg/l)	0.2-1.0*	
	PH	6.5-9.0*	5.0-9.0*
	BOD removal (%)		≥80*
	Suspended solids removal (%)		≥80*
	Grease/oil removal (%)		≥80*
	Odour		Absent
	Colour		Acceptable
WATER QUANTITY	Flow (l/s)	**	
	Volume (m^3/mes)	**	
	Volume per user (m^3/user.month)	**	
	Consumption (l/inhabitants.day)	**	
FUNCTIONING			
CONTINUITY	Daily uptime (h/day)	**	
	Monthly uptime (days/month)	**	
O&M	Damages (No. of incidents/month)	**	
	Time taken for reported damage to be repaired (days)	**	
	Maintenance index (No. of components maintained/No components)	1	
INFRASTRUCTURE	Leakage index (No. of components with visible leakage/No components)	0	
	Time taken for reported leakage to be repaired (days)	**	
ADMINISTRATION	Revenues/expenses index	≥ 1	
	O&M index (Available resources for O&M/Required resources for O&M)	≥ 1	
	Bad debtors (%)	**	
	Meetings with Community Monitoring Committees (No. of meetings/month)	**	
USER SATISFACTION	WATER QUALITY indicators		
	Volume per user (m^3/user.month)	**	
	Consumption (l/inhabitants.day)	**	
	Complaints (No. of complaints/month)	**	
	Time taken to satisfactorily answer the complaints (days)	**	

* Drinking-water and wastewater-disposal specifications under Colombian law

** Goal to be defined at the local level

7.4.3 Communication channels

Information flow is the basis of operation of the IS. This information flow needs to be defined: where the primary data are produced, where the information is given to the users, and the sort of information the users need. Most of the information is produced inside the administrative organisation (Figure 37), since communities have no tradition of recording data. Under the new thinking on WSS projects, communities are now responsible for monitoring service quality. This leads to problems: the administrative organisation does not have the data needed to monitor service quality, nor the know-how to organise these data and present it to the users, while the people themselves do not know what to monitor. Both the information flow and the type of information needed by each level of user should be defined at the local level. The Colombian National Programme for Sustainability used forms to record data, which are processed to generate the final performance graphs. Annex 4 shows the general proposal for the IS, which can be adapted at the local level to suite individual circumstances.

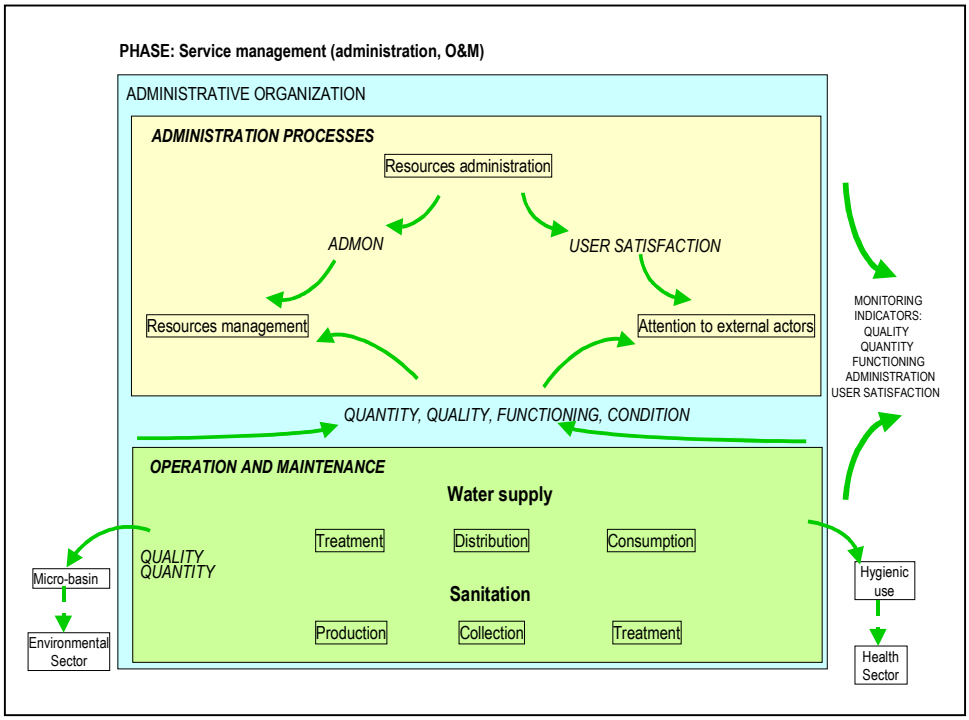


Figure 37 Information flow in a service provider organisation