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Progress of Using Risk Assessment to Manage Small Drinking-Water Supplies in Rwanda: A Preliminary Study

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Abstract: The World Health Organization promotes risk assessment and risk management through Water Safety Plans (WSPs) as the most effective way to manage drinking-water supplies. Despite proven advantages of this approach in other regions, WSPs are still not widely used across small drinking-water supplies in Sub Saharan Africa. The aim of this research is to identify good practices and related gaps which may assist with formal uptake of WSPs for small drinking-water supplies in Rwanda. Through semi-structured interviews with the key stakeholders involved in small drinking-water supply management across Rwanda, the aim is achieved through the investigation of the following: (i) current drinking-water management challenges; (ii) stakeholder collaboration and data management activities including reporting of information; and (iii) the regulatory and policy environment. The use and awareness of WSPs in Rwanda was confirmed as low. However certain drinking-water management activities which align with the WSP methodology are being carried out. These include catchment management and stakeholder collaboration. Although legislation and policy are in place in Rwanda, communication and training of methods to implement WSPs are required to sustainably embed WSPs into practice. Several elements, including community engagement, systematic review of risks and data management, require greater focus to align with the WSP methodology. Respondents highlighted key drinking-water management challenges, including reactive budgeting and lack of sector prioritization, which could benefit from formal WSP implementation.

Keywords: risk assessment; Rwanda; sanitary inspection; small drinking-water supplies; water quality; water safety plan

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1. Introduction

The World Health Organization (WHO) and UNICEF define the expected drinking-water standard as "safely managed drinking-water" [1]. These are drinking-water supplies which, by their nature and design, can provide safe water that is "accessible on premises, available when needed and free from contamination" [1]. No global region, including Europe or North America, is on track to meet the Sustainable Development Goal (SDG) Target of over 99% access to a safely managed drinking-water supply by 2030 [1]. Progress is especially lacking in Sub Saharan Africa (SSA) where only 37% of the population is expected to have access to a safely managed drinking-water source by 2030 [1].

In Rwanda, where 82% of the population live in rural areas, only 5% of the rural population use a drinking-water source which adheres to the WHO/UNICEF definition

of "safely managed" [2]. Unsafe drinking-water is the third leading cause of disease in Rwanda [3].

The main sources of drinking-water across Rwanda are protected and unprotected springs, other surface water sources, boreholes and rainwater [4,5]. The microbial contamination of drinking-water supplies, especially in rural areas of Rwanda, is widespread [4]. Contamination is associated with poor sanitation facilities and sanitary conditions, and extreme rainfall [4,6]. Many Rwandans travel long distances to access a drinking-water source, which can result in users consuming drinking-water from closer sources with higher degrees of contamination [5,6]. The Rwandan Ministry of Infrastructure (MININFRA) acknowledged concerns with the quality and management of rural drinking-water supplies in 2019, recognizing that many supplies are microbially contaminated, practice disinfection infrequently and struggle to regularly monitor drinking-water quality [7].

Small drinking-water supplies (SDWS) are set apart from large drinking-water supplies by their operational and managerial characteristics [8]. The definition of a SDWS can vary within and between countries and can be based on population, volume of water supplied, number of connections or technology used [8]. SDWS are often operated and maintained by individuals with limited training, who have limited access to further technical support, and who have limited and inconsistent access to financial resources. These supplies are often geographically remote but can also serve transient and peri-urban populations [8]. The drinking-water quality of SDWS is of particular concern due to these characteristics [8]. In Rwanda, rural drinking-water supplies are operated and maintained by private operators (POs) and the Water and Sanitation Corporation (WASAC) provides technical support. WASAC operate and maintain urban drinking-water supplies.

The WHO promotes the use of risk assessment and management, using Water Safety Plans (WSPs), as the most effective method to ensure safe drinking-water and to safeguard public health [9]. WSPs involve a systematic assessment and ongoing review of the risks posed to drinking-water quality at each process stage, from catchment to point of consumption. They were introduced to move away from the sole reliance on water quality sampling to monitor drinking-water supplies, and towards a proactive method of identifying and preventing risks to drinking-water supplies being realized. Sanitary inspection (SI) forms are simple, easy to use, standardized checklists which help to identify risks to drinking-water quality in the field [10]. SIs are advocated by the WHO as an appropriate risk assessment tool which can form a part of a WSP and are especially beneficial for managing risks to SDWS. Consideration for water quantity should be incorporated into a WSP [11], especially for sources which may be vulnerable to extreme climate conditions or seasonal fluctuations.

The application of WSPs to SDWS has been linked to increased financial efficiencies [12], improved hygiene behaviour [13,14] and greater consistency of appropriate operational and maintenance activities [12]. Although WSP implementation has been demonstrated to have led to improved drinking-water quality [13–15], the need for initial financial and technical resources have been identified [13,14,16]. Published studies of the direct outcomes and impacts of risk-based interventions are limited, especially for SDWS in SSA [12,17,18].

WSPs could reap great benefits to drinking-water quality, particularly in SSA, however uptake is relatively low in comparison to other regions worldwide [19–21]. In 2017, the WHO reported that only 10 of the 48 countries across SSA, including Rwanda, were developing strategies for large scale WSP implementation [19]. A search of the grey and academic literature returned little published evidence of the use of SIs, WSPs or other risk management approaches to drinking-water safety in Rwanda, although work may exist as part of wider regional studies (e.g., [22]). WSPs should not be seen as a standalone drinking-water management activity [14]. Embedding into existing practices and making use of existing frameworks and systems is important for WSP success, especially in resource-limited contexts such as SDWS [12,17].

WSPs were introduced into Rwandan legislation in 2015 [23]. The legislation requires drinking-water supply license holders to identify areas of water supplies which may be

vulnerable to contamination and complete subsequent remedial action. The legislation does not provide further WSP or water quality sampling requirements, but instead references the need to comply with the guidelines set by the WHO or the Rwandan Standards Board for further guidance. Provision for the Rwanda Utilities Regulatory Authority (RURA) to enforce legislative activities is included stating that a written warning should be served initially and if compliance is still not met financial penalties can be applied or the supply license can be amended or revoked [23]. Enforcement activities are not specific to WSPs but to non-compliance with the legislation in general.

The National Water Supply Policy, published in 2016, 'encourages' districts to prepare a WSP [24]. The policy states the need for stakeholder engagement, including at a community level, for successful WSP implementation and indicates the benefit of WSPs for managing climate-related risks. The policy calls for legislation to be reviewed and updated to include a 'definition of the legal requirements for mandatory WSP implementation' [24]. Subsequent legislation for water resource management was passed by the Rwandan government [25]. This legislation focusses on the prevention of pollution and catchment management, establishing catchment committees, but does not contain specific references to WSPs or wider risk management practices. Expediting the practical implementation of risk assessment could support the Government of Rwanda to meet their targets of providing universal access to water for both urban and rural communities by 2024 [26] and to meet SDG Target 6.1.

Using Rwanda as a case study, the aim of this paper is to evaluate SDWS management practices which align with the WSP methodology, and gaps which remain, to investigate the potential for incorporating WSPs into existing activities. By collecting data from the key stakeholders involved in the management of SWDS across Rwanda, this paper will (i) investigate current drinking-water management challenges and how risk management could support to address these; (ii) identify the practices that are already in place and could contribute to a WSP and (iii) identify areas which require further attention to support the effective implementation of WSPs. It is anticipated that the results of this study will support the implementation and upscale of risk management for SDWS in other countries aspiring to adopt the WSP approach to safeguard public health.

2. Materials and Methods

Key stakeholders involved in the management of SDWS across Rwanda were invited to participate in a semi-structured interview (Table 1). A sample of adults who fell within each stakeholder category listed in Table 1 were purposively selected. The higher number of water users and PO participants, compared to district participants, was chosen to reflect the larger number of individuals in these stakeholder groups and to ensure diversity of thought in the responses provided. Participants who are based in rural parts of the Northern, Southern and Western Districts of Rwanda were selected to minimize potential geographic bias (Table 1 and Figure 1). Non-governmental organizations (NGOs), RURA and MININFRA work countrywide and therefore the consideration was made to ensure the individual respondent who represented each stakeholder group had the appropriate experience of SDWS to participate in the study.

Data collection via semi-structured interviews was selected to promote discussion between the participant and interviewer. This method allows thoughts and perceptions of individuals to be drawn out and affords the researcher the flexibility to ask further questions where relevant [27]. The researchers aimed to conduct 30 interviews, as this number was perceived to be sufficient to meet data saturation based on the number of identified stakeholder groups [28]. The number of participants of each stakeholder group which were invited to interview was assigned to ensure a representative diversity of opinions and perspectives from within that group. One participant for each RURA and MININFRA was deemed satisfactory to represent their organization and the views and work conducted as part of those institutions.

Table 1. Stakeholders who were interviewed in the study (NGOs—non-governmental organizations, RURA—Rwanda Utilities Regulatory Authority, MININFRA—Ministry of Infrastructure). * Two PO participants worked across two districts, and one was based in the City of Kigali.

Stakeholder	Province (Number of Participants)	Number of Participants
Water users	Northern (4), Southern (3), Western (3)	10
Private operators	Northern (5), Southern (2), Western (4), City of Kigali (1) *	10
NGOs	n/a—countrywide	6
Districts	Northern (1), Western (3)	4
Regulator (RURA)	n/a—countrywide	1
Central government (MININFRA)	n/a—countrywide	1

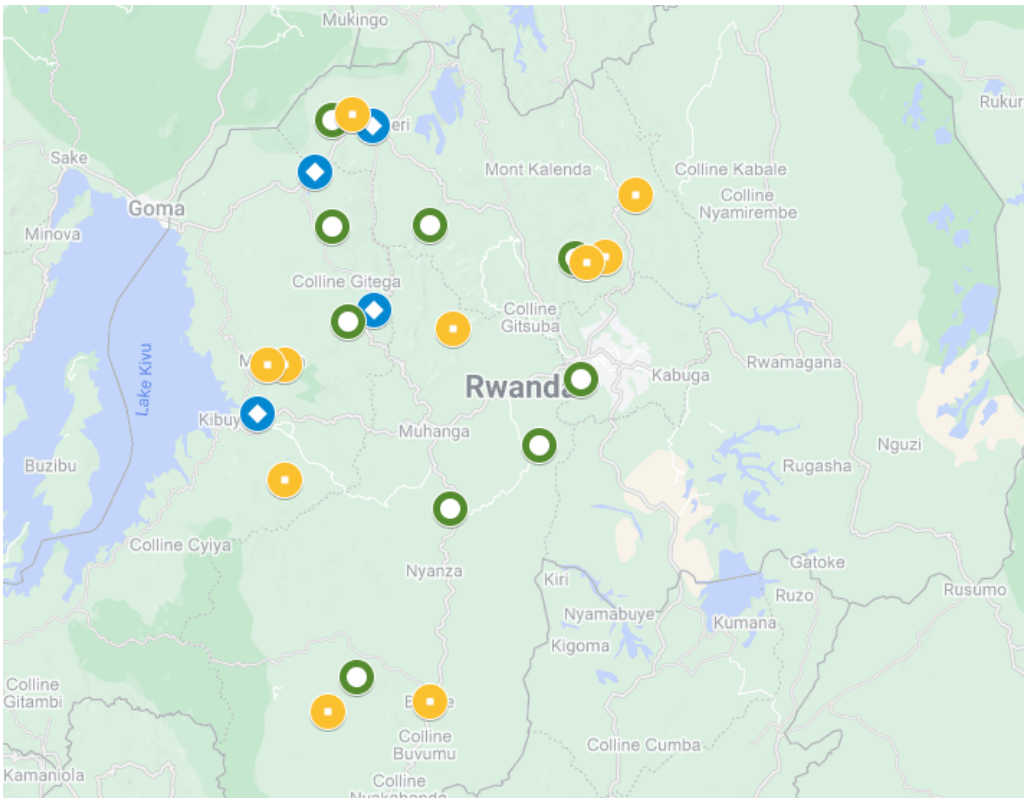

Figure 1. Geographic locations of the district, PO and water user participants (PO—private operator).

Interviews were conducted between June and August 2021. All interviews with water users and POs were conducted in person. Some of the remaining interviews were conducted virtually due to COVID-19 lockdown restrictions. Prior to commencing any interview, the purpose of the interview was explained, and participant consent was obtained.

Interview questions focused on current management practices in relation to SDWS, including the challenges faced and awareness of risk assessment. Two interview guides containing open-ended questions were developed and are provided in the Supplementary Material. These were based on a review of published and grey literature regarding data management structures and processes in Rwanda, and the wider implementation of WSPs in other countries in the SSA region. One interview guide was used for water users and one for other stakeholders to reflect the differing levels of involvement and expertise in drinking-water management. The interview guides were created and revised collaboratively through discussions and feedback between researchers in the UK and Rwanda. Topics included in the interview guides related to the participant's awareness of risk management to

manage drinking-water supplies, data collection and management practices, stakeholder collaborations and the role of technology and regulatory instruments.

The interview guides were produced in English and translated into the local language of Kinyarwanda by in-country researchers. Interviews were conducted and recorded in Kinyarwanda. They were then transcribed and translated back into English by researchers in Rwanda for analysis. Due to translations, any quotations provided in this manuscript are not the original dialogue but are translated text.

Prior to analysis, responses were anonymized. Responses were collated and analyzed using MS Excel and the NVIVO12 qualitative data analysis software package. Both inductive and deductive coding methods were used to allow themes to emerge from the data based upon certain pre-defined topics whilst allowing further themes to emerge where relevant.

This study was given a favorable ethical opinion by the University of Surrey's ethics committee prior to commencing interviews (reference number FEPS 20-21 012 EGA).

3. Results

The only respondent who recognized the use of risk assessment for managing SDWS was the government ministry responsible for water, sanitation and hygiene (WASH) services, MININFRA. They stated that WSP implementation is 'under development' and that 'SIs will be used once WSPs are implemented as the two are linked'. No other stakeholder group indicated an awareness of the WSP approach or SIs to manage drinking-water supplies. When asked what information they collect relating to risk management, one district replied, 'None because management is by the PO'. Water users were concerned that their lack of technical capacity would limit their ability to engage with risk management.

3.1. Identified Drinking-Water Management Challenges Which Risk Management Could Support to Address

The relevant factors which the POs, NGOs and districts interviewed highlighted as crucial for effective drinking-water supply improvement actions, and which could be supported by risk management, are provided in Figure 2.

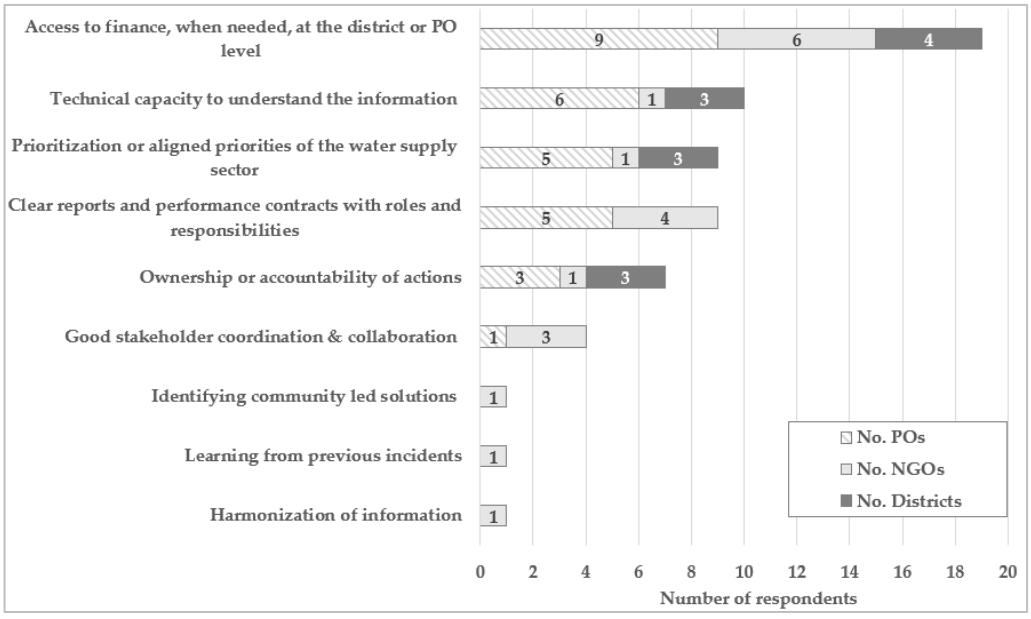

Figure 2. Factors respondents highlighted as critical for improvement action which could be supported by WSP implementation. PO—private operator, NGO—non-governmental organization.

All stakeholder groups recognized that POs generally act promptly to resolve issues which require the minimal funds they have access to. However, addressing bigger issues

can be delayed because of the need for POs to reactively obtain the funds from the district. Two water users noted that although water infrastructure is often impacted by potentially predictable extreme weather events, such as drought or heavy rainfall, remedial action is often delayed due to the need for budget approval by the district.

The need for the incremental prioritization of action was discussed by one district and one NGO:

> "*Not everything can be implemented at once, it is a multi-stage process and it takes time*" NGO

Contracts or partnership agreements held between the districts and POs or NGOs, respectively, were stated as being the key driver for action to improve water supply operations. However, concerns were raised that compliance with contracts is not always met:

> "*There are certain terms and conditions which are not respected by our contracting bodies, districts . . . the contract details that issues with regards to community sensitization for owning water infrastructures, debt recovery . . . are the mandates of the districts but sometimes we fail to get their involvement*" PO

Many of the gaps identified in this study which could support WSP implementation are related to a lack of formal documentation and communication of information. Of all stakeholder groups, NGO respondents most frequently highlighted a lack of consistent data collection or sharing as an issue, expressing a desire for "*one agreed instrument to be used while collecting the data*":

> "*Having one type of tool validated that can be used by different key players in the sector would be advantageous [as this would] help to monitor water supply system is more harmonized way*" NGO

RURA also called for better data harmonization to support the use of and confidence in collected data:

> "*There should be a proper channel on data collection, review and approval to ensure trustworthy of data and usefulness of information*" RURA

3.2. Activities Which Align with the WSP Methodology

Despite the lack of the formal awareness of risk management practices, several existing activities do align with the WSP methodology, although many gaps remain (Figure 3).

3.2.1. Stakeholder Collaboration and Community Engagement

Formal and informal stakeholder collaboration channels and methods of communication exist (Figure 4). These activities, which include regular WASH Board meetings, Joint Sector Review (JSR) meetings and the Sector Wide Approach (SWAp), are fundamental to many of the WSP steps (WSP steps 1, 4, 6, Figure 3). Respondents highlighted that districts play a central role as they drive stakeholder collaborations and source much of the funding for improvement work but also co-operate with RURA to support regulatory amendments, such as water tariffs. Some respondents indicated, however, that greater collaboration between stakeholders is required for sector improvements:

> "*I would say that we need collaboration with diverse researchers and other actors to form a platform for exchanging best practices and hurdles for the sector*" PO

Although many authoritative stakeholders are working together, there is a lack of engagement with the water users interviewed in this study (WSP step 1, Figure 3):

> "*We tend to believe that the service provider supplies safe water for us*" Water user

Means through which community participation could be leveraged were stated by interviewees as social media (WhatsApp), radio and the monthly, legislated, Umuganda sessions [29] which could provide an opportunity for the community to raise issues with authorities.

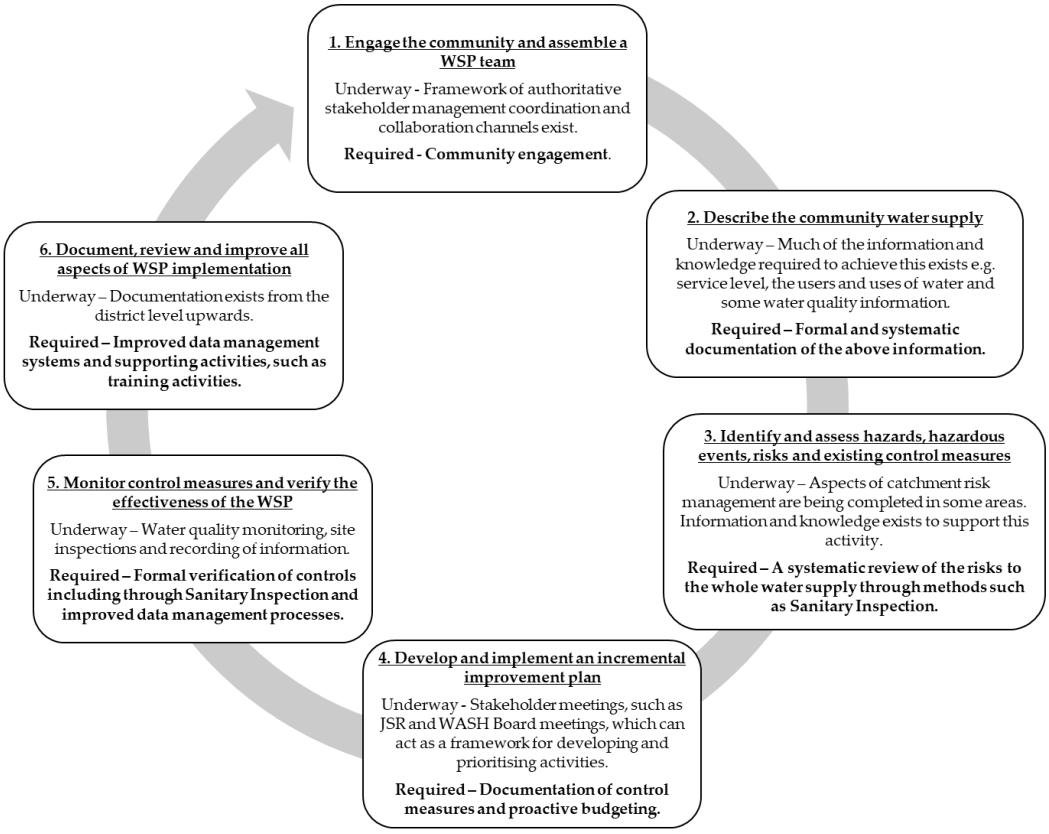

Figure 3. The six steps involved in a community WSP [11], the related activities occurring in Rwanda which could support the implementation of WSPs and gaps in existing tasks which require addressing to fulfil WSP guidance.

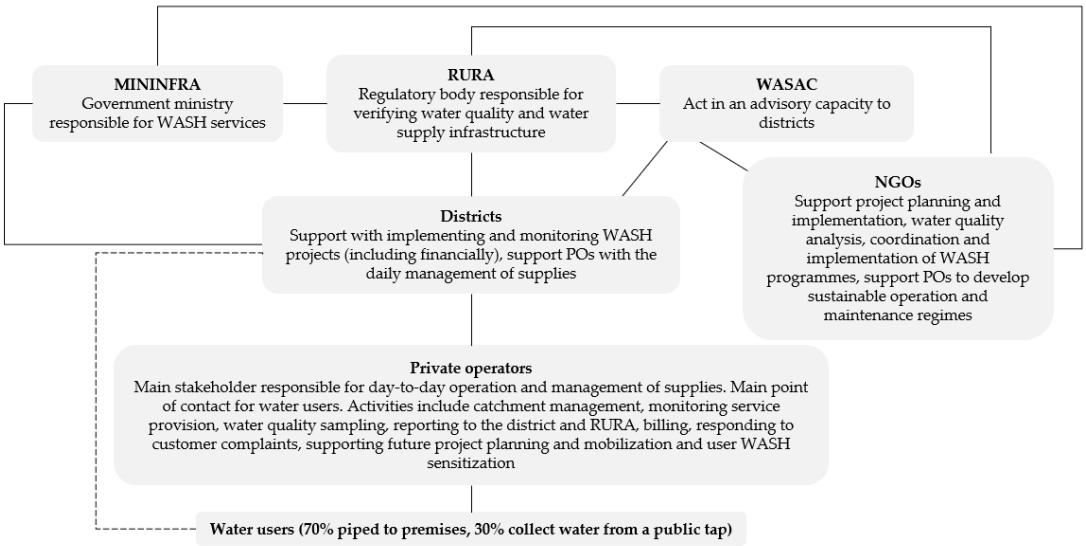

Figure 4. Communication channels and formal stakeholder collaboration methods relevant to provision of drinking water in Rwanda, as identified by respondents. The dashed line indicates an informal collaboration, solid lines indicate formal collaborations. RURA—Rwanda Utilities Regulatory Authority, MININFRA—Ministry of Infrastructure, WASAC—Water and Sanitation Corporation.

3.2.2. Data Collection and Availability of Information

The various pieces of information collected which could feed into steps 2, 3, and 5 of a WSP (Figure 3) are provided in Table 2. One NGO stated that water user committees

sometimes provide data, such as the current asset state, indicating that there may be further sources of data available within the community. Other NGOs called for '*more regular data collection from the POs*' with one highlighting a desire for more data on microbiological water quality. Data were not described by any respondents as being collected in a formal, consistent or systematic manner and generally focused on the catchment and distribution stages. One water user was concerned that although water quality samples are often collected from public taps, they are rarely collected from within consumer homes.

Table 2. Current data and information collected by the different stakeholder groups which could be used to feed into a WSP. PO—private operator, NGO—non-governmental organization.

Information Collected (Stakeholder Group and Numbers of Respondents)
• Risk data collected relating to landslide risks or climatic events (2 districts, 3 POs) • Catchment management activities to mitigate risk to water quality, e.g., installing fencing and catchment protection from upstream farming activities (2 districts, 3 NGOs, 6 POs) • Water quality monitoring program such as collecting in-situ including (turbidity, chlorine, temperature, pH) (10 POs, 6 NGOs), microbiology including coliforms, *E. coli* at varying frequencies (6 POs, 6 NGOs), chemistry analysis for example arsenic and chromium, nitrate and nitrite (2 POs) • Operational information, e.g., chlorine dosing, tank water levels, water pressure, leakage information, taps which require replacement, hours of service, connections, reliability and functionality of supply (10 POs) • Customer satisfaction/complaints (7 POs) • Billing and revenue information including meter readings (5 POs)

Data quality was raised as an issue by MININFRA, RURA, NGOs, district respondents and POs due to:

- Infrequent collection to provide an accurate understanding of the situation,
- The use of out of date, obsolete or uncalibrated equipment,
- Lack of accessibility for sampling during the rainy season.

NGOs felt that the data they collect are more reliable than data collected by POs because they consistently use calibrated and in-date water quality testing equipment. RURA and the districts interviewed carry out counter-verification of the data reported, especially for drinking-water quality, in situations when they do not trust the information gathered.

Respondents discussed data systems used to store and share the information they collect (WSP step 6), none of which were used widely by different respondents. MININFRA discussed the launch of the recent WASH Management Information System (MIS) designed to support sector planning, service improvement and decision making. One NGO stated that they used the MWater platform (https://www.mwater.co/ accessed 8 November 2022) and another stated that they use the Kobo toolbox (https://www.kobotoolbox.org/kobo/ accessed 8 November 2022). One PO and one NGO stated that they have developed their own checklist for data collection.

Although all stakeholder groups were positive about the use of technology for supporting with more accurate data collection and quicker decision-making, they were also concerned about the following related issues:

- Limited technical knowledge of individuals to effectively use technology (8 water users, 10 POs, 6 NGOs, 4 districts),
- Limited network coverage (4 POs, 4 NGOs, 2 districts),
- Poor affordability of the technology (4 POs, 4 NGOs),
- The risk of data loss (2 POs, MININFRA, 1 district).

3.2.3. Reporting of Information

Reporting activities which support WSP steps 5 and 6 are underway (see Table 3). These report findings are discussed at WASH board meetings and can form the basis of changes to operations and policy.

Table 3. Formal reporting mechanisms employed between drinking-water stakeholder groups in Rwanda, including how these reports are used by recipients. PO—private operator, RURA—Rwanda Utilities Regulatory Authority, NGO—non-governmental organization.

Report	How Used by Recipient
Contractual monthly report from PO to districts	Planning, intervention identification, monitoring staffing, condition of water infrastructure and improvement needs, customer complaints, new connections, water quality, water availability, billing.
Reactive reports from PO to districts following incidents	To request a joint assessment calling for intervention.
Routine, quarterly reports from PO to RURA	To improve regulatory guidelines, legislation and tariffs, to determine the need for site inspections, to verify remedial actions required and requested.
Reports from NGO to district or central government	Future planning purposes.
NGO reports to donors	Sometimes used to raise policy concerns to the regulator.

3.2.4. Regulation and Policy

Together with the contracts signed between POs and the districts, as required by legislation, interviewees highlighted the importance of regulations and national policies for guiding their work:

> " . . . *without them [regulations and policy instruments] people would be only looking for cheapest way of doing things*" PO

MININFRA recognized that political will to improve the water infrastructure is required if real improvements are to be made. They stated that laws and ministerial instructions require ongoing reviews and are under development to support sector improvements but did not provide further details. Although RURA said that the regulations help to enforce operational changes to drinking-water supplies, there was not widespread concern by other stakeholder groups about regulatory penalties following non-compliance with legislation. Only 2 POs highlighted the risk of regulatory penalties from RURA or the district. POs are driven to collect data to comply with their contract with the district or to prevent loss of revenue.

Several respondents were frustrated that although water supply tariffs are set by RURA, these tariffs do not currently include the cost of water quality monitoring (1 district, 2 POs, MININFRA). MININFRA noted that this had been identified as an issue which RURA is seeking to address but in the interim is affecting the collection of data:

> "*If we attempt to do water quality monitoring we might be bankrupted . . . we call for the regulator to revise a current tariff to include water quality cost*" PO

> "*The water quality data are collected too infrequently because it is not reflected in the rural water tariffs*" MININFRA

4. Discussion

Identifying processes and structures through which WSPs could be integrated are vital for effective implementation [12,17]. It is clear from this study that although the practical use of WSPs to manage SWDS in Rwanda is incomplete or unrecognized, some of the

steps of the WSP methodology are being followed. The formal introduction of WSPs may require limited additional activities, as has been identified in other studies (e.g., [12]) and may provide solutions to some of the drinking-water management challenges identified in this study.

4.1. Drinking-Water Management Challenges in Rwanda Which WSPs Could Help to Address

Risk management can help to highlight and prioritize risks to drinking-water infrastructure and drive the incremental improvement of drinking-water quality [8]. Interviewees in this study identified prioritization as a factor which supports improvement action (Figure 4) with some calling for strategies which help them to prioritize remedial action required to drive incremental improvement. Prioritizing action can be especially beneficial to focus attention and resources in resource-limited settings, such as SDWS [30,31].

This study found that although respondents recognized the critical need for financial support to assist improvement actions, there was widespread concern about the accessibility and availability of financial resources. The inadequacy of financial resources to monitor and improve SDWS is widespread across SSA with competition for these resources expected to increase [32,33]. WSPs can have long-term financial benefits including supporting with leveraging donor and other sources of funding [12,18,19]. In addition to increasing the efficiency of operation or maintenance activities, WSPs could help with budget estimations to proactively allocate appropriate funds for ongoing maintenance and capital expenditures. This could increase the speed of remedial action and reduce the need for reactive budget approvals, which was noted frequently throughout this study as a concern.

Results of this study highlighted concerns with the accuracy of the collection and analysis of water quality sampling data. In some cases, this was found to cause duplication of efforts due to resampling and the verification of analyzed data by the district. Effective risk management practices, using water quality sampling for risk verification, can help to guide remedial actions required, thus providing decision-makers with greater confidence that the action taken is appropriate. Furthermore, shifting from acting based on risk as opposed to water quality samples could increase the reliance on and reduce the duplication of the samples which are collected [17].

4.2. Drinking-Water Management Practices in Rwanda Which Could Be Incorporated into WSPs

WSPs require each stage of the water supply process, including the source water, treatment processes, storage and distribution stages, to be risk assessed sequentially. Residual risks from each stage of the water supply process are carried over to the next stage. As the first step in the process, a good understanding of the catchment is therefore an important aspect of a WSP [8]. This study identified widespread catchment risk assessment and management activities across Rwanda (Table 2). These activities could form a useful basis for subsequent risk management and should be built upon and incorporated as part of a wider WSP. The legislative attention on catchment management and pollution reduction [25] may have contributed to the practical focus on catchment management indicating the benefits of focused legislation to drive risk management [31]. Expanding the process of risk management to downstream activities, such as household water treatment or storage of drinking-water, would be beneficial to ensure assessment of risk at each drinking-water process stage.

Risk management is considered the most cost-effective method for identifying and mitigating potential future risks to drinking-water quality [34], including those exacerbated by the risk of climate change [1,35]. Information regarding climate-related risks, including landslides, is recorded by many of the stakeholders interviewed in this study which could be used to support an assessment of future risk. Climate-resilient WSPs from other low-resource settings, such as Ethiopia, Nepal and Bangladesh, highlighted that consideration for these future risks is important 'despite knowledge gaps and uncertainties' [36,37].

One of the most important factors for successful WSP implementation in low- and middle-income countries is support from NGOs [17]. NGOs interviewed in this study

are embedded into and closely involved with Rwandan drinking-water management. Tapping into the NGO community to embed and upscale risk assessment by drawing on international expertise could be beneficial for widescale implementation both at the community and authority level (e.g., [18,38]).

Although SIs are not used by the stakeholders interviewed in this study, some POs use simple check sheets to manage drinking-water supply activities which could form the basis of the process of conducting SIs. Any tools implemented must be simple to use and appropriate for the setting [12].

4.3. Priority Areas Which Need to Be Addressed to Support Practical WSP Uptake in Rwanda

Formal adherence to the WSP methodology in Rwanda will require increased technical capacity at national and community levels, which was found in this study to be already limited. Numerous guidance documents exist internationally which can be used to support uptake at the various levels (e.g., [11,34]) however, further guidance specific to Rwanda may be required.

4.3.1. Legislation and Policy Environment

Drinking-water quality regulation should be underpinned by risk management [1]. Effective WSP implementation requires governments to set a national, enforceable framework and wider institutional support [12,34].

The Government of Rwanda have set clear targets for achieving access to safe drinking-water, many of which are legally mandated [26]. Although Rwandan legislation has included WSPs since 2015 [23], with some policy to support, this study highlights that greater drive, support and clarification are needed for effective uptake. Further detail regarding the enforcement of legislation, the provision of an enabling environment and the communication or education of the legislative requirements, is required. The existing formal communication channels through which stakeholders collaborate, including WASH sector meetings, JSRs [39] and SWAp [40], could be used to introduce and roll-out WSPs nationally. Communication and an adequate provision of resources from the central government are needed to assist districts across Rwanda with WSP uptake.

Greater detail and clarity of responsibilities and expected activities, as provided by other governments (e.g., [41]), may strengthen uptake in Rwanda. The legislation states that POs are responsible for carrying out WSPs. However, supporting policy puts the responsibility on the districts. Consistency between the legislation and policy guidance documentation provided at the national level is required to prevent confusion around roles and responsibilities. A wider, integrated policy environment is needed to increase the clarity of roles and responsibilities, reduce fragmentation and support with resource mobilization and local decision-making [42].

Lack of enforcement has been found to be a critical challenge to WSP implementation globally [19]. This lack of resource provision for districts to carry out their mandate, as part of decentralization, is a concern throughout the WASH sector [42]. The lack of specific detail regarding the expectations and activities required to carry out part of a WSP in the legislation may be restricting the ability to enforce WSPs in Rwanda.

Legislation which includes drinking-water quality into the regulatory tariffs set by RURA is urgently needed as this was referenced by all stakeholder groups as one of the biggest factors restricting the collection of accurate water quality information. Revising tariffs alongside the implementation of enforceable risk-assessment would be beneficial to ensure a holistic approach to water management based on risk management. Any regulatory revisions should consider a 'source to consumer' approach and recognize that drinking-water quality needs to be verified to the point of consumption by implementing safeguarding strategies, such as consumer property sampling for piped supplies. Regulations must also reflect the specific challenges and set-ups of small systems through ensuring simple strategies [21,43].

4.3.2. Community Engagement

One of the key barriers to WASH improvements can be a lack of community engagement which WSPs can support to drive as they can empower communities to act [15,44]. Governance structures of many services in Rwanda, including drinking-water, are based upon a decentralized, community-centered approach [45]. Decentralization is not uncommon across SSA with Kenya, Zambia and Tanzania incorporating similar approaches [46]. For many years, the Rwandan Ministry of Health has driven the Community-Based Environmental Health Promotion Programme to afford communities the ability to operate, maintain and manage their drinking-water supplies [47]. Although community-based and decentralized methods are promoted in Rwanda, including through government policy [24], participants in this study stated that water user involvement in drinking-water management was minimal. Community engagement is critical for WSP implementation success, especially in rural settings and has been found to increase community awareness of water safety and the associated behaviour change required [8,17,21,33]. Several forums which could support community engagement in Rwanda, such as the mandated Umuganda sessions or SWAp, were identified as part of this study. Increased dialogue between communities and leaders across Rwanda, through forums such as these, has been called for to drive district-level accountability for WASH management [42].

Furthermore, reliance on the often-slow paced implementation of legislation to drive uptake needs to be combined with a bottom-up approach of implementation from a community level. For community-managed drinking-water supplies, SIs can be used as an effective component of a WSP, particularly for hazard identification [8,48]. Empowering local communities to carry out simple WSP activities through using tools such as SIs and simple water quality testing tools, can be very beneficial in remote settings, but local facilitators and supporting activities are required to support these activities [49].

4.3.3. Data Management Practices

The sources of data used to create a WSP are more varied than water quality sampling data which were previously relied upon to understand drinking-water quality. Numerous additional data sources exist, for example data collected by NGOs, as highlighted in this study, or from researchers (e.g., [6]), which could contribute to creating a WSP. However, simple methods to collate this information are required.

This study found a lack of consistency in the data collected and the way in which data are stored and shared. Issues regarding the collection of accurate, reliable and timely data for making effective decisions have been highlighted in previous studies (e.g., [42]). A central government-driven strategy for managing data could be encompassed when rolling out WSPs which supports a consistent methodology and allows for regional or national level decision-making and planning. The WASH MIS system may provide the start which is required as data were due to be collected from all districts from June 2020 [50]. None of the districts in this study, however, noted the use of this system, so greater communication and training from central government may be required to increase the uptake of use of the system. Such data systems, which support the collation and use of operational, regulatory and other data sources to improve decision-making, provide regulatory oversight and support planning, exist in urban settings in SSA [1]. Although needed to support rural contexts, any system should fit with the constraints of a resource-limited setting and not be complex or costly to use, access or maintain [21].

4.4. Areas for Future Research

Future research to carry out a case study which formally adopts a WSP by embedding the structures and addressing the gaps identified in this study could support and expand upon the initial findings of this research. Additional interviews with RURA and MININFRA could support understanding and potentially contribute to the future policy direction of WSPs. Further research into the direct and indirect links between the role of the regulatory

environment on elements of WSP implementation, specifically in Rwanda, would be beneficial to support effective regulatory change (e.g., [31]).

4.5. Limitations of the Study

The results of this study were based on a sample of districts, NGOs, POs and water users across Rwanda. Although the number of respondents included was deemed sufficient to meet data saturation, the results are based on a sample of the population and therefore may not be representative of the entire population. The risk of this limitation was reduced by ensuring inclusion from across the country to reduce the risk of geographic bias.

The participants from RURA and MININFRA were selected to reflect representative views of each organization; however, the views expressed cannot represent the whole organization.

5. Conclusions

Risk assessment and management has the potential to greatly drive drinking-water quality improvements in some of the most vulnerable contexts. These contexts often already suffer from resource and financial constraints. Identifying methods which drive the most efficient and effective transition, using existing systems or processes where possible, is vital. The implementation of WSPs could provide long-term benefits including prioritizing and reducing duplication of action, supporting effective resource allocation and leveraging finances, which have been identified as especially challenging in Rwanda.

Like many countries in SSA, the use of WSPs to manage SDWS across Rwanda is currently minimal. However, this study has identified many basic structures or activities, such as catchment management, NGO involvement and the use of simple checklists, that are already in place and could be built upon to support implementation. The legislative and policy framework for WSPs exists but an overall framework and consistency of responsibilities between districts and POs is required. Communication and supporting structures are needed from the national level to support countrywide implementation. Risk-management should also be applied through a bottom-up approach of community engagement which is especially pertinent in a country such as Rwanda, whereby governance is framed around the decentralization of services. Supporting and training resources, such as the use of SI forms, are required to encourage community-driven risk management. Appropriate data management techniques also need to be addressed to support effective data storage and sharing.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/pr11030748/s1: a copy of the technical and non-technical interview guides used during the interviews in English and Kinyarwanda.

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