

SISAR: An Innovative Sustainable Management Model for Small Decentralized Water and Wastewater Systems in Developing Countries

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Abstract

Innovative solutions for reducing the gap of population in development countries without access to good basic sanitation services are required. There is a great variety of investments programs that are executed focusing just on the construction of new installations, but forget about the necessity of implementing proper management models to operate and maintain the water supply and/or wastewater systems considering altogether social, technical, financial and institutional issues. The objective of this paper is to present the SISAR model, which has been implemented with small variations, in three states in north eastern Brazil. The case of SISAR in the state of Ceará is discussed with more detail due to the fact it has been implemented at a state level, thus demonstrating the strong commitment public policy has had in order to improve access to basic sanitation in rural areas. The SISAR model is based on the idea of creating a confederation of small water supply systems in which, through a cross subsidy scheme, revenues from larger systems contribute in covering the operational and maintenance costs of smaller systems. With a well trained technical, administrative and social team, SISAR guarantees that the local user groups in each settlement - where a water supply and/or waste water system exist - are capable or running them on a daily basis. Through social inclusion and clearly defining the responsibilities of each association, sustainability for the provision of services is achieved. Other important stakeholders in the model include local and state government organs and international financing institutions which provide financial resources for capital investments. Yearly, the number of settlements that join SISARs continue to grow: in 2001, the 8 SISARs in Ceará were serving 66 locations, while in 2010, this number has already reached over 560 (approximately 330.000 inhabitants).

Keywords

Brazil; decentralized basic sanitation model; operation & maintenance plans; self-administration and sustainable management;

INTRODUCTION

The implementation of sustainable basic water sanitation programs in developing countries is a great challenge which deeply relies in successfully integrating technical, financial and institutional components with the human dimension. A profound analysis of local cultural environments is mandatory and success for the implementation of these programs depends on correctly assessing this component. Following this approach, in three states of northeastern Brazil - one of the poorest regions in the country with scarce water availability and extreme climate conditions -, public policy has been directed towards reducing the gap of people without access to basic water and sanitation services through the implementation of an innovative decentralized model based on a confederation of various small and medium sized independent water supply (WSS) and wastewater (WWS) systems in rural areas.



Figure 1. Geographical distribution of SISARs in the Brazilian State of Ceará with their foundation date (CAGECE, 2009)

refining the first initiative in Sobral region, it was extended to all eight watersheds (Figure 1) within the state (Cortez, 2009). Results are impressive: after more than 15 years, SISAR has been responsible for bringing reliable and good quality water supply access to over 330.000 inhabitants in over 560 small to middle sized communities in Ceará (CAGECE, 2010). The SISAR model is currently supplying 13% of the Ceará's rural population, operating over 1.674 km of mains and having over 68.000 active household connections.

BASICS OF THE SISAR MODEL

In order the SISAR model to exist and be sustainable, a sound interaction between different stakeholders must be assured. These include the government – at different levels –, the local inhabitants, and SISAR as the water utility institution responsible for giving support not only on the technical side but also on the administrative and social.

Stakeholders Involved

The model SISAR needs a clear state public policy that supports the idea of implementing innovative management models for bridging the gap in access to rural water supply and wastewater services. In this specific case, the Government of Ceará embraced the idea of SISAR and selected CAGECE⁴ as the implementation organ. Inside CAGECE, different areas work together in order to bring support to SISARs. Especially relevant is GESAR⁵ (Gerência de Saneamento Rural) which is responsible for giving support to SISARs in order to secure their sustainability (technical,

Although different investment programs have been tested for designing, constructing and operating water and waste water supply systems, the SISAR¹ (Sistema Integrado de Saneamento Rural) model has been recently recognized by FUNASA² as one of the most promising for guaranteeing the sustainability of the investments and assuring the correct operation and maintenance through an active participation of local user groups and payment for metered water consumption. With some small variations in its institutional setup, SISAR is a reality in the Brazilian states of Bahia, Piauí and Ceará. International financing institutions like Kreditanstalt für Wiederaufbau³ (KfW Entwicklungsbank) and the World Bank (WB) have positively contributed to their implementation and development through the latter years.

Specially interesting is the case of the state of Ceará, where in the mid 90's the government embraced this model, and after testing and

¹ Integrated System for Rural Sanitation

² Brazil's National Health Foundation

³ German Development Bank

⁴ Water supply and Sewage Company of Ceará

⁵ Rural Sanitation Management from CAGECE, belonging to company's Engineering Division

administrative, social) and contribute to their regional integration through the execution of workshops for constant exchange of experiences.

As the Brazilian Basic Sanitation Law (No. 11.775 from January 2007) indicates, service provision is responsibility of municipalities, so therefore it is absolutely necessary their acceptance of the model and their continuous support in order to go forward with SISARs implementation. Today, many majors have identified SISAR too as a realistic and sustainable option for improving access to good quality water services inside the boundaries of their municipalities. As the implementation of SISAR often comes in hand with external financial resources, municipalities also see the Program with satisfaction and they approach SISAR in order to evaluate the possibility of including new settlements - which lag behind on basic sanitation provision indicators - as beneficiaries.

With state and local governmental support achieved, the process of identification of communities interested in belonging to SISAR must be executed. Common criteria for community eligibility includes the assessment of the existing WSS and WWS (need for rehabilitation or construction of a totally new system), water resources availability (quantity and quality), electricity availability and population size e.g. 500 inhabitants for WSS and 1,000 for WWS. A maximum for the cost⁶ of investments per inhabitant is observed. With the technical criteria fulfilled, the next step is the official creation (or identification and upgrading of existing) of a local user group association in compliance with Brazilian law regulations.

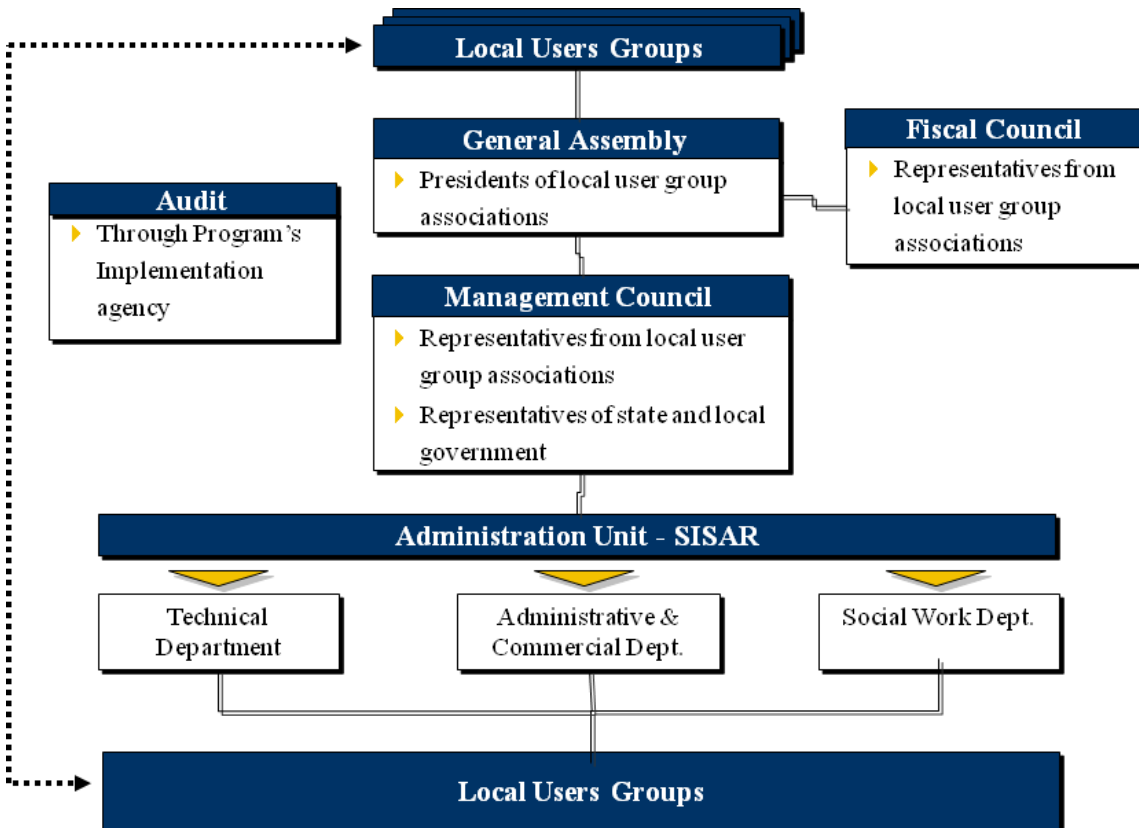


Figure 2. Institutional set-up of SISAR

⁶ Water supply systems :€\$100,00; Wastewater systems: €\$150,00

As SISAR is a confederation of local user group associations, Presidents of all local user groups come together and elect SISAR's General Assembly. SISAR's President, vice-president, treasurer and members of the administrative and fiscal councils are elected among the representatives of all associations. Only associations with no debt with SISAR and valid legal documents may participate in the elections. Overall, the management Council has a total of 11 members, with six of them belonging to the local user group associations and 5 representatives from State and municipal organs which provides a system of checks and balances. All have voice and vote. The General Assembly meets on a yearly basis to discuss and decide on important administrative, financial, technical and social issues regarding the institution, and the member systems-associations. A general overview of a common SISAR institutional set-up is presented in Figure 2. SISAR is a non-profit institution whose mission is to improve the quality of life in rural areas, providing maintenance to basic sanitation services through a self-managed and cost recovery model which contributes to social development and environmental preservation.

External consultants are also present during the initial stages of the creation and development of SISAR. Investors like KfW are really interested in assuring the sustainability of investments through the implementation of adequate operation and maintenance routines. Consultants also contribute to the liaison among all stakeholders, and give support especially to SISAR in order to become a self sustainable independent institution. The group of interdisciplinary consultants is required to implement measures that seek the development and strengthening of SISARs on the institutional, social, technical and administrative sides.

Characterization of SISARs in Ceará (Brazil)

The size of a SISAR may vary depending on geographical, political and water availability characteristics. In the state of Ceará, 8 SISARs were created in each of the existing watershed catchments following an IWRM⁷ approach. Today, SISAR is present in 128 of 180 municipalities in Ceará.

The number of independent communities which make part of one SISAR may vary from one case to another. Priority, though, is given to municipalities with lower classification on the HDI⁸. Real commitment of local governments to the model also plays an important role. The institutions and programs that have financed the construction or rehabilitation of WSS and WWS in Ceará which today make part of SISARs include: FUNASA (Projeto Alvorada), SOHIDRA⁹, World Bank (Projeto São Jose) and KfW (Basic Sanitation Program Ceará I, II and III). The financial schemes and amount of available resources also differ from one program to another. For example, on the case of the Basic Sanitation Project KfW II-III, KfW financed 50% (EUR 8,5mi approximately) while the Government of Ceará entered with the counterpart (CAGECE, 2009).

On the technical side, in order to assure a correct operation and maintenance of the water supply systems, only systems (from any of the above mentioned Programs) which comply with a defined set of technical standards are eligible for joining SISAR Individual WSS may vary from 50 to around 2,000 household connections. Each community, through the local group of users, runs on a daily basis the WSS and WWSS with support of SISAR. The model is based on economy of scale and cross subsidies¹⁰, where the bigger systems that generate profit cover the operational expenses of all systems and the overall SISAR cost structure. Each user pays a monthly fee¹¹ for metered

⁷ Integrated Water Resources Management

⁸ Human Development Index

⁹ Ceará's Superintendence of Hydraulic Works

¹⁰ At rural level only, subsidies between urban-rural systems are not foreseen

¹¹ Fees are not unified within the SISARs but depend on the cost of each system

water consumption¹². SISAR is in charge of preparing and distributing on a monthly basis the bills for each client. In them, the cost of water is clearly divided from other costs such as energy fee (total cost of energy for running the system, rated based on the client's water consumption) and the operator fee, thus seeking transparency.

Table 1. Operational data for the 8 existing SISARs in Ceará (CAGE CE, 2010)

SISAR	Municipalities	Systems	Network length [m]	Total # connections	# of Active connections	% active connections	Population served
BAC	28	88	243.772	16.603	15.097	90,93%	72.887
BAJ	13	56	171.100	7.995	7.510	93,93%	35.098
BBA	20	84	379.840	10.812	9.402	86,96%	47.465
BBJ	8	25	79.793	3.651	3.288	90,06%	16.028
BCL	15	59	169.726	6.998	6.264	89,51%	30.721
BME	9	36	98.711	3.521	3.130	88,90%	15.457
BPA	14	100	254.655	13.321	12.052	90,47%	58.479
BSA	21	112	277.228	12.531	11.521	91,94%	55.011
TOTAL	128	560	1.674.825	75.432	68.264	90,34%	331.146

WSS use surface and ground sources and water treatment may vary from simple chlorination to direct filtration. WWS may be in the form of individual sanitation solutions for households, or, in bigger systems, with sewage networks connected to aeration lagoons to reduce environmental impact and comply with existing regulations. Although priority has been given to water provision in Ceará, new financial cooperation programs like the one currently supported by KfW also emphasize the importance of improving wastewater services: around 40% of the Program's (began in 2007) available financial resources must be directed to the construction of waste water systems in settlements that also received a WSS. In the neighboring state of Piauí, the Basic Sanitation Program, financed too by KfW, has constructed 30 systems (named SISAR/PI¹³) with over 6.000 household connections, all of which besides have 100% water supply and waste water coverage, either through individual solutions or connection to a sewage network in bigger systems.

Basics for a successful implementation strategy

Overall, the success of the SISAR model is based on successfully integrating the following components through a manifold of well documented measures executed by an interdisciplinary set of consultants and local staff (Meleg, A., Bandeira, R., 2009): i) social work with local user groups, ii) defining and strengthening the institutional setup, iii) implementation of appropriate technical standards, and iv) guaranteeing financial sustainability.

Social Component. The social component is represented by the active participation of local user groups throughout the model. A wide range of activities raise model awareness among the population in potential eligible communities (CAGECE, 2009). Only after local user organizations freely accept joining SISAR, the technical project cycle begins. Constant training and accompanying measures by SISAR are carried out in order to guarantee the fulfillment of

¹² Water meter coverage is 100% in all SISARs

¹³ Name assigned to the SISAR model implemented in the Picos region, in the Brazilian state of Piauí.

responsibilities and duties by the associations that belong to the Program. A well structured network of social workers conducts all social activities including sanitary education and environmental campaigns and fostering the expansion of the Associativism.

Institutional Component. This component is based on the implementation of a sound legal framework in which all stakeholders clearly have their responsibilities and rights defined and which assures SISARs independence and protects it from external political and institutional risks. Governance is assured through the introduction and harmonization of a set of legal documents which are adapted to federal and state sanitation laws, and through the implementation of agreements and contracts between municipalities, associations, and SISAR (Meleg, A., Bandeira, R., 2009). Supporting documentation has been developed with the implementation of internal statutes and procedure manuals for both SISAR and the local user Associations. This component is really dynamic and is constantly monitored as stakeholders and their interests may change periodically. As a response to this, institutional capacity building has been assured by the presence of external consultants that work closely together with the project implementation agency and major stakeholders in order to mitigate institutional risks during the initial implementation stage.

Technical component. SISAR is responsible for guaranteeing that the individual water supply systems are correctly operated and maintained. Guaranteeing continuous water supply and assuring compliance with water quality standards is SISAR's main objective. In order to do this, SISARs rely on the work of local user group operators (depending on size, 1-3 operators may be selected and may work together), which are trained periodically to run the systems on a daily basis. Operator's responsibilities have to do with the correct operation of pumping systems (automatization of pumping systems is included in the technical standards), executing water treatment procedures (these may vary from one system to other depending on raw water quality) and making monthly lectures of water meters. Major maintenance services of the network or electromechanical equipment are carried out by SISAR's technical staff which is also responsible for monitoring the quality of the operation and implementing operation and maintenance plans. Through periodical training workshops at local and regional level, the technical staff of SISAR is trained.

In practice, technical staff from SISAR is responsible for: i) guaranteeing correct operation of WSS (24/7 supply) and WWS, ii) giving total maintenance to the water supply systems (hydraulic, electromechanical repairs, water treatment installations, etc) through the implementation of preventive plans and execution of corrective measures, iii) controlling water quality, iv) trainings and monitoring the execution of services by local operators, v) evaluate technical conditions of WSS systems with interest of joining SISAR, and vi) overall monitoring of technical indicators.

Nevertheless, the design and construction processes which come before the operational stage are of vital importance. Adequate technical standards that foresee local conditions, minimize operating costs, and observe simplicity to operate and maintain the systems, are fundamental and are constantly reviewed by the respective stakeholders: CAGECE, SISARs and external consultants in representation of the financial institutions.

Recently, SISAR has also started to focus its efforts in modernizing its technical management capacity through the implementation of both IWA¹⁴'s benchmark system and water balance analysis. Planning and execution of small rehabilitation or expansion of systems can be done with SISAR's own funds, but major investments need external financing i.e. federal institutions, state or local governments, and multilateral agencies. SISAR may also get specialized subsidies from

¹⁴ International Water Association

supporting institutions for specific investments or rehabilitation needs, e.g. through the rehabilitation of household water meters that have completed a 5 year period of installation and use and for which SISAR¹⁵s normally don't have the appropriate structure. Nevertheless, SISARs philosophy foresees to gradually cut all these subsidies in order to really become sustainable.

Financial component. Financial Sustainability is acquired through the implementation of a cost recovery tariff structure (Meleg, A. et al., 2010). Water pricing results after a thorough analysis supported by the elaboration business plans which are yearly reviewed. The final decision on acceptance of a new water tariff is a responsibility of SISAR's management council. From one SISAR to another, the social tariff structure (World Bank, 2004) may vary due to their own local conditions and interests. Each General Assembly is autonomous for deciding on this value.

For example in the case of SISARs in Ceará, a block tariff was implemented since the beginning in which each household must pay a monthly fee of R\$5,20¹⁶ that gives right to consume 10m³ of water. Above this consumption there will be an increase in the value of each additional cubic meter. In practice, over 99% of the connections belong to households. In the case of SISAR/PI, the minimum water consumption fee is R\$1.60 and corresponds to 2m³. In average, the monthly household water consumption varies from 8.0-11.0m³ (60-80 liters per capita/day). Seasonal variations due to climate conditions have a clear effect on the monthly billing values. Financial planning take these issue into account when defining the O&M plans and investment schedule.

Another aspect that safeguards SISAR from a financial point of view is the implementation of sound management and commercial practices i.e. use of an appropriate MIS¹⁷ for registering consumption and preparing the monthly bills, complete reporting and implementing debt recuperation schemes. Today, collection efficiency is above 95% (CAGECE, 2010).

CONCLUSIONS

The SISAR model was developed more than 15 years ago with the objective of increasing the percentage of rural inhabitants with access to continuous and good quality water services. Together with water supply, SISAR also has focused on improving access to basic sanitation services and health indicators, although its impact may vary regionally from one SISAR to another. Today, the fact that the existing SISARs continue to grow in number of settlements and inhabitants who benefit of this model for managing their WSS, is a clear indicator of its strengths. This idea is reinforced by the public attention it has gotten during the last years, when the experience and its promising results began to be presented in various Basic Sanitation events and called the attention of different sectors and institutions at Brazilian level. The state of Piauí is already considering replicating the successful experience of SISAR/PI¹⁸ to a state level, as Ceará did in 2001. Nevertheless, in Ceará there is still enormous potential to continue expanding the model as over 2 million rural inhabitants still need of improved water supply services.

The SISAR model has been effective reducing political paternalism in rural areas, and assuring the provision of sanitation services independent of political interests. It has also resulted in the empowerment of local user groups, strengthening their administrative and organizational capacities, which in some cases have extended from the operation of the water supply system to the implementation of productive schemes seeking increase of rent for the communities. Although

¹⁵ SISAR BAC (Sobral) already has a water meter laboratory for repair and calibration of household water meters

¹⁶ US\$1,00 equals R\$1,70, October 2010

¹⁷ Management Information System

¹⁸ SISAR Piauí (PI)

during the initial stages of implementation SISAR is dependent of subsidies for covering the operational costs, there are already very good examples of some SISARs which are totally financially independent and even offer services regarding rehabilitation of water supply systems and equipment at regional level. The gradual dismantlement of subsidies is a clear objective for SISARs and through the implementation of sound institutional, social, administrative and technical measures the principal stakeholders intend to achieve this stage.

Through the experiences acquired in Bahia, Ceará and Piauí, it has been observed that there is a need for adapting the SISAR model to specific local conditions and SISAR has proven to be flexible enough to do this. Through constant benchmarking results achieved from one SISAR to another are compared with the idea of a constant evolution and improvement on the delivery of services. To facilitate this, it is strongly recommended to i) implement strong institutional bases that mitigate risks, ii) guarantee constant dialogue, good communication among stakeholders (and their commitment), and iii) assure permanent training of technical, administrative and social staff of SISARs and from the representatives of the local user groups.

Regional integration among SISARs already takes place during periodic events. Nevertheless, the creation and implementation of a SISAR Reference Center which can be approached by every SISAR to seek advice and support at any level has been already identified. This concept was recently presented for the first time at a regional basic sanitation seminar in Natal, Rio Grande do Norte. The responsibilities of this Reference Center could include, among others, i) the mobilization of external resources for replication and expansion of new and existing systems (today this is done independently from one financial cooperation program or project to another), ii) specific support on technical, administrative, social and institutional issues to its members, and iii) foster experience exchange at a country and international level. The reality and development stage the SISAR model has already reached in northeastern Brazil already allows for this type of discussion. With the positive results achieved so far by SISAR as an example, high level decision makers have with it a tool for further improving sanitation services in their less developed regions. Whilst there has been an improvement in last years, there is still an enormous space for offering better living conditions and fostering economic development to their people.

REFERENCES

- CAGECE (2010). *GESAR's Report on Monthly Indicators for SISARs Ceará*. Fortaleza, Brazil, September 2010.
- CAGECE (2009). *UGP (Unit for Management of Programs) - Presentation of the KfW's Basic Sanitation Program Ceará II*. Fortaleza, Brazil, June 2009.
- Cortez H. (2009). *Ceará - Saneamento Rural (Rural Sanitation in Ceará)*, Presentation at Rural Sanitation Seminar in Recife, Pernambuco, Brazil, May 2009.
- Meleg, A., Bandeira, R. (2009). *Inception Report - Commencement of Consultancy Activities - Training and Building Capacities of SISAR BBA and SISAR BBJ*. KfW, Basic Sanitation Program Ceará II and III. Fortaleza, Brasil.
- Meleg, A., Bandeira, R., Rodrigues, K. (2010). *Progress Report First Quarter 2010 - Training and Building Capacities of SISAR BBA and SISAR BBJ*. KfW, Basic Sanitation Program Ceará II and III. Fortaleza, Brazil.
- World Bank (2004). *Brazil: Equitable • Competitive • Sustainable – Contributions for Debate, Chapter 11: Water, Poverty, Reduction, and Sustainable Development*. Washington D.C., USA, pp. 526.