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# SIASAR: A country-led indicator framework for monitoring the rural water and sanitation sector in Latin America and the Caribbean

D. Requejo-Castro[1*]; R. Giné-Garriga[*]; O. Flores[*]; G. Martínez[**]; A. Rodríguez[**]; A. Jiménez[***]; and A. Pérez-Foguet[*]

[*] Engineering Science and Global Development (EScGD) Research Group, Department of Civil and Environmental Engineering, Civil Engineering School (ETSECCPB), Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

[**] Water Global Practice, the World Bank, the World Bank Group, Washington D.C., United States of America.

[***] Stockholm International Water Institute (SIWI), Stockholm, Sweeden

E-mail[1]: david.requejo@upc.edu

**Abstract**

The provision of water supply, sanitation and hygiene services has emerged as a top priority in the development agenda in Latin American and the Caribbean. In light of the investments envisaged to reach the targets set by the Sustainable Development Goals (SDGs), Information Systems (IS) will play a key role in improving decision-making. In this context, this article introduces a country-led and global IS, which is increasingly implemented in a number of countries across Latin America and the Caribbean as a policy instrument to support national and local decision-making: the Rural Water Supply and Sanitation Information System (SIASAR). It includes a comprehensive framework for data collection, data analysis and data dissemination that simultaneously fulfils different stakeholders' needs. This article analyses these three key monitoring issues from the viewpoint of stakeholders' involvement. Results indicate that SIASAR represents a suitable monitoring framework to analyse sustainable services and the level of service delivered. Additionally, it is highlighted the advantages of adopting a continued participatory approach in system development, namely i) the stimulation of experience exchange and knowledge sharing among recipient counties, ii) the promotion of learning-by-doing, and iii) an increase of regional understanding, collaboration and comparison.

**Keywords**

Decision-making; information systems; participatory approaches; Sustainable Development Goals; rural areas; water and sanitation

## 1. INTRODUCTION

Today it is estimated that 663 million people worldwide still use unimproved drinking water sources and 2.4 billion people globally still use unimproved sanitation facilities (Joint Monitoring Programme, 2015b). Against this background, the 2030 Agenda for Sustainable Development adopted in September 2015 includes a specific Sustainable Development Goal (SDG) dedicated on water and sanitation (United Nations General Assembly, 2015). This goal (SDG 6) seeks to complete the unfinished business of the Millennium Development Goals (MDGs) and it specifically sets out to “ensure availability and sustainable management of water and sanitation for all” (United Nations, 2014; United Nations General Assembly, 2015). In light of the investments envisaged to reach this ambitious goal, updated and comprehensive data is required to inform sector performance and promote decision-making. In turn, indicator frameworks are needed to organize an increasing amount of available data. Furthermore, relevant communities of practice need to be consulted, and field pilots to test the monitoring framework are needed to ensure that they are scientifically valid, and contextually salient (Kayser et al., 2013).

Numerous approaches have been developed to provide a coherent monitoring framework to address specific problems that range from improving data availability to facilitating access to information and encouraging the use of this information in decision-making (Giné-Garriga, 2015). Water, sanitation and hygiene (WaSH) data have been typically collected through different methods (Bostoen, 2002; WaterAid and ODI, 2005; United Nations Children’s Fund, 2006; Jiménez and Pérez-Foguet, 2012; Giné-Garriga et al., 2013). As far as monitoring and evaluating service delivery, the sector has witnessed the development of a variety of approaches (Sullivan et al., 2003; Cohen and Sullivan, 2010; Giné-Garriga and Pérez-Foguet, 2011; Giné-Garriga and Pérez-Foguet, 2013a; Luh et al., 2013; Kayser et al., 2013; Flores-Baquero et al., 2013; Bartram et al., 2014). Ultimately, and regarding data use, important efforts have been made to provide decision-makers with reliable information to support planning, targeting and prioritization, particularly in decentralised contexts (Ghosh and Rao, 1994; Jiménez and Pérez-Foguet, 2011; Giné-Garriga et al., 2015).

At the international level, the WHO / UNICEF Joint Monitoring Program (JMP) has taken over the role of producing and facilitating national, regional and global estimates of population using improved facilities. Data have been analyzed using a binary categorization of those households that use an “improved” or an “unimproved” drinking water sources and sanitation infrastructure (Joint Monitoring Programme, 2006). In both cases, service “ladders” have been defined to allow a disaggregated analysis through four rungs, which represents the evolution from the worst scenario (surface drinking water sources and open defecation practice) to the optimum one (piped water on premises and sanitation facilities that ensure hygienic separation of human excreta from human contact). Admittedly, the indicators employed by the JMP have fallen short of measuring progress in some key areas, and more precise and complete measurements are required to drive the sector forward (Giné-Garriga and Pérez-Foguet, 2013b; Joint Monitoring Programme, 2015a).

In Latin America and Caribbean (LAC) countries, a regional sector information system has been developed, namely the Rural Water Supply and Sanitation Information System (SIASAR). It seeks to support decision-making of a variety of stakeholders involved in the sector (i.e. policy makers, national and local planners, sector practitioners, etc.). Among others, this initiative aims to improve resource allocation by influencing targeting and prioritization; in so doing it promotes evidence-based planning (Pena et al., 2014).

This research describes SIASAR as a country-led and global monitoring initiative. It aims to show the way in which this monitoring system can be used to help involved stakeholders more fully into the decision-making process by providing a focus for the stakeholder engagement process. In detail, this study assesses those aspects regarding data collection, data analysis and data use within SIASAR initiative, and pays special attention to the role played by all member countries in these steps. The paper is organised as follows. A short description of the information system's origin, organization and functionality is provided to complete the introductory session. Section 2 introduces the two-fold perspective upon which this research is conducted. Section 3 presents main aspects regarding data collection, analysis and use. In addition, results associated to this monitoring framework tested in the field are provided. This paper concludes that SIASAR is an adequate information system for monitoring the rural water supply and sanitation (RWSS) subsector, characterized by an increasing decentralization, by focusing on service level and sustainability aspects. It is also highlighted the advantages of the participatory process and the development of a large-scale information system.

*SIASAR Initiative*

The Rural Water Supply and Sanitation Information System was initially launched in 2011 by the governments of Nicaragua, Honduras and Panama. Although these countries already had their own Information Systems (IS), these were out-of-date and too focused on the water component, largely neglecting sanitation and hygiene issues. In this context, strategic partners such as the World Bank (through the former Water and Sanitation Program, currently known as Water Global Practice), the Inter-American Development Bank, the Spanish Agency for International Cooperation and the Swiss Agency for Development and Cooperation joined efforts to support these countries in the development of SIASAR. This IS focused not only on service delivery but brought sustainability aspects as a core element. This last aspect was identified and agreed by country experts as the main challenge to be addressed by the RWSS subsector. In 2012, the first version of SIASAR conceptual model, questionnaires and Information and Communications Technology (ICT) tools became functional. This milestone allowed countries to collect and process information, and display it publicly through a web site and other dissemination mechanisms (i.e. automatic reports, dynamic maps, defined indicators, etc.). From 2013 on, with the system consolidated and with more than 5,000 communities registered, SIASAR began to expand, principally through the natural framework of the Central American Forum and the Dominican Republic of Drinking Water and Sanitation (FOCARD-APS, by its acronym in Spanish). In 2014, the first Regional Agreement was signed, and SIASAR was adopted as the regional approved and free affiliation IS for both the FOCARD-APS countries and those ones that consider the convenience of using these instruments. The same year, Dominican Republic, Costa Rica and the Mexican state of Oaxaca joined the initiative. Between 2015 and 2016 Peru, the Brazilian state of Ceará, Bolivia, Paraguay and Colombia increased the number of country members. Today, SIASAR is in use in eleven countries.

In organizational terms, country members adopted a Regional Normative in 2014 (revised in 2016) that gives a clear institutional and operational body to the initiative. This progress is extremely important as SIASAR is located in the water-related governmental structures of each country. Furthermore, both sector technicians and ICT development required to operate the IS are assumed by the countries themselves. This fact involves the design of coordinated and collaborative structures within and between countries, since the information framework and related monitoring mechanisms are shared by all. As a result, there is a common and well-structured institutional framework implemented in every member country (see Figure 1). Specifically reflected in its Normative, each nation is committed to appoint a leader institution aiming to ensure the development, implementation, promotion and financing of the IS (SIASAR, 2016). At an operative and administrative level, these objectives are supported by the collaboration of three main complementary groups; i) a sectorial one which is responsible to coordinate the execution of conceptual and field aspects, ii) an ICT team that facilitates software development and update, and ensure working permits and data security, and iii) a communication group that collaborates with the creation, design and publication of content and communication materials of SIASAR. The creation of such structure and the commitment to ensure the sustainability of the IS through its institutionalization, actors capacity building and implementation, are minimum requirements to join the initiative. In parallel, these groups are coordinated by one SIASAR country, which assumes an annual leadership, in terms of group organization and economic management, and transfers it after this period. Similarly, national teams count with the support of external advisory groups when mutually agreed.

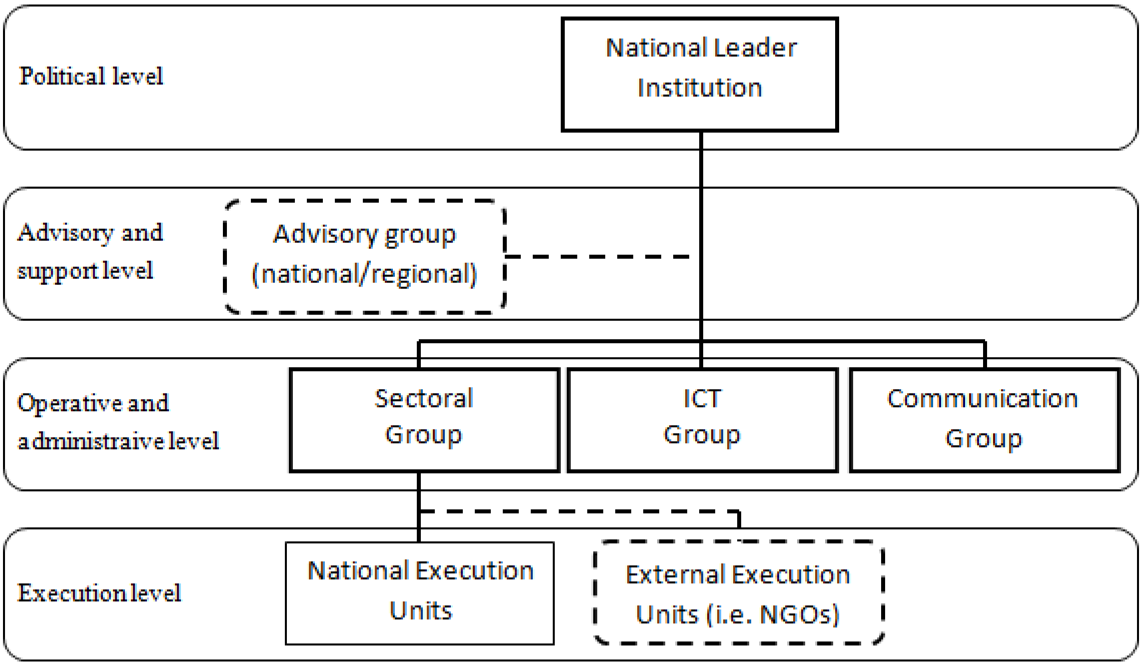


**Figure 1** Basic organizational structure of SIASAR replicated in each member country.

As previously mentioned, SIASAR initiative is rapidly expanding within the LAC region. This expansion clearly challenges the dynamic of the organizational structure and work sessions.

Nevertheless, these challenges are balanced by the strong governments' ownership and continuous participation of involved members, which generate positive aspects in terms of sustainability and stakeholders' empowerment.

Moreover, in terms of functionality, several instruments are in place to strengthen coordination. First, both sectorial and ICT issues have been discussed during innumerable virtual working sessions. To do this, different groups have been created taking advantage of their capabilities and specific interests. While sectorial teams focus on more conceptual aspects, ICT groups make resulting ideas and agreements tangible and functional. These parallel efforts are put together through a constant communication by all SIASAR stakeholders (i.e. monthly videoconferences), where main issues and improvements are discussed, shared and formally approved by all members. Among these aspects, key indicators and data collection processes have been defined (and revised when needed), a comprehensive conceptual framework has been developed (and updated when required) and several instruments for data use have been implemented. As a result, SIASAR was developed natively on a highly practical and interactive web platform that draws on the strengths of open source and mobile technology (Pena et al., 2014). Second, the annual SIASAR General Assembly takes places, bringing together all working groups, from the executive to the technical level, and allowing participating countries to debate current and future issues and to increase a sense of community. In addition to this, field missions and pilot studies are implemented when needed to test in practice required aspects. Finally, regional events take place when new countries join SIASAR officially to i) test in field the validity of the survey instruments, ii) share good practices for data collection, and iii) promote the sense of community that characterizes this initiative.

All this initiative, from the organizational to the functional level has been created ad hoc by SIASAR community itself. It is not dependent on any organization or international structure. SIASAR has designed its own coordination and work space and has even provided budget and distributed costs among country members. This level of "self-management" achieved by these countries is one of the strengths that allows SIASAR to be considered a successful case of collaborative and effective network among teams from 11 countries.

## 2. METHODS

In terms of method, this study aims to analyze SIASAR from a two-fold perspective. On the one hand, the focus is on major aspects related to the information cycle, including the issues of i) data collection, ii) data analysis and iii) data use.

On the other hand, the article remarks the existing participatory processes of the initiative. This is especially relevant when addressing i) stakeholders' engagement and appropriation of the information system, and ii) the medium- and long-term sustainability of the information system. The three information challenges cited above are addressed from this perspective.

Finally, a range of illustrative examples are provided to foster a better understanding by the reader in relation to SIASAR's scope and performance.

## 3. RESULTS AND DISCUSSION

### 3.1. Data Collection

Public investment in the RWSS subsector of Latin America and Caribbean countries has been traditionally biased toward the construction of new infrastructure while little attention has been paid to other factors that compound sustainable water and sanitation services delivery (Lockwood et al., 2010). Understanding those factors is critical for addressing sustainability gaps and improving policy development, sector planning, priority setting, budget allocation, project design and technical assistance provision. This core idea led countries to design a set of survey instruments to analyse the quality and sustainability of service from different perspectives: i) the community, ii) the water system, iii) the service provider, and iv) the technical assistance provider. In parallel, it was kept in mind the alignment of SIASAR with international monitoring standards (e.g. indicators related to use of water and sanitation infrastructure, as those proposed by the JMP during MDGs period). Briefly, one specific questionnaire was elaborated to collect data from each information source, as shown in the following table.

**Table 1** Relevant data associated to each questionnaire of SIASAR.

| | |
|---|---|
| **Community** | Location and georeference; population; water coverage (at household level); sanitation and hygiene infrastructure and use (at household level); water, sanitation and hygiene software (at education and health centres); community associated water systems and service providers; ongoing projects |
| **Water System** | Location and georeference; service type; water intakes; system infrastructure status (catchment, conduction, treatment, storage, distribution); water quality |
| **Service Provision** | Type of provider; organization; gender equity; legal status; tariff; revenues and expenses; accountability; operation and maintenance |
| **Technical Assistance Provision** | Type of provider; jurisdiction; human, economic and logistic resources; community coverage, frequency and type of support |

Regarding data collection process, SIASAR community paid attention to three key stages. The first one involves those preliminary tasks needed to ensure a successful field work. From these activities, special focus is given to i) previous contacts with local institutions and sector practitioners in a given area, as this aspect favours field planning, initiative dissemination and generation of synergies, and ii) survey teams training given by SIASAR responsible entity in each country. The second stage represents one of the salient aspects of SIASAR, as it combines data collection from the household, the water system, and the service provider. This is especially relevant as widely used household surveys (e.g. Multiple Indicator Cluster Surveys of UNICEF, Census of Population and Housing, etc.) are not sufficient to monitor many relevant questions related to the RWSS subsector (Giné-Garriga et al., 2013). One separate questionnaire is developed to assess these different information sources, and data is collected through different mechanisms: a closed-question survey, direct observation, and water quality testing. In a given geographical area, the methodology consists of visiting all communities in the area. In each community, all existing water systems are inspected, members of the organizations in charge of providing the service are interviewed, and a tour around the community takes place, including schools and health centres. Associated technical assistance provider is identified as well; pointing out that this actor generally has a different scale of intervention. Finally, sanitation and hygiene information is obtained through household visits and direct observation. The selected sample of households is defined according to each country resources and/or community participation degree. Additionally, it is noteworthy the use of ICT-based dispositive, facilitating survey teams to collect, store and transmit related data. Finally, the third stage integrates the validation process, as a crucial one to ensure data quality. In this respect, validation is carried out through i) an instant checked facilitated by the survey dispositive (internal programming and detection of logical errors) and an agreement with interviewed actors, and ii) a final verification executed by municipal or national authorities. Once the information is validated, data is published on the public web site. As it can be seen in Table 2, the majority of SIASAR countries have already collected a significant amount of data. Notably, it should be mention the case of Nicaragua, who carried out a baseline of all rural communities, systems and service providers. This milestone was officially certificated by its government. Furthermore, and as expected in any data collection process, Nicaragua has also finished updating this baseline.

**Table 2** Validated monitoring results at SIASAR by country (updated on March 2017).

| Country | Communities | Water Systems | Service Providers |
|---|---|---|---|
| Bolivia (2016) | 2 | 2 | 1 |
| Costa Rica (2015) | 5 | 5 | 5 |
| Dominican Republic (2013) | 943 | 371 | 319 |
| Honduras (2011) | 3,869 | 3,123 | 3,373 |
| Nicaragua (2011) | 6,863 | 4,792 | 2,585 |
| Panama (2011) | 1,130 | 599 | 551 |
| Peru (2015) | 10,097 | 10,674 | 10,703 |
| State of Ceará (2016) | 104 | 81 | 33 |
| State of Oaxaca (2015) | 26 | 25 | 24 |
| **TOTAL** | **22,039** | **19,672** | **17,594** |
| In brackets, year of joining SIASAR initiative | | | |

Undoubtedly, SIASAR is a growing initiative as years pass by. This challenge brings constant reviews of survey instruments with the aim of integrating each country reality and to ensure comparability. Under a principle of simplicity (as little information as necessary, but not less), countries' particularities are analysed, discussed and finally harmonised and approved by all countries. Additionally, SIASAR visualizes the need of alignment and collaboration with other international monitoring systems. In this sense, a deep revision of survey instruments is taking place with the aim to be tailored to post-2015 key monitoring elements.

### 3.2. Data Analysis

One salient aspect of SIASAR is the manner that collected data is organised and analysed (Pérez-Foguet & Flores-Baquero, 2015). Six aggregated dimensions are defined to assess water and sanitation services from different and complementary points of view. The aim of this structure is to keep in focus different aspects that characterise an increasing decentralized RWSS subsector, as in practice institutional roles and responsibilities of sectorial issues are assumed by different stakeholders (Giné-Garriga and Pérez-Foguet, 2013). This characteristic is common in most of SIASAR countries. Mentioned dimensions have been proposed to measure i) the water service level (WSL); ii) the community sanitation situation and various hygiene issues at the household (SHL); iii) the condition of water system infrastructure (WSI); iv) the service provider performance (SEP); v) the technical assistance provider performance (TAP); and vi) the WaSH situation in public institutions (SHC). Additionally, at an upper level, cited dimensions are aggregated in 2 partial indices: i) Water, Sanitation and Hygiene service Level (WSHL), and ii) Water Services Sustainability Index (WSSI). These partial indices pursue to keep in focus those aspects related to quality and sustainability of service identified by all member countries. Finally, a last level is represented by an aggregated Water and Sanitation service Performance index (WSP). These last indices must be seen as a means of initiating discussion and stimulating public interest. All presented elements are listed below.

**Table 3** General Index, Partial Indices, Dimensions and Components of SIASAR conceptual model.

| **Water and Sanitation service Performance index (WSP)** | |
|---|---|
| **Water, Sanitation and Hygiene service Level (WSHL)** | **Water Services Sustainability Index (WSSI)** |
| **Water Service Level (WSL)** | **Water System Infrastructure (WSI)** |
| Accessibility (ACC)<br>Continuity (CON)<br>Seasonality (SEA)<br>Quality (QUA) | System Autonomy (AUT)<br>Production Infrastructure (INF)<br>Water Catchment Protection (PRO)<br>Treatment system (TRE) |
| **Sanitation and Hygiene Service Level (SHL)** | **Service Provision (SEP)** |
| Sanitation Service Level (SSL)<br>Personal Hygiene (PER)<br>Household Hygiene (WAT)<br>Community Hygiene (COM) | Organizational Management (ORG)<br>Operation & Maintenance Management (OPM)<br>Economic Management (ECO)<br>Environmental Management (ENV) |
| **Schools and Health Centres (SHC)** | **Technical Assistance Provision (TAP)** |
| Water Supply in Schools (SWA)<br>Water Supply in Health Centres (HWA)<br>Sanitation in Schools (SSH)<br>Sanitation in Health Centres (HSH) | Information Systems (ICT)<br>Institutional Capacity (INS)<br>Community Coverage (COV)<br>Intensity of Assistance (INT) |

Each dimension is made up of four components. In turn, each component is fed by a short list of single indicators. In total, 109 indicators are employed. In terms of method and technique, index construction relies on a simple step-by-step procedure: i) the selection and combination of key indicators into their corresponding sub-indices, using an equal and dimensionless numeric scale; ii) the determination of weights for each sub-index and their aggregation to yield an overall index; and iii) the dissemination of index values by means of a grading system, classifying communities in four levels.

First, indicators are classified according to the conceptual framework previously described.

Collected data are typically represented on different scales (e.g., percentage of systems with adequate water treatment, distance-to-source in meters, service continuity in hours per day, and so forth), and they therefore have to be normalized prior to their analyses. For each parameter, it is assigned a score between 0 and 1, where 1 represents the best performance and 0 the worst case scenario. Components are then defined by simple and easy-to-use multi-attribute utility functions. Table 4 represents an example where the operation and maintenance (O&M) management of the service provider is assessed through discrete values (in other cases punctuation can be linear).

**Table 4** Utility function to assess O&M performance of the service provider. On the one hand, according to the residual chlorine measurement obtained, a different punctuation is given. On the other hand, a combination of different O&M aspects are assessed and rated. A final value of the utility function is provided by a linear mean of both criteria.

| Chlorine basic operation (residual chlorine) | Punctuation | General assessment of O&M |
|---|---|---|
| Cl <= 0.1 mg/l | **0** | Neither corrective nor preventive maintenance is provided |
| 0.1 mg/l < Cl <= 0.3 mg/l | **0.33** | Corrective AND/ OR preventive maintenance is provided |
| Cl > 1 mg/l | **0.66** | Corrective AND/ OR preventive maintenance is provided, AND O&M costs are registered |
| 0.3 mg/l < Cl <= 1 mg/l | **1** | Corrective AND preventive maintenance is provided, AND O&M costs are registered, AND there is a plumber at the organization |

Next, different components of each dimension are aggregated into one single value. Two major issues need to be addressed: i) the choice of weights should reflect the relative importance of each component, and ii) the aggregation function should be consistent with the theoretical framework (Nardo et al., 2008; Giné-Garriga and Pérez-Foguet, 2010; Flores-Baquero et al., 2016). For weight assignment, two approaches were compared: i) equal weights, and ii) weights according to expert opinion (Analytical Hierarchical Process, AHP). In this process, several experts from all country members were involved. Based on comparative analysis, equal weights are assigned to all components. Similarly, partial indices are calculated by using an equal weighted grouping of all dimensions and general index (WSP) is created considering both partial indices under the same relative importance. As regard the aggregation method, two different alternatives were tested: i) linear (compensatory), and ii) geometric (partial compensatory). According to the analysis carried out, partial compensatory methods (geometric) might favour the appearance of null values, hampering the duty of discrimination among results. In this way, all dimensions are constructed by allowing the compensation of their components (additive aggregation). However, and due to a first compensation, posterior aggregations for partial and general indices fall on geometric ones.

Finally, to promote greater understanding of achieved results among final users and stakeholders, components, dimensions and indices' values are linked to a defined set of categories (A / B / C / D, where A represents the best result and D the worst), in order to foster prioritization and decision-making. Nevertheless, this representation can be done in several ways. Two alternatives were tested: i) equal intervals, and ii) different intervals. In this case, results vary significantly. When different intervals are used, the difficulty to achieve better qualifications increases. Although it might be less simple conceptually, this method favours to establish higher service thresholds. Considering this fact a positive aspect, this is the classification methodology adopted for visualizing results. Specifically, intervals are defined as follows: A [1 - 0.9], both limits included; B (0.9 - 0.7]; C (0.7 - 0.4]; D (0.4 - 0].

Country members' involvement in conceptual framework design has been an indispensable process. Firstly, preference levels (punctuation) of component's utility functions were agreed by common consent at sectorial level. Same procedure was carried out to define aggregation methodology, while, as mentioned previously, the assignment of weights was based on a wider consultation. There is no doubt about the need to preserve the consensus among countries in relation to the SIASAR concept and its monitoring framework. However, it is also needed to validate the conceptual model against real data. The validation showed that the model is sufficiently flexible to evolve and to be adapted to future requirements. This principle of flexibility allowed the development of different versions regarding the conceptual model. As a result, and in terms of calibration, survey tools have been improved as well as the definition of the different components. The aim was to favour i) the refinement of the preference levels, and ii) the duty of discrimination. One illustrative example relates to the definition of grading system thresholds. As shown in Table 5, there is a notable difference when using equal against different intervals. According to the former, 62% of the communities reach a favourable value, which might lead to direct the attention to other locations. In contrast, using different intervals brings the 85% of overall communities to lower qualifications, which increase the range of more needed settlements. As the regional goal is to reach better service levels, this last grading system is currently implemented.

**Table 5** Results regarding the two different grading system methodologies. Values of General Index (WSP) are presented for the case of Nicaragua. On the left, equal intervals: A [1 - 0.75]; both limits included; B (0.75 - 0.50]; C (0.50 - 0.25]; D (0.25 - 0]. On the right, different intervals: A [1 - 0.9], both limits included; B (0.9 - 0.7]; C (0.7 - 0.4]; D (0.4 - 0].

| | **Equal intervals** | | | | **Different intervals** | | | |
|---|---|---|---|---|---|---|---|---|
| | **A** | **B** | **C** | **D** | **A** | **B** | **C** | **D** |
| General Index (WSP) | 8% | 54% | 35% | 3% | 0% | 15% | 68% | 17% |

### 3.3. Data Use

The ultimate goal of sound sector-related data is to facilitate its use and to improve decision-making. To do this, two elements are necessary (Grosh 1997): i) the data must be analyzed to produce outcomes that are relevant to the policy question, and ii) the analysis must be disseminated and transmitted to policy makers. Only if data is easily accessible and is presented in a user-friendly format, its use will be stimulated. Otherwise, decision-making will be carried out without the information.

When using SIASAR data, most remarkable aspects to take into account are i) the existence of a common monitoring architecture, ii) the possibility to compare WaSH issues at different scales, and iii) the development of a regional sector-related community where knowledge exchange and good practices transcend beyond national borders. As a starting point, SIASAR community designed a distinctive, easy-to-use and meaningful dissemination method of results, which aims to address sustainability aspects and it is applied over all SIASAR elements (indices, dimensions and components). According to the agreed intervals detailed in previous section, a specific meaning was defined as to facilitate interpretation. Figure 2 aims to represent SIASAR grading system graphically, where water system infrastructure (WSI) is chosen as an example to illustrate it. "A" grade represents the desirable situation where the system is completely functional. As time goes by, the system experiences different technical issues due to its use. If these deficiencies can be afforded by the community, service provider, etc., then the functionality is associated to a "B" classification. This fact is commonly related to a short time reaction that allows bringing initial functionality back. When no measures are taken in the short-term, deficiencies become more pronounced and external support would be required. This aspect represents the main difference from "B" to "C" grade. Finally, "D" qualification points the absence of system or the need to recover it. This last point might be led as a consequence of no action when initial issues were detected.

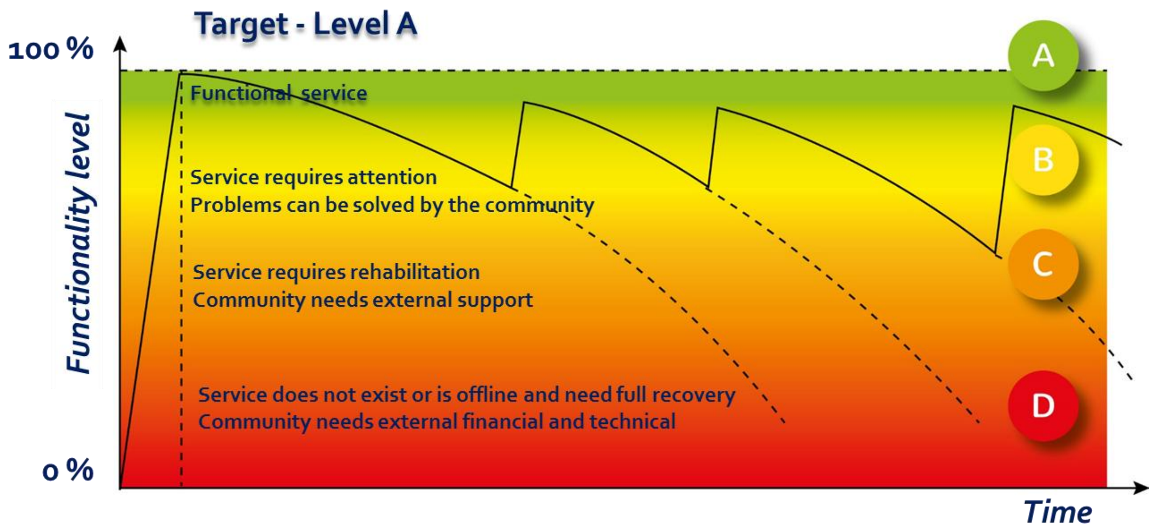


**Figure 2** SIASAR distinctive classification methodology A/B/C/D, where each value is associated to a specific meaning that has been defined and acquired by all country members. Source: SIASAR, 2016.

At regional level, and as an example of visualization instruments employed, Figure 3 presents those results regarding "Sanitation and Hygiene service Level, SHL" dimension for four country members. As mentioned, this dimension provides a simultaneous point of view to the community sanitation situation and various hygiene issues at the household. It is observed that Nicaragua and Panama posses, respectively, 45% and 48% of their communities classified as "D", while Honduras and Dominican Republic reach 17% and 23% regarding overall monitored communities. In any case, sanitation and hygiene service is deficient and require priority attention. In addition to this, there exist a relevant number of communities qualified as "C", ranging from 32% in the case of Panama to 48% in Honduras, which points out the need of external support to improve the service. This first approach provides i) the visualization of more needed countries to those possible interested actors, and ii) the starting point of a more in deep analysis. Nevertheless, these results must be analyzed carefully as available data differ notably among these countries (see Table 2). In this sense, the baseline of Nicaragua provides a more reliable image of SHL situation, while Panama current data base might not be completely representative of rural national condition. However, objective comparability is possible as an equal set of indicators to assess SHL are employed. It should be noted that same nature of analysis might be done at general and partial index level, as well as component plane. Additionally, and within SIASAR community, countries that count with a more tangible management (i.e. Honduras or Dominican Republic) share their experience as to support and guide partners' initiatives.

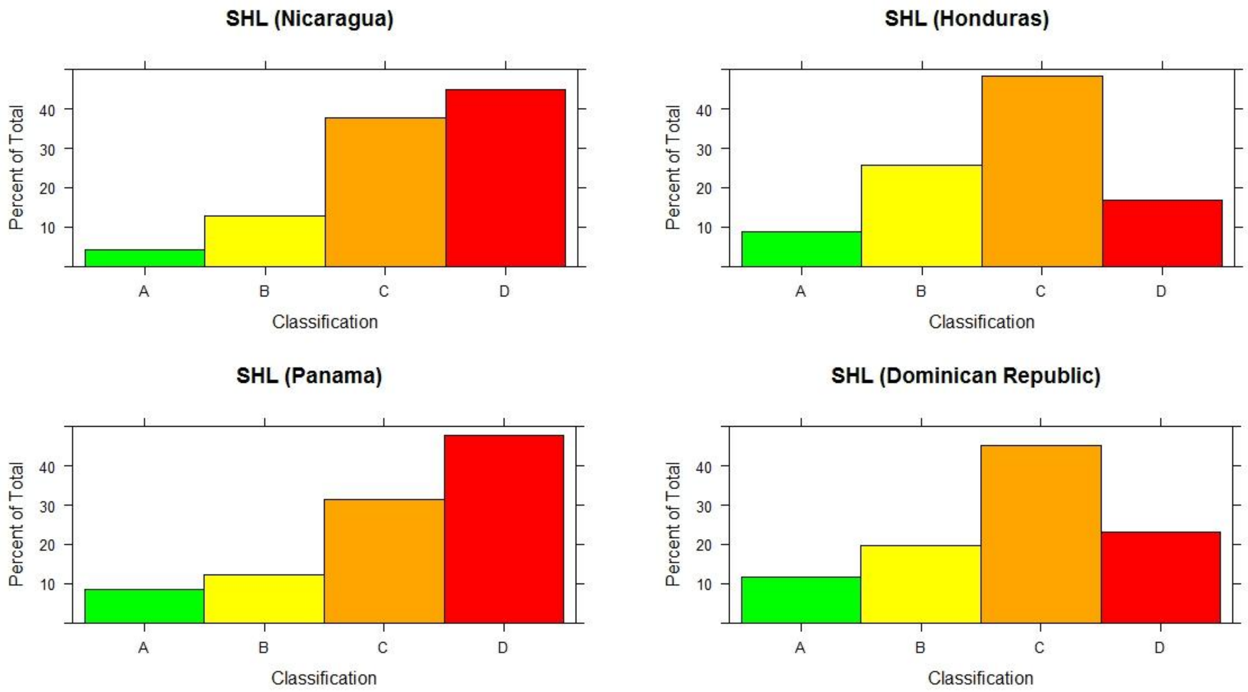


**Figure 3** Results associated to the evaluation of "Sanitation and Hygiene service Level, SHL" dimension, obtained by the aggregation of its four different components (data available at http://doi.org/10.5281/zenodo.571351).

Beyond the aggregated indices, model structure allows a narrower focus on specific components. Following previous first approach and analysis, Figure 4 presents detailed information regarding "SHL" dimension in Nicaragua. In this case, maps are powerful instruments for displaying information and enable non-technical audiences to easily understand current sectorial situation. The model permits to prioritize among the different components. In this case, hygiene-related aspects are visualized as the more needed ones to improve. Specifically, these components deal with appropriate hand-washing practices (SHL.PER), with safety water storage (SHL.WAT) and with the practice of open defecation and community cleanliness (SHL.COM). In this sense, the eastern region of the country presents a clear deficiency on these aspects. In addition to this, if this information is combined with health data, a complete picture of the context could be provided. On the other hand, component related to improved sanitation infrastructure (SHL.SSL) associates lower service levels to the south-east area of the country, which it should be considered in conjunction with previous results. This first assessment might lead to establish strategies that tackle sectorial needs. In addition to this, and more focused on local decision-making, SIASAR's platform also provides listed communities and rankings as to target precisely most vulnerable segments of the population and then to direct policy attention and public resources. It should be noted that results are easily obtained for different administrative scales, allowing decision-makers to better identify needs and target future investments more effectively.

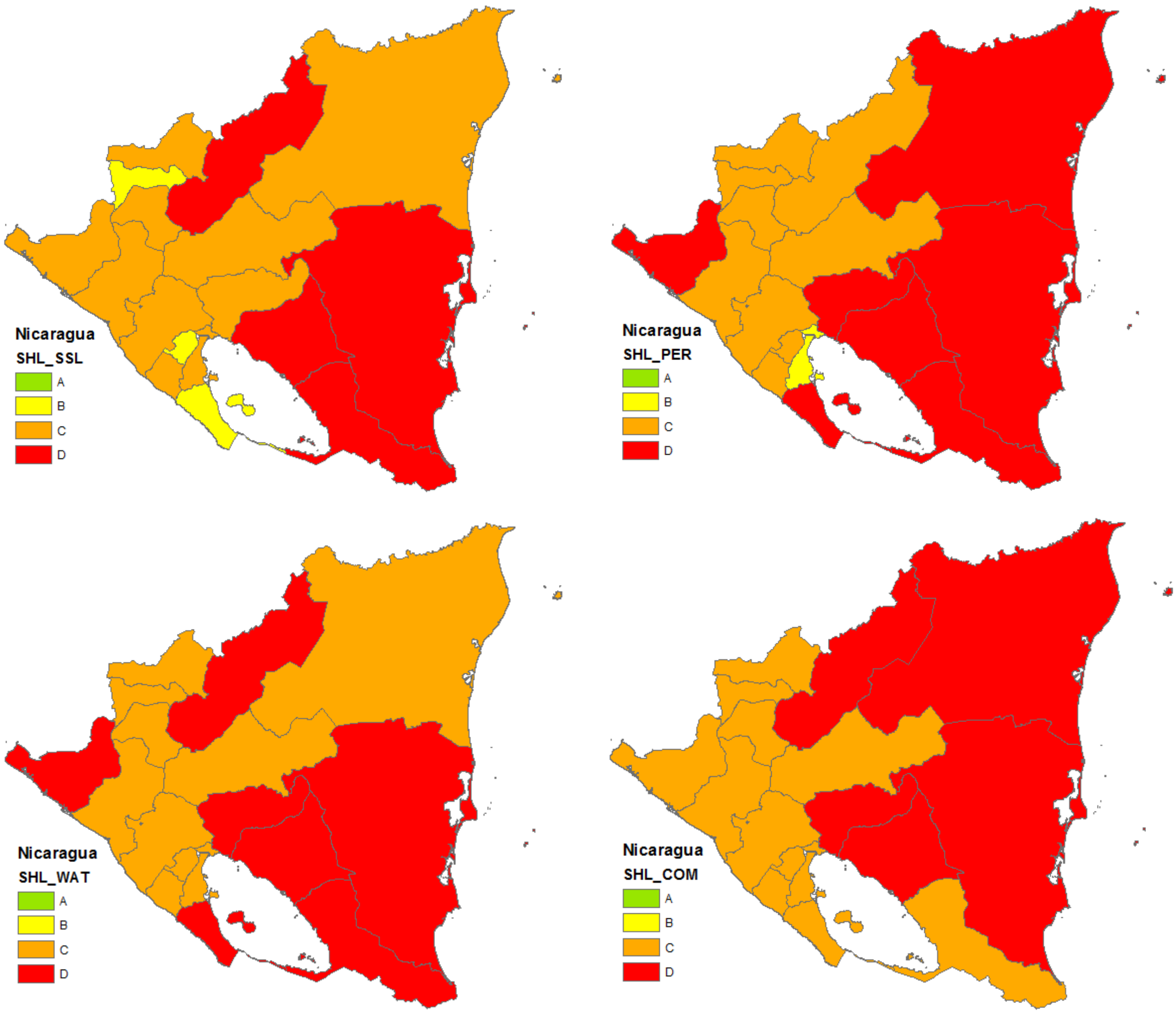


**Figure 4** Results represented by the four components of "Sanitation and Hygiene service Level, SHL". Aggregation to shown administrative units considers population size. Upper-left: "Sanitation Service Level, SHL.SSL"; Upper-right: "Personal Hygiene, SHL.PER"; Bottom-left: Household Hygiene, SHL.WAT"; Bottom-right: "Community Hygiene, SHL.COM".

To promote data use, SIASAR has designed and developed a battery of harmonized reports. They provide a comprehensive assessment of key issues reflected on the conceptual model. As the aim is to guarantee the usefulness of these tools, reports have been tested on field with key stakeholders, paying attention to the local level. The following examples show the practical utility of SIASAR as a decision-making tool. In Nicaragua, during the period 2013-2016, 64 rural water supply and sanitation municipal plans were developed using data from the system, supporting the prioritization of the most vulnerable communities to receive investments and technical assistance. In Honduras, since 2014, sectorial profiles of 28 municipalities have been developed based on SIASAR information to target technical assistance activities and inform the development of Municipal Development Plans. This is especially relevant as these plans are an instrument by which Honduran municipalities formally request the transfer of national funds for local investments. In Panama, and during 2016, SIASAR data is being used to better target investments and technical assistance in indigenous communities. In Dominican Republic, 33 water systems have been rehabilitated all over 2016 based on the information collected through SIASAR.

## 4. CONCLUSIONS

In this paper, we have presented the Rural Water Supply and Sanitation Information System (SIASAR) initiative, which has been implemented in several countries to provide updated and reliable information and to support sector decision-making. Key remarks of this initiative follow:

- Although a participatory process is time and resource-consuming, the benefits from such a strategy are remarkable in terms of governments' ownership, stakeholders' engagement and sustainability. The processes presented have stimulated pedagogic spaces where country members have learnt-by-doing, collaborating in the development of the information system. This fact facilitates a constant improvement of the tool.

- Clear advantages appear due to the development of a large-scale information system. The use of a harmonized monitoring architecture provides regional understanding, collaboration and comparison. In this sense, special attention is paid to the celebration of regional meetings aiming to i) test in field the validity of the survey instruments, ii) share good practices for data collection, and iii) promote the sense of community that characterises this initiative.

- SIASAR has emerge as an adequate monitoring framework for the RWSS subsector as:

    - it exploits relevant data to assess dispersed rural water systems, pointing from mere technical aspects to sustainable ones. It combines data at household, community, and water infrastructure and service provider levels. Its conceptual model permits to identify priority elements of the assessment and the technological platform facilitates this analysis at different scales, so as to design informed strategies or interventions.

    - resulting from the participatory process for conceptual model development, country members have experienced an increase of their technical capacities, understanding the implications of index construction, getting deeper into own sector needs, testing in field proposed alternatives and taking consensual decisions.

    - it provides easy-to-use and meaningful instruments to better identify needs and priority segments of the population, and so to target future investments more effectively. Already tested in field, existing tools have supported the development of sectorial diagnosis, the design of sectorial plans, the implementation of specific actions and, in summary, those relevant decision-making processes for which SIASAR was envisaged and created.

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