Interaction between Rural and Urban Areas in Water and Sanitation Management

A Strategy for the Santiago Water Company in the Dominican Republic (CORASSAN)

Water and Sanitation Division

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Authors:
Gonzalo Martínez Crespo
Sergio Pérez Monforte
María Rodríguez Vera
Francisco de Asís González Medina

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Acronym	Meaning
AECID	Spanish Agency for International Development Cooperation
ASOCAR	Community Association of Rural Water Supply Systems
AUSD	Autonomous University of Santo Domingo
COCODESI	Community Development Council
CORAASAN	Santiago Water Supply System and Sewer Corporation
ESU	Environmental and Social Unit (CORAASAN)
IDB	Inter-American Development Bank
INAPA	National Institute of Drinking Water and Sewers of the Dominican Republic
INDRHI	National Institute of Hydraulic Resources of the Dominican Republic
IU	Implementation Unit (CORAASAN)
JMP	Joint Monitoring Program
MEPYD	Ministry of Economy, Planning, and Development of the Dominican Republic
NSO	National Statistics Institute of the Dominican Republic
PES	Payment for Environmental Services
PU	Procurement Unit (CORAASAN)
PUCMM	Pontificia Universidad Católica Madre y Maestra
RU	Rural Unit (CORAASAN)
SDG	Sustainable Development Goals
SIASAR	Rural Water and Sanitation Information System
TCUC	Technological Catholic University of Cibao
TUS	Technological University of Santiago
WTP	Wastewater Treatment Plant
WR	Water Resources

Introduction

1.1 Sector Context

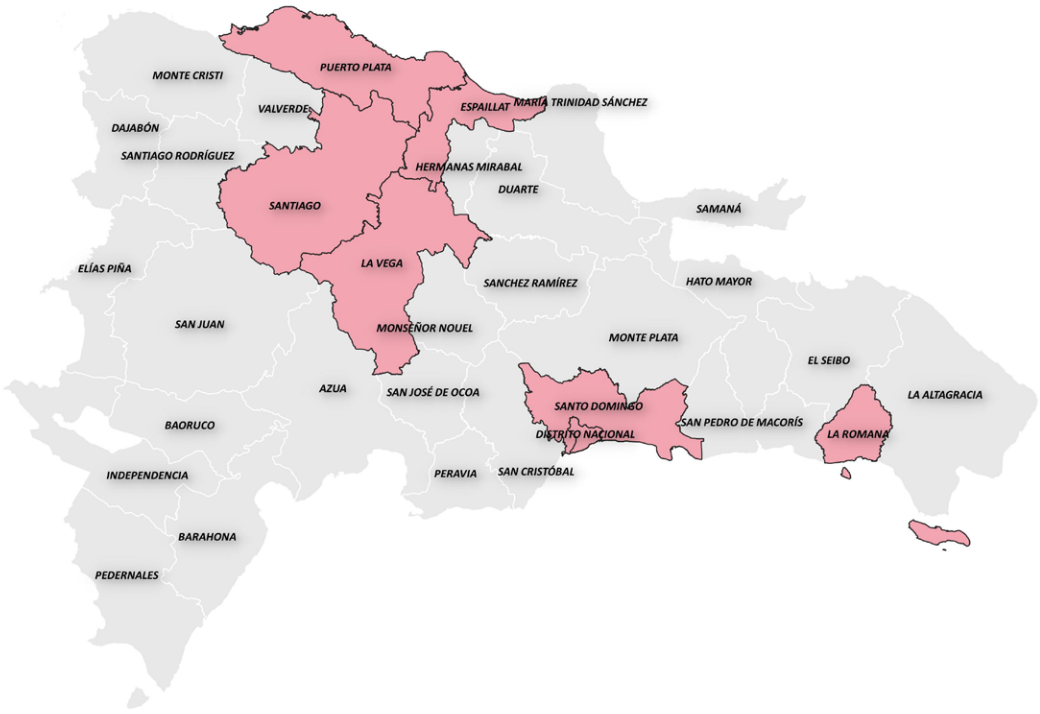
The 2010 reforms to the Constitution of the Dominican Republic recognizes water as a human right, and it also recognizes the right to a healthy environment. Article 15 of the Constitution establishes that "water constitutes an inalienable, essential, freely available, and strategic national asset for public use. Human consumption of water has priority over any other use." This new constitutional approach should be transposed to the specific regulatory framework of the sector, but this framework is pending a law to structure it. The draft of a fundamental law for the sector, the General Law on Drinking Water and Sanitation, has been under review in the Dominican legislature since 2019. In the absence of a legal framework that orders and regulates the sector, the reference standard is the Law on Land Water Domain and Public Water Distribution, which dates back to 1962. Based on this law, several sectorial laws have partially structured the sector over the last few decades.

Among these regulatory reforms, the laws that were created for the main sectorial entities are among the most important, such as Law 5994-62 of 1962 that created the National Institute of Drinking Water and Sewers (INAPA). Since its creation, INAPA has been the main developer of both urban and rural water supply systems throughout the country. Law 5994-62 gives powers to INAPA to "maintain and operate all drinking water, wastewater, and rainwater services, established or to be established in the future, throughout the national territory."

Since the 1970s, autonomous bodies called Water Supply and Sewer Corporations have been created in some of the country's most populated provinces. The creation of these corporations implies that they must assume responsibility for the implementation, operation, and maintenance of the urban and rural water supply systems of the entire province, taking these functions over from INAPA. But in the case of small rural water supply systems, this transfer has not always been effective, and many water supply systems in provinces with corporations continued to be managed by INAPA despite the provisions of the laws creating these bodies.

Starting in 1997, INAPA also began to decentralize rural water supply systems to community associations, a decentralization that

Figure 1: Provinces where the operation of services in 2019 has been assigned to a Water Supply and Sewer Corporation. The operation of the rest of the provinces is assigned to INAPA. Source: INAPA 2019



Law 5994-62 creating INAPA authorizes if it is considered suitable to achieve the ultimate objective of serving the entire population. The legal framework that protects community or cooperative water management is not fully developed and is one of the aspects that is expected to be clarified in the draft of the water framework law. Law 520 of 1920 (updated in 2004 with Law 122-05), defines how to create non-profit associations in the Dominican Republic and incorporates a specific type for "community development organizations," which are authorized to provide environmental sanitation and infrastructure services.

Traditionally, community development organizations that operate water supply systems are called Rural Water Community Associations (ASOCAR) by INAPA, although this name is not included in the Dominican regulatory framework and, therefore, is not legally binding. Just 96[1] organizations are recognized in INAPA records. The exact number of rural communities or water supply systems in the country is not known, but the number of ASOCARs seems low for a rural population of 2.4 million people[2], which indicates that there must be a significant number of rural systems served by other associations or groups of people, with varying levels of formality.[3]

Whether or not the service has been transferred to community associations, INAPA must

1. Source: INAPA 2019.
2. Census 2010. NSO.
3. This hypothesis about the significant level of informal provision was corroborated with information surveys carried out in the preparation of the project. As will be seen in the chapter on the presentation of the results, the number of community providers duly constituted and that could be classified as ASOCARs is under 25% in the province of Santiago.

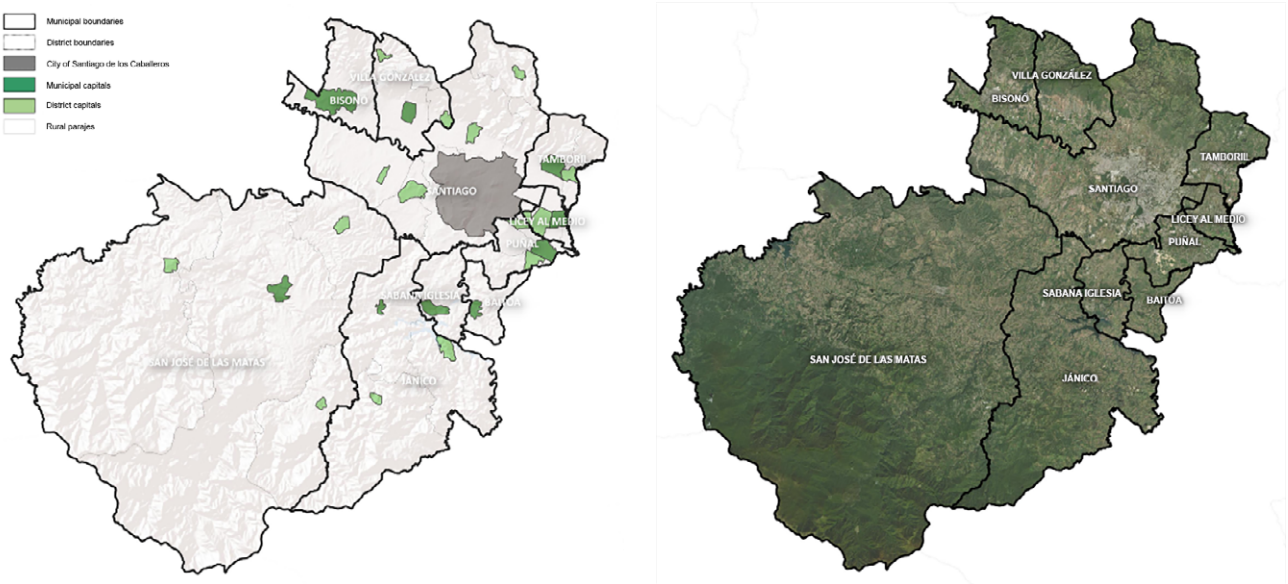
continue to provide technical assistance for the operation and maintenance of rural water supply systems, unless there is a corporation in that province, in which case, it is the corporation that should provide technical assistance. However, in general, this has not been widely implemented, since the corporations have limited themselves mainly to taking on the administration of the urban systems.

Santiago is the second most populous province in the Dominican Republic, after Santo Domingo, and is one of the most developed from an economic and industrial point of view[4]. It is located in the north-central part of the country and the central area of the province sits on the plain of the Cibao Valley, where the capital, Santiago de los Caballeros, is located.

Illustration 1: *General view from San José de las Matas. Mountains that surround the Cibao Valley are in the background. Source: Authors.*

4. NSO 2010 and MEPYD 2019.

Figure 2: Left, administrative divisions and areas of the province of Santiago. Right, municipal boundaries on satellite photo of Santiago. Source: Original design, NSO, and Map data © 2015 Google



The province is divided into 10 municipalities,[5] of which the northernmost and southernmost are occupied by mountain ranges that reach altitudes of up to 1,300 meters. Each municipality has a municipal seat, which is treated as an urban area by the National Statistics Office (NSO). In addition, municipalities are divided into one or more districts, each with a district capital, which is usually the main city of the district and is considered an urban area by the NSO.

The provision of Water and Sanitation (W&S) services in the province of Santiago is the responsibility of the Water Supply and Sewer Corporation of Santiago (CORAASAN), a regional autonomous public entity created in 1977 whose legal purview includes the population in both the urban and rural areas

5. The province had nine municipalities until 2016, the year when the Chamber of Deputies created Baitoa by splitting it from the municipality of Santiago de los Caballeros. Being a relatively recent change, not all the data or documents consulted and referred to in the note have disaggregated information for Baitoa.

Illustration 2: *CORAASAN administrative building in Santiago de los Caballeros. Source: CORAASAN.*

Table 1: Population distribution in urban and rural areas in the province of Santiago. Urban areas include the population in the municipal and district capitals. Source: NSO 2010

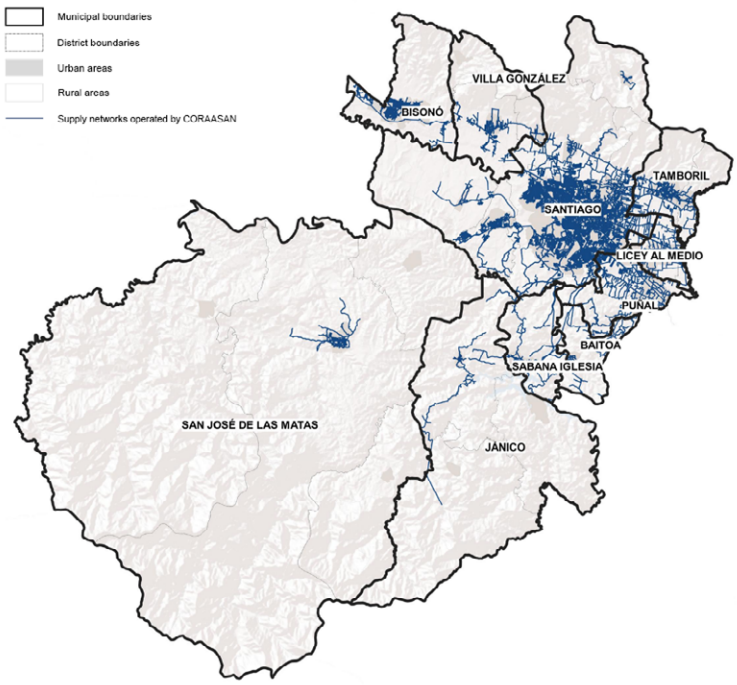
Municipality	Urban population		Rural population		Total
	Total	Percentage	Total	Percentage	
Santiago	591,580	87.06 %	87,904	12.94 %	679,484
Bisonó	31,608	75.09 %	10,484	24.91 %	42,092
Jánico	3,644	21.44 %	13,349	78.56 %	16,993
Licey al Medio	18,158	71.10 %	7,381	28.90 %	25,539
San José de las Matas	11,767	30.46 %	26,861	69.54 %	38,628
Tamboril	31,675	61.27 %	20,020	38.73 %	51,695
Villa González	18,288	48.97 %	19,061	51.03 %	37,349
Puñal	12,849	27.62 %	33,667	72.38 %	46,516
Sabana Iglesia	5,956	44.62 %	7,392	55.38 %	13,348
Baitoa	2,959	25.12 %	8,819	74.88 %	11,778
Total	**728,484**	**75.61 %**	**234,938**	**24.39 %**	**963,422**

within its boundaries. Law 582, which created CORAASAN, is very clear in this regard: "It will be in charge of the administration, operation, and maintenance of the Water Supply and Sewers of all the municipalities that make up the province of Santiago, both in rural and urban areas."

However, CORAASAN's operational management of the water supply systems in rural areas has not yet been fully taken on:

- Until 2017, CORAASAN provided service in the provincial capital, Santiago de los Caballeros, its suburbs, and certain municipal capitals: Tamboril, Licey al Medio, Puñal, Villa González, and San José de las Matas.
- In 2017, INAPA formally transferred to CORAASAN the operation of the rest of the municipal capitals that had been pending transfer since 1977: Bisonó, Jánico, Sabana Iglesia, and Baitoa.
- Small urban areas that are not municipal capitals and water supply systems located in fully rural areas have never been operated by CORAASAN.
- CORAASAN has not transferred the provision of rural services to community organizations, as INAPA did with the ASOCARs. Legally, CORAASAN's founding regulations do not seem to allow this transfer, but the Dominican legal framework is ambiguous about the transfers that INAPA made previously, since it does not cancel them, nor does it explain how the other community organizations can operate their water supply systems with full legal guarantees once CORAASAN makes the transfer to them.

Figure 3: Networks operated by CORAASAN as of the last transfer in 2017. Source: CORAASAN and NSO



1.2 Water and sanitation service levels

Although the country has made significant progress in universal access to water supply, according to NSO in 2010, 16% of the population still did not have access to an *'acueducto'* (water supply system), the term commonly used in the Dominican Republic to refer to conventional water systems with a distribution network.

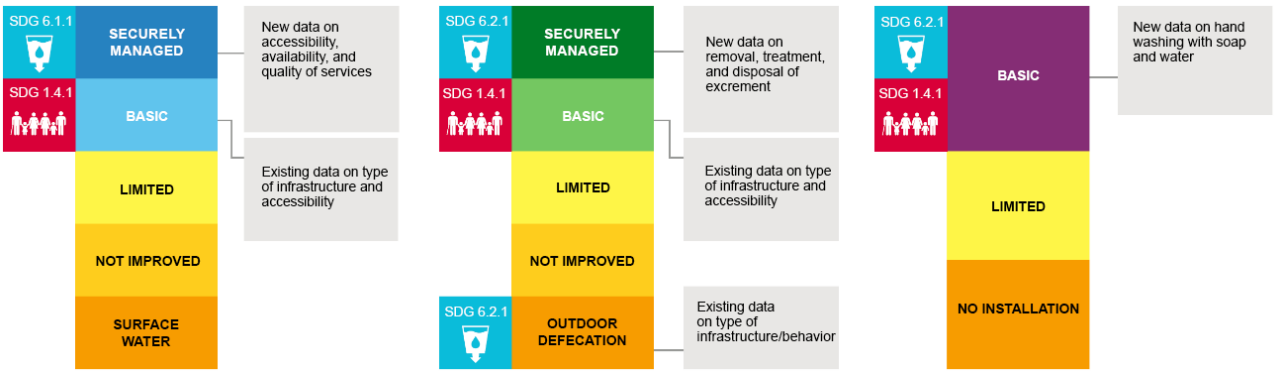
Data from the Joint Monitoring Program (JMP)[6] for monitoring the Sustainable Development Goals (SDGs) in the run up to 2030 show that, in 2017, only 3% of the population was without access to a basic water service. However, this percentage rose to 10% if we analyze the rural population separately. The JMP does not explain what percentage of the population with basic service actually had access to a securely managed service, i.e., access to drinking water from an improved source,[7] located inside the home or in the yard, or on the plot of land, available when needed and free from fecal contamination and priority chemicals.

In the case of sanitation, the country's situation is more deficient than in the case of supply, with significant challenges to achieving effective wastewater treatment in both urban and rural areas. According to JMP data, in 2017 only 84% of the population had access to basic sanitation and progress is being made slowly, just over 5% in the last 15 years. In rural areas, the percentage dropped to 74%. And, as with drinking water, the percentage of the population with access to a securely managed ser-

6. JMP: UNICEF's and the World Health Organization's Joint Monitoring Program to monitor SDG 6.

7. Improved water source: those that are potentially capable of providing safe water due to the nature of their design and construction. They include running water, water wells or boreholes, protected dug wells, protected springs, and rainwater collection. Unimproved sources include unprotected dug wells and unprotected piers.

Figure 4: JMP's service ladders, updated in 2017, for water (i), sanitation (c), and hygiene (d). Source: Progress in Drinking Water, Sanitation, and Hygiene: SDG baseline and 2017 update report



vice, i.e., with improved sanitation facilities[8] not shared with other households, where excreta are safely treated on-site or transported and treated elsewhere, could not be quantified.

8. Improved sanitation facilities: those that, through their construction, usually ensure a hygienic separation of human excreta from human contact. Improved sanitation facilities include: toilets connected to sewers or septic tanks; protected latrines, such as ventilated latrines or slab latrines; and composting toilets. Unimproved facilities include latrines without a slab or platform, hanging latrines, and bucket latrines.

The JMP data do not provide details at the province level, but according to 2010 NSO data, 75.2% of the population of the Santiago province had a water connection inside their house from a water supply system, although there is no information on the quality or continuity of the service. In terms of sanitation, 4.5% of rural households did not have any type of installation in 2010.

1.3 Urban–rural integration project in the Province of Santiago

In 2019, the Inter-American Development Bank (IDB) began working with CORAASAN on a new water and sanitation project in the province that would provide continuity with previous projects focused on improving supply coverage in the city of Santiago de los Caballeros.[9] In this case, the Bank and CORAASAN decided to expand the scope of work beyond the provincial capital, acting in other municipal capitals and also in rural communities, with a mission of bringing services closer to the objectives established by the 2030 SDGs, leaving no one behind. This resulted in a project that included an urban and a rural component, with investments in water and sanitation works in both contexts:

- In the urban component, actions in water and sanitation infrastructure were rolled out mainly in the city of Santiago de los Caballeros. These included construction and expansion of networks, improvements to water treatment plants, wastewater treatment plants, and the management of sludge from individual sanitation solutions.
- In the rural component, financing was provided for investments in drinking water systems in rural communities, mainly with regard to expanding and improving distribution and catchment networks and supporting the construction of sanitation facilities and sludge management. Also, within this component, a budget item was passed to improve sanitation facilities in rural schools.
- A third component was aimed at improving CORAASAN's operational and environmental management, paying special attention to enhancing technical and operational capacities, developing awareness campaigns and educating the population on better resource use, and preparing CORAASAN to assume more responsibility in the operation of rural systems.

This integration of urban and rural contexts within the same program—and with the same operator—posed a challenge for carrying out the project. CORAASAN had traditionally focused its activity on water and sanitation

9. Project DR-L1057, which closed in 2019, and which managed to increase household access to drinking water from 34% to 66% of households in the city of Santiago de los Caballeros. Continuity and citizens' perception of service quality also improved.

service in urban areas and to certain rural municipal capitals comparable to small cities, so its knowledge of the sector in strictly rural areas was limited, especially in communities and community management. Given that the project included a component with investments in rural areas to be implemented by CORAASAN, and given that management agreed on an operational reinforcement line for CORAASAN with regard to the support component, the design of a specific strategy for the program's rural intervention was deemed appropriate. This document includes that rural intervention strategy.

As a strategy designed under the framework of the urban-rural integration project in the province of Santiago[10], approved by the Bank on May 13, 2019, its content and approach are closely linked to the project. In other words, they structure the actions that CORAASAN will develop in rural areas of the project component, while consolidating its role as a rural operator, relying on the investment resources and actions made possible by the operation.

For the preparation of this strategy, the program team, in agreement with CORAASAN, decided to develop goals and lines of action based on the most reliable and current evidence and data possible. From the beginning, the teams from both institutions worked together on analyzing the basic information available at the state and regional level and one of the first conclusions was that there was hardly any up-to-date and detailed data on services in rural areas. Thus, in order to develop the strategy and make data-based decisions, the key decision was made to collect information, analyze it, and, based on the results, open up a dialogue with the main sectorial stakeholders in the province. With the conclusions of the analyses and by sharing the findings, the objectives and specific lines of actions for the rural part of Santiago could be set.

10. Project DR-L1139. At the time this report was written, the project was pending approval by the Dominican government.

The strategy preparation process was divided into four chronologically successive stages:

1 Methodological design stage

This initial stage consisted of identifying what rural information was available to try to generate the strategy, and designing the information gathering and results sharing stages.

2 Information gathering, analysis, and sharing stage

Information of various kinds was collected to ensure a complete analysis and diagnosis. The analyzed information was shared with local and international stakeholders in meetings and in a workshop to validate the results and invite reflection on what goals and actions to include in the strategy.

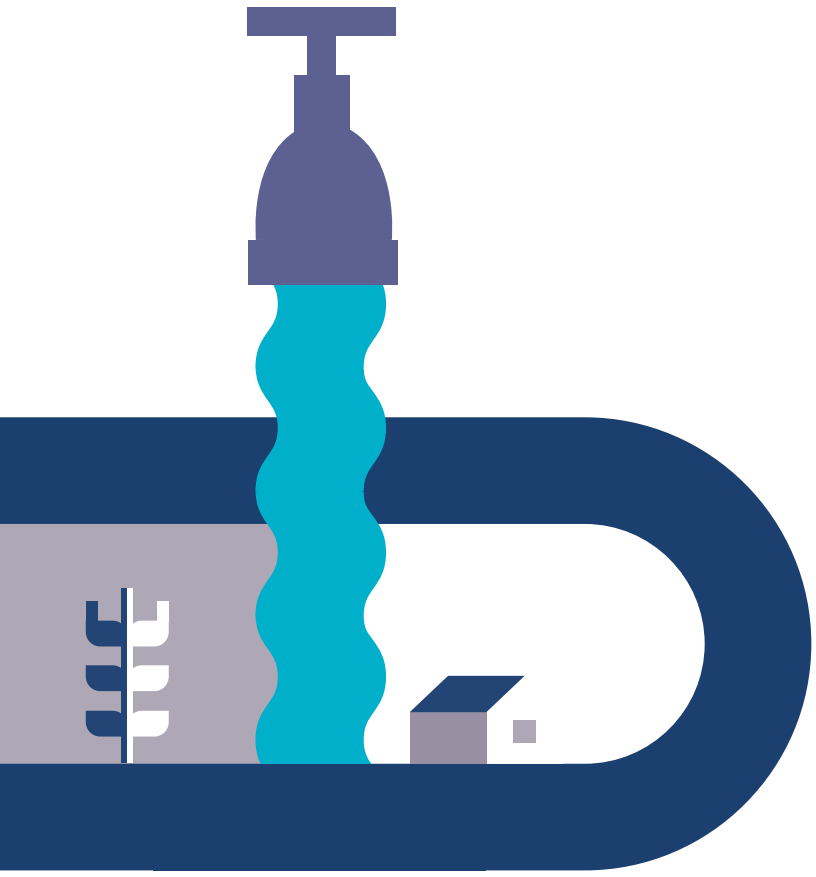
3 Scenario modeling stage

Based on the analyses carried out, several water service improvement scenarios were modeled, with different goals in critical parameters that define service quality. For each scenario, a cost schedule was devised to determine the viable objectives that could be achieved with the project's available resources.

4 Stage of defining lines of action and the implementation model

With the goals defined, a package of measures grouped into specific programs was designed for each of the priority areas identified in the diagnosis. A proposal for an institutional framework for the provision and a works implementation scheme were prepared in tandem. This scheme reflected CORAASAN's commitment to implementing a service model in rural areas, and its intention of working with local institutions, NGOs, universities, and civil society. A calendar of activities was also agreed upon that will allow the CORAASAN staff responsible for the strategy's implementation to keep track of all actions over time.

This note is structured in a partially chronological way; its structure is synchronized as much as possible to the timeline of the actual process that was followed to create the strategy itself. This narrative decision is intended to reflect the steps that the Bank and CORAASAN teams had to take to reach goals and propose concrete actions, and it can help in the preparation of projects in similar contexts where there is a lack of information. It also makes it easier to understand the reasoning behind the strategic decisions that were made.



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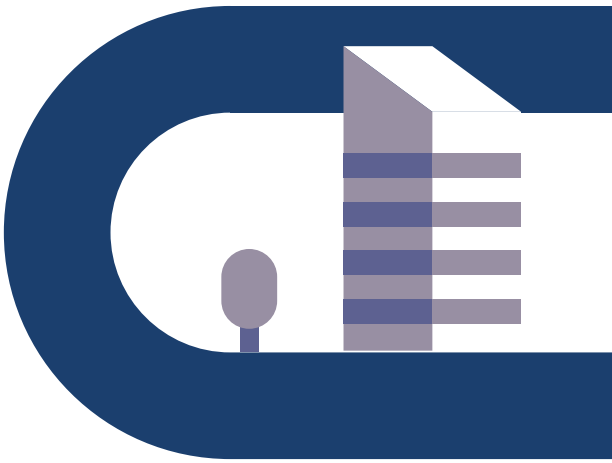


Methodological Design

2.1 Available information

The first stage in developing the strategy was to design the methodology to build it. In this stage, available data and the feasibility of collecting additional information were taken into account. The Bank and CORAASAN teams compiled and evaluated the main sources of information about rural water and sanitation available in the country and in the province of Santiago. Five primary sources of information were found:

- Maps of the official territorial division of the National Statistics Office (NSO).
- Official alphanumeric statistics of the NSO.
- Rural Water and Sanitation Information System (SIASAR)[11], run by INAPA.
- INAPA registry of users and databases of water supply systems.
- CORAASAN registry of users and databases of water supply systems.

11. SIASAR: Rural Water and Sanitation Information System, a system shared between several American countries and that INAPA implemented as official for rural sector monitoring in the country. SIASAR collects information about rural communities, improved water systems, service provision, and technical assistance. It is an open system, and all the information can be consulted on the website: http://globalsiasar.org/ .

The NSO publishes the country's official information, including both alphanumeric data and official maps. The cartographic information is linked to the country's official territorial division,[12] which periodically updates the NSO, together with the Ministry of Economy, Planning, and Development (MEPD), and has vector layers of information at all levels into which the Dominican Republic is territorially divided. These vector layers[13] do not include more data than the toponymy itself, so complex territorial analyses are not possible. The country's divisions are:

- The main division is those of the provinces, of which there are 31, plus the National District in the capital, Santo Domingo.
- Each province has various municipalities, which add up to a total of 157, which have political power and manage certain services. Each municipality has an urban municipal capital city.
- Larger or densely populated municipalities can be divided into districts, mainly administrative or census divisions. There are 234

12. Territorial Division 2017. Published by the NSO and by the MEPyD.
13. Refers to vector layers that were accessible to the team.

districts in the country and each one has an urban district capital city.
- Each district has one or more urban sections, up to a total of 391, and one or more rural sections, up to a total of 1,206.
- Finally, urban areas are divided into neighborhoods and sub-neighborhoods. The rural area is divided into *parajes*, which are the smallest subdivisions in rural areas. There are 10,021 rural *parajes* throughout the country.

The NSO also has abundant alphanumeric information, the main source of which is the 9th National Population and Housing Census of 2010.[14] Among many other types of population and housing data, the census collects sectoral information on water and sanitation, disaggregated at different territorial levels and between urban and rural areas, which allows a better understanding of what the service is like in each of these contexts. The breakdown, however, only goes to the municipality level, not all the way down to the *paraje* or neighborhood level, so there is no close-up picture of what the service is like. Neither were relevant questions included in the census to determine levels of service in water and sanitation as currently evaluated by the JMP.[15] In addition to the 2010 census, the NSO has a periodic household survey campaign with certain questions that provide more up-to-date information, but this catalog of data is not as complete from the sectoral point of view and many variables are not aggregated at a level more disaggregated than the province.

As for SIASAR, it collects information on water and sanitation services in rural communities, including data on the benefits of the system, service coverage, the hygiene situation in the communities, work done by community associations, basic service in educational and health centers, etc. In the Dominican Republic, SIASAR has been led by INAPA, which by 2019 was able to collect information on nearly 2,000 rural communities. The data collected in the province of Santiago before starting the project only included information on a few communities served by a single rural water supply system in the municipality of San José de las Matas.[16] This survey did not cover more than 5% of the total of rural communities that were estimated to exist at that time in the province,[17] and they were also located in a very specific area, so were not representative of the entire rural area in the province.

The information on water supply systems and users in INAPA and CORAASAN was very scarce and limited to urban areas, so it could not be used for the development of the rural intervention strategy.

Therefore, after analyzing the catalog of available data, the Bank and CORAASAN made the decision to prepare a complete survey of data in the field within the first few months of 2019, and to adopt a strategy of sharing results with stakeholders to ensure validation of the data collected.

14. This is the source of the data on service levels in the province that were mentioned in the note's introduction.
15. JMP service levels were defined after 2015, so they are after the NSO census.

16. The SIASAR survey in Santiago was carried out by INAPA in 2014 and was limited to the water supply system operated by a local association supported by the NGO Plan Sierra. This is the Community Development Council (COCODESI)'s water supply system, located in Pedregal, an example of a well-managed rural system serving more than 20 rural communities in the south of the province.
17. After the completion of the surveys in the entire province, it was found that the COCODESI communities represented 6% of the total in the province. However, they were served by a single water supply system, compared to the more than 100 that were eventually surveyed. Therefore, it was confirmed that these data were not representative of the province as a whole.

2.2 Surveys

To respond to the need for information, two parallel field survey campaigns were designed and coordinated by the CORAASAN management team:

- First, a household survey was carried out in the city of Santiago de los Caballeros and in the urban areas of rural municipalities and in rural *parajes* where there might be a community. The main difficulty in rural *parajes* was precisely that of determining what a community was, since the NSO does not officially recognize that entity and there is no list of communities in the country.
- For the sample of households, the territory was divided into segments and the exact samples needed in each segment were calculated to ensure statistical representativeness and that all territorial singularities were collected.
- The SIASAR survey was aimed at communities, water supply systems, and service providers. Although the objective was primarily related to rural water supply systems and providers, in some cases information was also collected on urban water supply systems whenever they were extending their services to places that the NSO considers rural.
- The "dispersed rural" population, those who live in rural areas with nine or fewer homes, was not included in the survey.

Figure 5: Municipalities in the province of Santiago, and distribution of urban and rural areas. Rural areas with more than ten dwellings are those chosen as places where there might be rural communities. Those with fewer than ten dwellings are considered "dispersed rural." Source: Authors' design, based on NSO's territorial information

The division most similar to the community that the NSO recognizes is the rural *paraje*, but it is not exactly a community. In some cases it is, but in others, there is no community in the area, and there are even cases where a community extends over several *parajes*. Therefore, the project's design criterion for what would be considered a community was a grouping of ten or more dwellings concentrated around a specific place, with a toponym recognized by its inhabitants. In preparing the project, an analysis was first carried out in the office using orthophotogrammetry to correctly identify how many rural communities there might be. Later, it was verified in the field whether the communities identified in the office were indeed communities.

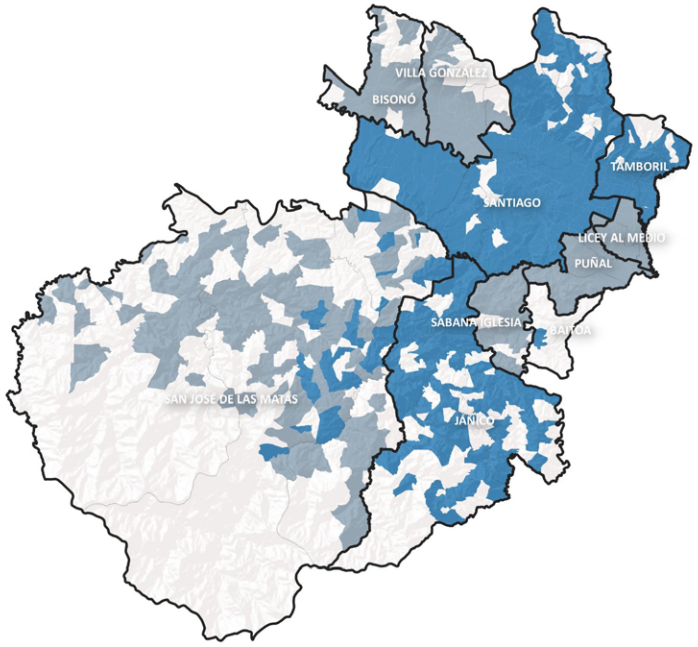
The surveys were carried out by CORAASAN's own teams with the support of IDB consul-

tants, final year students from the Autonomous University of Santo Domingo (AUSD) on its campus in Santiago de los Caballeros, from the Technological University of Santiago (TUS) and from the Technological Catholic University of Cibao (TCUC).

Illustration 3: *Training sessions for CORAASAN teams and universities, with the accompaniment of Bank and INAPA personnel. Source: Authors.*

Illustration 4: *Pilot in the field in Los Cocos, Santiago de los Caballeros. Source: Authors.*

Figure 6: In blue, rural and urban areas surveyed in phase 1, corresponding to areas of the project sample; in gray, urban and rural areas in phase 2, not included in the sample; in white, scattered rural areas not included in the survey. Source: Authors' design, based on NSO's information.



The province was divided into two parts, one with the areas designated by project management as "sample areas,"[18] and another with the rest of the provincial territory (Figure 6). Two successive work phases were planned, one for each area of the province:

- Phase 1 covered the territories of the sample areas: the municipalities of Santiago de los Caballeros,[19] Jánico, and Tamboril, in addition to the eastern area of San José de las

18. When preparing projects, the Bank team usually designates a territorial area that is considered the sample on which the preliminary analyses and studies are carried out and which allow the project to be designed. The sample must be representative of at least 30% of the project's final intervention scope.
19. The municipal capital of Baitoa was also surveyed in phase 1 because the data used to plan the household surveys still included it as part of the municipality of Santiago de los Caballeros. In SIASAR, it was surveyed in phase 2.

Matas coinciding with the area covered by the COCODESI water supply system. This sample constitutes approximately 46% of the total population of the capitals and 57% of the population of the rest of the rural area, and includes municipalities with various socioeconomic and morphological profiles, so it was considered representative of the rural reality of the entire province.

- Phase 2, in which household surveys and SIASAR surveys were carried out in all the other municipalities of the province, as well as in the San José de las Matas area, which was not included in phase 1. Although this survey stage was not necessary for the project design, the CORAASAN team observed the importance of completing the surveys in the entire province, especially with SIASAR, because that way they would have a benchmark baseline of the services of the entire rural area.

The strategy began to be built on this partial information collected during phase 1, which implied assuming that there would not be total certainty of what the rural area was like in the areas that were left out of the sample. CORAASAN completed phase 2 of the surveys, but the results were not expected to be validated or processed within the preparatory analysis stage of the strategy and scenario modeling, so they were not used for this process. Nor have they been included in the note, in order to maintain consistency with the work done at the time.

One of the main design criteria of the survey was that it would allow the construction of the service ladders proposed by the JMP to monitor the SDGs in terms of water, sanitation, and hygiene. Thanks to household surveys, these ladders could be determined for both the city of Santiago de los Caballeros,[20] where 397 surveys were carried out in phase 1, as well as for households in the other urban municipal capitals and rural *parajes*, where another 4,981 surveys were conducted.[21]

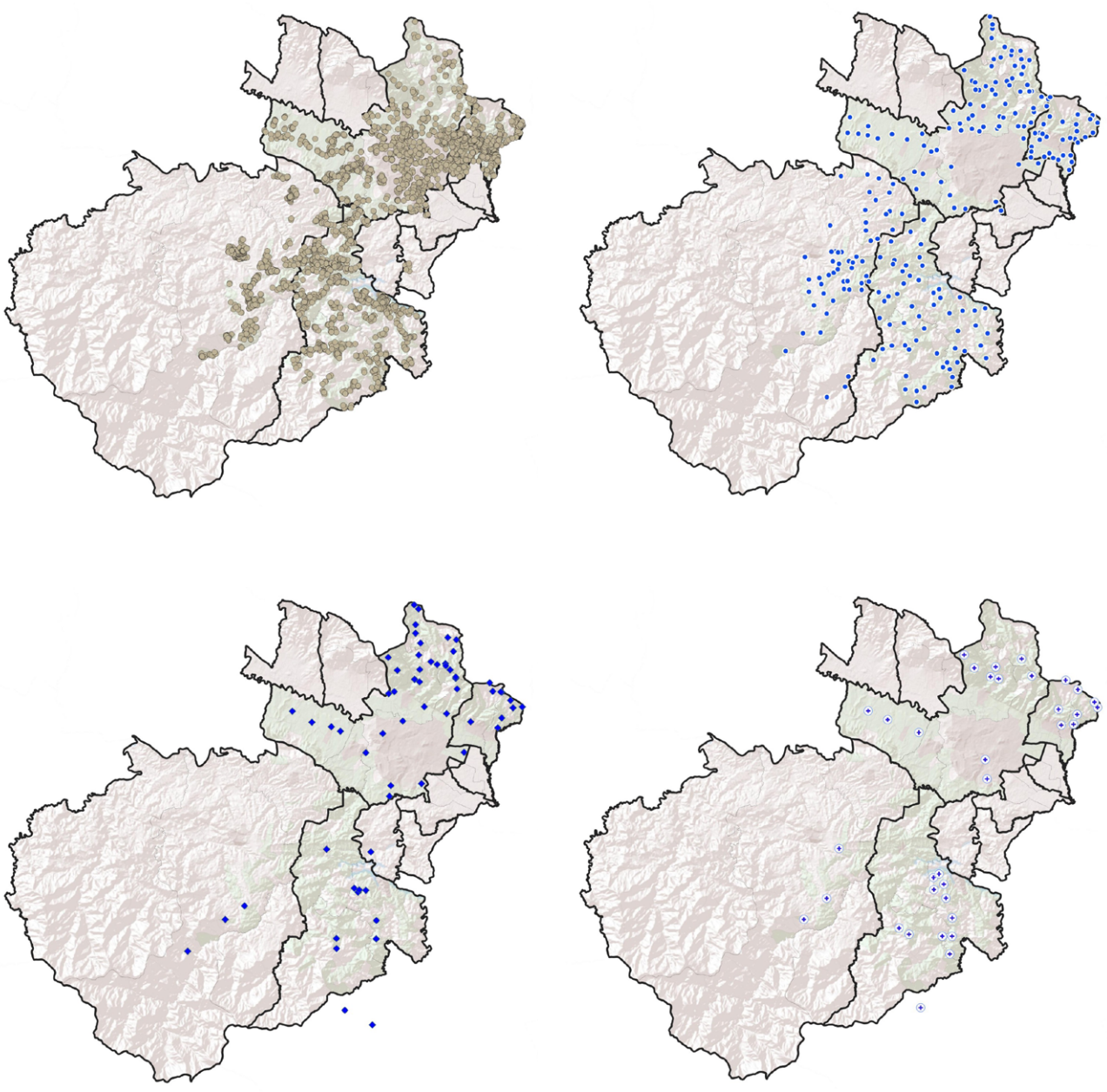
Illustration 6: *Information gathering in homes in San José de las Matas. Source: Authors.*

Illustration 5: *Information gathering in schools in Santiago de los Caballeros. Source: Authors.*

20. Although the results of the city of Santiago de los Caballeros are not decisive for a rural intervention strategy, they have been included in the analyses to highlight the contrast between urban and rural environments.

21. Appendix I shows the distribution of households surveyed in each municipality and context.

Figure 7: From left to right and top to bottom: Location of the household surveys carried out in phase 1; communities surveyed with SIASAR; water systems surveyed with SIASAR; water system service providers surveyed in SIASAR. Source: Authors' own preparation and SIASAR.



In this same phase 1, a total of 231 communities, 70 water supply systems, and 36 service providers were surveyed with SIASAR. Given that it was the first time that an exhaustive survey of rural communities had been carried out in the province of Santiago, there was no certainty about how many there were. Despite this initial uncertainty about the scope of the survey, the team considers that practically all the communities of the four municipalities included in this phase were surveyed.[22]

The data collected in the surveys went through a review and validation process before being processed to generate analysis and results. The validation methodologies were different for each case:

- In the survey of households, the surveys could not be reviewed one by one, given the volume of information collected. Instead, surveys were verified at random to ensure that the fieldwork was correct. The location of the points on the map was also checked to investigate any deviations or errors in the field, and telephone calls were made to verify data of 200 households (5% of all surveys).
- SIASAR does have a validation mechanism in the system, and since there were fewer surveys, it was possible to review them one by one to detect possible errors. The main revisions and corrections had to do with flow data, chlorine dosage, coverage, and the number of dwellings in the communities. In most cases, incidents could be resolved by telephone with community leaders, although in some cases a trip back to town was needed to collect additional information.

Illustration 7: *Example of a rural community concentrated in Jánico. Source: Authors*

Illustration 8: *View of communities around highways in San José de las Matas. Source: Authors*

22. The total of the rural population from whom data was collected in the SIASAR surveys is of a similar magnitude to the rural population reflected in the NSO's 2010 census. This leads us to think with some degree of certainty that practically all the communities must have been surveyed, even assuming that the population numbers of the NSO and SIASAR cannot be the same since: (i) the population has varied between 2010 and 2019; (ii) the SIASAR population survey has a certain margin of error because it is an estimate; and (iii) some of the rural population lives in scattered dwellings outside communities. More information about the SIASAR survey is in Appendix I.

2.3 Criterion for the definition of urban and rural areas

Once the surveys were completed, it was necessary to clearly differentiate between what was an urban area versus a rural area in the analysis phase and in the presentation of the results. Technically, in the country's official territorial division documents, the NSO clearly defines the urban and the rural, but that differentiation has little traction in the country, and it has been verified in the field that it has become obsolete in the face of urban development. Figure 8 shows how some rural *parajes* have a clearly urban structure, while other areas classified as urban appear to be open areas more typical of a rural setting.

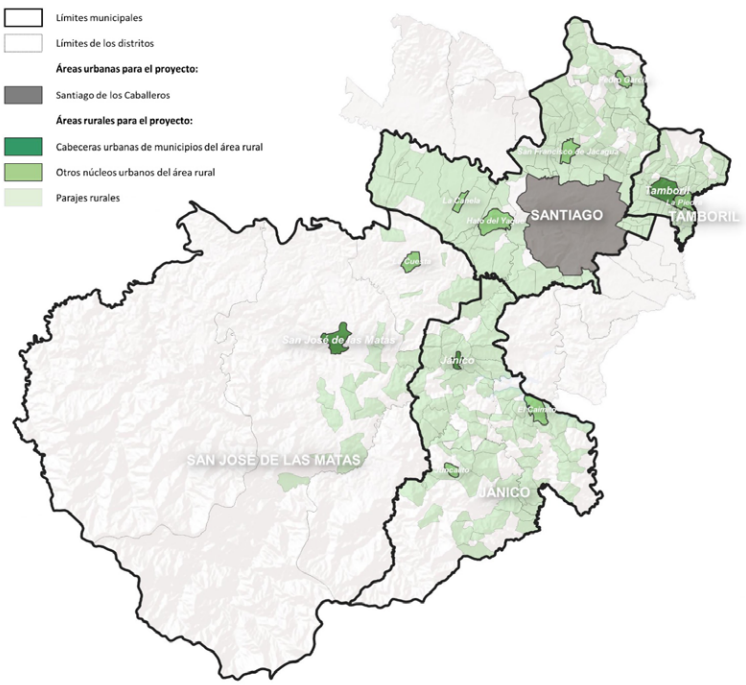
The difficulty of defining the areas represented an added challenge when preparing the project, since this strategy is oriented to the rural area and the information analyzed and presented should be limited to that context. In addition, beyond the NSO's own classification and the problems observed, the rest of the institutions and sources consulted in the country have different criteria about what is urban and what is rural, all of which are justified based on what those institutions need for their action plans.

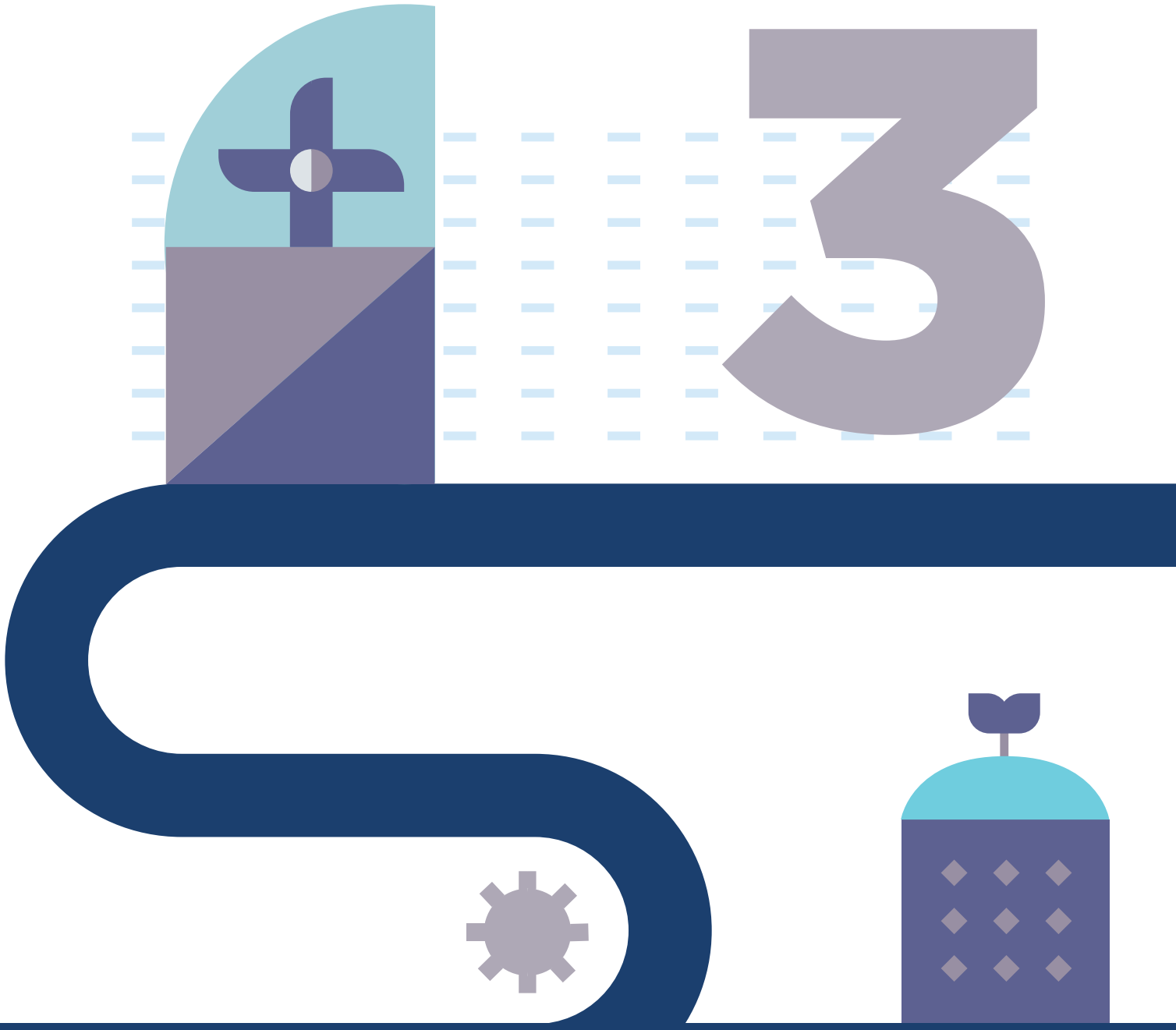
To clarify this, the team took into account a criterion based on the fact that in the province of Santiago, the city of Santiago de los Caballeros and its suburbs are often colloquially referred to as an "urban area" and the rest of the province is the "rural area," although for NSO this is not the case.

Following this criterion, the strategy groups together as a rural area everything that is traditionally understood as a "rural area" in Santiago, i.e., purely rural *parajes*, the rural municipality capitals and other cities (section capitals) that, although urban for NSO, are in the rural area of the province (Figure 9). Only the provincial capital and certain areas of its suburbs are still urban areas.
For a better understanding of the results, some graphs have been divided to show, on the one hand, the results of households in rural *parajes* and, on the other, households in the capital cities, since although both fall within the "rural area" of the project, they have somewhat different social and urban structures. In all cases, the municipality has been privileged as a division to which results can be added.

Figure 8: Example of inconsistencies in the formal delimitation between urban and rural. To the north, the light areas are rural *parajes*. To the south, the darkest areas are urban neighborhoods in Santiago de los Caballeros. Source: NSO

Figure 9: Classification of urban and rural areas for the purposes of the project and designing the strategy. Only the areas integrated into phase 1 of the surveys are shown. Source: Authors' own preparation based on NSO's information.





Survey results

3.1 SDG perspective: Household surveys

3.1.1 Water

Results in terms of drinking water service showed that practically all households in rural *parajes* have access to basic service (water obtained from improved sources under 30 minutes away) (Figure 10). Yet, no household receives the highest level of service defined by the JMP: a securely managed service. A similar situation was observed in the municipal

Figure 10: JMP in rural *parajes* of the four municipalities sampled (excludes municipal capitals). Source: Authors' preparation based on the results of Phase 1's household surveys.

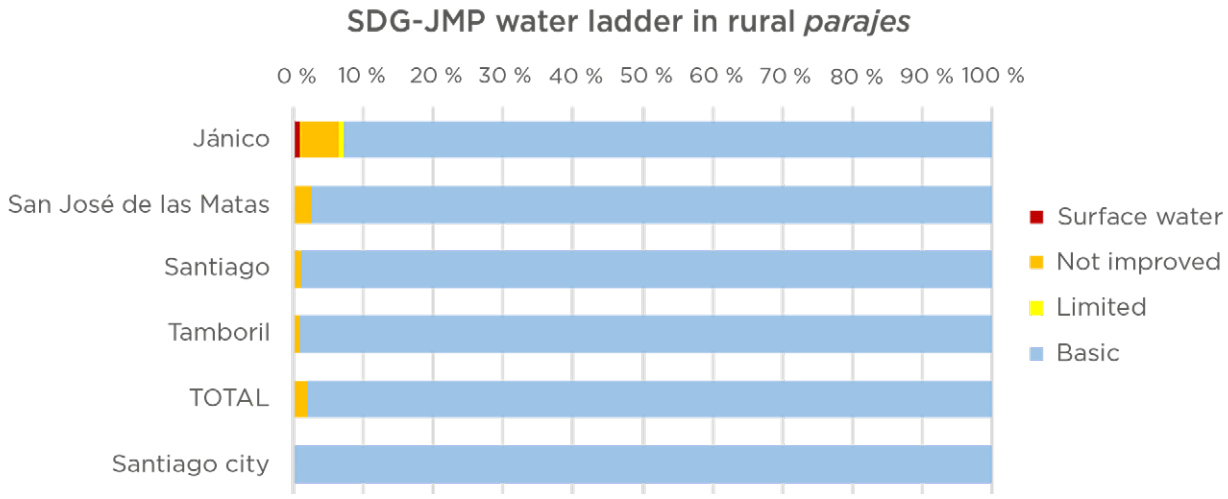
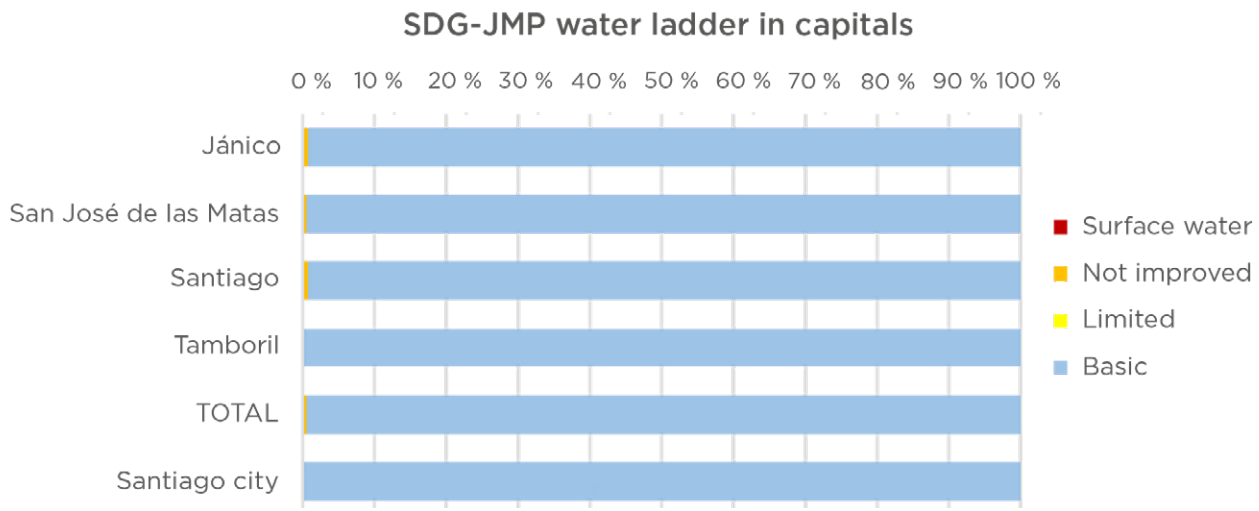


Figure 11: JMP water ladder in rural locations of the four municipalities sampled (excludes municipal capitals). Source: Authors' preparation based on the results of Phase 1's household surveys.



capitals of the rural area of the municipalities analyzed, although in this case, 99% of households in the municipalities in this survey phase had basic service (Figure 11).

The fact that no household in a rural area has access to the securely managed service, whether in capitals or in *parajes*, may be due to, as the results of the SIASAR surveys indicate, the lack of guaranteed service continuity or absence of contamination. Water treatment or disinfection is not carried out in almost all of the strictly rural water supply systems. There is also no monitoring or chlorine treatment done by the provincial provider, i.e., CORAASAN. It should be noted that even if there was treatment to ensure that water was contamination free, 80% of households would still not have access to a securely managed service due to low continuity and provision rates observed.

3.1.2 Sanitation

In terms of sanitation, the majority of service is at least basic (improved installation not shared with other households), although there is a significant percentage of households that receive unimproved service, especially in the rural areas of the municipality of Jánico (Figure 12). In municipal capitals, the level of improved sanitation service is more widespread (Figure 13) but it is not universal either, in contrast to the urban context of Santiago de los Caballeros, where practically all households have access to at least basic service. In addition, the practice of open defecation, despite being limited, is not non-existent, with 2% of people engaging in this habit at least occasionally, both in rural *parajes* and in the rural area capitals.

These household surveys cannot determine the percentage with access to securely managed service sanitation because sufficiently reliable information on storage, removal, transport, treatment, and the use of sludge or wastewater generated by households could

Illustration 9: *Examples of the differences found in sanitation facilities in homes in different rural areas of the province of Santiago. Source: CORAASAN household survey.*

not be captured. However, during the project's implementation, additional surveys are planned to be carried out that characterize all management along the entire sanitation chain, which is expected to make it possible to estimate this level of service.

Figure 12: JMP sanitation ladder in rural *parajes* of the four municipalities sampled (excludes municipal capitals). Source: Authors' preparation based on the results of Phase 1's household surveys.

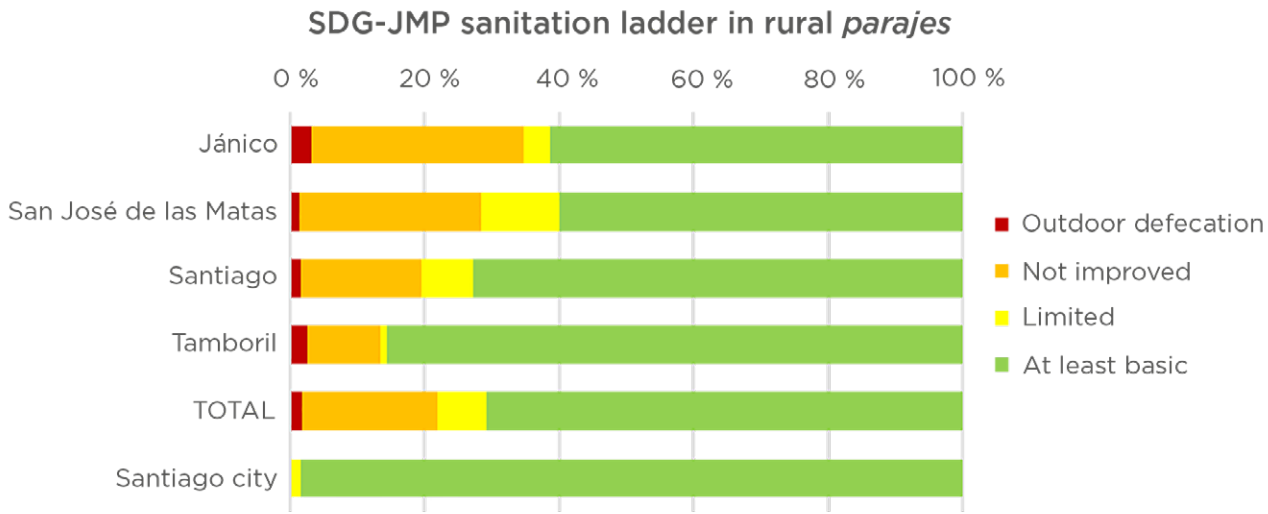


Figure 13: JMP sanitation ladder in the capitals of the four municipalities sampled. Source: Authors' preparation based on the results of Phase 1's household surveys.

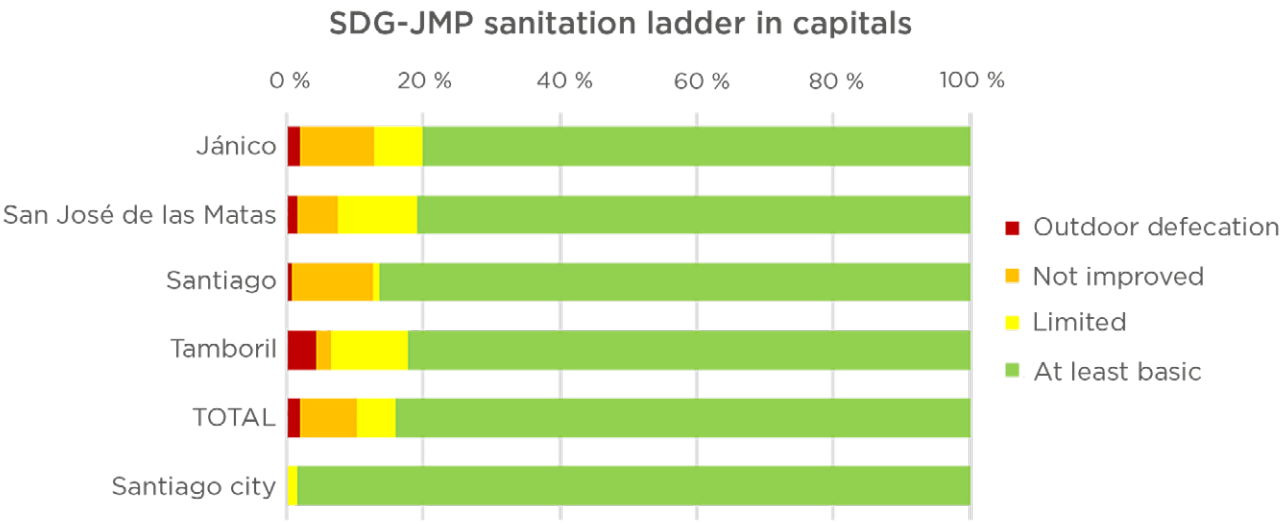


Figure 14: Right, distribution of households by installation in rural *parajes* of the four municipalities sampled (excludes municipal capitals). Left, distribution according to its location. Source: Authors' preparation based on the results of Phase 1's household surveys.

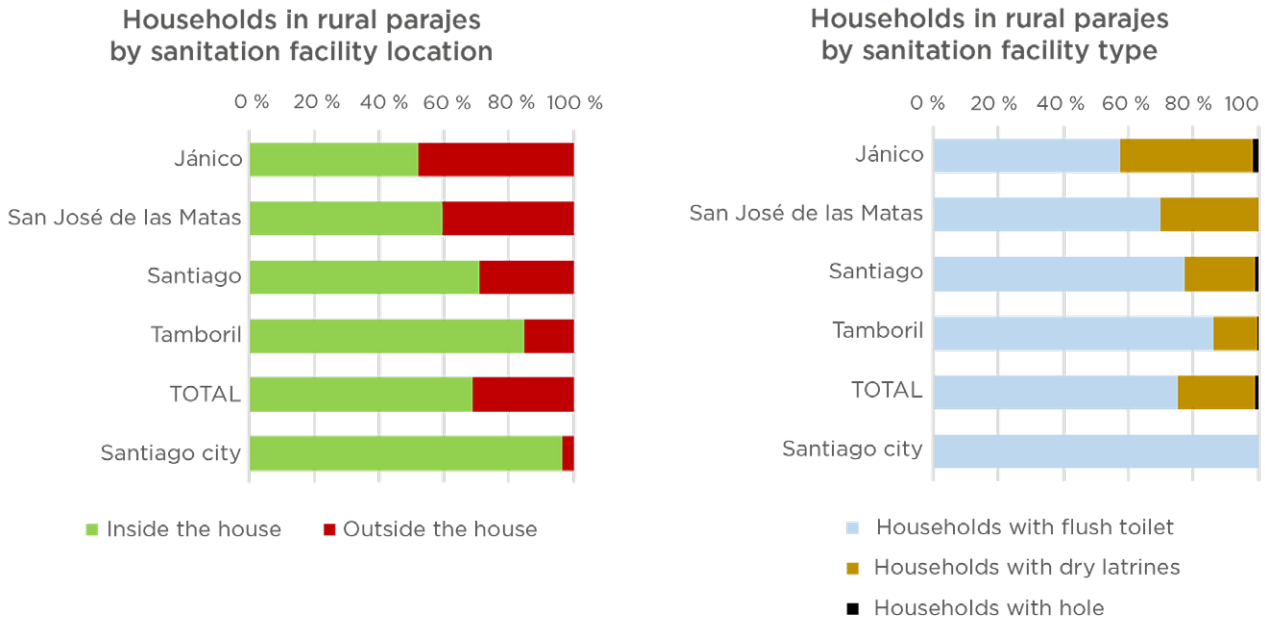
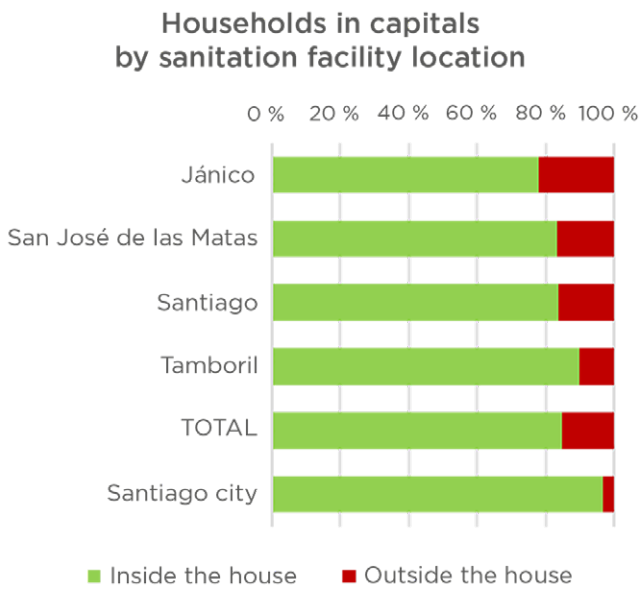
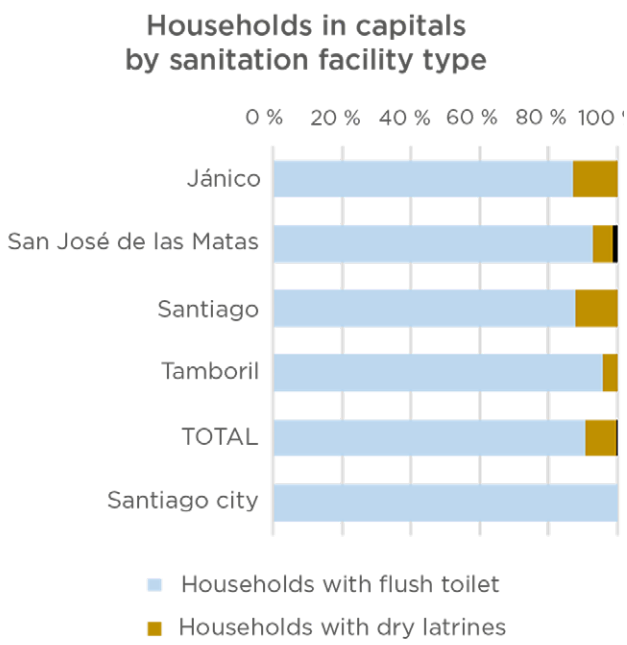


Figure 15: Right, distribution of homes by installation in municipal capitals of the four municipalities sampled. Left, distribution according to its location. Source: Authors' preparation based on the results of Phase 1's household surveys.





Regarding sanitation facilities, while the entire population in the city of Santiago de los Caballeros has a flush toilet, in the context of rural areas, dry latrines represent more than 20%, and reach a maximum of 40% in the rural *parajes* in the municipality of Jánico. In addition, in 50% of the homes in the rural *parajes* of this municipality, the sanitation facility is located outside the home (Figure 14).

3.1.3 Hygiene

Regarding hygiene, less than 40% of the homes located in rural *parajes* have a facility for washing hands with soap and water near the sanitation facility, while that number is over 60% in the city of Santiago de los Caballeros

Illustration 10: *Example of improved installation outside the home. Source: CORAASAN household survey.*

Illustration 11: *Construction of a new installation over a pit. Source: CORAASAN household survey.*

(Figure 16). Many homes do not have a specific installation or, even if they have one, did not have soap on the day they were surveyed. In this case, the differences between the two contexts —*parajes* and capitals— are not as noticeable, although a higher percentage of households with basic service in the capital areas was noted (Figure 17).

Figure 16: JMP hygiene ladder in rural *parajes* of the four municipalities sampled (excludes municipal capitals). Source: Authors' preparation based on the results of Phase 1's household surveys.

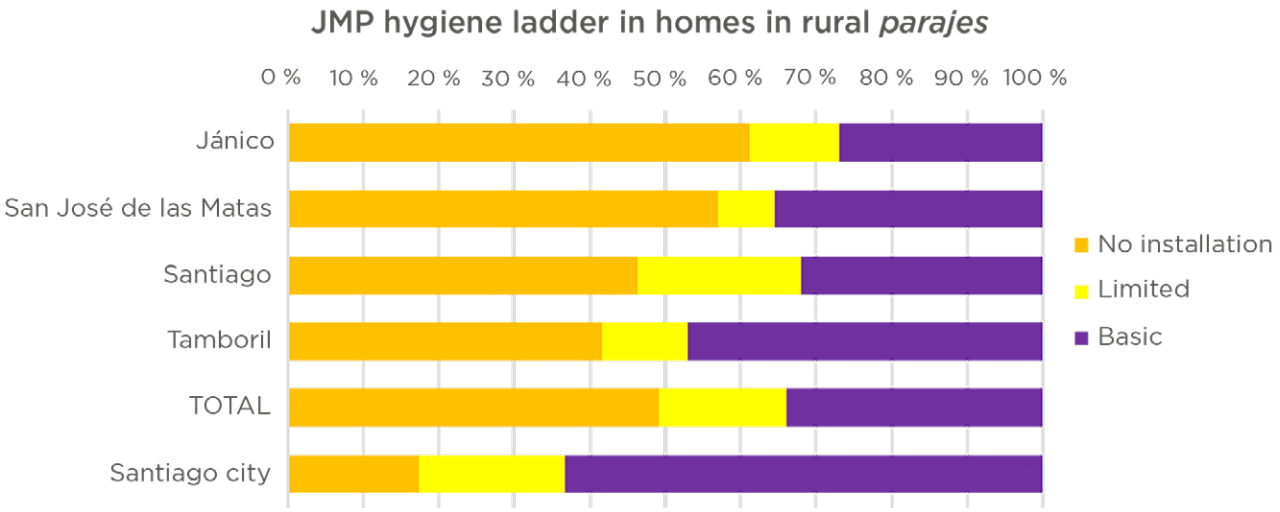
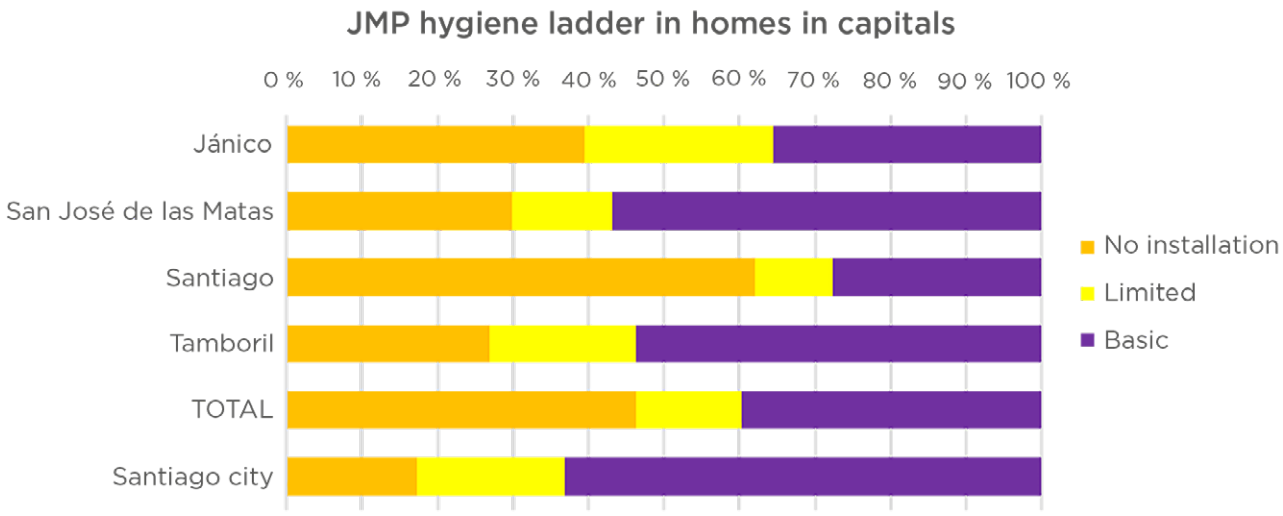


Figure 17: JMP hygiene ladder in rural locations of the four municipalities sampled (excludes municipal capitals). Source: Authors' preparation based on the results of Phase 1's household surveys.



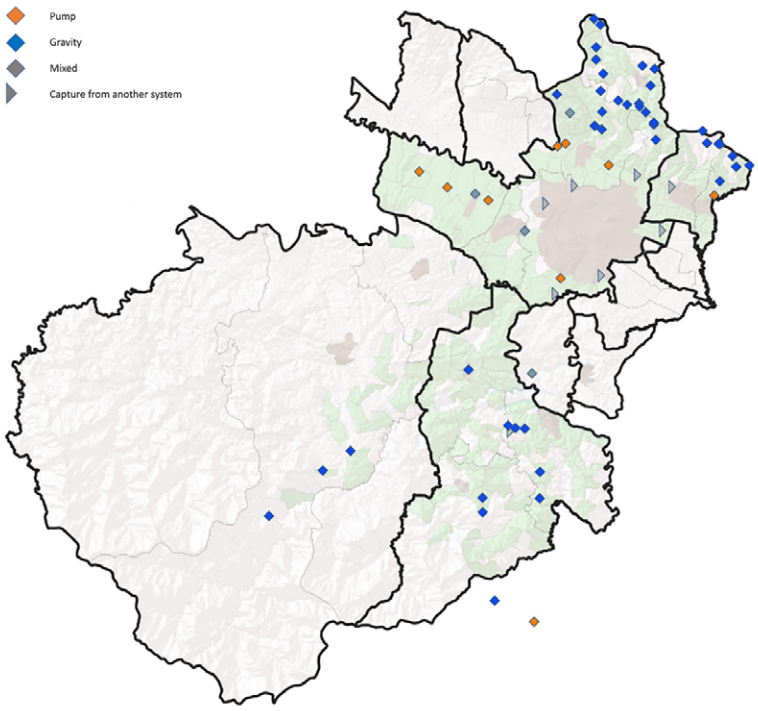
3.2 Services provided by water supply systems and rural operators: SIASAR

The SIASAR surveys revealed the large number of existing water supply systems in the rural part of the province—up to 70 in the Phase 1 survey area alone (Figure 18)—many of which were not known to exist by the institutions of the sector. The vast majority of these water supply systems are located in mountainous areas and each of them usually serves a single community of just a few dwellings, so they are generally small systems with storage volumes of less than 100 cubic meters. However, some water supply systems that serve various communities have also been noted, such as the COCODESI, Jánico, and El Caimito water supply systems, among others. These water supply systems can run several kilometers, have tanks with volumes between 100 and 500 cubic meters, and average flow rates above one liter per second.

A unique situation that was uncovered in the survey is the significant number of rural *parajes* or urban capitals in the rural area classified as "community" for the purposes of SIASAR and which are served by branches of the urban water supply systems from the city of Santiago

Illustration 12: *Main storage for the water supply systems of the Carrizal community in San José de las Matas. Source: Authors' preparation.*

Figure 18: Water supply systems surveyed with SIASAR, by type. Those marked as "intake from another system" are actually branches/ extensions of the urban water supply systems, mainly, although not only, of the city of Santiago de los Caballeros. Source: Authors' preparation based on SIASAR surveys (Phase 1).



de los Caballeros. This situation occurs in 70 of the 231 communities surveyed, which represent 60% of the rural population in the survey areas of Phase 1.

The information on these *parajes* was collected with SIASAR, and assumes that the water supply systems that serve them are not "rural water supply systems" in the strict sense of the term. The level of service for this rural population supplied by the city of Santiago de los Caballeros' systems has been characterized in the surveys because it is a population settled in rural *parajes* according to the NSO. But the solutions proposed to improve water and sanitation services in these *parajes* were located within the project's urban investments, not the rural ones. Therefore, the rural strategy will not have a direct impact on these areas that are covered by the strategies and actions planned in the urban component.

In light of the high coverage results reported in Table 2, the conclusion can be drawn that practically the entire rural population has a household connection to a water supply system. However, when analyzing the characteristics of the service (treatment,[23] chlorination, continuity, and provision), it was concluded that rural inhabitants do not receive secure drinking water service since the water is not treated, the physicochemical and biological

23. Treatment is understood as those physical, chemical, or biological processes that ensure that raw water reaches the point of consumption free of contamination or characteristics undesirable for its use, such as turbidity, color, bad taste, or odor. For the JMP, safe water is understood as water that is free from fecal contamination and priority chemicals.

Figure 19: Left, rural *parajes* with communities served by CORAASAN's urban water supply systems; Right, communities by population. As shown, the most populated communities are around the city of Santiago de los Caballeros and practically all of them are part of the urban network. Source: Authors' preparation based on SIASAR and NSO data.

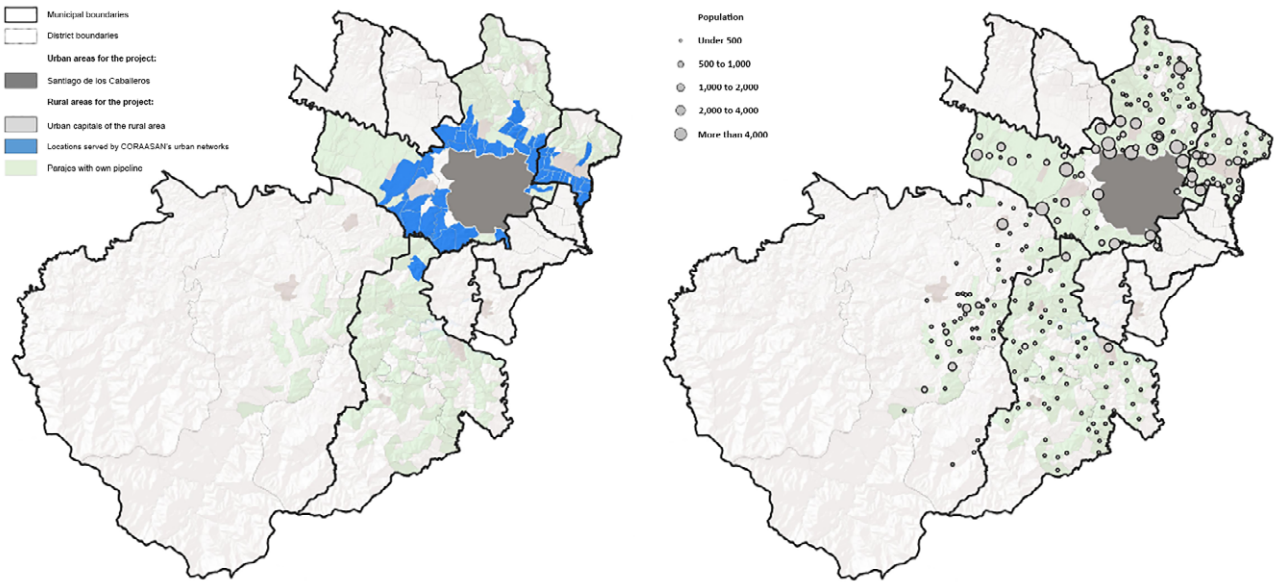


Table 2: Main critical parameters in rural supply (rural *parajes* and municipal capitals, excluding areas served by urban water supply systems). Source: Authors' preparation based on SIASAR surveys (Phase 1). The data for San José de las Matas corresponds to the area of the COCODESI water supply system.

Town	Treatment	Chlorination	Continuity	Provision	Coverage
	Treatment facility in system [% population]	Chlorine dosage between 0.2 and 1.0 ppm [% population]	Average of more than 12 hours a day [% population]	More than 50 l/p/d [% population]	Access to water supply system [% population]
Jánico	0 %	0 %	11 %	43 %	87 %
San José de las Matas *	0 %	0 %	87 %	79 %	97 %
Santiago	5 %	9 %	29 %	8 %	90 %
Tamboril	0 %	0 %	56 %	8 %	92 %
TOTAL	**2 %**	**4 %**	**44 %**	**35 %**	**91 %**

Illustration 13: Example of surface catchment in the Las Piedras gravity flow water supply systems in San José de las Matas. Source: SIASAR.

Illustration 14: Example of underground catchment by electric pumping managed by CORAASAN in Los Cocos, municipality of Santiago de los Caballeros. Source: Authors' preparation.

quality parameters are not monitored,[24] and it is not properly disinfected (Figure 20). In addition, service availability during the day is not assured and average supply is less than 50 liters per person per day in almost two-thirds of the homes. This figure contrasts with the 500 liters per person per day that are consumed on average in some areas of the city of Santiago de los Caballeros, according to analyses carried out when preparing the project's urban component.

In this generalized context of low service quality, the service level achieved by the COCODESI operator is notable. In fact, it is considered a rural environment management success story in the country, which has been supported by the data collected (Figure 20).

The COCODESI water supply system, in the municipality of San José de las Matas, is one of only six systems that have been found to be actually operated by fully constituted community associations or cooperatives, recognized as ASOCARs by INAPA. The rest of the water supply systems are operated either by non-specialized organizations such as community neighborhood councils or by water committees that are informal groups (Figure 21). Twenty-four informal providers have been found in this survey, i.e., only 23% of community providers are duly constituted, recognized by INAPA, and have certain legal guarantees to operate their water supply systems.

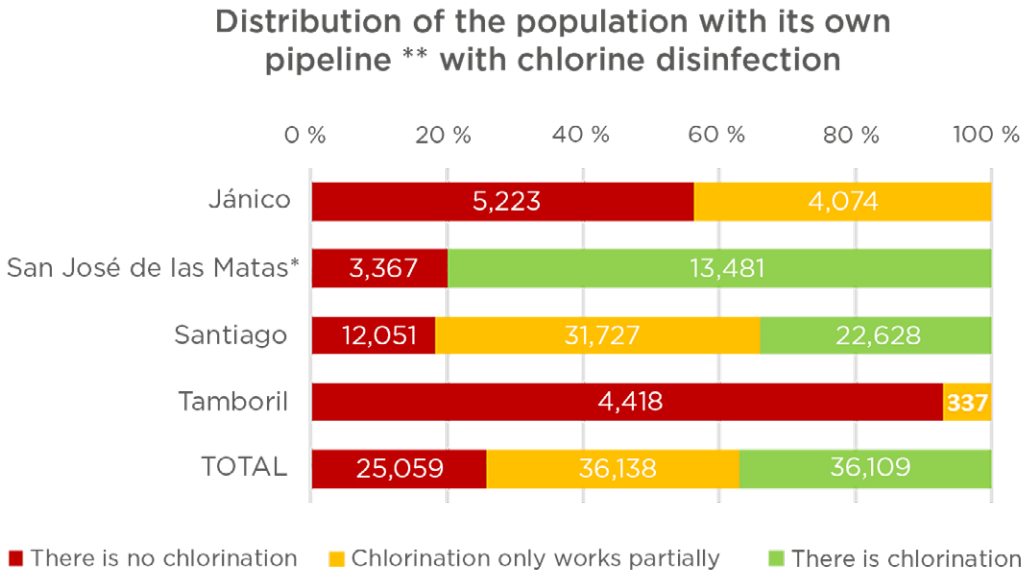
There are also numerous water supply systems that do not have real service, and it is a volunteer or a family that knows the water supply system and, although they can with some effort make sure that everything is still working, they cannot adequately carry out maintenance or service the sources. This last case has been called informal provision in Figure 21. CORAASAN also provides rural service, but in the cases mentioned above: populations characterized as rural that are being served with urban or capital water supply systems.

24. During the strategy preparation period, the team did not have enough quality analysis information from the sources. As a precautionary principle, and taking into account that many are located on land close to livestock and agricultural operations, the team considered that it cannot be said that the water is safe in terms of quality for human consumption.

Illustration 15: Customer service and fee payment office in Los Montones, San José de las Matas. Source: SIASAR.

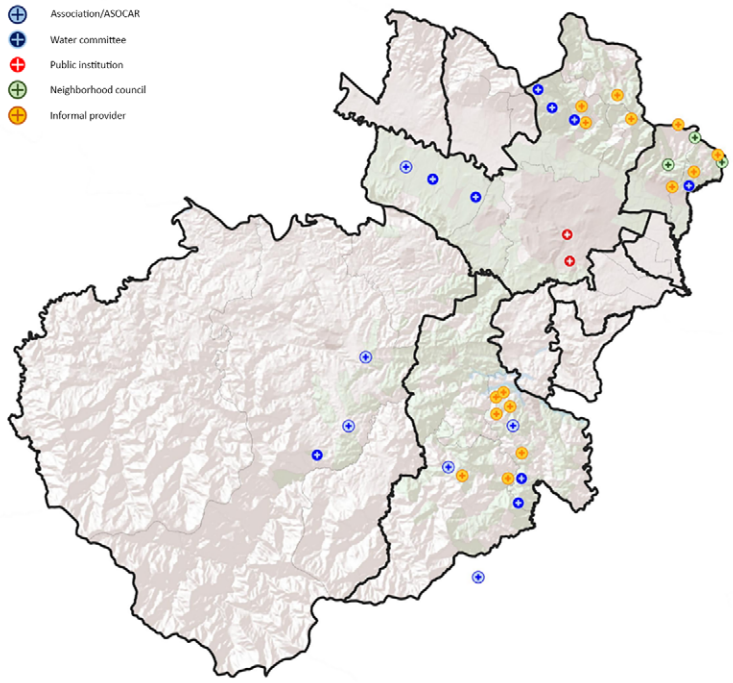
Illustration 16: Main COCODESI office in Pedregal, San José de las Matas. Source: SIASAR.

Figure 20: Population based on access to systems with chlorination treatment. Source: Authors' preparation based on SIASAR surveys (Phase 1). * The data for San José de las Matas correspond to the COCODESI area. ** The population supplied by branches of urban water supply systems is excluded, with the term "own water supply system" understood to mean one that provides service only to that rural population or rural capital[25]



25. This explains, for example, why in Tamboril there are so few houses on the graph and why there is no chlorination. The capitals of Tamboril and part of its rural *parajes* are served by COCODESI's Cibao water supply systems, excluded from the graph.

Figure 21: Rural providers according to their typology. Source: Authors' preparation based on SIASAR surveys (Phase 1).



3.3 Institutional rural workshop

An important milestone in the design of the strategy was the rural workshop that took place in June 2019 at the Pontificia Universidad Católica Madre y Maestra (PUCMM) in Santiago de los Caballeros, and which had three main objectives: (i) present the results of the analyses and to some extent validate that the diagnosis obtained corresponded to the stakeholders' vision for the sector; (ii) learn about experiences, best practices, and future plans of different institutions and social organizations; and (iii) work together on identifying the most relevant lines of work for the rural strategy.

The main sectorial stakeholders in the province participated in the workshop, as well as some international representatives:

- Representatives of public institutions such as CORAASAN, INAPA, representatives of the Ministry of Education and the Ministry of Public Health, municipal representatives, local authorities, and the Presidential Commission for the Planning and Management of the Yaque del Norte River Basin.
- Sector donors such as the Spanish Agency for International Development Cooperation (AECID) and the IDB.

Illustration 17: *Rural workshop on the PUCMM campus in Santiago de los Caballeros. Source: Authors' preparation.*

- Researchers, international consultants, and representatives from academia.
- Members of community associations and development foundations, such as Water Aid, Plan Sierra, COCODESI, and the Association for the Development of the Dominican Republic (APEDI).

Around 75 people participated and contributed to validating the results of the surveys, since the data presented was in line with the perception of local stakeholders. It also made it possible to establish a common view of how to improve service quality in rural areas. Some of the workshop's most important conclusions included:

- Participation of stakeholders and institutions is a strength that can be used by the project to increase impact. There are some success stories in the management of community water supply systems in Santiago, especially in the municipality of San José de las Matas.
- CORAASAN received the recommendation to strengthen its role as the main effective and continuous technical support for rural water supply systems.
- The need for 100% of the water served by rural water supply systems to be treated with chlorine was shared.
- The increasing scarcity of water resources is a challenge that must be faced from a multisectoral perspective.
- Faced with provision and continuity problems, micro-metering can be an alternative to be explored in certain contexts.
- Grouping small service providers into larger-scale associations can help maintain better operation and maintenance of water supply systems.

4

Scenarios and objectives

4.1 Scenario modeling

4.1.1 Water service levels

After completing the first phase of the surveys, a generation model of different scenarios was built that incorporated the following tools:

- A tool to classify water supply systems and communities without a system, based on levels of water service similar to those used by the JMP to monitor the SDGs.
- An interventions models[26] that applies a catalog of solutions in response to the diagnostic results of each water supply system or community without a system.
- A table of scenarios that combines the level of service achievable with the budget available for it.

In the classification tool, critical parameters were identified that limit the rural population's access to better service levels: ensuring that water is fit for human consumption, disinfection through chlorination, continuity of service, sufficient provision, taking the recommendations of the World Health Organization[27] and water coverage from improved sources. These five parameters were partially inspired by concepts that are used at the levels of the JMP ladder (use of improved sources, continuity, water free of contamination, etc.), but also in concepts relevant to the project's general objectives (increase of coverage, provision improvement).

Each of these parameters was divided into up to four ABCD traffic light levels inspired by SIASAR's current KPI classification.[28] However, these KPIs were tailor-made for this project. Native SIASAR algorithms were not used.[29] In service levels, A represents optimal and D represents minimal or non-existent (Table 3). Levels A and B are acceptable and levels C and D should be avoided. For each of the criti-

26. The intervention model is expected to be able to be calibrated and improved once the project's investments begin to be implemented.

27. *Domestic Water Quantity, Service Level and Health*; G. Howard, J. Bartram; World Health Organization; Geneva; 2003

28. http://globalsiasar.org/es/content/documentacion-tecnica

29. SIASAR's traffic light classification is clear and facilitates decision-making since institutions can establish minimum levels for services. This criterion of intervening at one level or another has already been used by INAPA in the Dominican Republic and, on a much larger scale, by sectorial institutions in Nicaragua. Therefore, the team deemed using analogous classifications appropriate. But original levels and indicators were designed because, among other reasons, the SIASAR's KPIs are calculated on communities, while in Santiago they needed to be applied mainly to water supply systems.

cal parameters, any action should be aimed at scaling up to higher levels of A or B and guaranteeing them in the long term.

A general categorization of the service level of the water supply system (or of the community without a system) was established by combining the ABCD levels of each parameter, with seven levels (Table 3). Level 6 represents the optimal state in all the analysis criteria; Levels 5 and 4 are good and fair statuses respectively, while Levels 3, 2, and 1 are inadequate service levels. Level 0 indicates that there is no service, or it is very deficient in continuity and provision, or it offers very low coverage in its communities. Based on this grouping, processing the SIASAR information gathered and excluding the rural areas served by CORAASAN's urban water supply systems, it was determined that currently there is no inhabitant of the rural area of the province that has optimal or adequate service levels, i.e., levels 6, 5 and 4 (Table 4). Furthermore, most of the rural population is included in service levels 1 and 0 (Table 4). In Figure 22, a fragment of the table for calculating service levels (service criteria in the figure) and the specific analysis parameters with which each system was evaluated is shown.

Table 3: Specific levels for each of the analysis parameters built.

Quality	Criteria
A	Comply with quality regulations
B	-
C	-
D	Do not comply with regulations

Treatment	Criteria
A	0.2 - 1.0 ppm
B	-
C	0.01 - 0.2 ppm, or > 1 ppm
D	Not chlorinated

Continuity	Criteria
A	24 hours
B	12 - 24 hours
C	6 - 12 hours
D	0 - 6 hours

Provision	Criteria
A	100 l/p/d or more
B	50 - 100 l/p/d
C	25 - 50 l/p/d
D	0 - 20 l/p/d

Coverage	Criteria
A	100 % of dwellings
B	90 - 100% of dwellings
C	Less than 90% of dwellings
D	Community without a water supply system

Figure 22: System classification table, with calculation of service criteria and analysis for some water supply systems in the province of Santiago, based on data obtained from SIASAR information gathering.

DATOS BÁSICOS			
Comunidad / Acueducto	PSE principal	Tipo de fuente principal	Año
ACUEDUCTO MÚLTIPLE COCODESI	PRESTADOR COCODESI	Ojo de Agua o Manantial	1986
TOMA DE LAS CAOBAS	PRESTADOR DE AGUA LA YALLITA	Fuente	2013
TOMA CONGO ABAJO	PRESTADOR DE AGUA LA YALLITA	Fuente	1991
TOMA DE PALMA LIMPIA	PRESTADOR DE AGUA LA YALLITA	Ojo de Agua o Manantial	1994
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	Fuente	1999
JAIBERO CANCA ARRIBA	COMITE DE AGUA CANCA ARRIBA	Fuente	1984
ACUEDUCTO BEJUCAL	COMITÉ BEJUCAL	Otras	2010
JULIO SENON VIÑAS (EL PAPAYO)	COMITÉ JULIO SENON VIÑAS (EL PAPAYO)	Fuente	2014
ACUEDUCTO LA CALABERNA	PRESTADOR CALABERNA	Fuente	2011
SISTEMA DE EL ACUEDUCTO EL AÑÓN	PRESTADOR EL ANÓN	Ojo de Agua o Manantial	1985
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	JUNTA DE VECINO NUEVA ESPERANZA	Pozo Perforado	2019
ACUEDUCTO BOCA DE LICEY	JUNTA DE VECINO SAN FRANCISCO DE ASIS	Ojo de Agua o Manantial	1979
ACUEDUCTO ALTO DEL AGUACATE	PRESTADOR ALTO EL AGUACATE	Fuente	1985
ACUEDUCTO JUAN MARÍA HENRIQUEZ	JUNTA DE VECINO JUAN MARÍA HENRIQUEZ	Fuente	1974
TOMA DE LOS LEONES	PRESTADOR DE LOS LEONES	Río	2002
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	COMITE DE AGUA RANCHITO	Fuente	1997
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	COMITÉ DE AGUA PICHE	Fuente	2003
ARROYO PRIETO - ACAM	ACUEDUCTO CERRO ANGOLA LOS MONTONES (ACAM)	Ojo de Agua o Manantial	1989
ARROYO PRIETO - RINCÓN DE PIEDRA	COMITÉ DE AGUA RINCÓN DE PIEDRA	Ojo de Agua o Manantial	1970
CODUPLA	CODUPLA	Canal	2016
ACUEDUCTO EL MAIZAL Y HAINA	PRESTADOR MAIZAL Y HAINA	Ojo de Agua o Manantial	1984
SISTEMA SABANA GRANDE	COMITÉ SABANA GRANDE	Canal	2017
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	PRESTADOR DE AGUA EL AGUACATE DE JACAGUA	Fuente	1999
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	PRESTADOR ALTO DEL JAMO	Fuente	1999
TOMA LA FINCA	PRESTADOR DE AGUA LA YALLITA	Ojo de Agua o Manantial	1995
TOMA ALTO GORDO	PRESTADOR DE AGUA LA YALLITA	Ojo de Agua o Manantial	2003
TOMA DE LA GUAZARA	PRESTADOR DE AGUA LA YALLITA	Río	1994
TOMA DEL HOYAZO	PRESTADOR DE AGUA LA YALLITA	Río	1994
TOMA DEL CONGO	PRESTADOR DE AGUA LA YALLITA	Río	1994
TOMA DE LA YALLITA 1	PRESTADOR DE AGUA LA YALLITA	Fuente	2001
TOMA LA YALLITA 2	PRESTADOR DE AGUA LA YALLITA	Fuente	2003
TOMA DE LOS RINCONES	PRESTADOR DE AGUA LA YALLITA	Río	1999
SISTEMA PINALITO	PRESTADOR PINALITO	Río	1999
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	ASOCIACIÓN ACUEDUCTO ARROYO BONITO CAIMITO	Río	1998
ACUEDUCTO LOS AUQUEYES	PRESTADOR LOS AUQUEYES (LORA)	Fuente	1994
TOMA LOS CACAOS	PRESTADOR DE AGUA LA YALLITA	Ojo de Agua o Manantial	1994
TOMA DEL PULIDO	PRESTADOR DE PULIDO	Pozo excavado	2012
TOMA DEL CORAL	PRESTADOR DE AGUA LA YALLITA	Río	2011
SISTEMA DE AGUA LA FALDIQUERA	PRESTADOR LA FALDIQUERA	Fuente	2016
SISTEMA RÍO HENEQUÉN	PRESTADOR RÍO HENEQUÉN	Captación desde otro sistema	2019
TOMA LA GUAMA DE LA CUMBRE	PRESTADOR DE AGUA LA YALLITA	Fuente	1994
ARROYO DE PALO QUEMADO	PRESTADOR DE AGUA LA YALLITA	Ojo de Agua o Manantial	2000
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	Fuente	1999
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	Fuente	1999
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	Fuente	1999
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	Fuente	1999
SISTEMA DE ACUEDUCTO JUNCALITO	ASOCIACIÓN COMUNITARIA JUNCALITO	Ojo de Agua o Manantial	2001
SISTEMA LAS AUYAMAS	PRESTADOR LAS AUYAMAS	Fuente	2007
ACUEDUCTO RURAL AMACEYES	JUNTA DE VECINO AMACEYES TAMBORIL ARRIBA	Fuente	1993
RIO DE MIGUEL PALMA PICADA	PRESTADOR PALMA PICADA	Río	1989
ACUEDUCTO HATILLO SAN LORENZO	COMITÉ HATILLO SAN LORENZO	Canal	2018
TOMA DEL EMPALME	PRESTADOR DE AGUA LA YALLITA	Río	1990
RANCHO VIEJO	PRESTADOR RANCHO VIEJO	Ojo de Agua o Manantial	1990
SISTEMA LOS PILONES	ASOCAR LOS PILONES	Fuente	2014

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CRITERIOS DE SERVICIO						
Comunidad / Acueducto	Calidad	Tratamiento	Continuidad	Dotación	Cobertura	NIVEL SERVICIO
ACUEDUCTO MÚLTIPLE COCODESI	D	C	B	A	B	3
TOMA DE LAS CAOBAS	D	D	A	A	A	3
TOMA CONGO ABAJO	D	D	A	A	A	3
TOMA DE PALMA LIMPIA	D	D	A	A	A	3
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	A	D	A	B	A	3
JAIBERO CANCA ARRIBA	D	D	D	A	A	2
ACUEDUCTO BEJUCAL	D	D	C	B	B	2
JULIO SENON VIÑAS (EL PAPAYO)	D	D	C	B	A	2
ACUEDUCTO LA CALABERNA	D	D	C	A	A	2
SISTEMA DE EL ACUEDUCTO EL AÑÓN	D	D	D	B	A	2
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	D	D	D	D	A	1
ACUEDUCTO BOCA DE LICEY	D	D	A	C	A	1
ACUEDUCTO ALTO DEL AGUACATE	D	D	D	D	A	1
ACUEDUCTO JUAN MARÍA HENRIQUEZ	D	D	B	D	A	1
TOMA DE LOS LEONES	D	D	D	C	B	1
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	D	D	D	D	A	1
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	D	D	D	D	A	1
ARROYO PRIETO - ACAM	D	D	D	D	A	1
ARROYO PRIETO - RINCÓN DE PIEDRA	D	D	B	C	A	1
CODUPLA	D	D	D	D	A	1
ACUEDUCTO EL MAIZAL Y HAINA	D	D	B	D	A	1
SISTEMA SABANA GRANDE	A	D	C	D	A	1
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	D	D	B	D	A	1
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	D	D	D	D	A	1
TOMA LA FINCA	D	D	C	C	A	1
TOMA ALTO GORDO	D	D	C	D	B	1
TOMA DE LA GUAZARA	D	D	D	D	A	1
TOMA DEL HOYAZO	D	D	C	D	A	1
TOMA DEL CONGO	D	D	D	D	A	1
TOMA DE LA YALLITA 1	D	D	D	D	A	1
TOMA LA YALLITA 2	D	D	C	D	A	1
TOMA DE LOS RINCONES	D	D	A	C	B	1
SISTEMA PINALITO	D	D	D	D	A	1
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	D	D	C	D	A	1
ACUEDUCTO LOS AUQUEYES	D	D	B	D	A	1
TOMA LOS CACAOS	D	D	D	D	A	1
TOMA DEL PULIDO	D	D	D	D	A	1
TOMA DEL CORAL	D	D	D	D	A	1
SISTEMA DE AGUA LA FALDIQUERA	D	D	D	D	A	1
SISTEMA RÍO HENEQUÉN	D	D	A	C	A	1
TOMA LA GUAMA DE LA CUMBRE	D	D	A	D	A	1
ARROYO DE PALO QUEMADO	D	D	D	D	A	1
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	D	D	D	D	A	1
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	D	D	D	D	A	1
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	D	D	D	D	A	1
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	D	D	D	D	A	1
SISTEMA DE ACUEDUCTO JUNCALITO	D	D	D	C	A	1
SISTEMA LAS AUYAMAS	D	D	D	D	A	1
ACUEDUCTO RURAL AMACEYES	D	D	D	D	C	0
RIO DE MIGUEL PALMA PICADA	D	D	A	D	C	0
ACUEDUCTO HATILLO SAN LORENZO	D	D	D	D	C	0
TOMA DEL EMPALME	D	D	D	D	C	0
RANCHO VIEJO	D	D	D	C	C	0
SISTEMA LOS PILONES	D	D	C	B	C	0

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CRITERIOS DE ANÁLISIS														
Comunidad / Acueducto	Q1 - Planta tratamiento	Q2 - Planta tratamiento funciona	Q3 - Indicador protección fuente	T1 - Equipo cloración	T2 - Equipo cloración funciona	C1 - Estado físico del acueducto	C2 - Tanque	C3 - Tanque adecuado para demanda	D1 - Recurso insuficiente	D2 - Fuente mal aprovechada	B1 - Prox. Contexto periurbano o cabecera	A1 - Contexto	A2 - Tipo de sistema	A3 - Población objetivo 20a
ACUEDUCTO MÚLTIPLE COCODESI	No	No	B	Sí	Sí	C	6	D	No	No	Sí	CA	Gravedad	13821
TOMA DE LAS CAOBAS	No	No	C	No	No	D	0	D	No	No	No	CO	Gravedad	185
TOMA CONGO ABAJO	No	No	C	No	No	D	0	D	No	No	No	CO	Gravedad	30
TOMA DE PALMA LIMPIA	No	No	B	No	No	D	0	D	No	No	No	CO	Gravedad	65
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	No	No	B	No	No	D	0	D	Sí	No	No	CO	Gravedad	44
JAIBERO CANCA ARRIBA	No	No	C	No	No	D	1	A	No	No	No	CO	Gravedad	344
ACUEDUCTO BEJUCAL	No	No	B	No	No	C	2	A	Sí	No	No	CO	Bombeo	406
JULIO SENON VIÑAS (EL PAPAYO)	No	No	C	No	No	C	1	A	Sí	No	No	CO	Gravedad	228
ACUEDUCTO LA CALABERNA	No	No	B	No	No	C	1	A	No	No	No	CO	Gravedad	184
SISTEMA DE EL ACUEDUCTO EL AÑÓN	No	No	D	No	No	D	0	D	Sí	No	No	CO	Gravedad	66
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	No	No	C	No	No	D	0	D	Sí	No	No	CO	Bombeo	252
ACUEDUCTO BOCA DE LICEY	No	No	C	No	No	C	2	A	No	Sí	No	CO	Gravedad	800
ACUEDUCTO ALTO DEL AGUACATE	No	No	B	No	No	D	1	A	Sí	No	No	CO	Gravedad	160
ACUEDUCTO JUAN MARÍA HENRIQUEZ	No	No	B	No	No	C	1	A	Sí	No	No	CO	Gravedad	429
TOMA DE LOS LEONES	No	No	B	No	No	C	1	A	Sí	No	No	CO	Gravedad	112
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	No	No	A	No	No	C	4	A	Sí	No	No	CO	Mixto	716
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	No	No	B	No	No	D	0	D	Sí	No	No	CO	Gravedad	264
ARROYO PRIETO - ACAM	No	No	A	No	No	C	1	A	Sí	No	No	CO	Gravedad	2007
ARROYO PRIETO - RINCÓN DE PIEDRA	No	No	B	No	No	C	1	A	Sí	No	No	CO	Gravedad	1360
CODUPLA	No	No	B	No	No	D	0	D	Sí	No	No	CO	Bombeo	1250
ACUEDUCTO EL MAIZAL Y HAINA	No	No	C	No	No	D	2	A	Sí	No	No	CO	Gravedad	960
SISTEMA SABANA GRANDE	No	No	B	No	No	D	0	D	No	Sí	No	CO	Bombeo	648
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	No	No	B	No	No	C	3	C	Sí	No	No	CO	Gravedad	489
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	No	No	B	No	No	D	1	A	Sí	No	No	CO	Gravedad	93
TOMA LA FINCA	No	No	A	No	No	C	1	A	Sí	No	No	CO	Gravedad	100
TOMA ALTO GORDO	No	No	A	No	No	C	1	A	Sí	No	No	CO	Gravedad	89
TOMA DE LA GUAZARA	No	No	B	No	No	C	1	D	Sí	No	No	CO	Gravedad	340
TOMA DEL HOYAZO	No	No	B	No	No	D	1	C	Sí	No	No	CO	Gravedad	250
TOMA DEL CONGO	No	No	A	No	No	C	1	C	Sí	No	No	CO	Gravedad	170
TOMA DE LA YALLITA 1	No	No	A	No	No	C	1	A	Sí	No	No	CO	Gravedad	105
TOMA LA YALLITA 2	No	No	B	No	No	C	1	C	Sí	No	No	CO	Gravedad	955
TOMA DE LOS RINCONES	No	No	B	No	No	C	2	A	Sí	No	No	CO	Gravedad	771
SISTEMA PINALITO	No	No	B	No	No	C	1	A	Sí	No	No	CO	Gravedad	170
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	No	No	B	No	No	D	2	A	Sí	No	Sí	CA	Gravedad	3280
ACUEDUCTO LOS AUQUEYES	No	No	B	No	No	C	1	A	Sí	Sí	No	CO	Gravedad	130
TOMA LOS CACAOS	No	No	B	No	No	D	1	D	Sí	No	No	CO	Gravedad	1263
TOMA DEL PULIDO	No	No	A	No	No	C	1	A	Sí	No	No	CO	Gravedad	525
TOMA DEL CORAL	No	No	B	No	No	C	1	A	Sí	No	No	CO	Gravedad	220
SISTEMA DE AGUA LA FALDIQUERA	No	No	C	No	No	D	1	A	Sí	Sí	No	CO	Gravedad	180
SISTEMA RÍO HENEQUÉN	No	No	C	No	No	C	2	A	Sí	No	No	CO	Captación desde otro sistema	155
TOMA LA GUAMA DE LA CUMBRE	No	No	B	No	No	D	0	D	Sí	Sí	No	CO	Gravedad	520
ARROYO DE PALO QUEMADO	No	No	B	No	No	D	1	C	Sí	No	No	CO	Gravedad	1318
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	No	No	B	No	No	D	5	A	Sí	No	No	CO	Gravedad	376
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	No	No	B	No	No	D	1	A	Sí	No	No	CO	Gravedad	62
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	No	No	B	No	No	D	1	A	Sí	No	No	CO	Gravedad	44
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	No	No	B	No	No	D	1	A	Sí	No	No	CO	Gravedad	96
SISTEMA DE ACUEDUCTO JUNCALITO	No	No	C	No	No	C	1	A	Sí	No	No	CO	Gravedad	1030
SISTEMA LAS AUYAMAS	No	No	C	No	No	D	1	A	Sí	No	No	CO	Gravedad	225
ACUEDUCTO RURAL AMACEYES	No	No	A	Sí	No	D	1	A	Sí	No	No	CO	Gravedad	477
RIO DE MIGUEL PALMA PICADA	No	No	B	No	No	D	1	A	Sí	No	No	CO	Gravedad	193
ACUEDUCTO HATILLO SAN LORENZO	No	No	B	No	No	D	0	D	Sí	No	No	CO	Bombeo	3058
TOMA DEL EMPALME	No	No	B	No	No	C	1	D	Sí	No	No	CO	Gravedad	203
RANCHO VIEJO	No	No	B	No	No	C	1	A	Sí	No	No	CO	Gravedad	109
SISTEMA LOS PILONES	No	No	C	No	No	C	1	A	Sí	No	No	CO	Gravedad	371

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The second part of creating scenarios was to build the intervention model. This model included a catalog of solutions with 29 specific interventions, each of which could potentially solve a *typical weakness* identified in the analysis tool, with the estimated budget that this action would have (Figure 23). The budget for the interventions considered what service level could be reached by making a given intervention. All of the analyses and interventions were applied to each water supply system and to each community without a system. The approximate geographical location of the water supply systems and the communities without a system was also taken into account to consider the possibility that the latter could be connected to nearby water supply systems, avoiding the need to build a new system in each community that lacks one.

By combining the specific diagnosis of each water supply system with the solutions catalog interventions, the budget necessary to take each water supply system from its current level to each of the higher levels could be estimated. By adding the results and extrapolating for the entire province, it was possible to determine the budget necessary for the entire rural population to acquire each of the service levels above what they currently have. The calculation considered that the sample collected in the survey is partial (46% of the population of the rural area's municipal capitals and 57% of the rural *parajes*), taking as valid the hypothesis that the sample numbers can be extrapolated to 100% of the province.

By grouping the population into service levels, it was possible to establish several scenarios with different costs and solutions, which helped to have alternatives to determine the viable objectives that can be achieved through the operation's resources, both in terms of improving service parameters and the population covered. Specific objectives are included below. This distinction of levels has made it possible to identify rapid impact measures to improve services by optimizing project resources. So, for example, investments that guarantee correct chlorination would mean that 25% of the rural population[30] acquires a service level of 4. This figure could even increase to 35% of the population if chlorination is combined with additional infrastructure rehabilitation to improve service continuity.

30. Figures calculated on the rural population not served by CORAASAN's urban water supply systems, given that the interventions to improve these areas fall within the project's urban component.

Table 4: Classification of service levels according to the analysis parameters and percentage of rural population at each level.

% of sample population at each level	Levels	Quality	Treatment	Continuity	Provision	Coverage
0.00 %	6	A	A	A	A	A
0.00 %	5	A	A	B	B	A
0.00 %	4	-	A	B	B	A
24.59 %	3	-	-	B	B	B
9.96 %	2	-	-	-	B	B
46.35 %	1	-	-	-	-	B
19.10 %	0	-	-	-	-	-

Figure 23: Table of application of the catalog of solutions to each water supply system to achieve a target service level of 6 in all of them on the scale defined by the project. An equivalent table was prepared for levels 5 and 4.

DATOS BÁSICOS			CATÁLOGOS DE SOLUCIONES				
Comunidad / Acueducto	PSE principal	NIVEL META	SURBQ - Actuación calidad en componente URBANO	SURBT - Actuación cloro en componente URBANO	SURBC - Actuación continuidad componente URBANO	SURBD - Actuación dotación en componente URBANO	SURBB - Actuación cobertura componente URBANO
ACUEDUCTO MÚLTIPLE COCODESI	PRESTADOR COCODESI	6	-	-	-	-	-
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	JUNTA DE VECINO NUEVA ESPERANZA	6	-	-	-	-	-
ACUEDUCTO BOCA DE LICEY	JUNTA DE VECINO SAN FRANCISCO DE ASIS	6	-	-	-	-	-
JAIBERO CANCA ARRIBA	COMITE DE AGUA CANCA ARRIBA	6	-	-	-	-	-
ACUEDUCTO ALTO DEL AGUACATE	PRESTADOR ALTO EL AGUACATE	6	-	-	-	-	-
ACUEDUCTO JUAN MARÍA HENRIQUEZ	JUNTA DE VECINO JUAN MARÍA HENRIQUEZ	6	-	-	-	-	-
ACUEDUCTO RURAL AMACEYES	JUNTA DE VECINO AMACEYES TAMBORIL ARRIBA	6	-	-	-	-	-
TOMA DE LOS LEONES	PRESTADOR DE LOS LEONES	6	-	-	-	-	-
RIO DE MIGUEL PALMA PICADA	PRESTADOR PALMA PICADA	6	-	-	-	-	-
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	COMITE DE AGUA RANCHITO	6	-	-	-	-	-
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	COMITÉ DE AGUA PICHE	6	-	-	-	-	-
ARROYO PRIETO - ACAM	ACUEDUCTO CERRO ANGOLA LOS MONTONES (ACAM)	6	-	-	-	-	-
ARROYO PRIETO - RINCÓN DE PIEDRA	COMITÉ DE AGUA RINCÓN DE PIEDRA	6	-	-	-	-	-
CODUPLA	CODUPLA	6	-	-	-	-	-
ACUEDUCTO EL MAIZAL Y HAINA	PRESTADOR MAIZAL Y HAINA	6	-	-	-	-	-
SISTEMA SABANA GRANDE	COMITÉ SABANA GRANDE	6	-	-	-	-	-
ACUEDUCTO HATILLO SAN LORENZO	COMITÉ HATILLO SAN LORENZO	6	-	-	-	-	-
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	PRESTADOR DE AGUA EL AGUACATE DE JACAGUA	6	-	-	-	-	-
ACUEDUCTO BEJUCAL	COMITÉ BEJUCAL	6	-	-	-	-	-
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	PRESTADOR ALTO DEL JAMO	6	-	-	-	-	-
TOMA DE LAS CAOBAS	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA LA FINCA	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DEL EMPALME	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA ALTO GORDO	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DE LA GUAZARA	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DEL HOYAZO	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DEL CONGO	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DE LA YALLITA 1	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA LA YALLITA 2	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA CONGO ABAJO	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DE LOS RINCONES	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
RANCHO VIEJO	PRESTADOR RANCHO VIEJO	6	-	-	-	-	-
SISTEMA PINALITO	PRESTADOR PINALITO	6	-	-	-	-	-
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	ASOCIACIÓN ACUEDUCTO ARROYO BONITO CAIMITO	6	-	-	-	-	-
ACUEDUCTO LOS AUQUEYES	PRESTADOR LOS AUQUEYES (LORA)	6	-	-	-	-	-
JULIO SENON VIÑAS (EL PAPAYO)	COMITÉ JULIO SENON VIÑAS (EL PAPAYO)	6	-	-	-	-	-
ACUEDUCTO LA CALABERNA	PRESTADOR CALABERNA	6	-	-	-	-	-
TOMA LOS CACAOS	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DEL PULIDO	PRESTADOR DE PULIDO	6	-	-	-	-	-
TOMA DEL CORAL	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
SISTEMA DE AGUA LA FALDIQUERA	PRESTADOR LA FALDIQUERA	6	-	-	-	-	-
SISTEMA RÍO HENEQUÉN	PRESTADOR RÍO HENEQUÉN	6	-	-	-	-	-
TOMA LA GUAMA DE LA CUMBRE	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
ARROYO DE PALO QUEMADO	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
TOMA DE PALMA LIMPIA	PRESTADOR DE AGUA LA YALLITA	6	-	-	-	-	-
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	6	-	-	-	-	-
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	6	-	-	-	-	-
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	6	-	-	-	-	-
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	6	-	-	-	-	-
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	COMITÉ DE AGUA DE SALAMANCA	6	-	-	-	-	-
SISTEMA LOS PILONES	ASOCAR LOS PILONES	6	-	-	-	-	-
SISTEMA DE ACUEDUCTO JUNCALITO	ASOCIACIÓN COMUNITARIA JUNCALITO	6	-	-	-	-	-
SISTEMA DE EL ACUEDUCTO EL AÑÓN	PRESTADOR EL ANÓN	6	-	-	-	-	-
SISTEMA LAS AUYAMAS	PRESTADOR LAS AUYAMAS	6	-	-	-	-	-
BABOSICO	-	6	-	-	-	-	-
CANCA ARRIBA LA NUEVA	-	6	-	-	-	-	-
CAPILLA	-	6	-	-	-	-	-
CERRO PRIETO	-	6	-	-	-	-	-

This information is only available in Spanish

CATÁLOGOS DE SOLUCIONES								
Comunidad / Acueducto	SQ1 - Nueva planta tratamiento	SQ2 - Rehabilitar planta tratamiento	SQ3 - Protección y limpieza de fuente	ST2 - Instalación clorador	ST3 - Rehabilitar clorador	ST4 - Ajustes dosificación / cloración / distribución	SC2 - Ajustes distribución	SC3 - Mejora mayor estructura
ACUEDUCTO MÚLTIPLE COCODESI	Sí	No	No	No	No	Sí	Sí	No
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	Sí	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO BOCA DE LICEY	Sí	No	Sí	Sí	No	No	No	Sí
JAIBERO CANCA ARRIBA	Sí	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO ALTO DEL AGUACATE	Sí	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO JUAN MARÍA HENRIQUEZ	Sí	No	Sí	Sí	No	No	Sí	No
ACUEDUCTO RURAL AMACEYES	Sí	No	Sí	No	Sí	No	Sí	Sí
TOMA DE LOS LEONES	Sí	No	Sí	Sí	No	No	Sí	Sí
RIO DE MIGUEL PALMA PICADA	Sí	No	Sí	Sí	No	No	No	No
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	Sí	No	Sí	Sí	No	No	Sí	Sí
ARROYO PRIETO - ACAM	Sí	No	Sí	Sí	No	No	Sí	Sí
ARROYO PRIETO - RINCÓN DE PIEDRA	Sí	No	Sí	Sí	No	No	Sí	No
CODUPLA	Sí	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO EL MAIZAL Y HAINA	Sí	No	Sí	Sí	No	No	Sí	No
SISTEMA SABANA GRANDE	No	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO HATILLO SAN LORENZO	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	Sí	No	Sí	Sí	No	No	Sí	No
ACUEDUCTO BEJUCAL	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DE LAS CAOBAS	Sí	No	Sí	Sí	No	No	No	No
TOMA LA FINCA	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DEL EMPALME	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA ALTO GORDO	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DE LA GUAZARA	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DEL HOYAZO	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DEL CONGO	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DE LA YALLITA 1	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA LA YALLITA 2	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA CONGO ABAJO	Sí	No	Sí	Sí	No	No	No	No
TOMA DE LOS RINCONES	Sí	No	Sí	Sí	No	No	No	No
RANCHO VIEJO	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA PINALITO	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	Sí	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO LOS AUQUEYES	Sí	No	Sí	Sí	No	No	Sí	Sí
JULIO SENON VIÑAS (EL PAPAYO)	Sí	No	Sí	Sí	No	No	Sí	Sí
ACUEDUCTO LA CALABERNA	Sí	No	No	Sí	No	No	Sí	Sí
TOMA LOS CACAOS	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DEL PULIDO	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DEL CORAL	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE AGUA LA FALDIQUERA	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA RÍO HENEQUÉN	Sí	No	Sí	Sí	No	No	No	No
TOMA LA GUAMA DE LA CUMBRE	Sí	No	Sí	Sí	No	No	No	Sí
ARROYO DE PALO QUEMADO	Sí	No	Sí	Sí	No	No	Sí	Sí
TOMA DE PALMA LIMPIA	Sí	No	No	Sí	No	No	No	No
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	No	No	Sí	Sí	No	No	No	No
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA LOS PILONES	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE ACUEDUCTO JUNCALITO	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA DE EL ACUEDUCTO EL AÑÓN	Sí	No	Sí	Sí	No	No	Sí	Sí
SISTEMA LAS AUYAMAS	Sí	No	Sí	Sí	No	No	Sí	Sí
BABOSICO	No	No	No	No	No	No	No	No
CANCA ARRIBA LA NUEVA	No	No	No	No	No	No	No	No
CAPILLA	No	No	No	No	No	No	No	No
CERRO PRIETO	No	No	No	No	No	No	No	No

This information is only available in Spanish

CATÁLOGOS DE SOLUCIONES								
Comunidad / Acueducto	SC4 - Contrucción tanque adicional	SC5 - Construcción primer tanque	SC6 - Sustitución bombeo	SC7 - Mejora menor estructura	SD1 - Instalación de macro-medición	SD2 - Instalación de micro-medición	SD3 - Nueva captación (100 lpd)	SD4 - Nuevo pozo bombeo (100 lpd)
ACUEDUCTO MÚLTIPLE COCODESI	No	No	No	-	No	No	No	No
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	No	Sí	Sí	-	Sí	Sí	No	Sí
ACUEDUCTO BOCA DE LICEY	No	No	No	-	Sí	Sí	No	No
JAIBERO CANCA ARRIBA	No	No	No	-	No	No	No	No
ACUEDUCTO ALTO DEL AGUACATE	No	No	No	-	Sí	Sí	Sí	No
ACUEDUCTO JUAN MARÍA HENRIQUEZ	No	No	No	-	Sí	Sí	Sí	No
ACUEDUCTO RURAL AMACEYES	No	No	No	-	Sí	Sí	Sí	No
TOMA DE LOS LEONES	No	No	No	-	Sí	Sí	Sí	No
RIO DE MIGUEL PALMA PICADA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	No	Sí	No	-	Sí	Sí	Sí	No
ARROYO PRIETO - ACAM	No	No	No	-	Sí	Sí	Sí	No
ARROYO PRIETO - RINCÓN DE PIEDRA	No	No	No	-	Sí	Sí	Sí	No
CODUPLA	No	Sí	Sí	-	Sí	Sí	No	Sí
ACUEDUCTO EL MAIZAL Y HAINA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA SABANA GRANDE	No	Sí	Sí	-	Sí	Sí	No	No
ACUEDUCTO HATILLO SAN LORENZO	No	Sí	Sí	-	Sí	Sí	No	Sí
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	No	No	No	-	Sí	Sí	Sí	No
ACUEDUCTO BEJUCAL	No	No	Sí	-	Sí	Sí	No	No
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	No	No	No	-	Sí	Sí	Sí	No
TOMA DE LAS CAOBAS	No	No	No	-	No	No	No	No
TOMA LA FINCA	No	No	No	-	Sí	Sí	Sí	No
TOMA DEL EMPALME	Sí	No	No	-	Sí	Sí	Sí	No
TOMA ALTO GORDO	No	No	No	-	Sí	Sí	Sí	No
TOMA DE LA GUAZARA	Sí	No	No	-	Sí	Sí	Sí	No
TOMA DEL HOYAZO	Sí	No	No	-	Sí	Sí	Sí	No
TOMA DEL CONGO	Sí	No	No	-	Sí	Sí	Sí	No
TOMA DE LA YALLITA 1	No	No	No	-	Sí	Sí	Sí	No
TOMA LA YALLITA 2	Sí	No	No	-	Sí	Sí	Sí	No
TOMA CONGO ABAJO	No	No	No	-	No	No	No	No
TOMA DE LOS RINCONES	No	No	No	-	Sí	Sí	Sí	No
RANCHO VIEJO	No	No	No	-	Sí	Sí	Sí	No
SISTEMA PINALITO	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	No	No	No	-	Sí	Sí	Sí	No
ACUEDUCTO LOS AUQUEYES	No	No	No	-	Sí	Sí	Sí	No
JULIO SENON VIÑAS (EL PAPAYO)	No	No	No	-	Sí	Sí	No	No
ACUEDUCTO LA CALABERNA	No	No	No	-	No	No	No	No
TOMA LOS CACAOS	Sí	No	No	-	Sí	Sí	Sí	No
TOMA DEL PULIDO	No	No	No	-	Sí	Sí	Sí	No
TOMA DEL CORAL	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE AGUA LA FALDIQUERA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA RÍO HENEQUÉN	No	No	No	-	Sí	Sí	No	No
TOMA LA GUAMA DE LA CUMBRE	No	No	No	-	Sí	Sí	Sí	No
ARROYO DE PALO QUEMADO	Sí	No	No	-	Sí	Sí	Sí	No
TOMA DE PALMA LIMPIA	No	No	No	-	No	No	No	No
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	No	No	No	-	Sí	Sí	No	No
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	No	No	No	-	Sí	Sí	Sí	No
SISTEMA LOS PILONES	No	No	No	-	Sí	Sí	No	No
SISTEMA DE ACUEDUCTO JUNCALITO	No	No	No	-	Sí	Sí	Sí	No
SISTEMA DE EL ACUEDUCTO EL AÑÓN	No	Sí	No	-	Sí	Sí	No	No
SISTEMA LAS AUYAMAS	No	No	No	-	Sí	Sí	Sí	No
BABOSICO	No	No	No	-	No	No	No	No
CANCA ARRIBA LA NUEVA	No	No	No	-	No	No	No	No
CAPILLA	No	No	No	-	No	No	No	No
CERRO PRIETO	No	No	No	-	No	No	No	No

CATÁLOGOS DE SOLUCIONES

Comunidad / Acueducto	SD5 - Nueva captación (50 lpd)	SD6 - Nuevo pozo bombeo (50 lpd)	SB1 - Conexión acueducto cabecera	SB2 - Nuevo acueducto	SB3 - Ampliación acueducto (100%)	SB4 - Ampliación acueducto (90%)	SB190 - Conexión acueducto cabecera (90%)	SB290- Nuevo acueducto (90%)
ACUEDUCTO MÚLTIPLE COCODESI	-	-	No	No	Sí	-	-	-
ABASTECIMIENTO CANCA ARRIBA, DIVINO NIÑO (ENTRADA LA FE)	-	-	No	No	No	-	-	-
ACUEDUCTO BOCA DE LICEY	-	-	No	No	No	-	-	-
JAIBERO CANCA ARRIBA	-	-	No	No	No	-	-	-
ACUEDUCTO ALTO DEL AGUACATE	-	-	No	No	No	-	-	-
ACUEDUCTO JUAN MARÍA HENRIQUEZ	-	-	No	No	No	-	-	-
ACUEDUCTO RURAL AMACEYES	-	-	No	No	Sí	-	-	-
TOMA DE LOS LEONES	-	-	No	No	Sí	-	-	-
RIO DE MIGUEL PALMA PICADA	-	-	No	No	Sí	-	-	-
SISTEMA DE LAS COMUNIDADES (RANCHITO , LA HONDURA , LOMA SABANA , LOS MANANTIALES).	-	-	No	No	No	-	-	-
SISTEMA DE LAS COMUNIDADES PICHE, LA GUAZUMITA	-	-	No	No	No	-	-	-
ARROYO PRIETO - ACAM	-	-	No	No	No	-	-	-
ARROYO PRIETO - RINCÓN DE PIEDRA	-	-	No	No	No	-	-	-
CODUPLA	-	-	No	No	No	-	-	-
ACUEDUCTO EL MAIZAL Y HAINA	-	-	No	No	No	-	-	-
SISTEMA SABANA GRANDE	-	-	No	No	No	-	-	-
ACUEDUCTO HATILLO SAN LORENZO	-	-	No	No	Sí	-	-	-
SISTEMA DE LA COMUNIDAD DEL AGUACATE DE JACAGUA	-	-	No	No	No	-	-	-
ACUEDUCTO BEJUCAL	-	-	No	No	Sí	-	-	-
SISTEMA DE LA COMUNIDAD ALTO DEL JAMO	-	-	No	No	No	-	-	-
TOMA DE LAS CAOBAS	-	-	No	No	No	-	-	-
TOMA LA FINCA	-	-	No	No	No	-	-	-
TOMA DEL EMPALME	-	-	No	No	Sí	-	-	-
TOMA ALTO GORDO	-	-	No	No	Sí	-	-	-
TOMA DE LA GUAZARA	-	-	No	No	No	-	-	-
TOMA DEL HOYAZO	-	-	No	No	No	-	-	-
TOMA DEL CONGO	-	-	No	No	No	-	-	-
TOMA DE LA YALLITA 1	-	-	No	No	No	-	-	-
TOMA LA YALLITA 2	-	-	No	No	No	-	-	-
TOMA CONGO ABAJO	-	-	No	No	No	-	-	-
TOMA DE LOS RINCONES	-	-	No	No	Sí	-	-	-
RANCHO VIEJO	-	-	No	No	Sí	-	-	-
SISTEMA PINALITO	-	-	No	No	No	-	-	-
SISTEMA DE ACUEDUCTO ARROYO BONITO CAIMITO	-	-	No	No	No	-	-	-
ACUEDUCTO LOS AUQUEYES	-	-	No	No	No	-	-	-
JULIO SENON VIÑAS (EL PAPAYO)	-	-	No	No	No	-	-	-
ACUEDUCTO LA CALABERNA	-	-	No	No	No	-	-	-
TOMA LOS CACAOS	-	-	No	No	No	-	-	-
TOMA DEL PULIDO	-	-	No	No	No	-	-	-
TOMA DEL CORAL	-	-	No	No	No	-	-	-
SISTEMA DE AGUA LA FALDIQUERA	-	-	No	No	No	-	-	-
SISTEMA RÍO HENEQUÉN	-	-	No	No	No	-	-	-
TOMA LA GUAMA DE LA CUMBRE	-	-	No	No	No	-	-	-
ARROYO DE PALO QUEMADO	-	-	No	No	No	-	-	-
TOMA DE PALMA LIMPIA	-	-	No	No	No	-	-	-
SISTEMA QUEBRA MALA DE LA COMUNIDAD DE SALAMANCA	-	-	No	No	No	-	-	-
SISTEMA LA CACATA DE LA COMUNIDAD DE SALAMANCA	-	-	No	No	No	-	-	-
SISTEMA DE LOS CACAITOS ARRIBA DE LA COMUNIDAD DE SALAMANCA	-	-	No	No	No	-	-	-
SISTEMA DE LOS CACAITOS ABAJO DE LA COMUNIDAD DE SALAMANCA	-	-	No	No	No	-	-	-
SISTEMA DE LA PLAYITA DE LA COMUNIDAD DE SALAMANCA	-	-	No	No	No	-	-	-
SISTEMA LOS PILONES	-	-	No	No	Sí	-	-	-
SISTEMA DE ACUEDUCTO JUNCALITO	-	-	No	No	No	-	-	-
SISTEMA DE EL ACUEDUCTO EL AÑÓN	-	-	No	No	No	-	-	-
SISTEMA LAS AUYAMAS	-	-	No	No	No	-	-	-
BABOSICO	-	-	No	Sí	No	-	-	-
CANCA ARRIBA LA NUEVA	-	-	No	Sí	No	-	-	-
CAPILLA	-	-	No	Sí	No	-	-	-
CERRO PRIETO	-	-	No	Sí	No	-	-	-

This information is only available in Spanish

Table 4 is a simplification of the set of model scenarios, since in cells without a level there may be a population in A, B, C, or D. The complete scenario table considers which level the entire population is at when calculating costs. In other words, the budget necessary to reach the level 4 goal for the entire rural population of the province already considers that there may be a population at level A in quality or treatment, but that currently does not reach level 4 because its continuity, provision, and coverage are not at level A.

4.1.2 Individual sourcing solutions

In the final table of scenarios, a particular scenario for dispersed rural areas was also included. There are an estimated 1,630 homes in this area, representing 0.59% of the population of the province of Santiago.[31]

The only scenario that was considered viable for individual solutions was the installation of rainwater collection systems. Practically all of the dispersed rural areas in the province of Santiago are located in the high mountain areas that have around 1,150 mm of rainfall.[32] TWith this precipitation and taking into account an average of 50 m^2 of roof space to accumulate water, a provision of 32.48 liters per person per day can be achieved (Table 5).

With a storage capacity of 10 m^3 per dwelling, a supply of up to 35 liters per person per day could be achieved with an additional water tanker filling every four years. A provision of 50 liters per person per day could even be ensured provided that once or twice a year a water tanker could supplement the natural rain supply.

4.1.3 Sanitation solutions

The service level model did not include sanitation, since the project did not include investments in improving sewerage networks in rural *parajes*, and those planned in municipal capitals in rural areas were already well defined by the Bank's and CORAASAN's technical teams. Therefore, defining scenarios to intervene in sanitation was not deemed necessary.

The budget necessary to ensure that the population of rural areas had improved sanitary solutions with a flush toilet and septic tank was calculated. This could be useful for later stages in the implementation of the project or in other programs that might be implemented in the future.

31. More detailed information on dispersed rural areas and individual solutions can be found in Appendix II.
32. National Meteorological Office of the Dominican Republic for 1982-2012.

Table 5: Estimated calculation of provision for a residential rainwater collection system in rural areas of the province of Santiago.

ANNUAL SCENARIO	Example year	Average rainfall	Average roof area	Efficiency	Effectiveness	Liters/ year	Liters/ day	People/ house	L/p/d
	2012	1,159.00	50.00	0.80	0.90	41,724.00	114.31	3.52	32.48

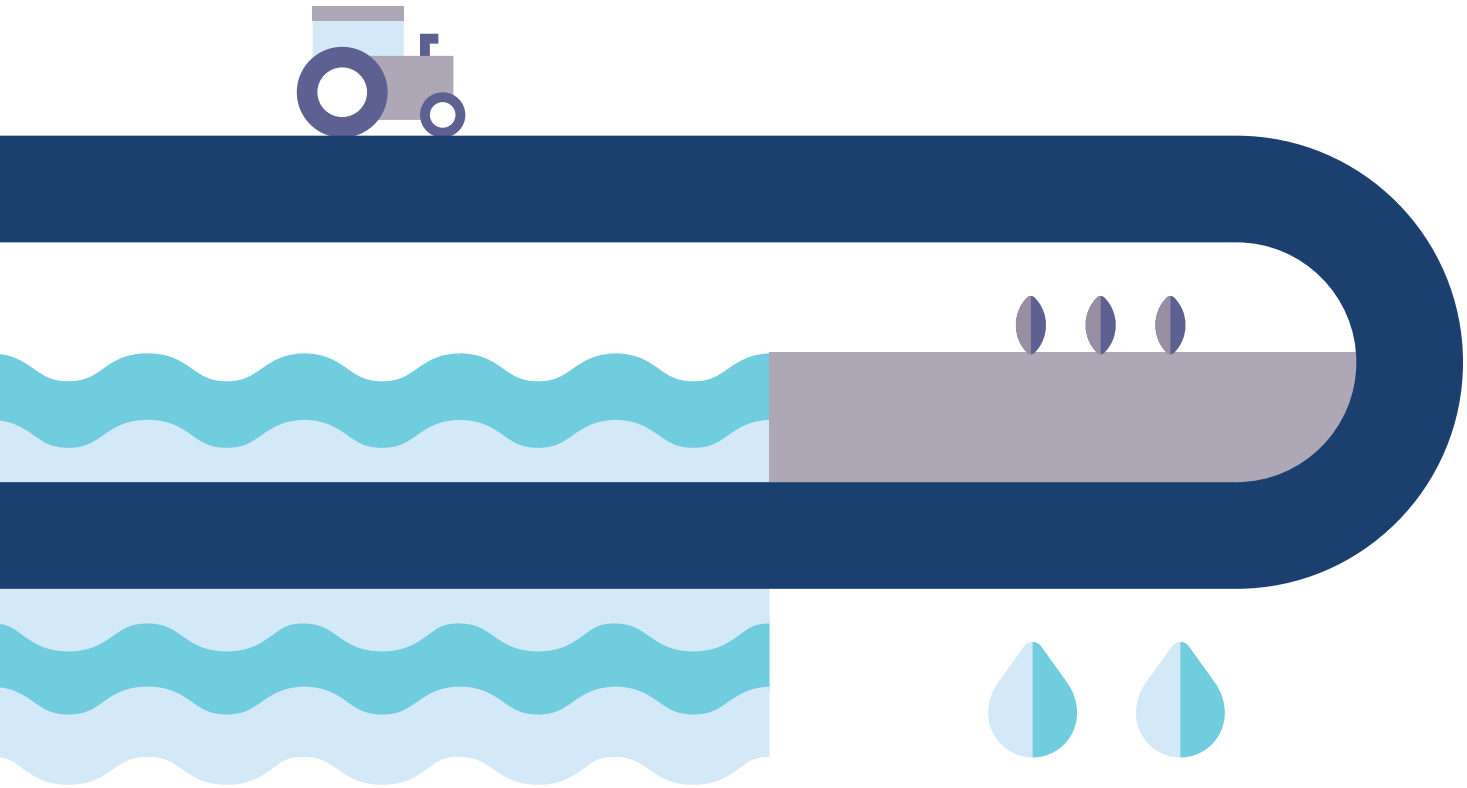
4.2 Objectives of the rural strategy

Based on the model and the estimated cost analyses stated above, the objectives of the rural component of the project were determined, which apply to the entire province. The objectives are:

1	**CORAASAN operates 100% of the municipal capitals effectively and progressively.** They operate billing and collection, customer management, monitoring of KPIs, etc.
2	**35%** of the population of the rural *parajes* and capitals **has access to a water service managed securely** in terms of the project (home access, at least 12 hours a day of service continuity, quality assured with pretreatment and disinfection through chlorination, a minimum supply of 50 liters per person per day, and assurance of service monitoring. This equates to a level 4 service on the Table 4 scale).
3	**CORAASAN provides technical assistance to at least 40% of the water supply systems in rural *parajes*** (under the protection of an agreement between CORAASAN and the rural service provider).

These three objectives were agreed upon when the Bank and CORAASAN were preparing the project after evaluating the results of the analyses, the feasibility of the scenarios designed, and the financial capacity mobilized with the project.

5



Lines of action

5.1 Structure and justification of the policy lines

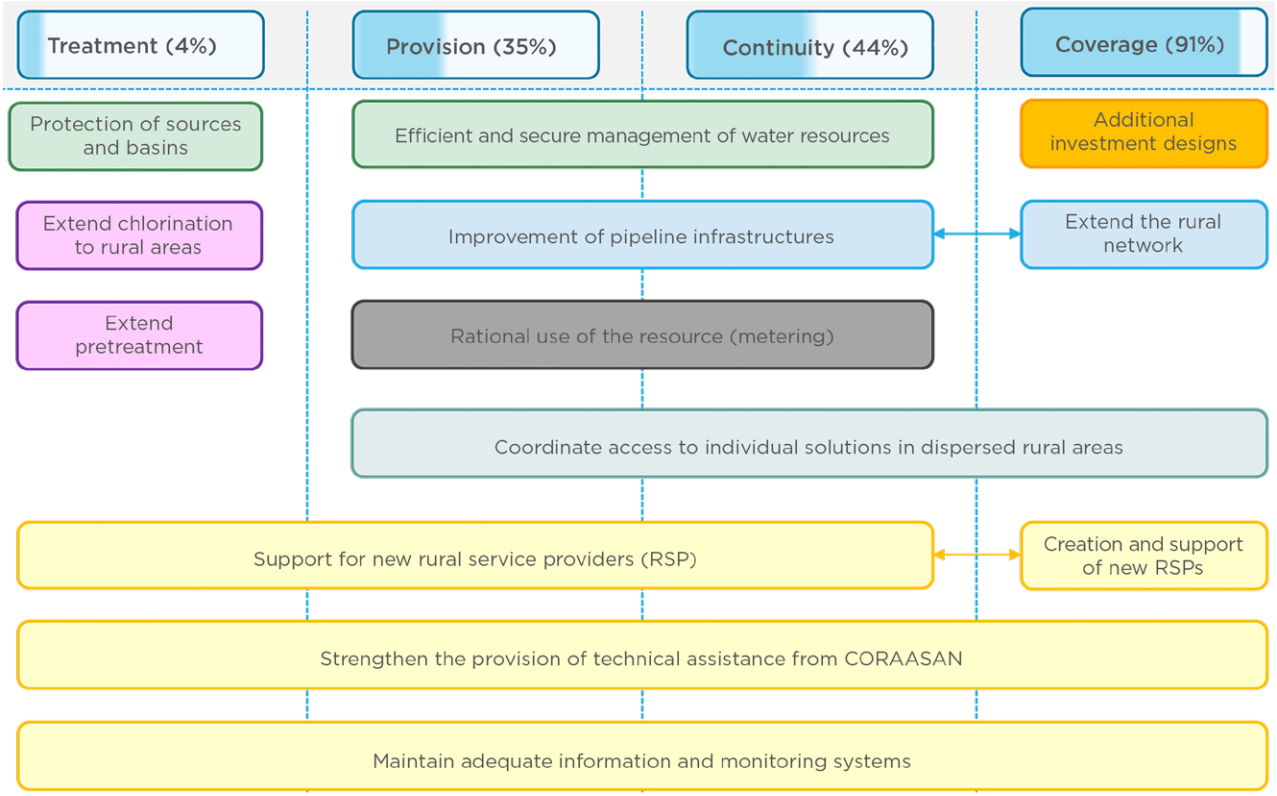
To transform the results of the rural component into interventions, a series of cross-cutting policy lines were proposed that in some cases cover several of the critical parameters with which the service levels were built (Figure 24). There were also tangential lines not related to the levels of the scenario model, such as the one on sanitation or intervention in dispersed rural areas. These policy lines in turn facilitated the design of a series of more specific programs. The policy lines attempted to meet the goal of bringing the water supply systems of the province of Santiago to level 4 service, according to the level scales defined in the model (Table 4).

One of the most important interventions is the urgent need to diagnose and plan water resources to extend services and increase provisions in a long-lasting way, taking into account the water resource guarantee.

The diagnosis will include an inventory and characterization of potential and in-use surface and underground water sources, after which, considering demand projections and climate change scenarios, the use of resources in the different localities will be planned, monitoring actions established, and their protection standardized. The protection of sources can be coordinated through the Payment for Environmental Services Program (PES) given CORAASAN's prior experience in this type of project,[33] as well as the PES Law that protects them. Additionally, to strengthen efficiency in the context described, in which only a third of the rural population receives 50 liters per person per day, running systems of a certain size with micro-metering is proposed, in line with the indications at the rural workshop. In line with the conclusions of the rural workshop, there is also a need to support rural providers in service operation and maintenance, with special focus on rates management and the chlorination of systems, since the latter is done only in a few strictly rural water supply systems.

33. In collaboration with the Ministry of the Environment and the Electricity Company of Santiago, CORAASAN has been implementing a PES in the Upper Yaque Norte Basin for 10 years.

Figure 24: Main policy lines in rural areas. The percentages indicate the population of capitals and rural *parajes* whose chlorine treatment is adequate, continuity of more than 12 hours a day, provision of more than 50 l/p/d, or coverage from improved water sources. (Rural areas served by urban water supply systems are excluded.)

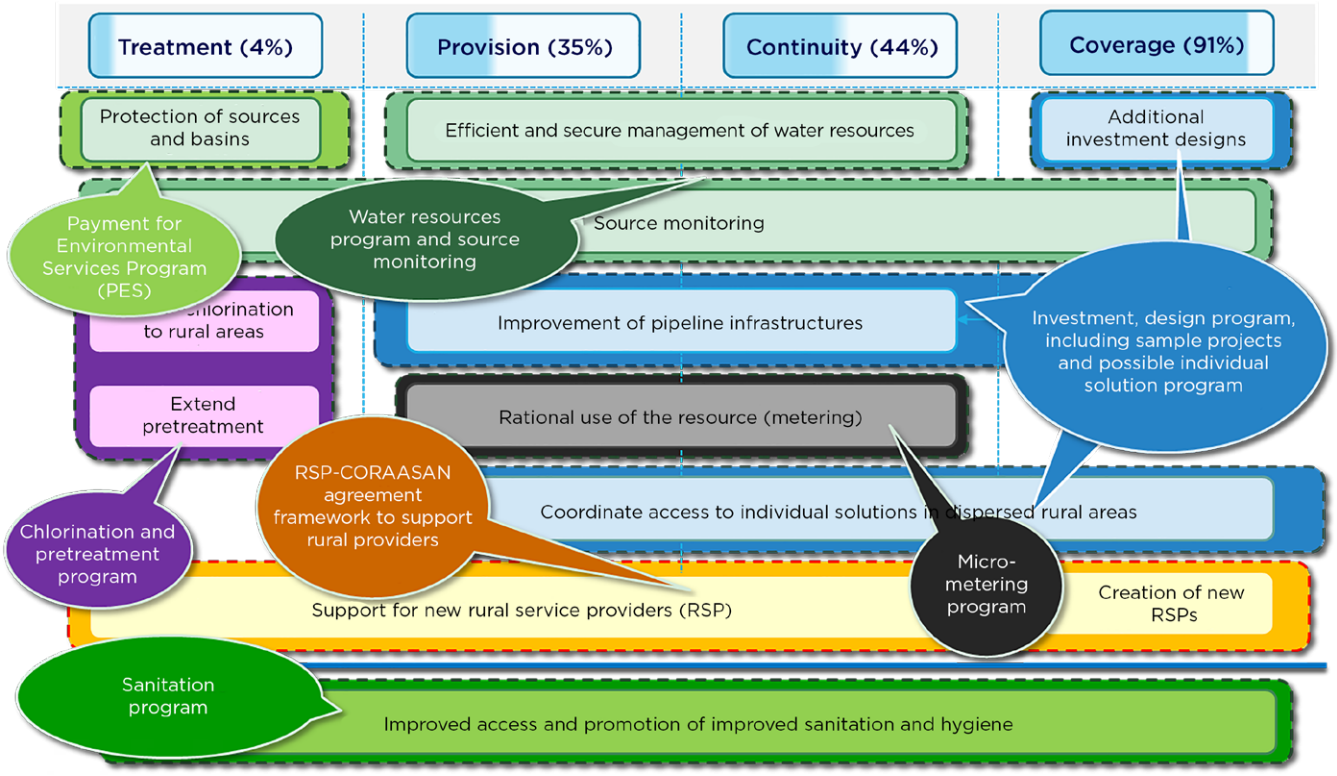


Regarding sanitation, investments were incorporated that will benefit the population of some rural municipal capitals, particularly San José de las Matas, where the network and the wastewater treatment plant will be improved. The strategy's specific programs were mainly improvement actions in community schools and in management of sludge from septic tanks and its treatment in a wastewater treatment plant. In addition, indirectly, reinforcing the presence of CORAASAN in rural areas may be a relevant step to plan future actions to improve sanitation in these areas.

5.2 Programs

The actions resulting from the policy lines were grouped into specific sector programs, each of which has its own budget line in the corresponding components of the project, its own lead team, and its own implementation outline. The approach was to try to intervene at least partially in the areas where the main needs were identified in the previous diagnoses. This approach is linked to the importance for both the Bank and CORAASAN of changing the rural service scheme in the province. CORAASAN strengthening its role in the operation of services—or technical assistance—in rural areas is an opportunity to begin to build on what CORAASAN could focus as its priorities and interventions in this area on and how. Therefore, the catalog of programs aims not only to improve services in certain areas, but also to accompany the CORAASAN teams in this new stage.

Figure 25: Programs and main activities related to the different policy lines. The percentages indicate the population of capitals and rural *parajes* whose chlorine treatment is adequate, and where there is continuity of more than 12 hours a day, provision of more than 50 l/p/d, or coverage from improved water sources. (Rural areas served by urban water supply systems are excluded.)



In addition to the programs, the project included:

- A specific investment line for the design and implementation of works that were identified in the project preparation phase[34]: the rehabilitation and optimization of the water supply systems for the municipal capital of Jánico and for the municipal capital of San José de las Matas, as well as the final design and supervision of those works.
- A specific line of technical assistance to accompany CORAASAN in the development of the entire strategy. This line translates into a consultancy that supports the CORAASAN teams that will be linked to rural programs, aiding in the design and implementation of work methodologies, preparation of contracts and design of bid specifications, coordination of technical and human resources, etc. This technical assistance will play an especially important role in programs that require a larger social work component.

5.2.1 Water Programs

Management Improvement Program through Micro-metering

This program included: (i) the acquisition of 12,000 micrometers, as well as their installation in homes, probably in the municipal capitals of the rural area; (ii) the supervision of their installation; and (iii) technical assistance from CORAASAN for rural operators that join the metering program and are committed to implementing it in their localities. Training and behavior change actions are planned in the areas where meters will be installed.

Chlorination and Pretreatment Program

This program included: (i) a CORAASAN subsidy of chlorine[35]; (ii) works to install hypochlorinators and filters to reduce turbidity to acceptable limits established by the Dominican Republic's quality regulations for disinfection to be effective; (iii) the design and supervision of these works; (iv) technical assistance from CORAASAN for the operation of these elements, as well as periodic monitoring of turbidity and chlorination, as is already being done in urban water supply systems. As reflected in the analysis, some rural providers carry out chlorination but without reaching the optimal parameters at points far from the network. It was also previously indicated that more than 25% of the population would see a speedy improvement in the service through this program, which would lead to the operation having a rapid impact in the rural context.

Water Resources (WR) Program, including a Drought Plan

This program covers: (i) the diagnosis of WR in the province, paying attention to periods of drought; (ii) identification of vulnerable WR in terms of the certainty of water availability and of anthropic threats; (iii) specific evaluation to provide long-lasting water services to the rural population; (iv) development of a WR monitoring plan in the province; (v) development of the drought plan in which drought scenarios are defined quantitatively and measures associated with each scenario are established to minimize socioeconomic impacts

34. During the preparation of the operation, the "sample" projects were determined to analyze the environmental and social impact and the economic and technical viability of the overall works that will eventually be financed by the project resources. The scope of the sample was the same as that used for Phase 1 of data collection: the municipalities of Santiago, Tamboril, Jánico, and a part of San José de las Matas.

35. The chlorine subsidy will come from CORAASAN's own funds and not from the operation's resources. This service is considered to have the possibility of being sustainable because CORAASAN performs adequate chlorine management in urban plants. The additional amount of chlorine needed to supply rural plants is manageable, since it is small compared to what is already used in urban plants.

derived from scarcity of resources; (vi) identification of the most appropriate monitoring tools for different types of sources, their acquisition and installation, and supervision of that monitoring by an external consultant for six months. The actions of this program will be carried out in coordination with the National Institute of Hydraulic Resources of the Dominican Republic (INDRHI).

Investment Program in Capital Cities and Small Rural Towns

In this program, the main investments were located in works in localities or in *parajes* not yet identified during the project's development phase. Included in this are: (i) network optimization and extension works and individual solutions[36] and (ii) their designs and supervision. All investments will have adequate environmental supervision to guarantee compliance with the operation's environmental and social safeguards.

Payment for Environmental Services Program (PES)

This program is one of the available tools and it has a legal framework to guarantee the protection of water sources. It will be part of the agreement between CORAASAN and rural providers so that the latter can benefit from other programs in the rural strategy, such as the chlorination program. Through this agreement, the provider must guarantee the protection of lands immediately surrounding the water sources. If the providers do not have sufficient means to guarantee this protection, an offer will be made to include the land in this PES. To structure this program, the project will finance three consultancies whose main objectives are: (i) development of a financial model for the self-sustainability of the PES, including diversification of financing; (ii) optimization of PES administrative processes and geographic management systems; and (iii) optimization and development of conservation measures. Implementation of the resulting PES will fall within the implementation structure of the current PES.

5.2.2 Sanitation Programs

Pilot Program in Schools

The objective is to contribute to an improvement in the management and provision of water, sanitation, and hygiene services in rural schools, including menstrual hygiene. The project envisions the implementation of up to two pilot projects that will consist of small works to adapt facilities. In sanitation, testing the operation of artificial wetlands was considered.

Pilot Program for Secure Sanitation Management

The objective of this pilot is to contribute to an improvement in sanitation management in rural areas. The project will finance a consultancy for the implementation and monitoring of this, the acquisition of goods, and the adaptation work on a wastewater treatment plant (WTP) so that it can also treat the sludge from individual solutions. This WTP will be managed by CORAASAN.

5.2.3 Rural Institutional Structuring Programs

Structuring of the Rural Fund

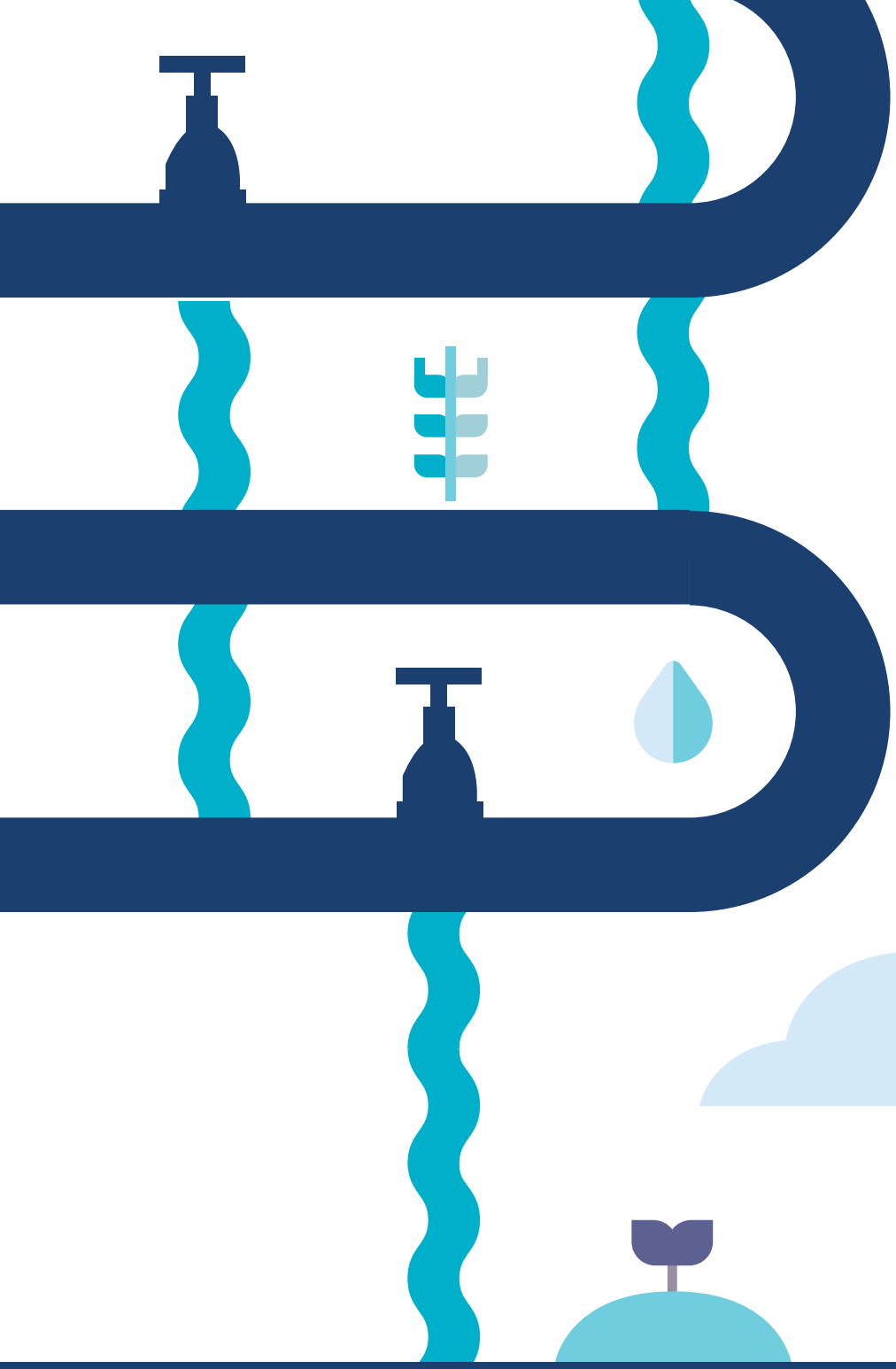
The project includes financing a consultancy

36. The need to design and implement individual solutions to provide a water service in certain areas where it is not feasible to provide service through the water supply system, beyond the areas already identified as dispersed rural, could be deduced from the water resources program.

to create seed capital and organize the rural fund in the medium- and long-term. This fund must be self-sustaining for CORAASAN and will serve to support rural areas during the operation's implementation through the chlorine subsidy, and to continue support once the project is over.

Coordination of the Agreement between CORAASAN and Rural Providers

Rural providers may join if they choose, which will involve signing a formal agreement between providers and CORAASAN that covers CORAASAN's technical assistance, as well as the conditions for providers to benefit from the programs included in the rural strategy. The operation includes technical assistance to develop this agreement, to train and disseminate among rural operators about the benefits and responsibilities that could derive from these agreements, and to support the legalization of providers who are not fully certified.



6

Implementation model

6.1 Implementation outline and organizational chart

For the implementation of the policy lines and programs mentioned above, the project will finance a Rural Unit (RU) that will be created within the Implementation Unit (IU) of the project in CORAASAN, which will be key in the implementation outline agreed in the project. In the medium-term, the plan is for CORAASAN to integrate this Rural Unit into its structure and remain after the project ends, supporting both service provision and the implementation of new investments in rural areas of the province.

Although the responsibility for the implementation of the rural component of the project will fall mainly on the IU through the RU, certain monitoring actions will be carried out by a new device established by CORAASAN: the rural antennas. These antennas will manage the water supply systems of the municipal capitals and provide support for other water supply systems in urban areas of the rural area and in rural *parajes*. They follow the model of a first antenna that was installed by the commercial department in San José de las Matas, but expand powers and attributions beyond the commercial area.

The rural antennas will always operate under the coordination of the RU (Table 6), thus contributing to the transfer of information and skills to rural operators. Likewise, the RU must coordinate with other IU units, namely, the Environmental and Social Unit (ESU) and the Procurement Unit (PU) (Table 6).

Based on the needs of the policy lines described above and on the distribution of responsibilities during the implementation of Table 6, a specific organizational chart was proposed to implement the rural component (Figure 26). The sizing of this structure will be reviewed at the beginning of the operation according to the needs and degree of involvement of other institutions participating in the program's implementation.

To carry out the activities included in the rural component of the operation, technical assistance (TA) will be financed to support RU

Table 6: Implementation outline for the rural component of the operation, distinguishing different activities in the project cycle.

	Execution plan						
	Preparation of specifications	Bidding	Execution	1st level monitoring	2nd level monitoring	Environmental supervision	AT operation and monitoring
Water policy lines in capitals and small rural water supply systems							
Investments in the sample projects	RU/TA, PU, ESU	PU	Outsourcing	Outsourcing	RU	ESU	RA (1)
TA to accompany the RU in component launch	PU, EM	PU	n/a	RU	n/a	n/a	n/a
Micro-metering program	RU/TA, PU, ESU	PU	Outsourcing	RA	RU	ESU	RA (2)
Chlorination and pretreatment program	RU/TA, PU, ESU	PU	Outsourcing	RA	RU	ESU	RA (2)
Water resources program, including drought plan							
Consulting products	RU/TA, PU	PU	Outsourcing	RU	n/a	n/a	n/a
Source monitoring (bidding process and execution plan)	RU/TA, PU, ESU	PU	RA	RU	n/a	ESU	n/a
Investment program in capital cities and small towns	RU/TA, PU, ESU	PU	Outsourcing	Outsourcing	RU	ESU	RA (3)
Payment for Environmental Services Program							
Consulting products	RU/TA, PU, PES team	PU	Outsourcing	PES team	n/a	n/a	RA (4)
Execution of the PES	n/a	n/a	PES	n/a	n/a	n/a	n/a
Sanitation policy lines in capitals and small rural towns							
Pilot in schools	RU/TA, PU, ESU	PU	Outsourcing	Outsourcing	RU	ESU	RA (1)
Sanitation improvement pilot	RU/TA, PU, ESU	PU	Outsourcing	Outsourcing	RU	ESU	RA (1)
Institutionally coordinated rural policy lines							
Rural background	PU, EM	PU	n/a	RU	n/a	n/a	n/a
CORAASAN agreement - rural providers	PU, EM	PU	n/a	RU	n/a	n/a	n/a

TA: technical assistance; RU: rural unit; RU/ TA: rural unit with technical assistance support; PU: procurement unit; ESU: environmental and social unit; IU: implementation unit; EM: IE's engineering management; RA: rural antenna

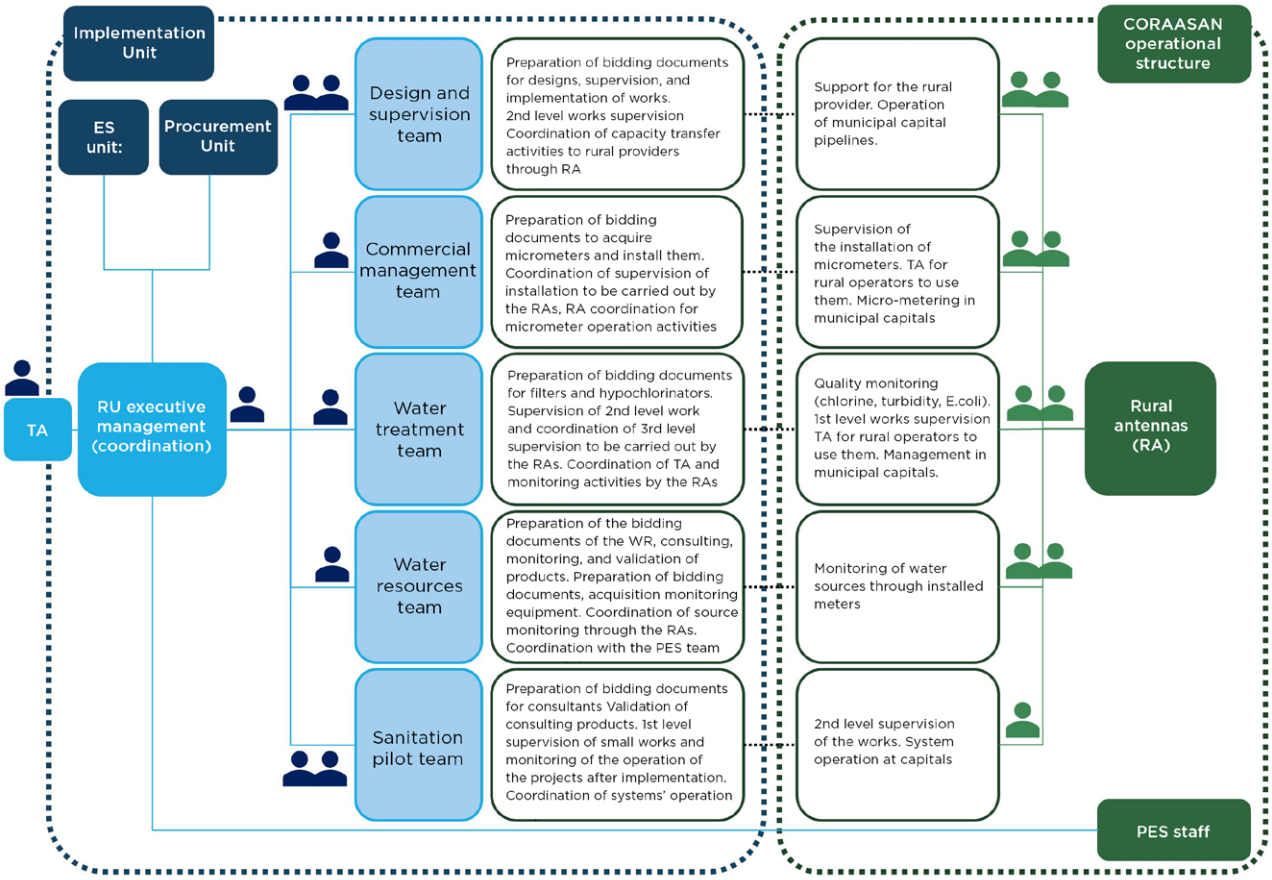
(1) CORAASAN is the capitals' operator supported by the RA

(2) Includes TA to rural providers coordinated by RU

(3) As support for rural operators to properly operate the works. In capitals, CORAASAN itself, supported by the RAs, who will carry out the operation

(4) As the main contact between rural operators and the PES team

Figure 26: Proposed organizational chart for the RU, details of responsibilities and link with Rural Antennas (RA). ES unit: Environmental and Social Unit. TA: technical assistance



coordination, the main benefits of which will be: (i) structuring the RU by defining a staff work methodology, including details of processes and coordination actions with rural antennas and with other units of the Implementation Unit; (ii) support for the preparation of terms of reference and bidding documents for specific work for the micro -metering and chlorination and treatment program, including preparation of the work methodology with rural providers; (iii) prioritization analysis of investments in rural water supply systems for each of the identified programs (chlorination, micro-metering, and investment program) to optimize the operation's resources and guarantee that its results are achieved; (iv) support for the development of the agreement between providers and CORAASAN; (v) preparation of basic work designs for the installation of disinfection and treatment systems to reduce turbidity; (vi) detailing the water supply system management model in rural areas based on rural antennas, differentiating capitals from *parajes*; (vii) monitoring and support for RU coordination for two years.

6.2 Proposal for a model for the execution of investor contracts

In addition to the proposed organizational chart, a standard model of terms of reference will be designed for the bidding documents for works planned for investments in water supply systems that are not part of the sample. The main differentiating factor of the model will be that the works and social support will be tendered in the same contract, so that payments to the contractor will be linked to milestones characterized by progress in work in addition to a certain degree of progress in products and measurable results in the social component. The latter can be indicators of the participation and community acceptance of the works, workshops, and trainings carried out, or the development of informational materials, among others.

6.3 Budget and details of activities

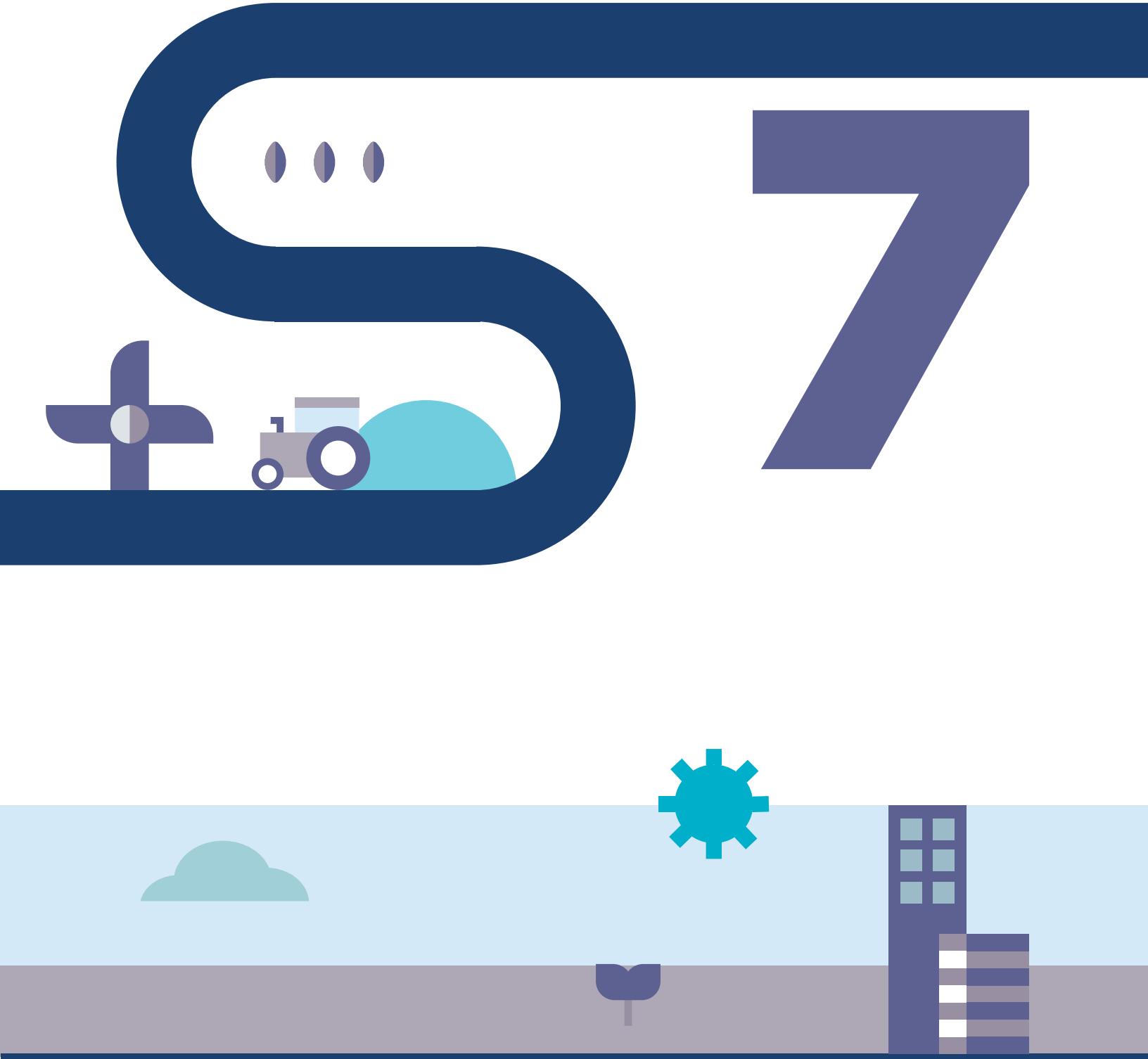
	USD Operation funds	USD Own funds	Comments	Activities calendar
				Year 1 / Year 2 / Year 3 / Year 4 / Year 5 — 1st week 2nd week 1st week 2nd week 1st week 2nd week 1st week 2nd week 1st week 2nd week
Water in capitals and small rural water supply systems				
1. Investments in the sample projects				
1.1. Work to rehabilitate and optimize the Jánico water supply system	1,860,000			PB
1.2. Work to rehabilitate and optimize the San José de las Matas water supply system	4,278,000			PB
1.3. Final design and supervision of the works in Sajoma and Jánico	462,000			PB
1.4. Environmental supervision of the environmental and social unit	Admin. funds		Supervision from design of the specifications to ensure that PGAS is included in the specifications. During the works, monitoring of compliance with the PGAS.	
2. TA (technical assistance) to accompany the RU in launch of component				
2.1. TA contract	175,000		Consultancy that includes the following services: (i) structuring the RU by defining a staff work methodology, including details of processes and coordination actions with rural antennas and with other units of the Implementation Unit (IU); (ii) support for the preparation of terms of reference and bidding documents for specific work for the micro-metering and chlorination and treatment program, including preparation of the work methodology with rural providers; (iii) prioritization analysis of investments in rural water supply systems for each of the identified programs (chlorination, micro-metering, and investment program) to optimize the operation's resources and guarantee that its results are achieved; (iv) support for the development of the agreement between providers and CORAASAN; (v) preparation of basic work designs for the installation of disinfection and treatment systems to reduce turbidity; (vi) detailing the water supply system management model in rural areas based on rural antennas, differentiating capitals from *parajes*; (vii) monitoring and support for RU coordination for two years.	Products (i), (ii) , (iii) / PB / Products (iv), (v) / Product (vi)
3. Micro-metering program				
3.1. Definition of work methodology in rural areas			Purpose of the TA contract (2.1)	
3.1. Acquisition of 12,000 micrometers	600,000		In a larger tender for an estimated 5.7 million that includes all the micrometers to acquire charged to the operation	PB
3.2. Micrometer installation	60,000			PB
3.3. Supervision of the installation	Admin. funds[1,2]			
3.4. TA for handling micrometers and monitoring	Admin. funds[1,2]			
4. Chlorination and pre-treatment program				
4.1. Installation works, includes acquisition of hypochlorinators	400,000			PB
4.2. Design and supervision of the installation	Admin. funds[1,2]		Purpose of the TA contract (2.1) and of the RU	
4.3. Acquisition and subsidy of reagents for disinfection		A/d	Object of the consulting #10.1	
4.4. TA for handling and monitoring	Admin. funds[1,2]			

	USD Operation funds	USD Own funds	Comments	Activities calendar
				Year 1 / Year 2 / Year 3 / Year 4 / Year 5 1st week 2nd week 1st week 2nd week 1st week 2nd week 1st week 2nd week 1st week 2nd week
Water in capitals and small rural water supply systems				
5. Water resources program, including drought plan				
5.1. Consulting for the analysis of water resources in the province, of drought and support for monitoring of water sources.	1,360,000		Consulting that includes the following services: (i) diagnosis of WR in the province with a drought focus; (ii) identification of vulnerable WR in terms of the certainty of water availability and in terms of anthropic threats; (iii) specific and detailed evaluation to provide water services to the capitals and small rural towns, identifying the optimal WR to guarantee supply, includes characterization of quality and quantity; (iv) coordination of a monitoring plan for water resources in the province, including in rural areas, which includes a budget as well as the preparation of technical specifications for the acquisition of monitoring devices; (v) coordination of the drought plan; (vi) supervision of the acquisition and installation of monitoring tools and monitoring supervision for six months.	Products (i), (ii) , (iv) / Product (iii) / Product (v); PB
5.2. Acquisition of water source monitoring tools and their inst.	500,000		There will be coordination with INDRHI.	PB
5.3. WR monitoring	Admin. funds[1,2]		Total amount for the acquisition of monitoring assets for the province as a whole. Will require coordination with INDRHI.	
6. Investment program in capital cities and small rural towns				
6.1. Designs and supervision. May include individual solutions (based on result of WR analysis)	1,323,750		Takes macro-meters into account. The designs include the feasibility studies for the comparative analysis of possible solutions according to the WR study. The need to implement individual solutions could be deduced from this WR study.	PB
6.2. Works in capitals and rural water supply systems	13,141,250		The execution of works in rural water supply systems can be executed through a mixed bidding contract that includes physical progress in works and progress in the social component.	PB
6.3. Environmental supervision of the environmental unit	Admin. funds		Preparation of PGAS, design and execution of public consultations. Supervision from design of work specifications to ensure that PGAS is included in the tender specifications and contractor contracts. The unit monitors compliance of PGAS during the works.	
7. Payment for Environmental Services Program (PES)				
7.1. Financial and PES coordination consulting	80,000		Consulting that includes the following services: (i) determine the cost/ha for different intervention models (reforestation vs. preservation); (ii) coordination of a financial model for the self-sustainability of the PES, including diversification of financing; (iii) based on the financial model, determine the intervention scope for different intervention scenarios to determine the one that optimizes financial resources and maximizes PES results; (iv) coordination of the PES program in the short term (four years) and medium term (10 years). The product (iv) must include: a) intervention logic with expected results and products, including physical and financial progress; b) program activities differentiating management/administration activities, monitoring activities with measurable KPIs, conservation/preservation activities to be implemented quickly thanks to accumulated experience, research activities, accountability activities; c) description and review of the contractual conditions with the land owners, taking into account the country's legislation; d) necessary structure (human capital), means and tools required to implement the PES, including an organizational chart where responsibilities are indicated; e) detailed budget differentiating the activities listed in point b) (management/ administration, monitoring, preservation, research, accountability); f) links with other stakeholders with competencies in the matter	Products (i), (ii) , (iii) / Product (iv); PB

	USD Operation funds	USD Own funds	Comments	Activities calendar
				Year 1 / Year 2 / Year 3 / Year 4 / Year 5
				1st week 2nd week 1st week 2nd week 1st week 2nd week 1st week 2nd week 1st week 2nd week
Water in capitals and small rural water supply systems				
7.2. Systems and process consulting	80,000		Systems and process consulting that includes the following services to contribute to the structuring of the PES: (i) review of the ongoing PES project processes to identify the processes to be optimized; (ii) an action plan to optimize them, including measurable KPIs and a budget to execute the action plan; (iii) supervision and support for six months.	PB
7.3. Conservation activities consulting	80,000		Consulting on conservation and restoration activities that includes the following services: (i) review of the reforestation and conservation activities of the ongoing PES project, collaborating in the preparation of a budget that will help develop the financial model within the framework of consulting # 7.1; (ii) review of reforestation and conservation activities to identify actions to optimize and research activities that may be pertinent and feasible; (ii) development of the reforestation, conservation, and research activities to be included in the PES document and determining the detailed budget for them, the monitoring actions, and KPIs, and the technical details necessary for their proper execution; (iv) monitoring of activities for six months. Product (iii) includes description of related activities or infrastructures, such as the creation of a nursery for plant production.	PB
7.4. Identification and prioritization of areas of intervention, drawing up of contracts, and execution of the rest of the PES activities		333,000	Funded under the MINISTRY OF THE ENVIRONMENT- CDEEE / EGEHID - CORAASAN agreement. The intervention areas will cover both the Alta del Yaque Norte basin to extend the life of the Tavera-Angostura dam system and contribute to the lifespan of CORAASAN thanks to a reduction in treatment costs, as well as rural areas made available to the PES program by rural water operators that take advantage of this program for the preservation of the micro-basins of the sources of water. This activity will be carried out in close collaboration with the financial consultant since the financial model will result in the optimal surface area that can be covered through the PES program to guarantee sustainability.	
Sanitation in capital cities and small rural towns				
8. Pilot in schools				
8.1 Design and execution of pilots	300,000			PB
8.2 Pilot supervision	Admin. funds[1,2]			
9. Sanitation improvement pilot				
9.1. Consulting for pilot execution	1,600,000		Consulting for development and monitoring of the execution of the pilot; may include small PTAR adaptation work for individual solution treatment.	PB
9.2. Buying goods	800,000			PB
9.3 Pilot supervision and support	Admin. funds[1,2]			

	USD Operation funds	USD Own funds	Comments	Activities calendar									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				1st week	2nd week	1st week	2nd week	1st week	2nd week	1st week	2nd week	1st week	2nd week
Institutionally articulated rural													
10. Creation of the rural fund and provision of a budget													
10. Financial consulting	80,000		Financial consulting to create seed capital and articulate the long-term rural fund. The consulting includes supervision of the fund's operation during its first months. The fund includes the chlorine subsidy.	PB ✦									
12. CORAASAN agreement - rural providers													
12.1. Institutionalization activities: development of the agreement model between borrowers and CORAASAN, consultations with			With support of TA (2.1)										

1. RU staff will be in charge of coordinating these activities, the execution of which will be the responsibility of rural antennas (see execution scheme for more detail)
2. The profile of the RU technicians and the antennas must guarantee this responsibility
3. PB: Preparation of the Bidding Specifications. An EU procurement specialist will be dedicated to preparing rural tender documents
4.X: Critical product (other significant investments depend on its results)
D/p: Details pending (during coordination of the rural fund)
Award of contract ✦



Conclusions

The intervention strategy for the improvement of the rural water and sanitation service in the province of Santiago responds to the need expressed by Dominican authorities to achieve the SDGs by 2030 without leaving anyone behind. It is also because of CORAASAN's commitment to take on a more active role in water and sanitation services in the rural part of Santiago province. In preparing the project, CORAASAN's new approach to rural intervention was present not only as a goal but also as a way to reach that goal, considering that the strategy development process itself should be part of the implementation of CORAASAN's strengthened role in the rural area.

Throughout the process, a fundamental point was the involvement of all parties in gathering information, aware of the cost that this entailed. But the decision to carry out the two

Illustration 18: View of a rural paraje in Jánico. Source: Authors' preparation.

massive information surveys (households and SIASAR) was key to building a solid argumentative basis on which to make decisions and define objectives and programs, as well as to make the entire process more participatory.

When designing the solutions, the wide sample of communities suggests that its representativeness is adequate, the projections for the entire province are reliable, and the catalog of observed cases is sufficient to model a wide range of solutions. The practically individualized categorization for each community allowed the construction of investment scenarios at both a quantitative and a qualitative level: the goals to be achieved and the necessary investment could be precisely defined, as well as defining through which programs, with what focus, and in which areas, with which stakeholders, etc.

The large amount of information gathered is also a very valuable piece of input for the institution, which now has a baseline of information. A good updating strategy would ensure, for CORAASAN, continuous monitoring of the entire urban and rural sector of the province, allowing for the definition of new strategies, making it easier to find a place for other stakeholders' possible plans, to face emergencies or unforeseen events, etc.

This strategy is also particularly relevant for CORAASAN. With this document and all the work that it has entailed, an attempt was made to facilitate this increase in scale and take advantage of the synergies that an entity like CORAASAN can transfer to rural areas, such as:

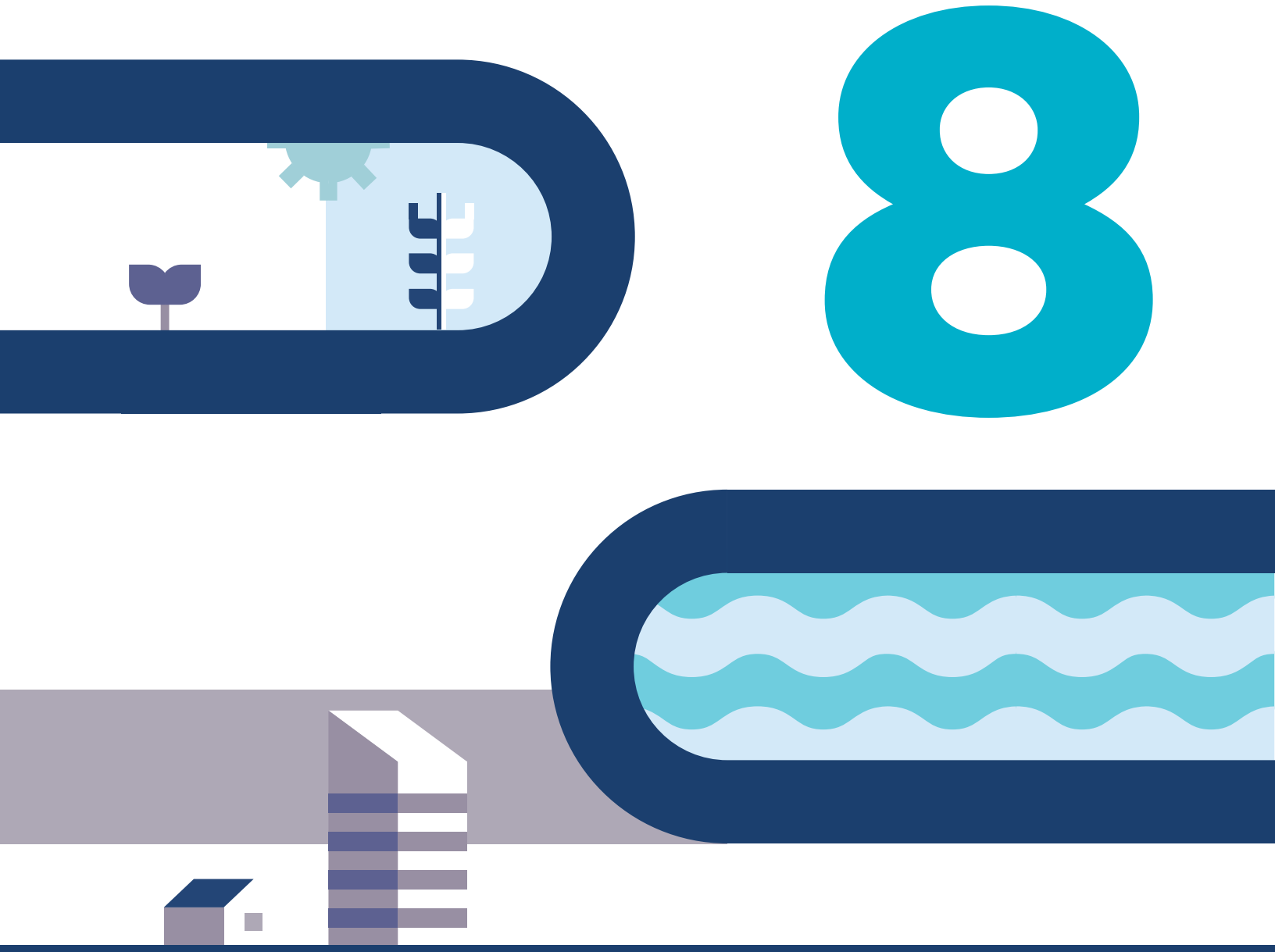
- the technical capacity to adequately manage large water supply systems such as Santiago de los Caballeros' complex sanitation systems and treatment plants. These capacities are, in general, much greater than those any small rural operator may have. Given that rural systems are less complex than urban ones, the strategy opted to create mechanisms so that these technical capacities installed by CORAASAN can also serve the rural area, both directly and indirectly, through technical assistance to community providers. This support will not only be for construction aspects, but will also include social, administrative, organizational, and legal aspects.
- The lead arm of a sectorial institution like CORAASAN also allows some lines of work to be brought to the rural area that would not fit in well without a robust sector head. This is the case of the Payment for Environmental Services program, where CORAASAN will collaborate with each small provider for the joint protection of local water and environmental resources.
- From the point of view of sustainability, CORAASAN could consider the creation of contingency funds for rural water supply systems out of the institution's general budgets. This indirect mechanism for transferring funds to rural areas can be very valuable to encourage service sustainability in rural areas.

Another relevant conclusion is the perspective that a corporation's rural strategy could have in the rest of the country: it can produce valuable input for other sectorial institutions in the Dominican Republic. In particular, this applies to all the other autonomous corporations that have sectorial responsibility in their respective provinces. But it is also a valid operational model for INAPA, which continues to be the largest sector institution in the country and the operator of hundreds of urban and rural water supply systems. There are some arguments that point in this direction:

- The information deficit observed in the province of Santiago exists in the entire country. Although there is a lot of information from SIASAR in provinces where the service is still operated by INAPA, data from 2014 to 2016 is generally incomplete.
- The information survey methodology developed in Santiago has been shown to be feasible and replicable in any other prov-

ince in the country. It is already adapted to the Dominican context and could be a relevant contribution for monitoring the SDGs.

- As in Santiago, other autonomous corporations have prioritized the operation of urban water supply systems and have limited their activities in the rural areas of their provinces. This step that CORAASAN has taken may indicate a framework for action for the other corporations and may help alleviate the vagueness of the regulatory framework, which hinders the development of the country's cross-cutting strategic planning instruments.



Appendix I - Brief synthesis of the surveys

8.1 Background and objectives

The objective of the surveys proposed in the province of Santiago was threefold: first, to determine the levels of water, sanitation, and hygiene services following the methodology of the JMP service ladder; second, to measure the rural universe in terms of the real number of communities, water supply systems, or existing service providers; and third, to diagnose the state of the water supply systems and the capacity of rural providers. All of the above was especially relevant considering that CORAASAN is a stakeholder in the process of expanding in rural areas; therefore, there was not enough current, reliable, and complete information on the reality of the sector in that context.

8.2 Instruments for the surveys

To achieve the planned objectives, the decision was made to use two instruments for gathering information:

- A home questionnaire that was developed with a commercial software tool. Collecting data in households allowed the JMP methodology to be followed in the sense that the data to calculate the service ladders must come from domestic surveys. Furthermore, being an ad hoc tool for this operation, the questionnaire was flexible enough to incorporate questions of interest to both IDB and CORAASAN specialists. Household questionnaires were also sent out in urban settings, which made it possible to compare service levels between urban and rural contexts.
- SIASAR community, system, and service provider questionnaires, which it uses with its own existing tools and data model. The SIASAR survey ensured that it had a diagnosis of water supply systems and providers, in addition to serving as a comparison

for the survey of households in terms of community data.

- Within the SIASAR community questionnaire, information was included at a basic level on water and sanitation in health and educational centers located in the communities or capital cities surveyed.
- Water quality data was also collected for each water supply system, which was incorporated into the SIASAR system questionnaire.

8.3 Survey phases

Considering the cost and time of the surveys, two work phases were defined. The first one was used as a "sample" to prepare the Bank's operation, and the second one was used for the rest of the province's territory. The distribution of the territorial areas in phases was as follows:

Table 7: Distribution of municipalities in survey phases

Town	Phase 1 (sample)	Phase 2
Santiago	■	
Baitoa		■
Bisonó		■
Jánico	■	
Licey al Medio		■
San José de las Matas	■	■
Tamboril	■	
Villa González		■
Puñal		■
Sabana Iglesia		■

In the case of the municipality of San José de las Matas, in the first phase, the municipal capital and the rural or urban communities served by COCODESI's rural water supply system and its surroundings were surveyed. The rest of the communities and areas were surveyed in the second phase. In the case of Baitoa, the household surveys of the municipal capital were carried out early in Phase 1.

8.4 Survey universe

To plan the survey, it was necessary to define the survey's universe, which was divided into five different areas:

Households:

- Based on the service points that CORAASAN located throughout the province, a random sample of households that was statistically representative was taken.
- To calculate the total sample, the fact that in some areas the randomized points in the information system were not homes, but shops or agricultural or livestock structures, among others, was taken into account so more points had to be visited than anticipated.
- Household samples were collected in both urban and rural areas, including disadvantaged areas in the municipality of Santiago. The urban ones were divided between the municipal and the district capitals to guarantee the representativeness of all the areas and because the district capitals in many cases have rural characteristics.

Rural communities in SIASAR:

- The communities in the province were not localized, so the following technical criteria were used to identify them: based on CORAASAN's service points and the NSO's borders of rural *parajes*, how many homes there were in each area and how they are distributed in the territory was estimated. Those that had more than 10 houses concentrated territorially around a point in the *paraje* were considered candidates to house a community. Some additional considerations that were taken into account were:
- The previous criterion was validated in the field, and some of these candidate *parajes* were ultimately not communities or vice versa.
- If the location had a place name and the inhabitants had the perception of living in a community, that was also taken into account.
- In the *parajes* that considered themselves communities, the entire *paraje* was taken as a single community.
- Some communities cover more than one *paraje*, in which case only the main one was surveyed as a community, and the *parajes* associated with it were indicated in the remarks.

NSO urban areas:

- According to the NSO, all the municipal and district capitals are urban. But within the framework of the operation, all except Santiago de los Caballeros were surveyed with SIASAR. Although SIASAR is designed for rural areas, this decision was made to ensure that the operation had a service diagnosis in all areas outside the city, and is consistent with the criteria for urban and rural areas decided on by the project team.
- Given that SIASAR is an official rural public system and should not show data from areas with urban characteristics, a criterion was determined to decide what would be validated in SIASAR and therefore officially published, in other words, to differentiate between what was really rural and what was not. This criterion was that the town could not be the municipal capital and could not have more than 5,000 inhabitants.

Systems in SIASAR:

- The systems that were included in SIASAR were those collective systems that according to the JMP could be considered as service from an improved water source.
- Using the corresponding questionnaire, the information from all rural systems in the province was collected, which includes using gravity, pumps, wells with manual pumps, and domestic rainwater systems.
- In the case of the urban water supply systems of Santiago de los Caballeros, those that serve urban areas or rural communities that were surveyed in SIASAR were surveyed totally or partially.

Service providers in SIASAR:

- In the case of the service providers, those that serve the systems that were surveyed in SIASAR were surveyed totally or partially.

Based on the above, the universe that was determined is set out in the following tables and in the map of randomized points in the different contexts.

In the case of SIASAR, the urban areas were correctly defined and are included in Table 10, differentiating those that were validated from those that were not:

Table 8: Universe of the survey of households by zones in Phase 1.

TOWNS	TYPES	Households (ONE)	Base points	Sample Points
Santiago municipality	Urban municipal capital (not disadvantaged)	175,421	145,075	154
	Not an urban municipal capital (not disadvantaged)		14,791	152
	Disadvantaged		15,855	152
	Concentrated rural	26,900	28,367	454
	Dispersed rural		313	-
Jánico municipality	Urban municipal capital	1,070	545	159
	Not an urban municipal capital		553	167
	Concentrated rural	3,702	6,102	450
	Dispersed rural		602	-
San José de las Matas municipality*	Urban municipal capital	2,694	3,806	292
	Not an urban municipal capital		535	90
	Concentrated rural	-	2,314	439
	Dispersed rural		-	-
Tamboril municipality	Urban municipal capital	8,974	5,768	220
	Not an urban municipal capital		1,723	92
	Concentrated rural	5,557	5,719	447
	Dispersed rural		130	-
TOTAL		**224,418**	**235,059**	**3,298**

* The data for San José de las Matas are for two out of four urban areas (San José and La Cuesta) and for 21 out of 174 concentrated locations or *parajes*.

Table 9: Universe of the survey of households by zones in Phase 2

TOWNS	TYPES	Households (ONE)	QGIS points	Sample points
Bisonó	Urban municipal capital	10,501	13,299	453
	Not an urban capital		-	0
	Concentrated rural	3,633	4,847	440
	Dispersed rural		-	-
Licey al Medio	Urban municipal capital	5,720	1,700	102
	Not an urban capital		3,732	243
	Concentrated rural	2,359	3,412	397
	Dispersed rural		602	-
San José de las Matas *	Urban municipal capital	2,694	-	-
	Not an urban capital		538	258
	Concentrated rural	-	11,356	530
	Dispersed rural		-	-
Villa González	Urban municipal capital	5,773	4,221	293
	Not an urban capital		1,538	102
	Concentrated rural	5,819	7,537	473
	Dispersed rural		-	-
Puñal	Urban municipal capital	4,131	1,570	135
	Not an urban capital		2,166	195
	Concentrated rural	10,825	12,375	417
	Dispersed rural		-	-
Sabana Iglesias	Urban municipal capital	2,140	2,656	387
	Not an urban capital		-	0
	Concentrated rural	2,511	4,118	490
	Rural disperso		-	-
TOTAL		**56,106**	**75,867**	**4,916**

* The data for Son José de las Matas are for urban and rural areas that were left out of the first phase.

Table 10: List of NSO urban centers according to their validation in SIASAR

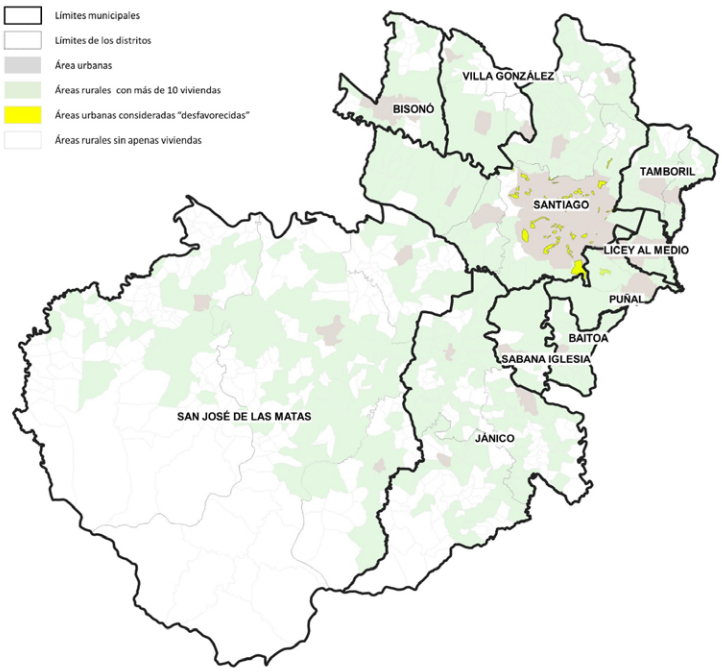
List of urban centers according to ONE to be surveyed with SIASAR questionnaires					
	Capital type	Households	Population	Work phase	Validation in SIASAR **
Santiago municipality					
Santiago	Municipal	163,193	550,753	Not surveyed	-
Pedro García (D.M.)	District	348	1,288	1	Yes
Baitoa (D.M.)*	Municipal*	601	2,959	2	No
La Canela (D.M.)	District	1,815	6,581	1	No
San Francisco de Jacagua (D.M.)	District	2,469	9,321	1	No
Hato del Yaque (D.M.)	District	6,647	23,637	1	No
Bisonó municipality					
Bisonó	Municipal	9,039	31,608	2	No
Jánico municipality					
Jánico	Municipal	532	1,730	1	No
Juncalito (MD)*	District	257	916	1	Yes
El Caimito (MD)	District	281	998	1	Yes
Licey al Medio municipality					
Licey al Medio	Municipal	1,658	5,956	2	No
Las Palomas (MD)	District	3,269	12,202	2	No
San José de las Matas municipality					
San José de las Matas	Municipal	2,359	8,442	1	No
El Rubio (MD)	District	282	958	2	Yes
La Cuesta (MD)	District	335	1,225	1	Yes
Las Placetas (MD)	District	300	1,142	2	Yes
Tamboril municipality					
Tamboril	Municipal	7,029	24,825	1	No
Canca La Piedra (MD)	District	1,945	6,850	1	No
Villa González municipality					
Villa González	Municipal	4,044	13,752	2	No
Palmar Arriba (MD)	District	1,086	4,044	2	Yes
El Limón (MD)	District	128	492	2	Yes
Puñal municipality					
Puñal	Municipal	1,824	6,785	2	No
Guayabal (MD)	District	804	2,846	2	Yes
Canabacoa (MD)	District	911	3,218	2	Yes
Sabana Iglesia municipality					
Sabana Iglesia	Municipal	1,556	5,956	2	No

* Although Baitoa is classified as a district of Santiago, it is actually an independent municipality.

** The criteria for it to be validated in SIASAR is that it is considered "rural," i.e. not a municipal capital and with a population of fewer than 5,000 inhabitants.

Figure 27: Distribution map of the random points of households to be surveyed in Phase 1 and in Phase 2. Source: Authors' preparation.

Figure 28: Map of areas to survey in SIASAR in Phase 1 and in Phase 2. Source: Authors' preparation based on NSO's territorial information.



The final map of areas to visit was as follows: in gray, urban; in yellow, disadvantaged; in green, rural *parajes* classified as densely populated:

8.5 Survey results

In the presentation of the rural strategy, only the household surveys of Phase 1 were processed, so the analyses in the note correspond to that phase only. During the survey, some difficulties were encountered in finding inhabited homes in rural areas and capital cities, so in Phase 1 the sample had to be expanded to reach minimum representativeness thresholds, going from 3,298 planned visits to 5,378. Table 11 shows the distribution of end points by municipalities and areas, as well as the percentage of valid surveys, including a preview of the Phase 2 surveys of San José de las Matas.

Table 11: Final universe of the household surveys in Phase 1

Municipality and Environment	Total points surveyed	Total valid points	% valid points of total
Santiago municipality			
Disadvantaged	178	129	72 %
Metropolitan urban	219	146	67 %
Not metropolitan urban	173	118	68 %
Rural	634	413	65 %
Jánico municipality			
Urban municipal capital	203	118	58 %
Not an urban capital	306	128	42 %
Rural	938	423	45 %
San José de las Matas municipality			
Urban municipal capital	467	205	44 %
Not an urban capital - Phase 1	95	57	60 %
Not an urban capital - Phase 2	262	102	39 %
Rural - Phase 1	398	199	50 %
Rural - Phase 2	579	249	43 %
Tamboril municipality			
Urban municipal capital	234	175	75 %
Not an urban capital	170	86	51 %
Rural	522	327	63 %
TOTAL			
Total	5,378	2,875	53 %

The information collected with the household surveys fulfilled the objective of characterizing the service levels to calculate the JMP ladders following the corresponding methodology, except in the levels managed securely, since those require more information than what was gathered in homes.

Regarding SIASAR, the data validated and processed for the development of the strategy corresponded to Phase 1 of the surveys. However, just as for households, the rest of the information was collected, and a preview of the surveys can be shown in terms of the number of communities, systems, providers, or centers with the information collected.

A series of factors must be taken into consideration in the table of results presented:

- The data of the municipal or district capitals that was not validated was not added, following what was presented in Table 10.
- Although there are some municipalities with few or no water supply systems, this does not mean that there is no water service. This result is explained because all or almost all the communities in the municipality are served by large water supply systems branching off from the urban line, which SIASAR assigns to the municipality in which the sources are located, even though they are serving areas beyond that source municipality.

Table 12: Final result of the SIASAR survey universe, taking into account Phase 1 and Phase 2 of the survey

Town	Communities	Communities without water	Coverage	Water supply systems	Service providers	Schools	Healthcare centers
Baitoa	23	2	97.13 %	2	0	7	2
Bisonó	14	4	84.14 %	5	4	8	4
Jánico	65	19	84.93 %	15	14	21	7
Licey al Medio	9	0	99.72 %	1	0	7	1
Puñal	41	0	100.00 %	0	0	21	8
Sabana Iglesia	16	0	97.98 %	1	0	10	1
San José de las Matas	119	17	92.83 %	32	31	49	15
Santiago	87	5	91.42 %	41	13	49	24
Tamboril	34	4	94.66 %	11	10	20	3
Villa González	31	7	90.90 %	10	5	11	4
TOTAL	439	58	92.86 %	118	77	203	69

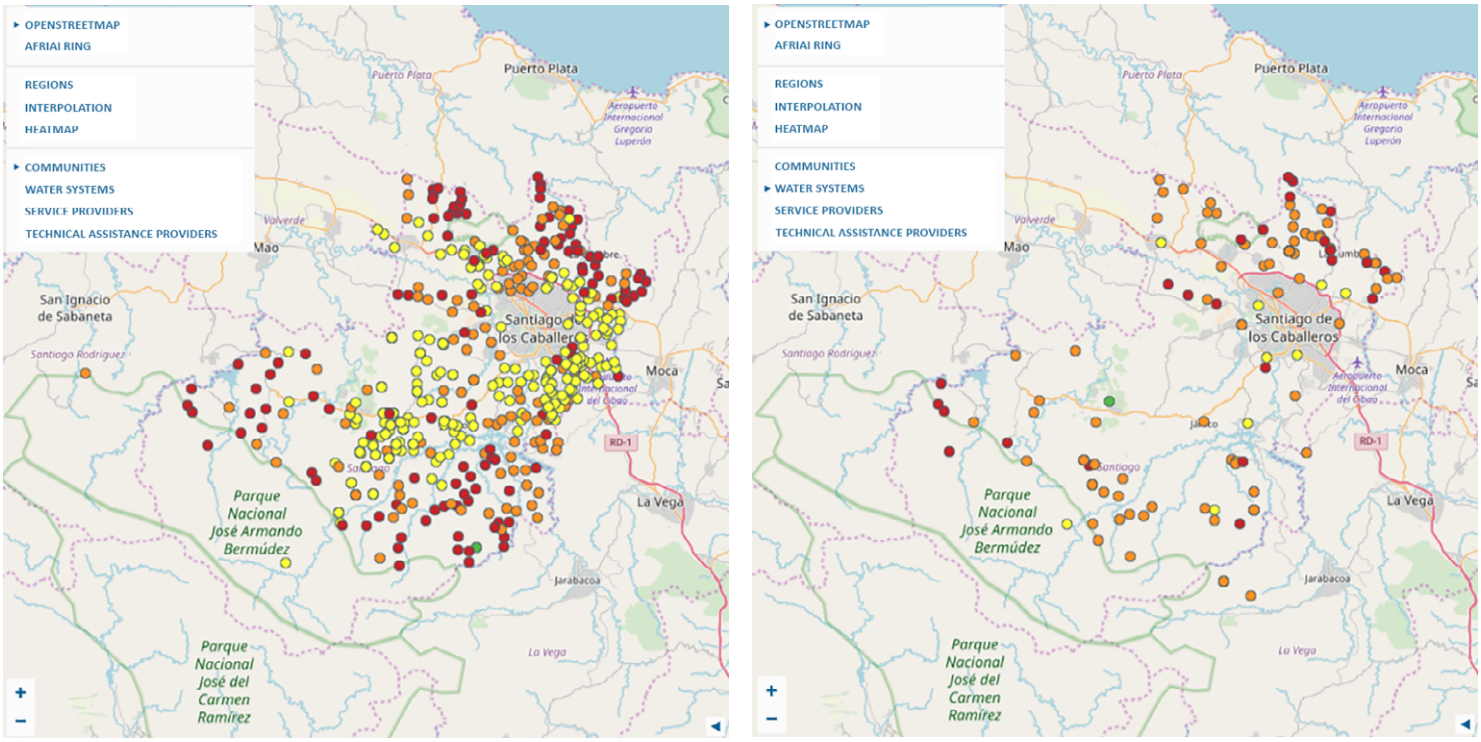
- This situation is repeated with service providers. The fact that some municipalities do not have them indicates that these providers are based in other municipalities, as could be the case of INAPA or CORAASAN itself. Theoretically, provision through INAPA should no longer occur because it should have been transferred, but in the surveys some small community associations were found that stated that INAPA was still providing them with service.
- Since the data from the non-validated capitals is not included, the data from educational and health centers in those localities are not included in the table.

SIASAR information is public and can be downloaded through the following links:

- All the information is on the initiative's website: **http://globalsiasar.org/.**
- As indicated, it should be noted that the information on urban areas will not be available on the website, even though they were also surveyed with SIASAR. Although they are studying how to publish it, for now the data for these specific areas needs to be requested from CORAASAN.
- Each country has its own web page with the main data in maps and graphs. Under the main map on this web page there is a menu to download all the data. In the case of the Dominican Republic, the page is: **http://globalsiasar.org/es/paises/republica-dominicana.**
- If you want to navigate through the information in a simple and visual way, you can use the SIASAR data intelligence tool, which has specific reports, forms, and graphics to gain a quick understanding of the sector in the country. There, you can also download information: **http://data.globalsiasar.org/.**
- In addition, a technical documentation section is available, presenting the questionnaires used, manuals, KPI and algorithm model, presentations, and other training material, both general and for specific countries. It can be consulted at: **http://globalsiasar.org/es/content/documentacion-tecnica.**

The SIASAR “snapshot” for the province of Santiago at the end of the project surveys was the following, where the traffic light colors indicate the rating of the service in communities and systems.

Figure 29: Left, map of communities in SIASAR. Right, systems map. Source: SIASAR 2019



Appendix II – Proposal of individual supply solutions

9.1 Background and objectives

After the territorial, geographic, and demographic analysis of the province of Santiago, it was observed that a small percentage of the population lives in isolated dwellings, in what has been called "dispersed rural." To locate this context in the territory, a criterion was established by which every *paraje* with fewer than 10 dwellings was considered dispersed rural. Also located in this context were those *parajes* that were initially considered to be home to a community, but where it was eventually found that this was not the case.

Although the exact number of people living in dispersed rural areas is unknown (and cannot be quantified with SIASAR since there are no communities in those areas), the population projection from CORAASAN data points to an estimated 5,737 people occupying some 1,630 homes. These figures represent 0.59% of the province's total population and 2.44% of the rural population, according to the NSO's 2010 census.

The *parajes* classified as dispersed rural do represent a representative percentage of some Phase 1 municipalities, such as San José de las Matas and Jánico, and to a much lesser

Figure 30: Location of the dispersed rural *parajes* in the Phase 1 areas. Source: Authors' preparation based on NSO's territorial information

extent Santiago and Tamboril, while in the rest of the municipalities there were hardly any *parajes* classified as dispersed rural. As can be seen in Figure 30, many of the dispersed rural areas of Phase 1 are in places far from the capitals, in mountainous regions. There are some in areas near Santiago de los Caballeros, but they are usually industrial areas with hardly any housing or areas with some type of issue or protection.

Observing the map and the population of the dispersed rural area, it was concluded that equipping all these houses with conventional water supply systems, complying with the parameters established by the rural strategy, presented a plethora of difficulties, at least at today's stage of development of the rural water sector in the province. Therefore, it was suggested in these areas to act with an individual solution proposal that can guarantee a level of service as close as possible to that of the densely populated rural population and that of the inhabitants of rural capitals.

9.2 Individual solution alternatives

Although there are multiple solutions to provide water to single-family homes (or populations with a small number of houses), we can classify them into three main groups:

- Solutions through rainwater collection. This technology is based on taking advantage of rainwater and accumulating it in tanks with sufficient capacity to guarantee supply in the rainy season and in the dry season. Rainwater solutions are obviously highly dependent on the rainfall in the area, so they are not applicable in all contexts.
- Well solutions. These facilities are common in much of the planet and consist of drilling a well to the aquifer and raising the water with manual or electric pumps. These solutions can be complemented with tanks in the home. Although it is a very common solution, it requires aquifers to be accessible and adequate technology to drill and maintain both the well and the pump. In the case of electric pumps, this solution is dependent on electricity supply or access to a generator in the home.
- Solutions with catchments from springs. These solutions are only possible in homes located on slopes or hills in which there are water courses that emerge near the home and can be captured. They must have sufficient flow throughout the year and there should be a small tank in the house. Catchment at streams is a similar solution.

In principle, any of the above solutions could be applicable to the rural context of the province of Santiago. However, after analyzing the specific conditions of the province and the mostly mountainous location of the dispersed areas, the main alternative that was proposed was to install rainwater collection solutions, without excluding other solutions proposed as the project advances. It must be kept in mind that one of the results of the strategy is to undertake an in-depth study of the province's water resources, which will undoubtedly help draw a better map of different types of individual solutions adjusted to each area.

The reasons why rainwater collection was proposed as the first alternative were:

- First, because it was the only solution for which we can estimate the availability of the resource, since the rainfall data for the province of Santiago is available and shows average values of approximately 900 to 1,200 mm per year, depending on the municipality. In the worst-case scenario, it would be possible to guarantee supplies of at least 20 liters per person per day all year round. Better provision could also be achieved if large enough tanks were installed and occasionally supplemented with water from tanker trucks.
- It is a relatively simple solution, with a low operating and maintenance cost since it does not require a power supply. The cost of installation is also relatively low.
- Although it is highly variable, many of the houses observed in rural Santiago de los Caballeros have enough roof surface area to capture a reasonable amount of rainwater. They are also designed to quickly clear the heavy rains of the rainy season, so they are well suited for adaptation to collecting water.

The project could also assess the provision of domestic water treatment systems (such as ceramic filters) to contribute to improving the quality of water for human consumption. It could also assess the provision of hygienic kits and the promotion of alternative sanitation solutions.

9.3 Rainwater solutions model

The alternative that was presented is a system consisting of an adaptation to a house's roof with a semi-perimeter channel around the roof, which carries water to a filter. The filter prevents large particles or elements such as vegetation from passing through and connects to the tank or tanks. Depending on the type of tank used, manual pumps could be installed to make it easier to use the water in the tanks, or alternatively small dispensers of chlorine in tablets, or even a small tank or cistern on the house, using gravity to help water flow into the home.

To properly characterize the solution and estimate a tentative budget, a spreadsheet was designed that is part of the project's investment table. The calculation model designed for this characterization is described below.
The initial variables that were used as boundary conditions, as well as the values that have been considered for the first calculation of the model, were the following:

- Average annual rainfall, in mm. The model used 1,159 mm, as recorded at the Jánico meteorological station between 1982 and 2012, consistent with the rainfall recorded in the San José de las Matas mountainous regions and Jánico, where rainfall is around 1,150 mm (National Meteorological Institute of the Dominican Republic).
- The distribution of precipitation over the months of the year was also included as an initial variable, associated with the average annual precipitation. This is important to ensure that tanks are big enough to last the dry seasons and to calculate the necessary storage volume. A conservative distribution was used, with periods of heavy

rain and dry periods with limited rainfall.

- Average roof area, in m2. An average of 50 m2 was used, from a measurement on aerial photography in a random sample of 10 rural houses.
- Roof efficiency. This one-dimensional factor takes into account factors such as the slope of the roof or the material it is made of. As the roofs of the rural area are adapted to drain water quickly, are hard, and are inclined, their efficiency in water collection was estimated to be 80%.
- Capture effectiveness. This one-dimensional factor takes into account how much collected water manages to enter the filter and reach the tanks. In this case, 90% effectiveness in capture and channeling was estimated.
- People per dwelling. This data was extracted from the average of the surveys of households in rural areas carried out at the beginning of the project. The result was an average of 3.52 people per dwelling.

The initial variables are presented below in table format. With the indicated boundary conditions, the initial calculation for a rainfall of 1,159 mm resulted in it being possible to supply up to 32.48 liters per person per day.

The design variables that were used to calculate the feasibility of each solution scenario were:

- Provision, in liters per person per day. The ideal goal would be to achieve a provision of more than 50 liters, keeping this solution in line with the proposals for collective solutions, but lower provisions have been considered.
- Tank storage capacity, in liters. This is the key design variable since a balance must be struck between the cost and feasibility of the construction of the tanks and the capacity that ensures supply continuity throughout the year.
- Cost, estimating a cost of 230 USD for the installation of a rainwater system with a 5,000-liter tank. The cost is multiplied by each tank that the house has, and an additional 20% would need to be added for other operating expenses for the work itself. The cost of possible pumping to the roof was not included, nor was any treatment or a small additional cistern located on it.

The distribution of rainfall month by month can be observed in Table 14, which is important to ensure that continuity is year-round.

Based on this data, some preliminary scenarios for provisions and recommended tank capacities for the dispersed rural population could be presented. The scenarios were designed with supplies of 20, 35, and 50 liters per person per day, and with initially full 5,000 or 10,000 liter tanks.

Table 13: Estimated calculation of provision for a residential rainwater collection system in rural areas of the province of Santiago.

ANNUAL SCENARIO	Example year	Average rainfall	Average roof area	Efficiency	Effectiveness	Liters/ year	Liters/ day	People/ house	L/p/d
	2012	1,159.00	50.00	0.80	0.90	41,724.00	114.31	3.52	32.48

Table 14: Monthly distribution of rainfall and achievable result in provision

MONTHLY SCENARIO	Month	Average rainfall	Average roof area	Efficiency	Effectiveness	Liters/ month	Liters/day	People/ house	L/p/d
	1	54	50	0.8	0.9	1.944	64.80	3.52	18.41
	2	61	50	0.8	0.9	2.196	74.02	3.52	21.03
	3	73	50	0.8	0.9	2.628	88.58	3.52	25.17
	4	118	50	0.8	0.9	4.248	143.19	3.52	40.68
	5	193	50	0.8	0.9	6.948	234.20	3.52	66.53
	6	90	50	0.8	0.9	3.240	109.21	3.52	31.03
	7	57	50	0.8	0.9	2.052	69.17	3.52	19.65
	8	72	50	0.8	0.9	2.592	87.37	3.52	24.82
	9	106	50	0.8	0.9	3.816	128.63	3.52	36.54
	10	136	50	0.8	0.9	4.896	165.03	3.52	46.88
	11	115	50	0.8	0.9	4.140	139.55	3.52	39.65
	12	84	50	0.8	0.9	3.024	101.93	3.52	28.96

Table 15: Solution scenarios according to different volumes in homes

	SOLUTION SCENARIOS					
Initial Vol.	5,000	10,000	5,000	10,000	5,000	10,000
Capacity (l)	5,000	10,000	5,000	10,000	5,000	10,000
Provision (lpd) Volume/month	20	20	35	35	50	50
1	4,832	9,832	3,248	8,248	1,664	6,664
2	4,916	9,916	1,748	6,748	0	3,580
3	5,000	10,000	680	5,680	0	928
4	5,000	10,000	1,232	6,232	0	0
5	5,000	10,000	4,484	9,484	1,668	1,668
6	5,000	10,000	4,028	9,028	0	0
7	4,940	9,940	2,384	7,384	0	0
8	5,000	10,000	1,280	6,280	0	0
9	5,000	10,000	1,400	6,400	0	0
10	5,000	10,000	2,600	7,600	0	0
11	5,000	10,000	3,044	8,044	0	0
12	5,000	10,000	2,372	7,372	0	0
Annual result	0	0	-2,628	-2,628	-5,000	-10,000

9.4 Results

As can be seen in the model's results, dispersed houses can be supplied with rainwater solutions, but the service levels will depend on the installation's capacity and the objective sought. By analyzing the results for the input data entered, we can observe that:

- With supplies of 20 liters, continuity can be guaranteed year-round and the tanks are kept practically full every day, meaning that, in some months, the house could even use a greater amount of water per person without any risk of interrupting continuity.
- With supplies of 35 liters, continuity is possible during the first year of service, but the year ends with a deficit. With a 5,000-liter tank, a tanker would have to be hired to fill it every two years to compensate for the deficit. With a 10,000-liter tank, the tanker truck would have to come every four years.
- The 50-liter endowments do not guarantee continuity with the applied boundary conditions, and the tank would always have to be 10,000 liters or more. In that case, you would have water for four or five months, or a few more with a hypothetical 15,000-liter tank. Any solution, however, would have to be complemented with annual filling by a tanker truck.

The above results are for an initial analysis with boundary conditions that could be changed to optimize the results. Specifically:

- Initially, the roof area was estimated at 50 square meters; however, fieldwork would be important to better estimate what the real average area is in rural Santiago. In the event that useful roof areas of 60 or 70 meters are obtained, the amount of useful water increases notably and as such, provisions would improve.
- The rainfall regime should be better adjusted to different geographical settings (lowlands and mountainous regions) and to extreme weather events, such as prolonged droughts.
- The first scenarios have been calculated with constant consumption throughout the year; however, scenarios can be designed where in some months there are supplies of 50 liters or more, while others are limited to 20. The habits of the dwelling's residents could also be analyzed. If part of the household only resides in the house occasionally, this could be taken into account when fine-tuning the results.

Finally, taking into account the initial results, the cost per family is estimated to be around USD 550 in the case of the installation of 10,000-liter storage (actually two 5,000-liter tanks) and the adaptation of the roof to collect the rainwater. If 15,000 liters were needed, the cost would rise to an estimated 830 USD.