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Factors That Impact the Implementation of Water Safety Plans—A Case Study of Brazil

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Abstract: A water safety plan (WSP) is a tool proposed by the World Health Organization (WHO) for the mitigation of risks in water consumption, and little is known about the challenges of its implementation stage. The goal of this work was to identify the facilitating factors and challenges regarding WSP implementation from a case study in Brazil. Semi-structured interviews were conducted with water supply public service providers who already have implemented such policy and with supporting institutions that helped with the process implementation. As a result, it has been identified that the WSP implementation is strongly influenced by the quality of WSP preparation process, which means that this process is the foundation of the WSP implementation; through internal management of the organization, whose administrative discontinuities thwart the actions' implementation; and through the relationship of the service provider with the external actors, which can interfere be it in the data collection or the WSP implementation scope's entirety. Lastly, it was possible to conclude that the WSP preparation process, the organization's internal management, and its relationship with external actors are the specific factors that impact the WSP implementation. The conduction and deepening of studies aiming to improve the tools of support for WSP implementation are thus recommended.

Keywords: water safety plan; WSP preparation; implementation; water supplying management; water supply service providers; stakeholders



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1. Introduction

The world has 60% of its water bodies in good quality conditions, but despite that, only 74% of the population has safe access to potable water services, which indicates that until 2030 we will not achieve one of the sustainable development goals (goal number 6), without investing into improving safe access to potable water [1]. The scenario is similar in Latin America, especially in the country with one of the largest territorial extensions in the world: Brazil. Despite the expressive quantity of water existing within the national territory—whose surface water availability is estimated at 76.500 m³/s [2]—and supplying water to 93,4% of the urban population through water supply systems (WSS) [3], inequality can be seen in Brazil, between the populations with access to water. When the service is available, its quality is deemed inadequate, especially regarding intermittence and water quality.

The water safety plan (WSP) is a tool developed and recommended by the World Health Organization (WHO) for the management of health risks in water supply systems. It is an approach in which there is the conduction of a system evaluation regarding the possible risks to which the service users are prone, the prioritization of actions that should

be taken from the risk evaluation, and, lastly, its continuous management. All these aspects are analyzed from the water catchment to the consumer [4]. Therefore, WSP is a tool that orientates the direction of investments, prioritizing the actions which grant greater sanitary safety in the use of water and it is recommended in order to improve water management [5].

Beyond its potential to grant water safety, the WSP began being recommended in 2011 by the Brazilian regulation in effect pertaining to water drinkability (former Decree nr. 2914/2011, current Consolidation Decree nr. 5/2017, updated by Decree GM/MS nr. 888/2021) [6,7] as a measure for the control of produced and distributed water. The inclusion of WSP in the regulatory mark regarding water for human consumption is not limited to Brazil, and it occurs in countries such as Australia, Iceland, New Zealand, Nigeria, Philippines, Singapore, Uganda, and the United Kingdom [8–11].

Since the 2011 normative decree came into effect, several WSP experiences in accordance with the methodology proposed by the WHO have been developed throughout the world and, as with any other public policy, the WSP formulation and implementation steps present difficulties in their execution in several countries [9–15].

Despite international studies pointing out problems in the implementation, such as the cultural matters involved or the adaptation to rural areas [13,14], the experiments of WSP implementation in Brazil have the potential to evidence the best practices in this process, and they need to be explored, given that the Latin American WSP implementation experiments have not been deeply analyzed yet. Therefore, characterizing the challenges and facilitating factors of the implementation of an instrument that can aid in the confrontation against the inequalities in service providing is fundamental for the better application of the WSP. The goal is to identify the facilitating factors and challenges in WSP implementation through a case study in Brazil, as a way of making allowance for the implementation of akin plans or methodological adaptations.

2. Materials and Methods

The study is an exploratory, bottom-up approach study, which seeks to discover how and what is happening in the WSP implementation process in Brazil, stemming from a study of multiple cases, according to [16] a proposal, developed in four sequential steps (Figure 1), and described in the following items. Interviews are applied to this kind of study [8,16,17] and their results can be organized in conceptual maps [18,19]. This research was undertaken from June to November 2019 and reviewed from October to November 2022.

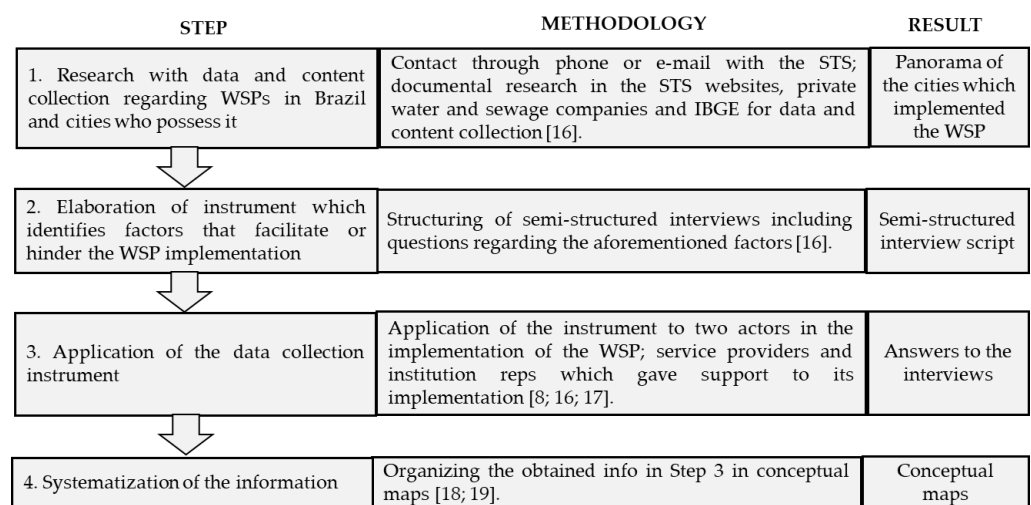


Figure 1. Objectives, methodology, and results of the steps for the execution of this work (drafted by the author).

2.1. Survey Regarding Existing WSPs in Brazil

In this step, a survey was conducted for the cities in the country which have implemented WSPs, as [16] suggests for the conduction of data and content collection (Figure 1).

Two stakeholders have an important role in WSP spreading in Brazil: the National Health Foundation (Funasa) and the water supply service providers (WSSP). Funasa is an institution that promotes a set of actions to improve health, water, and sanitation safety plans in Brazil, which includes the safety plans and WSP workshops/training courses. This institution has headquarters in Brasília and 26 branches (called Suest), one in each state of the country. Service providers are the organizations responsible for creating, implementing, operating, and improving the water supply utilities in the cities. Those can be public, private, or public–private companies. Currently, 88.99% of the service providers are public; 8.35% are private; 2.22% are mixed (public–private), and 0.44% are non-profit organizations [20].

Thus, all Funasa branches were contacted by phone or e-mail, for the sake of seeking information regarding the existence of WSPs within every Brazilian Federative Unit. Additionally, both Funasa's and the private water service providers' electronic addresses have been consulted, in order to find out about the availability of documents that indicated the existence of WSPs.

Stemming from the identification of service providers who have implemented WSPs in Brazil, there was surveying of the city in which such implementation happened, population, federative unit, GDP, type of service provider and its coverage, the time elapsed since the WSP was implemented, and also the geographical location in the databases of the Brazilian Institute of Geography and Statistics—IBGE [21]. The result of this step is an overview of the federative entities which have implemented WSP in Brazil. Federative entities are, by definition, all Brazilian cities, states, and the Federal District.

2.2. Preparation of the Evaluation Tool

In this step (Figure 1), the data collection tool comprised of a semi-structured interview was built, aiming to capture the motivation for the implementation of WSP, the main challenges regarding its preparation, adaptation, and daily implementation, as well as the participation of the workers regarding methodology. The choice for a semi-structured interview and preparation of its protocol was made in accordance with [16] orientations.

The result of this step was the adoption of an interview protocol, which can be found in Table 1 (Section 3.1) and Appendix A, having been approved by the Ethics in Research Committee of the Federal University of Goiás (CAE n. 21361619.6.0000.5083).

Table 1. Interviewed actors, the main topic addressed, and examples of questions asked.

Actor Interviewed	Main Topic	Examples of Questions
Service Provider	General information	Interviewee data, provider data, federal unity data, which planning the provider usually does, etc.
	WSP preparation and implementation process	How did the interviewee found out about WSP, how did the preparation process happen, challenges in implementation, what are the harder steps, etc.
	Other stakeholders	If there is some external influence on the processes, if regulatory or other agencies help in the process.
Members of Supporting Institutions	Experience with WSP	How the interviewed heard about WSP, how it was to support service providers in this process, etc.
	External representatives importance	Importance and impact of stakeholders external to service providers in WSP preparation or implementation.
	Main challenges and facilitating factors identified	Challenges they have identified in training courses or workshops, main difficulties and factors that help service providers, etc.

Source: drafted by the authors.

2.3. Identification of Facilitating/Challenging Factors of WSP

The instrument of identification of the facilitating/hindering factors (semi-structured interview, following the protocol proposed in step 2.2) was applied in service providers which have implemented WSP and supporting institutions that have helped the provider in such service (Figure 1). These institutions were identified within reports made by service providers. The semi-structured interview protocol was applied to the service providers who have returned contact during the period of this research. The conduction of the semi-structured interview occurred following [16] orientations and was based on studies regarding WSP which have used such methodology [9,17]. The result of this step is the performed interview, whose transcription occurred in a manual manner.

Besides the application of interviews, there was complementation of information with data from the IBGE database and the service providers themselves, regarding the population covered by the water supply system (WSS); the volume of water produced; losses; area covered by the service; type of service provider; whether the WSP is inserted in the Municipal Plan for Basic Sanitation; whether there is a regulation bureau acting within the provider's jurisdiction area; and the identification of the interviewee.

2.4. Systematization of the Information

The data were analyzed starting from the interviews' content analysis (Figure 1). This included pre-analysis, where a first reading of the interviews happened, identifying the terms that were repeated the most in the answers; exploration of the material, selecting the keywords in the answers; and the treatment of results and interpretations [19]. This last step had the systematization of information with the use of conceptual maps [18], where it was possible to clarify the main points cited by the literature and the interviewees as possible key investigation points for the problems of WSP implementation in Brazil. The result of this step became a set of conceptual maps of the facilitating factors and challenges.

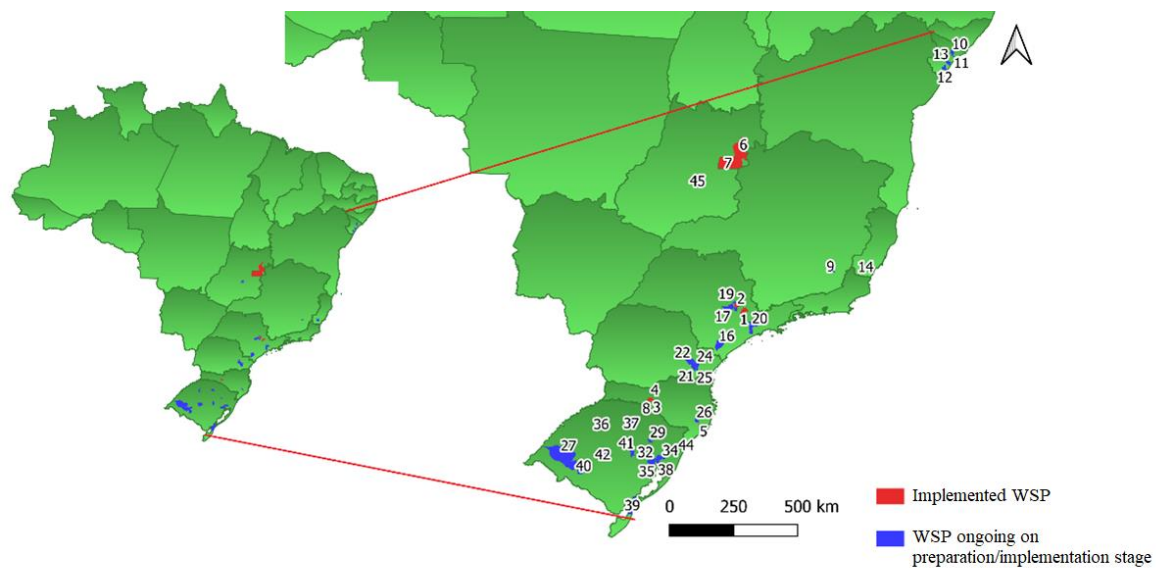
The present work did not cover WSP elaborated within private service providers because they had limited availability during the period of the study and, in some states, it was not possible to obtain double confirmation (that is, by two different sources) that there was no WSP being elaborated or already implemented. Those states are: Acre; Amazonas; Amapá; Ceará; Pernambuco; Piauí; Roraima; and Rio de Janeiro. It was limited to one member from each service provider and not all providers which have an elaborated and implemented WSP were interviewed.

3. Results and Discussion

3.1. Overview of WSP in Brazil

Within the execution of step 1 of the methodology, a total of 45 federative entities (cities or the Federal District) which had a process of preparation or an already implemented WSP have been identified (Figure 2), and those are distributed mainly throughout the country's southern and southeastern regions. Among those whose process is in progress, the stages vary widely: from the beginning of preparation, up to the final writings of the WSP. These are federative entities with different demographic characteristics, but those with a population between 50,001 and 500,000 inhabitants are predominant (Figure 3).

However, it is noteworthy that among those 45 federative entities, in only 8 had the water supply public service provider already prepared and implemented the WSP effectively in the WSS, whether they are following all the steps advocated by WHO or adapting its reality and goal, as observed in Figure 2. Within the work execution deadline, it was possible to have the greenlight for 5 interviews among the 45 federative entities surveyed, 3 of them being with service providers that had effectively implemented the WSP and 2 with service providers whose implementation had not taken effect, included in the map within the group of the federative entities shown to be in the ongoing implementation stage. One of the interviewed service providers covers three cities, as it is an intermunicipal service provider.



Implemented WSP			WSP ongoing on preparation/implementation stage											
Nr	Federative Entities	FU	Nr	Federative Entities	FU	Nr	Federative Entities	FU	Nr	Federative Entities	FU	Nr	Federative Entities	FU
1	Campinas	SP	9	Viçosa	MG	18	Santa Bárbara DOest	SP	27	Alegrete	RS	36	Ijuí	RS
2	Limeira	SP	10	Capela	SE	19	Santa Gertrudes	SP	28	Alvorada	RS	37	Passo Fundo	RS
3	Herval DOeste	SC	11	Carniópolis	SE	20	São Paulo	SP	29	Bento Gonçalves	RS	38	Porto Alegre	RS
4	Luzerna	SC	12	Estância	SE	21	Araucária	PR	30	Cachoeirinha	RS	39	Rio Grande	RS
5	São Ludgero	SC	13	São Cristóvão	SE	22	Campo Largo	PR	31	Canoas	RS	40	Rosário do Sul	RS
6	Formosa	GO	14	Cachoeiro de Itapemirim	ES	23	Campo Magro	PR	32	Eldorado do Sul	RS	41	Santa Cruz do Sul	RS
7	Brasília	DF	15	Cordéirópolis	SP	24	Curitiba	PR	33	Esteio	RS	42	Santa Maria	RS
8	Joaçaba	SC	16	Eldorado	SP	25	Fazenda Rio Grande	PR	34	Gravatá	RS	43	Sapucaia do Sul	RS
			17	Piracicaba	SP	26	Grão Pará	SC	35	Guaíba	RS	44	Torres	RS
											45	Goiânia	GO	

Figure 2. Federative entities with WSP under implementation or preparation (drafted by the author, data obtained from [21]).

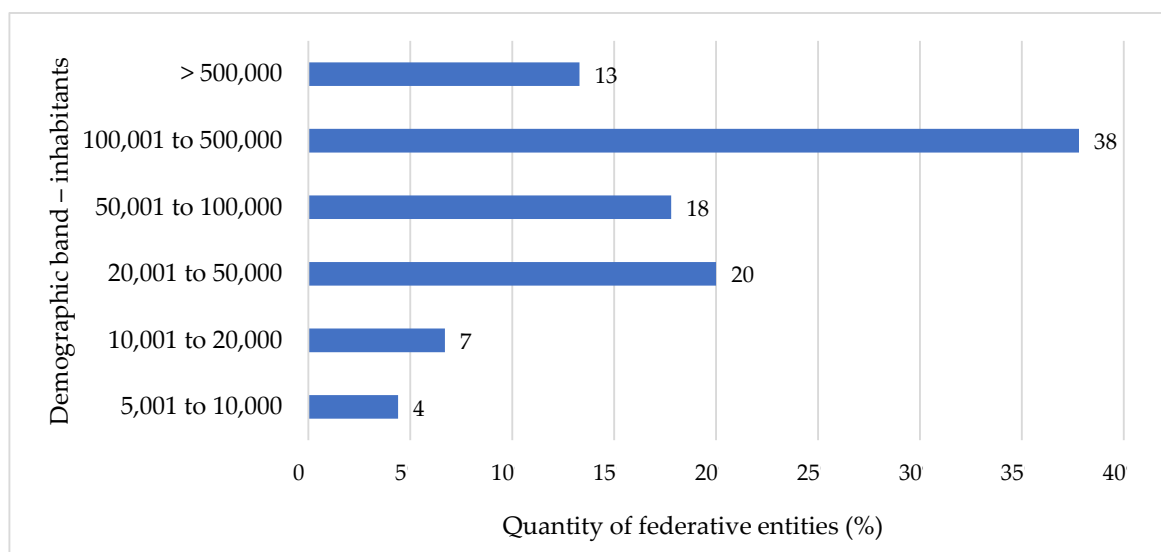


Figure 3. Demographic bands from the federative entities that have WSP in the preparation process [22]; graphic prepared by the author.

In addition to that, three interviews were conducted with members of supporting institutions that took part in the capacity building and technical support of the WSPs. These institutions supported the WSP preparation or implementation by offering workshops, speeches, or even daily mentoring. The study aimed to identify what are the challenges and difficulties of WSP implementation from the support entity’s point of view as well. Eight actors have been interviewed, including successful WSP implementing agents, agents that have gone through unsuccessful implementations, and supporting institutions. In Table 2 the interviewees can be seen, with codes being used to refer to them, as well as which of the aforementioned have received support. Table 3 presents characteristics of the water supply service providers interviewed.

Table 2. Interviewed actors, codification attributed to the interviewees, and supporting institutions.

Code	Actor	Covered City/Cities	Time since 1st WSP Implementation Tentative (Years)	Supporting Institutions		
				Suest (A1)	National Funasa (A2)	PAHO/WHO ¹ (A3)
S+	Service provider (SP) covering state/district	1	8	-	-	-
M+	Municipal SP	1	10	-	x	-
IM+	Intermunicipal SP	3	5	x	x	-
S-	State/municipal SP whose WSP implementation did not happen	1	5	-	-	-
M-	Municipal SP whose WSP implementation did not happen	1	13	-	x	x

¹ Under Headquarters Funasa service. Source: Drafted by the author.

Herval D’Oeste, Joaçaba, and Luzerna are cities that have their water supply service provided by a single service provider, the Intermunicipal Water and Sewage Service (SIMAE); that is, despite being 8 federative entities covered by the WSP, five different service providers are implementing such policy.

The municipal and regional service-providing modalities together are responsible for 66.7% of the WSPs implemented and identified in Brazil. Table 4 presents demographic data and GDP per capita of the cities whose service providers implemented WSP in their WSS, data collected on [22,23]. Only Joaçaba, Campinas, and the Federal District have a GDP per capita greater than the Brazilian average (USD 5,852.18), and great variability in demographic size can be verified.

Table 3. Characteristics of the five public water supply service providers (WSSP) who have implemented WSPs and were interviewed [3,24].

Service Provider	S+	M+	IM+			M-	S-
City	All ¹		A ²	B ³	C ⁴		All
WSSP-covered Population	3,000,236	1,159,711	20,563	29,607	5329	75,246	11,279,793
Produced Water Volume (m ³)	218,977	99,401.97	1713.2	2725.21	481.7	5883.1	944,611.5
Revenue Losses (%)	19.95	12.86	26.2	20.6	26.3	29	Average of 27.8
WSSP Coverage (%)	98.71	98.08	91.6	100	93.4	96	Average of 61.8
WSP in the MBSP	No	Yes			No		
Regulatory Authority				Yes			
WSSP Joint Venture	No				Yes		
Interviewee role in the WSP	Workgroups		Coordination			Data supplying	Coordination

¹ Refers to all cities of the state/federal district; ^{2,3,4} Cities pertaining to the intermunicipal service whose staff was interviewed. Source: Drafted by the author.

Table 4. Characteristics of the federative entities whose service providers have implemented WSPs in their WSS.

City	Population ¹	GDP per Capita (USD) ²	Type of Service Provider (SP)/Coverage
Federal District	3,094,325	15,153.21	District/Regional Semi-Public Corporation (SPC)
Formosa	125,705	3535.76	SPC—State/Regional
Campinas	1223,237	9554.91	SPC Municipal/Local
Limeira	310,783	7099.11	Private/Local
Herval D'Oeste	22,820	3379.65	Intermunicipal/Micro-
Joaçaba	30,684	9725.17	regional Autonomous Water
Luzerna	5683	5229.54	and Sewage Service (SAAE)
São Ludgero	13,886	8883.85	Municipal/Local SAAE

¹ [22]; ² [23]. Source: drafted by author.

Of the public works service providers who have implemented WSP, two had the support of partner institutions, such as FUNASA (National and Suest-SC), and Pan American Health Organization/World Health Organization (PAHO/WHO), with technical cooperation accords that involve capacity building, technical visits, and guidance for the preparation of WSPs [25]. There were partnerships among supporting institutions and service providers (such as SAAE São Ludgero), for the sake of information sharing among entities.

3.2. Aspects related to Water Supply Public Service Providers

Among the five identified and interviewed service providers, all are subject to municipal surveillance, be it sanitary, epidemiologic, or endemic control. They have smaller billed losses than the national average of 38.03% and coverage greater than the national average of 83.47% [3]. Such information and other service-providing characteristics of the interviewees can be observed in Table 3.

Most service providers (four out of five) met the WSP tool through the Water Drinkability Decree in 2011 (Decree nr. 2914/2011, from the Ministry of Health) [6]. The only service provider who learned about it through another mechanism was a municipal provider, who had first contact with the WSP through the local Federal University, which had a project in such scope, and wanted to implement it into the system.

Through the conduction of the semi-structured interviews, it was identified that the implementation of the WSP is affected by three main factors (Figure 4).



Figure 4. Factors that affect the WSP.

First WSP preparation process: defined by the period comprised in-between the formation of the workgroup, until the final document delivery. Therefore, there is a mandatory inclusion of decision-making actions regarding which methodologies must be followed for each step, and this step is where a great time investment by the creation team occurs.

Second organization management: defined as the group of activities, praxis, routines, and interactions among employees of an organization which aims towards a main goal, in this case, to provide water supply to a population. Included in this factor are the standard operation procedures, means of communication, and operational and maintenance activities, among other frequent practices of the institution, be those office or field practices.

Third external actors: defined as “All the elements who, acting outside of an organization, are relevant to its operations; including elements of both direct and indirect action” [26]. Here are included the city/town halls, WSSP users, regulatory entities, government bureaus, basin committees, basin agencies, joint ventures, and inhabitants of the watershed where the service provider collects water.

In the next topics, there is a discussion regarding the factors from the content within the conducted interviews and the literature, with the goal of highlighting aspects that are related to these factors and were pointed out by the interviewees.

3.2.1. Aspects Related to WSPs’ Preparation

Although the interviewees have pointed out that the WSP is valid and that its benefits impact positively in service providing, they also have difficulties regarding its preparation. From what has been reported by the conducted interviews, it is possible to perceive that the WSPs preparation process by the service providers impacts how and when the actions listed in the plan will happen. Such occurs due to the necessary knowledge for its preparation and implementation, the time invested in the process, or even through the process of collecting the necessary data (Figure 5), built based on step 4 of the methodology, where the main aspect, WSP preparation (1) is detailed.

The WSP preparation (1) requires work time investment (1a), and even in service providers which already work with risk evaluation, the time taken is always long. The shortest timespan in which such preparation happened in the conducted survey was three years, with a variation in preparation timespan ranging from three to five years. The implementation time or even the time invested in fieldwork, when there are no data, is one of the challenges faced by WSP implementing groups not only in Brazil but throughout the world [12,27–29]. Such a factor is attributed, according to the interviewees, to the lack of time for the employees, who work on several fronts (including emergencies, such as water crises) and have restricted time to dedicate to the WSP, especially when such a policy is not a priority of the organization (1e), whatsoever. The non-prioritization of WSPs as a company policy is a problem pointed out by the literature [12,27,30] as a challenge to implementation since they did not involve and support WSPs.

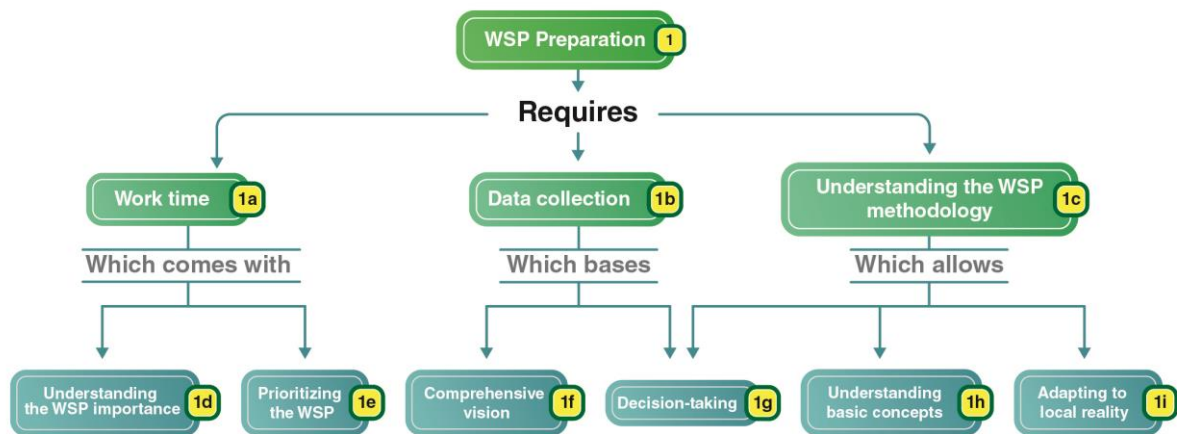


Figure 5. Requirements for the preparation of water safety plans (WSP) that impact its implementation (drafted by the author).

Understanding the importance (1d) of the tool leads to better dialoguing and integration between areas, allowing the data collection to be conducted more easily, according to the interviewees. Such a noteworthy factor is pointed out by the literature as relevant, the fact that such understanding passes by understanding that the WSP must observe all the system's aspects and not only infrastructure and that the WSP is a continuous process [31–33].

One of the greatest difficulties pointed out in preparation is exactly the internal and external data collection (1b) to compose the parts of the WSP. Regarding WSS' internal information, it is made evident that the understanding of the employees of all sectors and the board of directors about the importance of the WSP reduces to a minimum the difficulties of obtaining information. For the interviewees, the WSP, especially the risk evaluation activity, is a way to organize and technically ascertain problems observed by the provider on a daily routine. The lacking data (about the system or diseases, for example) is pointed out by the literature as being important to WSP preparation and implementation [31,34,35].

To reach the scope suggested by WHO (which includes investigating and reducing the risks of water collection to a household's tap), the service provider needs information on all the watershed that supplies the system, which implies having a relationship with organizations such as city halls, watershed committees, and diverse government agencies that have not shown themselves to be inclined towards disclosing information in due time. That way, many implementing actors decided to elaborate the WSPs only with the information available to them, which reduces the WSP's Scope of Action (1g).

The step of WSP preparation is an exercise in seeking to assure water safety from the standpoint of a wider approach [4], which demands the availability of information and technical knowledge from each elaborating team member so that not only the risks inherent to their pertaining sector can be seen, but risks from the WSS as a whole may also be perceived. The comprehensive vision (1f), therefore, is highlighted and deemed by the service providers as being necessary and a benefit of adopting the WSP, which can be a challenge for greater scale service providers, due to the WSS extension, and for smaller scale providers, due to the lack of communication or knowledge and information sharing.

The service providers present difficulties concerning their understanding of the methodology (1c) in its entirety, especially while choosing the adequate methods for their context (1g), as on the risk evaluation step, which is one of the decisions that must be taken. Such difficulty is reported in the literature [34,36] and by WHO, which admits that no tall risks will have good evaluation through a single method, suggesting, in some cases, that the risk is evaluated in a simplified manner through group discussion and decision-making [4].

In the case of the system evaluation step, for example, where a diagnosis and risk evaluation are made, the interviewees have presented difficulties (which were confirmed by

the supporting institutions) related to the distinction between dangerous events and danger, basic concepts for the preparation and implementation of the WSP (1h). Although the WHO brings a definition of the dangerous event and standard danger in its guidelines for WSP implementation and makes extensive support material available, such will not necessarily collaborate to clarify the doubts of the service providers if there is no understanding of what such definitions mean within the system. Understanding the methodology and its applications contributes to its correct application, it is important to continually improve the implementation of the PSA in an effective way, as shown by [12,13] and it can be the first step to integrating the WSP with other plans and assessments, as suggested by [37].

WHO’s proposal was, originally, open and flexible, given that the goal is ensuring that each place incorporates its needs. Despite such prerogative, it is observed that the service providers show insecurity in making modifications and that smaller cities face problems in transporting the results of risk evaluation to the professional practice, which can be associated with difficulty in elaborating management plans adequate to their reality (1i).

The Brazilian literature regarding WSP is vast when referring to methodologies for the identification of dangers and precise and automatized risk evaluation [38–40]. However, in the interviewees’ point of view, methods that demand a deep information load (such as, for example, watershed hydro-geological modeling) or are unavailable (such as long historical series of water resources surveillance data) can be inadequate to smaller service providers and in regions which are less studied by the academy.

3.2.2. Aspects of Management

Besides the WSP preparation process, its implementation is strongly influenced by the organization’s management (2), which includes discontinuity practices; old habits in activities execution; and low prioritization of planning policies interfering not only in the main activity but also the implementation of new policies such as the WSP (Figure 6).

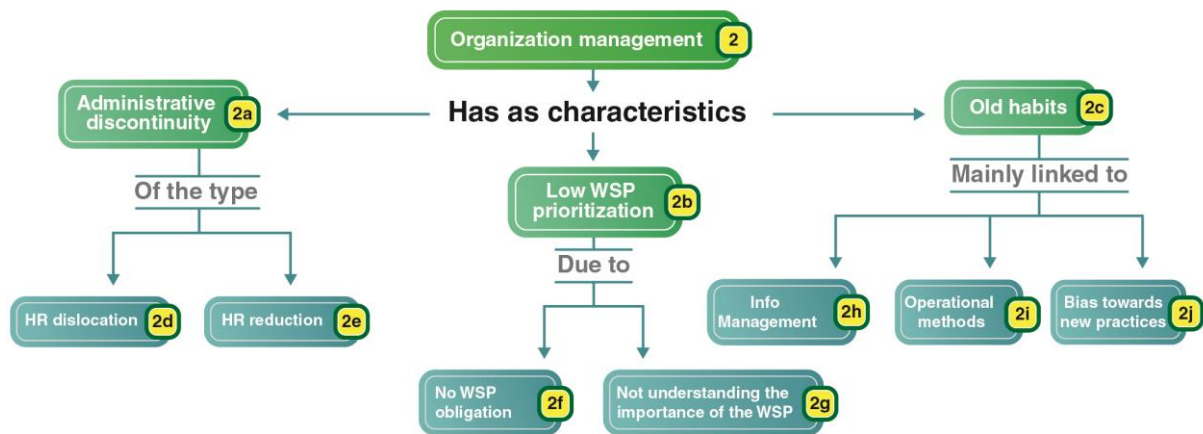


Figure 6. Aspects of an organization’s management that impact the water safety plan (WSP) implementation (drafted by the author). Note: HR = human resources.

The administrative discontinuity (2a), especially concerning human resources, is an important aspect observed in the interviews, where only one interviewee (M+) did not point an example out during the WSP implementation. There are examples of employee dislocation (2d) for the sake of covering emergencies, or due to changes in attributions and contingent reduction due to retirement, as a result of an organization’s internal policy. Employee and direction changes may happen due to municipal elections in service providers strongly influenced by local politics. Both keeping employees [32] and the corruption cases [9] are pointed out by the literature as challenges that other countries face while implementing WSP, being aspects that cause recurrent impact.

Upon reducing the number of employees (2e), whatever the motivation is, all the acquired training and learning will be gone along with the retirees and dismissed employees.

Such a setback implicates posterior time investment, which is a limited resource in organizations. Not having enough human resources or maintaining existing ones is a situation that occurs in other places, and it has a negative impact on WSP [31,32,36]. The constant alteration of positions and functions has a similar effect, and in both cases, the continuity of WSP preparation and implementation are affected, as exemplified by interviewee E+: “Now we also have a problem: of those who took part in the pilot project, the first, many have retired. Then, when you have people engaging, people leave, then you create a new team and start almost everything over again.”. The interviewees have emphasized that it is necessary to make the WSP benefits clear for everyone in the organization, and at this point, the commitment of the senior management is a condition for the WSP to be implemented.

The literature indicates that team involvement is crucial, especially for the members with experience in WSPs and system operators, being a facilitating factor in implementing WSPs, according to [11,32,35]. On the other hand, when the whole team, including the operational level actors, has direct participation, there are benefits to WSPs [30,31].

The interviewees’ report reveals that when senior management and the staff understand the importance of the WSP (2g), the policy has a higher potential in being successfully implemented and becomes a desirable tool, prioritized by every sector and senior management (2b). As for the employees, the WSP begins to be seen as a tool that highlights the main demands of each area and the WSS as a whole, justifies the decisions taken by the technicians, and guarantees that the procedures are more properly executed. Additionally, for the system as a whole, implementing the WSP may result in conformity with the quality requirements and the establishment of control points and more strategic surveillance, which implies a more efficient use of resources. The literature points out that some factors about the team may favor the WSP implementation, such as understanding that this kind of plan does not cover only infrastructure issues [31] and that it is a process [33], operators who are trusted and respected by decision makers [41], and team empowerment [42]. By contemplating these aspects in WSP implementation, it is possible that their importance becomes more evident. Again, the support and commitment of high-level directors have a positive impact on the WSP [27,41,42].

On the other hand, since the WSP is not a mandatory management tool (2f) and the higher management prioritizes exclusively organization management actions associated with legal obligations, there is a tendency for the policy not to be prepared and, most of all, implemented. References [10,11,43] remarked that the absence of legislation, a legal framework, and a lack of legal pressure are challenges to the implementation of the WSP.

Other characteristics which impact WSP implementation are old habits and rooted concepts within the organization’s daily practices (2c). The preparation of the WSP implies data and information collection scaled in great numbers, and it needs to be managed for the plan to be effective (2h). Being able to maintain an organized database that provides the necessary information is a challenge that, if not surpassed, might hinder the WSP’s continuity. The absence of data about the system, including data regarding diseases, is pointed out by the literature as a challenge in the implementation of WSP [34,35].

An attachment to already known habits (2c) can also be observed, especially concerning system operation and surveillance (2i), mainly in smaller service providers. Several times the information registry needs to be standardized and happen in all the steps, or surveillance might come into existence or become more frequent, which can cause discomfort among older employees, and demands certain adaptation effort (2j). The motivation for change can come from the senior management itself or an external agent, for example: “All that is new gets some resistance. Tends to generate resistance. We had a facilitator which was ‘look, people, the Sanitary Surveillance came here and demanded that surveillance is needed’, so there is not much leeway for complaints.” (IM+). In fact, the role of water surveillance [44] and the responsibility of service providers towards public health [29] are factors that encourage the WSP implementation. In addition, conditions already implemented, whether quality standards [12], management systems [44], or continuous improvement systems [45] contribute positively.

When the service provider already uses other management tools, especially the ones that approach the concept of risk, such as quality management, or even environmental policy, makes it easier to adopt the tool. Such does not necessarily implicate faster preparation but a faster understanding of the importance of registers and control adopted in the WSP.

When senior management and employees begin realizing that there is a proximity between their daily routine and WSP, such a pre-conceived idea is surpassed and WSP becomes desirable, as it is perceived that the tool will also be a facilitator for the work once implemented. Thus, bias against new ideas (2j), many times tied to old habits are characteristics of the organization's management that impact the WSP preparation.

3.2.3. External Actors in WSP

Working along with some of these entities is important to cover all the aspects and dangerous events to which the system is subjected, and the relationship with the external actors is fundamental for the WPS benefits to be maximized. Figure 7 shows in which manner the external actors (3) to the water supply public service provider may impact positively the WSP implementation.

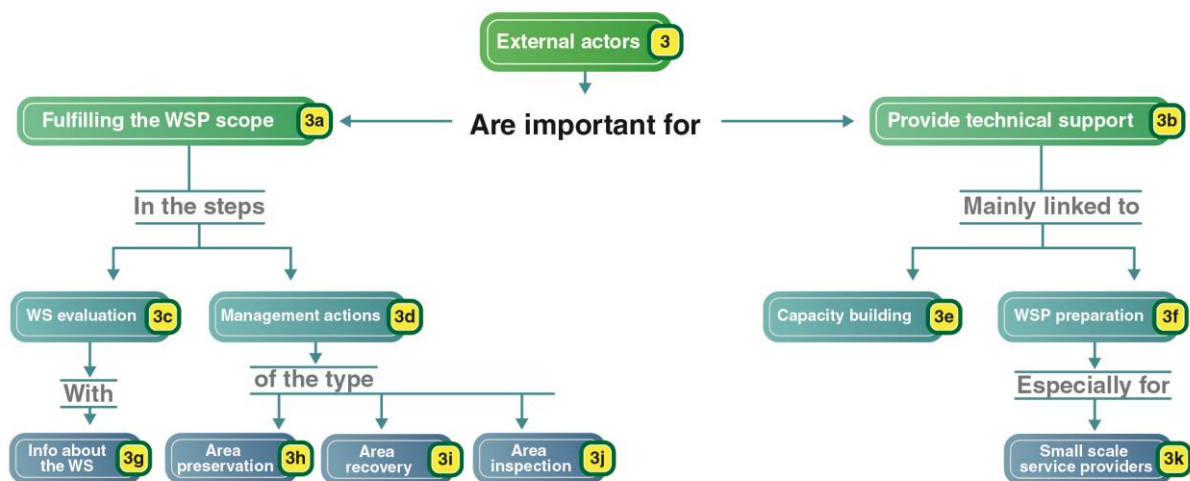


Figure 7. Acting field of external actors to the water supply public service providers which impact the WSP implementation (drafted by the author). WS = watershed; WSP = water safety plan.

The WSP implementing process implies an analysis of WSS operational and management aspects and the watershed (WS) as a whole [4]. In Brazil, the WS is the unit for planning water resources, and its management plan is approved by the respective watershed committee and, in certain circumstances, by the water resources councils (3c). The lack of control over the collection and the quality of raw water generates fear among PES implementers [11,35] regarding its complete implementation. The information data of a watershed can be dispersed throughout the most diverse national and state entities of statistics and geo-information, agriculture, environment, water resources, and WS entities themselves (3g). This problem is also presented by the literature as a factor that impacts negatively on WSP implementation [34,35].

In addition to that, any action taken by the water supply public service provider inevitably will compel the institution to have a relationship with the city hall, the contractor, the service regulatory agency, consortiums, or the state and federal government, especially the surveillance, which possesses the attribution of vigilance of the water quality for human consumption [7] and it is a factor that can impact positively on WSP implementation [44].

The obtaining of information is, from the interviewed service providers' point of view, a challenge and a hindrance to the WSP implementation and preparation, especially to accomplish everything within its scope (3a). The search for external partners, whether being aimed at obtaining information or towards the construction of joint management

actions, is not a common practice among the interviewees, be it so that they consider they already have the tools and necessary technical knowledge for the implementing, or be it because they have chosen to conduct the WSP only in the WSS domain. Even with the search for information and external partnerships, its continuity is made difficult.

Beyond the information sharing and management plans implementation (3d), as recovery (3i) or area preservation (3h), another point emphasized by the interviewed service providers is that, in case of a situation that presents a high or critical risk in the WS, at a point that is not within the provider's domain, it would not be possible to intervene as to avoid a certain situation since the provider has no police powers to inspect areas (3j), which would limit the WSP reach, a concern that also appears in examples of implementation presented in the literature [11,35]. However, from the point of view of WSP implementing supporters, that should not be a hindrance, seeing that the WSP makes it possible for the provider to conduct actions within their reach.

External actors may be fundamental also in the capacity building (3e) and technical support for the WSP implementation (3b). The capacity build includes events, such as workshops and training courses, benchmarking initiatives, and time dedicated to studying WSP-related material, such as the Water Drinkability Decree (Ministry of Health and FUNASA) and WHO support material. They are relevant to awaken the introduction to the WSP theme and have the potential to reach bigger and smaller service providers. Among the interviewees, only one of them did not take part in that sort of initiative directly. The literature points out that the external support for WSP implementation may be positive or negative. When there are limitations in the external actor's participation and when he offers aid in training and the handling of instruments, the participation is beneficial; when the actor writes or conducts the WSP, without the service provider themselves being empowered, the implementation is harmed by the distancing between the written plan and reality [29,36,46].

The impact of external actors in the WSP preparation (3f) is especially positive and important in the smaller service providers (3k), where there is a human resources deficit. Thus, the technical support offered for a longer time period, with specialists guiding the technical team that is preparing the WSP and being an agent that seeks results, has presented significant results, according to the interviewees. The literature experiences on WSP implementation reinforce the external support importance [44–46].

3.3. Facilitating and/or Challenging Factors in the Implementation of WSP in Brazil

As seen in the observed reports, it is possible to perceive that the difficulties of relationship with the external actors and internal management of the service provider reflect on the preparation and implementation WSP process and, therefore, are facilitating factors for these processes, or not.

The non-prioritization of mid and long-term planning activities results in frequent employee dispatching to fight emergencies; short time dedicated to the WSP preparation; and constant changes in the number of employees and positions. In the two cases, what can be seen as a result is a preparation that demands a very long time (in the interviewed cases, the minimum necessary timespan for the preparation was 3 years).

Even if the implementation happens throughout said process, establishing a relationship with external actors is not easy: these actors already show low disposition towards collaborating with the WSP preparation, given that it is not their responsibility, and the longer the collaboration time required, the harder it is to establish lasting relationships. Articulating the several sectors and entities is a challenge that persists in the Brazilian reality [12]. Little cooperation or buy-in from stakeholders is a challenge to PES [28,35,46] which, when overcome, facilitates its implementation [10,41]. In all successful cases (or those resulting in failure) the preparation timespan was long, even in the case in which there was previous contact with risk evaluation, which shows that other factors interfere more with the WSP preparation time.

The difficulty in getting along with external actors, especially government agencies that have information and acting power in the WS, impacts the WSP scope and makes the tool's reach become much shorter. With less information and partnerships to execute control measures, the identified risks may not be reduced enough to become tolerable, thus reducing the WSP effect in society as well as its reach. The WSP's important sensitization work must go beyond the service provider, to reach all those engaged in the water resources field [12,34,47].

A challenge highlighted by the interviewees was the organization, systematization, and integration of the already existing information regarding the WSSP and the information that will come with the WSP in order to follow the plan, without overlapping and bureaucratization of information and data. Such integration is an activity of greater complexity in big-scale service providers, but it can be the result of the little experience possessed by the managers with information management, especially concerning the comprehensive vision of their WSS. The disorganization or inadequacy of information relevant to the PSA is already pointed out as an aspect to be overcome for effective implementation of the plan [11,48].

With that, it is possible to list a series of facilitating and hindering factors to the WSP implementation. The first important point is the prioritization of the senior management, which passes through recognizing the importance of the WSP and its potential into reducing the risk of problems with the quality of water provided by the service provider and cost reduction, especially with surveillance. In the case of the senior management understanding the importance and transforming it into guidelines, the policy strengthens internally. The senior management and staff commitment is an important factor, not only in Brazilian cases but in all countries around the world in which the WSP was implemented [9,10,12].

Associated with that, comes the understanding of the WSP by the employees, which in general possess a view associated with very burdensome daily work without any benefit. For such, identifying daily actions that are WSP characteristics may help demystify such image, as such reality is also observed in other cases [12,17]. There is still the need to have time dedicated to WSP in the context of its daily attributions and that the team is formed with a multidisciplinary nature, as a way to speed up the preparation process and, along with the sensitization of the WSP's importance, to facilitate the integration between the areas. The WSP is a tool that demands systemic thinking; therefore, integration is a relevant aspect and may be something complex in service providers with too-big systems.

For those service providers that have risk management or ISO 9001 certifications already implemented, possibly the understanding of risk evaluation methodologies or specific WSP methodologies may be facilitated [12]. Within the interviewees' answers, it becomes clear that, in practice, the WSP is a dynamic tool that needs constant updates, in a way that despite being covered by risk management, needs a slow start, then improvement of each step at every review cycle; therefore, starting with a simple plan eases a first implementing and instills confidence to the team.

Having an external motivation may be important to stimulate the WSP implementation and preparation, be it for government entity incentives, be it for the sake of improving its indicators and competing for prizes and certifications, and mainly for the possibility of sanctions in the Sanitary Surveillance.

Lastly, technical knowledge of the WSP steps, its risk evaluation methodologies, the system itself, and the WS are crucial for the policy to be effective. For such, government entities linked to water supply are important actors in the WSP dissemination and its benefits for both big and small service providers.

It has been perceived that a few factors may hinder the implementation and preparation of the WSP. The first one is that complete unawareness of the methodology and methods associated with it may lead to an extensive search for the vast available material in the literature, as well as possible confusion of concepts and methods. Such may lead to a complexification of the WSP preparation, leaving it far from the service providers' reality.

For the implementation of the PSA, the need to adapt the methodology to the local context is pointed out, especially in terms of systems [28,34,48].

Adapting the WSP to its reality is an initial WHO recommendation and a condition for it to be made possible to implement. Despite being a recommendation that is listed in the WHO manuals [4], in practice the provider takes a while to perceive that it is a priority to implement the WSP, to empower the plan, and to include what indeed happens in their daily routine. Creating plans unbefitting reality and without the active participation of the service provider is a hindering factor, as it transmits the feeling that the WSP is inadequate for its service-providing type, a fact also observed in the North American reality [13].

The lack of time focused on implementing and elaborating the WSP, which comes as a consequence of not having it as a priority policy in the company, is also a factor that does not favor the preparation of the plan, as it hinders the minimum necessary reflection to its implementation. Time is a determining factor given that the employees already have their daily schedules filled, a fact observed not only in the performed interviews but also in the North Carolina, USA experience [17], Salta experience [14], and another Brazilian example [12].

The lack or impossibility of access to information about the WS may make the WSP more fragile regarding the actions beyond the WSS. In that sense, an example of implementation in South Africa was reported that the WSP success comes with the adoption of good practices and support from the senior management and other interested stakeholders [2]. Furthermore, it is important to not ignore certain problems, especially when the team finds problems that impact health [14].

There is a tendency to emphasize the diagnosis and risk evaluation part; however, the steps of surveillance and management plan implementation are the ones that lead to the most challenging events of a risk management tool implementation. These difficulties, if not worked on, disfavor the plan's implementation, such as integration among the areas, information management, and the capacity to analyze existing data as a whole and come to global conclusions.

4. Conclusions

There is no database covering WSP implementation in Brazil, and this paper has identified nine federative entities with implemented WSPs. It is a small number when the country's size is put into perspective.

This work evidences the three major factors which interfere in the implementation of water safety plans according to the Brazilian case study. According to service providers that have implemented those plans, the factors are the WSP preparation process; organization management; and relationship with external actors.

Difficulties in understanding the WSP methodology, its benefits, and in adapting the WHO methodology impact the WSP preparation process negatively.

Regarding the organization management, characteristics of the organization such as administrative discontinuity; internal policies; the non-prioritizing of the WSP; and the number of employees and their daily responsibilities may either help or be a challenge to WSP implementation.

The external actors engaging with the implementer's team also affect the WSP by acting as agents that may assist and/or demand results on the plan. External actors help with the capacity building of the WSP team, especially during the preparation steps. However, when external actors refuse to share data, it can impact the WSP negatively. A receptive and collaborative environment is needed in order to foster and maintain partnerships with external stakeholders.

Finally, exploring the strategies and possibilities in the WSP implementation is key for the policy to spread, as well as its benefits to the society and the governance of the public water supply services are more effective. This is the first study in Latin America that evaluates the implementation of a WSP regarding its success and failure factors by collecting data directly from the service providers.

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Appendix A. Interview Script

Interview with the service providers

Part A: Presentations and introduction

1. Researcher introduction, her research project, the terms of free consent of the research, guaranteeing of anonymity and opening space for eventual doubts in the interview or in the future, clarifying the means of communication described in the Free and Clarified Term of Consent;
2. Present the day's schedule and the procedures that will be done after the interview.

Part B: Experience of the Water Safety Plan in the City

1. Confirming the interviewees' data: name, company, position and role in the preparation and implementing of the WSP.
2. Confirming already obtained data regarding the WSP and about the city: year of the preparation beginning, year of implementing beginning; comprised systems, city population, existence of municipal basic sanitation plan, acting watershed committees in the region; type of service provider; if there is a preview in changing the type of service provider; if there is a regulatory entity to which the SAAE/SIMAE/CAESB answers to.
3. What kinds of planning the SAAE/SIMAE/CAESB does daily? Did it take part in the preparation of the Municipal Basic Sanitation Program?
4. Report how did the SAAE/SIMAE/CAESB learn of the existence of the Water Safety Plans and what was the motivation for implementing it.
5. Report the WSP preparation process. What factors hindered the process of preparation? Which factors were crucial for facilitating the WSP preparation process?
6. Did the SAAE/SIMAE/CAESB team have contact with risk evaluation methodologies yet?
7. Did the SAAE/SIMAE/CAESB face hardships in understanding the WSP methodology proposed by the WHO, which involves a great step of system evaluation, operational surveillance and management plans definition? In which of those steps was there more difficulty and more ease?
8. How was the process to move the WSP while written plan to its effective implementing?
9. What were the challenges in WSP implementing? Was there a need for an adaptation period? Were there difficulties in convincing the workers to adopt the new procedures?
10. What is the importance of the supporting institutions for the WSP preparation? And in the implementing, have you had aid of supporting institutions?
11. The WSP collaborates to establish good relationship with the regulatory agency of basic sanitation services?
12. Was there any kind of interference from the city hall fostering or culling the WSP preparation and implementing?

Part C: Ending

1. Thanking the interviewee for making time for the interview.
2. Reinforcing that the interview results will be sent to the interviewees.
3. Interviewing other institutions.

Interviewing the institutions' reps

Part A: Presentations and introduction

1. Researcher introduction, her research project, the terms of free consent of the research, guaranteeing of anonymity and opening space for eventual doubts in the interview or in the future, clarifying the means of communication described in the Free and Clarified Term of Consent.

Present the day's schedule and the procedures that will be done after the interview

Part B: Experience of the Water Safety Plan in the City

1. Confirming the interviewees' data: name, organization, position, role in the support to WSP preparation and which service providers/city the interviewee has supported.
2. Report how did you approach the WSP theme.
3. What is the importance of the supporting institutions for the WSP preparation? And the implementing, have you had aid of the supporting institutions?
4. How were the experiences of support to the mentioned cities (Joaçaba, Luzerna, Herval D'Oeste, Viçosa). How was your organization's and your support performed, specifically?
5. What difficulty did you notice that the service providers have shown in training and capacity building?

Which of the three WSP steps (system evaluation, operational surveillance and management plans definition) did the providers have the most understanding and execution difficulties with?

Did you notice that the service providers have shown difficulties or doubts with abilities linked to planning, such as establishing goals, objectives, action plans to solve problems, among others? How was the relationship with other collaborating institutions?

Was there any sort of interference from the city hall fostering or culling the WSP implementing and preparation?

Part C: Ending

1. Thanking the interviewee for making time for the interview.
Reinforcing that the interview results will be sent to the interviewees.

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