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Successful Partnerships for Multiple-Use Water Services (MUS) in Zimbabwe

FINAL REPORT

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ACRONYMS AND ABBREVIATIONS

AGRITEX	Ministry of Agriculture Extension
AMA	Agricultural Marketing Authority
ARDA	Agricultural and Rural Development Authority
ARDAS	Agricultural, Rural Development, and Advisory Services
BCR	Benefit Cost Ratio
BHA	Bureau for Humanitarian Assistance (USAID)
CARE	Cooperative for Assistance and Relief Everywhere
CNFA	Cultivating New Frontiers in Agriculture
COD	Chemical Oxygen Demand
DDC	District Development Coordinator
DDF	District Development Fund
DDP	District Development Plans
DMT	District Maintenance Team
DoI	Department of Irrigation
DoM	Department of Mechanisation
DO	Dissolved Oxygen
DWSC	District Water and Sanitation Sub-Committee
EC	Electrical Connectivity
ELI	Environmental Law Institute
EMA	Emergency Management Act
EMA	Environmental Management Agency
ENSURE	Enhancing Nutrition, Stepping Up Resilience and Enterprise
FAO	UN Food and Agriculture Organization
FGD	Focus Group Discussions
FNSC	Food and Nutrition Security Committee
IRR	Internal Rate of Return
IRWSSP	Integrated Rural Water Supply and Sanitation
IWRM	Integrated Water Resource Management
KII	Key Informant Interview
MASSMUS	Mapping Systems and Services for Multiple Uses of Water Services
MOU	Memorandum of Understanding
MUS	Multiple Use Water Services
NAC	National Action Committee
NDSI	National Development Strategy I
NGO	Non-Governmental Organization
NPV	Net Present Value
O and M	Operation and Management
OPC	Office of the President and Cabinet
PCA	Provincial Councils and Administration
PDC	Provincial Development Committee
PRO-WASH	Practices, Research and Operations in Water, Sanitation and Hygiene (USAID)
PWSSC	Provincial Water and Sanitation Sub-Committee
RDC	Rural District Council
RDDC	Rural District Development Committee
RFSA	Resilience Food Security Activities
SCALE	Strengthening Capacity in Agriculture Livelihoods and Environment (USAID)
TCPL	Total Consumption Poverty Line
TDS	Total Dissolved Solids

TSS	Total Suspended Solids
TVC	Total Viable Count
UNICEF	United National Children's Fund (formally United Nations International Children's Emergency Fund)
USAID	United State Agency for International Development
WASH	Water, Sanitation, and Hygiene
WDP	Ward Development Plans
WHO	World Health Organization
ZINWA	Zimbabwe National Water Authority

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EXECUTIVE SUMMARY

Multiple-use water services (MUS) is ideally a holistic and participatory approach to water services that takes the multiple domestic and productive water uses and needs of poor communities as the starting point for planning, designing, and managing investments in water services. When implemented effectively, MUS ameliorates the impacts of climate change and variability, such as more variable rainfall patterns and increased incidences of droughts, floods, and other extreme weather events. These impacts are felt most keenly by smallholder farmers, particularly those relying on rainfed agriculture, who require both coping and adaptation measures to strengthen their resilience. MUS approaches offer an opportunity for addressing these challenges through more sustainable access to water for both domestic and agricultural uses, expanded potential for irrigation and diversification of livelihoods and improved water and food security, which are main drivers of increased resilience. In this way, MUS approaches advance several benefits, including: cost-effective rural livelihoods diversification and resilience building; increased food security; improved gender relationships, women's empowerment, nutrition, and health; and increased financial, technical, and institutional sustainability of systems

Objective and Research Questions

The objective of this study was to support the USAID Bureau for Humanitarian Assistance (BHA)-funded Practices, Research and Operations in Water, Sanitation and Hygiene (PRO-WASH) award, and the Strengthening Capacity in Agriculture Livelihoods and Environment's (SCALE) award in learning and evidence building outcomes through innovative and context-specific research on strategies for MUS planning, design, operation, and sustainability in Zimbabwe and beyond. Experiences with MUS in two Zimbabwean Resilience Food Security Activities (RFSAs) – Takunda and Amalima Loko (and their predecessor projects, ENSURE and Amalima) – were documented to provide data for actionable recommendations for sustainable MUS implementation in Zimbabwe and in other USAID BHA-funded projects in other countries. Sustainability of MUS was defined in terms of financial sustainability, technical sustainability, institutional sustainability, and (water) resource sustainability. These findings were complemented and contextualized by a literature review, and in-depth analyses on financial and economic aspects of MUS in Zimbabwe, water quality issues at the sites studied, and the legal and institutional contexts.

The main research question guiding the study was: What are the institutional and organizational factors that are important in designing, implementing, and sustaining MUS in Zimbabwe, and what promising interventions (based on the experiences of the Takunda and Amalima Loko RFSAs and their predecessors) can be identified bearing in mind the scope of RFSA programs? This was supported by specific research questions, namely:

1. How can local government be better integrated into MUS planning and operation in RFSA projects and what are the gaps and challenges with local government integration?
2. What institutional mechanisms or principles can be shown to be successful in facilitating more effective organizational cooperation and sustainable MUS implementation?
3. How well do the existing governance frameworks (laws, policies, and institutional mandates and capacities) facilitate and support different MUS interventions and what are the key gaps?
4. What principles can be derived from the ways in which various financial arrangements have been implemented to support MUS, and what steps are needed to bring them to scale?
5. How is the sustainability of water (particularly groundwater) resources addressed in planning for, implementing, and sustaining MUS?
6. What factors and mechanisms ensure that MUS interventions drive more equitable allocation of water service provision and can effectively target historically vulnerable and persistently marginalized populations, including gender and youth equality?

7. What management systems ensure continued functionality and sustainability of established MUS, from a users' point of view?

Methodology

The study was undertaken between June and December 2022 and included: two virtual inception workshops; drafting of field research tools and protocols; an ethics review and creation of relevant safeguards for data collection; data collection (literature and legislative reviews, interviews, and field visits); report drafting; and two virtual validation workshops.

Site selection criteria were developed in consultation with consortium stakeholders, and a total of 13 sites were chosen: eight sites in the ENSURE and Takunda area covering two districts in Masvingo province and five sites in the Amalima and Amalima Loko are covering four districts in Matabeleland South and North provinces.

Data was collected through 20 Key Informant Interviews (KIIs), 23 Focus Group Discussions (FGDs), 158 household survey questionnaires, and participant observations. KIIs focused on government departments and agencies at the national, provincial and districts level and the Zimbabwe National Water Authority (ZINWA), catchment, and sub-catchment representatives.

Water quality was analysed for 21 variables across 10 sites to determine both its suitability for drinking water and for maintaining the health of the ecosystem. Financial and economic analysis was undertaken for projects where irrigation was involved. This focused on incremental benefits (food security, income, health, poverty reduction, etc.) against costs (capital, operation and maintenance, and replacement) of the different types of MUS projects to determine the degree to which costs could be minimized and benefits maximized and sustained across projects with different characteristics.

Findings

Detailed findings of the study are contained in Annex C (Literature Review) Annex D (Water Quality Analysis), Annex E (Financial and Economic Analysis), Annex F (Amalima and Amalima Loko Field Findings) and Annex G (ENSURE and Takunda Field Findings). The main findings are highlighted below.

Legal and Institutional Frameworks

There is no explicit framework governing MUS under the current policy and legislative framework in Zimbabwe. Rather, the water governance framework in Zimbabwe currently consists of several different laws and institutions across various water sub-sectors (and other related sectors) and levels of government. A key challenge to effective MUS approaches in Zimbabwe, therefore, is the current division – legally, institutionally, and financially – of water services provision for domestic uses, water resources planning (for allocation and use) and management, and irrigation water resource planning and management. While sufficient institutional platforms exist for coordination among government agencies at the district and provincial levels through water and sanitation sub-committees of councils, their effectiveness is compromised by the lack of a regulatory framework guiding these cooperative efforts, clarifying mandates related to MUS, and ensuring that they are not competing for funding and other resources in planning for and implementing MUS. There is a clear need for relevant agencies to agree upon a common definition of community-driven MUS in the Zimbabwean context and to develop guidance on how it should be planned for and implemented by various actors.

Other key governance issues related to MUS in Zimbabwe include:

- Uncertainty and overlap in institutional mandates relevant to MUS, exacerbated by the current reorganization of relevant agency mandates around irrigation and rural water supply;

- Severe resource constraints for government agencies mandated with technical, administrative, and capacity support for MUS, including resource assessment, monitoring, and ongoing financial and technical support post-construction;
- Need for alignment of water resource (catchment) and district level water services planning;
- Insufficient requirements for access to information and public participation in relevant sectoral laws and regulations; and
- High level of uncertainty around community-based water tenure, including discretionary determination of which community water uses are exempted from permitting and fees.

MUS at Project Level

Demographic, Land, and Cropping Characteristics

The majority of survey respondents were female: 90% and 78% in ENSURE and Amalima projects, respectively. The average household size was similar across all projects, with an average of 5-7. The size of the irrigated projects ranged from 1 to 5 hectares, while plot size ranged from 81 to 724 m2. A wide range of crops (as many as ten) were grown. Land utilization, as indicated by a cropping intensity of 300%, was the maximum possible with three crops grown on the same piece of land per year.

MUS in Projects and MUS Typologies

While the projects under Amalima were ultimately meant to provide water for multiple uses, the projects were not conceptualized and designed as multiple use projects. Rather, they were designed as single-use interventions focusing on irrigation or livestock watering. ENSURE projects were designed and implemented as MUS projects to provide both irrigation and drinking water through small water treatment plants in irrigation schemes but did not provide drinking water to households. Regardless of the design, communities indicated that their water priorities included water for irrigation, domestic and livestock watering, and where possible used the infrastructure developed for all of those water uses.

All government departments and state agencies (including the Departments of Irrigation and Mechanisation, AGRITEX, DDF, ZINWA and Rural District Councils) acknowledged that communities used available water sources for uses in addition to those for which the sources were designed and that achieving MUS was difficult because of budget constraints and the lack of a clear strategy to guide MUS planning, design, and implementation. No documentation or policy statement at the national, provincial or district level has provided guidance on how MUS projects can or should be implemented. The Presidential Borehole Programme, which aims is to drill 35,000 boreholes (one in each of the country's villages) is pursuing a MUS agenda by providing water for domestic use, irrigation, aquaculture, and watering small livestock, such as poultry and goats. There are, however, no specific guidelines on how this should be done.

Community Involvement

Since community involvement is widely regarded as key contributor to project ownership, effectiveness, and sustainability, the study sought to establish the perceptions of households regarding the level of their engagement in relation to planning and site selection, labour for construction and financial contributions, operation and maintenance, choice of irrigation infrastructure/technology, conflict resolution, during the post-construction phase/hand-over of projects, and in the broader set of partnerships.

Planning and site selection: In both ENSURE and Amalima projects, community participation in the planning and selection of projects was rated as high to very high. Community leaders, such as traditional leaders and Ward Councilors have critical roles in mobilizing communities, as well as facilitating entry of organizations (such as ENSURE and Amalima) into the communities. Dedicated committees were formed to spearhead the planning and implementation of the projects in the form of Asset Management Committees to manage and protect small dams and Irrigation Management Committees to manage of issues pertaining to irrigation schemes. While communities can make suggestions regarding the siting of a project, ultimately site selection depended on the availability of water based on technical assessments and availability of land for irrigation.

Labour for Construction and Financial Contributions: For both ENSURE and Amalima projects, the community contributed labor for construction and, in some cases, community members with specific skills were identified and trained. The labor they contributed was compensated in cash or in kind. Generally, communities were not expected to make direct financial contributions, but in Mahambangombe and Manzimhale, community members were asked to contribute 50 percent of infrastructure development costs under a matching grant programme. The matching grant programme was only implemented in Amalima and only in projects that were already operating as it was expected that communities could raise the matching funds.

Operation and Maintenance: Operational rules mostly emanated from the committees established for the projects and revolved around water rationing, proper water management of water sources, and irrigation duties. Generally, rules about managing assets (i.e., small dams) were more difficult to enforce than those related to irrigation schemes, potentially because irrigation is a continuous activity and requires close attention, has significant financial consequences on plot holders, and involves comparatively fewer people.

Community members contributed to operation, maintenance, and replacement costs and were willing to continue to do so, but only contributed between USD1-2 per month (an amount determined by the Committee). There was willingness to pay full operation and maintenance costs, mobilize funds in the case of a breakdown, and replace the infrastructure. The community was felt to have capacity to replace infrastructure and that the project would continue to work after the donor withdraws. These positive sentiments seemed to be guided by an underestimation of how much investment is actually required.

Irrigation Infrastructure/Technology: Surface irrigation was dominant across all projects, which mostly involved fetching irrigation water using buckets from wellpoints and some cases where taps were installed. The labor-intensive nature of the bucket irrigation has led to some communities attempting to install taps or other mechanisms.

Striking the appropriate balance between the articulated needs and priorities of communities and the constraints related to technology choice and resource sustainability was shown to be complex as illustrated by the introduction of drip irrigation under ENSURE and Amalima in Chetsanga and Manzimahle, which was chosen to save water and sustain the resource but ultimately rejected by the communities.

The introduction of solarized boreholes, which are replacing boreholes equipped with Bush pumps, is likely to pose operational and maintenance challenges to communities because of the complex technical requirements.

Conflicts and Conflict Resolution around MUS did not feature as a priority among the communities, but where conflict arose, it revolved around water shortages, irrigation water management system failures, and the payment arrangements for different services. The low reporting of water conflicts was explained variously as being related to successful negotiations which solved the conflict, instances where community cohesion was regarded as more important than resolving the conflicts and so the status quo was tolerated.

Partnerships MUS projects were complicated by the fact that there are no fewer than 10 institutions that involved in planning for, implementing and sustaining MUS. As noted in the legal and institutional frameworks discussion, this results in overlapping and unclear mandates that indicate a need for further clarity and guidance specific to MUS.

Post-Construction Phase/Hand-Over of Projects: When the project is complete, it is handed over to the community, Rural District Council, and government institutions such DDF, AGRITEX or Department of Irrigation and Department of Mechanisation (depending on the type of the project). A Completion Certificate and Commissioning Certificate are provided indicating that the work was completed in accordance with the technical specifications and checked by the implementing partner and relevant government departments. The community also receives all remaining materials and a Directory of Suppliers for obtaining replacement parts. Operation and Maintenance Plans were also left with the community. Despite this process, many projects recorded low functionality, indicating a need to rethink what steps and materials are required for successful handover, such as more realistic planning and identification of partners for ongoing financial and technical support to communities.

Water Quality showed that, of the ten sites that were sampled, only water from three sites, which were boreholes, was safe to drink. All surface water sources were contaminated, except for the water from the second tank of the water treatment plant in Nyimai. Water quality assessment and monitoring is critical in rural water supply at the commissioning of the water infrastructure and quarterly thereafter but was found to be inconsistent (sometimes non-existent) due to financial and material resource limitations of the relevant agencies.

Financial and Economic Analysis revealed that all households can make a profit at the current production level if they invest 10% of profits into operation maintenance and replacement costs. There were smaller benefit cost ratio for projects with drip irrigation and those with small plots and poor water availability.

Profitability, however, does not guarantee sustainability as measured by the repayment period. All projects but two (Pasvana and Mbengwa) have a repayment period of greater than 10 years. This means that, at current production levels, it will take more than 10 years to raise enough capital to meet operation, maintenance, and replacement costs, which will result in deterioration of the infrastructure. While Pasvana and Mbengwa have lower repayment periods (close to 10 years), they also will likely suffer degradation. The most affected projects are those facing critical water shortage (Toindepi, Cheshanga, Chemvuu, and Cheshanga), where the repayment period was over 40 years. The contribution of very small amounts (~USD$1-2 per month per household) did not help the situation.

Assessment of perceptions of community members/farmers revealed that farmers are willing to pay, but progressively less willing when the amount is doubled, trebled, and quadrupled. This results in under-investment in operation, repair, and maintenance and is a threat to project sustainability. The low household income meant that farmers were willing but unable to pay.

Conclusions

Based on the findings, several conclusions can be drawn:

1. There is **no explicit framework legal and institutional governing MUS**, **which has resulted in ineffective partnerships for MUS** as indicated by the following:
    a. Mandates for various aspects of MUS are found across various laws and silos that persist around water sub-sectors.
    b. Existing institutional mechanisms to facilitate coordinated implementation of MUS (Provincial and District Development Committees) bring together relevant government actors and NGOs but are compromised by: (1) lack of a regulatory framework guiding the cooperative efforts; (2) unclear mandates relating to MUS; and (3) inadequate financial resources to carry out the mandate.
    c. Current re-organization of relevant government departments and agencies is complicating this situation further but also present opportunities for clarification of mandates.
    d. Lack of presence of critical government departments at the district level has created a gap in critical expert support and advice for small dam and irrigation development.
2. **MUS was implemented by Default and Not Design.** While ENSURE included some design elements for MUS (i.e., irrigation-plus with in-scheme water treatment plants for drinking water), overall projects were very focused on a primary, single use. Under Amalima projects, not MUS-specific planning was undertaken. In all cases, communities resorted to using existing projects for non-designed uses and

relied on other water sources for domestic needs, indicating a strong need for more concerted and deliberate approaches to MUS.

3. **Community-Led approaches** through "community visioning" process is now regarded as an integral component of MUS planning process but was introduced after the projects assessed for this report. Such visioning is critical to balance out the technical or financial imperatives for cost savings or resource sustainability with community priorities, needs, and capacities and provide capacity building throughout.
4. The lack of central focus on provision of water for **domestic water uses** across the projects indicates a lack of more holistic approaches to MUS that place such uses at the center of community needs. The expectation that domestic uses would be addressed by other partners operating in the area of the projects was not realized.
5. **Water quality** analysis proved that boreholes were sources of safe water while surface water required treatment. While surface water treatment is possible, the cost is often prohibitive and is not necessarily required for all uses such as brickmaking and laundry. Water quality testing is also important for other uses such as for fisheries but is compromised by inadequate water quality monitoring.
6. **Financing MUS** in Zimbabwe is challenging, as demonstrated by the financial analysis findings that communities failed to meet O and M costs across all projects, despite an expressed willingness to pay. This underlines the need for a clearer understanding during planning phase of what costs communities can feasibly cover, the level of support required, the partners that may assist in closing the gaps, and the pursuit of reasonable alternatives where sustainable financing is not possible.
7. While irrigation generated **benefits** to participating households as indicated by profitability, communities could not raise enough money to meet operation, maintenance, and replacement costs because of small plot sizes, poor/incomplete designs, poor water availability, and low household incomes. However, the projects generated other benefits, such as food and nutrition security, health and improved welfare of women and girls. It is therefore important to account for the multiple dimensions of well-being that can be improved through increased access to water for various priority uses and the ways in which these benefits contribute, in turn, to increased livelihoods viability.
8. Despite the fact that **climate change** is known to have negative impacts on water resources and supply, these impacts and their potential effects on MUS is not mainstreamed into water resources planning and management. It will be critical to undertake better integration of climate uncertainties and impacts in MUS planning, revise parameters for irrigation development and water supply under different climate scenarios, and adopt of climate smart technologies.

Recommendations

The recommendations include: (1) specific interventions that can be undertaken to address the gaps as identified in the Zimbabwean context; (2) planning and programmatic interventions that can be undertaken by BHA, RFSAs and implementing partners; and (3) steps and assessments for improved, community-led MUS. All the recommendations are structured to increase the reliability, resilience, and overall success of MUS in the implementation areas, as well as in other USAID BHA-funded projects in Zimbabwe and other countries.

For Zimbabwe, national level water sector agencies, through the National Action Committee, should:

- Articulate a clear policy commitment to community-led MUS that is coordinated at the provincial and district levels and aligns with integrated development and water planning goals.
- Through a participatory process, create clear guidance on community-led MUS to facilitate more inclusive, integrated, and structured approaches to MUS; and
- Seek improved coordination mechanisms across relevant agencies and non-governmental partners for more effective, efficient, and inclusive MUS interventions.

Additional, specific recommendations include:

- Clarifying the legal definition of "primary water" uses to include small-scale productive uses;
- Clearly defining institutional mandates with respect to MUS;
- Assessing options for ensuring that Catchment and Sub-Catchment Councils can achieve their mandates and support MUS;
- Elaborating more detailed and meaningful community and stakeholder participation requirements;
- Exploring ways in which recognition of customary tenure and other existing practices (including self-supply and farmer led irrigation) can support effective MUS;
- Explicitly recognizing and protecting women's water rights;
- Mandating the creation and maintenance of a data and information management system to document existing water projects especially on how MUS can be incorporated and inform future projects;
- Mandating detailed and tailored MUS guidance that promotes rights-based, community-led MUS and can be adapted at the District level to align with district and catchment operational plans.

Recommendations for BHA, RFSAs, and Implementing Partners

The overarching recommendation for BHA and implementing partners is to **develop and more specific set of steps and guidance for completing those steps when undertaken MUS interventions**. Specific recommendations include:

1. **Donor/implementing partner coordination.** BHA and implementing partners should work closely with other donors and partners to coordinate MUS interventions at the local level to leverage complementary funding and expertise that can benefit specific communities in an integrated manner.
2. **Investment in planning phase and flexibility.** MUS project finance should be designed to invest in up front assessments and be flexible enough to respond to the outcomes of more cooperative (community-led) planning approaches.
3. **Accounting for multiple dimensions of well-being as project goals/outcomes.** Identify and account for the multiple dimensions of well-being that can be improved through increased access to water for various priority uses and the ways in which these benefits contribute, in turn, to increased livelihoods viability. Such benefits contribute to MUS financial sustainability, albeit through less direct pathways.
4. **Addressing water quality.** Safe water for drinking is important but is not required in high volumes of water, which justifies other solutions than the conventional water treatment plans. Implementing partners should account for water quality assessment and treatment needs by exploring the cost-effectiveness and social acceptability of point-of-use treatments (e.g., filters, chemicals, solar disinfection). Where regular monitoring is uneven or missing, communities should also be trained to fill this gap.
5. **Building on community visioning to achieve community-led MUS**. Community visioning can provide an important first step in planning for and implementing MUS and the resulting Community Action Plan can help determine how various MUS interventions can achieve multiple community goals simultaneously. BHA and implementing partners should strengthen the visioning process as a first critical step in planning for community-led MUS, complemented by the steps recommended below.

Recommended Steps and Assessments for Community-led MUS

Community-led MUS operationalizes well-known community participation tools for the specific case of water infrastructure, including life cycle considerations, professionalization, and embeddedness in local government structures (as applied by the WASH sector) or local arms of line agencies (as in the irrigation sector). The following recommendations are common steps that have been used successfully for MUS planning and implementation in a number of contexts.

Step One: develop multistakeholder MUS institutional forum and develop mutually agreed expectations and process. The first step is to identify and engage with MUS stakeholders (including from the most vulnerable groups) to include perspectives from these stakeholders from planning onward. Mutual expectations should be discussed and endorsed, and partners should indicate what capacities they can contribute. Any limitations on potential options should be clearly explained.

Step Two: Participatory diagnosis of existing assets and problems. Communities are engaged in facilitated meetings and transect walks to map their land and waterscapes, which identifies: (1) residential, crop land, grazing areas, forests, and roads; (2) the multiple surface and groundwater sources accessed and used by the community; (3) consumptive and non-consumptive water uses; and (4) existing infrastructure used to store and convey water. Mapping enables issues to be clearly diagnosed.

Step Three: Envisioning and prioritizing sustainable, cost-effective, life-cycle solutions/technology choices. Communities identify and rank the range of possible solutions, including support to self-supply, and technology choices, including the life cycle requirements of each option. Solutions should explicitly consider gender equity goals. Support agencies and implementing partners facilitate this process and provide technical and institutional advice. A full financial sustainability assessment based on the full life cycle costs of the options provides additional, critical insights into which options are most viable and where partners will need to support communities in sustaining MUS.

Step Four: Fitting the Financial Framework. Final decisions on site and technology selection and fund allocation among prioritized solutions of communities are in implementing partners'/support agencies' hands. They also remain accountable to their funders for transparent procurement and establishment of contracts with competent private or public implementers.

Step Five: Implementing Construction. Procurement of materials and labor should be done locally, where possible to save money and develop local capacities. Voluntary or modestly remunerated construction labor by community members and local artisans create ownership of the infrastructure.

Step Six: Post-construction Support. Operation, maintenance, and small repairs should follow earlier agreements and updated as needed. To facilitate handover and ensure ongoing transparency and accountability, BHA and implementing partners could create a list of necessary documentation, roles for post-construction support, and additional capacity needs to supplement the project outcomes.

Following implementation, a final consideration is to ensure ongoing exchange and learning from across MUS interventions. It is recommended to require documentation and develop platforms for sharing experiences with *de facto* multiple uses, the "plus" approaches and community-led MUS among support agencies and with all relevant local and national government institutions to continue to learn and improve MUS on an ongoing basis.

1. INTRODUCTION

1.1 Project Background

Multiple-use water services (MUS) is ideally a holistic and participatory approach to water services that takes the multiple domestic and productive water uses and needs of poor communities as the starting point for planning, designing, and managing investments in water services. Communities have developed water systems for multiple uses throughout history and increasing evidence from implementation of MUS approaches globally demonstrate that MUS plays an important role in fostering poverty alleviation and achieving multiple development goals for the world's poorest communities.[1]

When implemented effectively, MUS ameliorates the impacts of climate change and variability, such as more variable rainfall patterns and increased incidences of droughts, floods, and other extreme weather events. These impacts are felt most keenly by smallholder farmers, particularly those relying on rainfed agriculture, who require both coping and adaptation measures to strengthen their resilience. MUS approaches offer an opportunity for addressing these challenges through more sustainable access to water for both domestic and agricultural uses, expanded potential for irrigation and diversification of livelihoods and improved water and food security, which are main drivers of increased resilience. In this way, MUS approaches advance several benefits, including: cost-effective rural livelihoods diversification and resilience building; increased food security; improved gender relationships, women's empowerment, nutrition, and health; and increased financial, technical, and institutional sustainability of systems.[2]

The overarching goal of this project was to support the USAID Bureau for Humanitarian Assistance's (BHA's) funded Practices, Research and Operations in Water, Sanitation and Hygiene (PRO-WASH) and Strengthening Capacity in Agriculture Livelihoods and Environment's (SCALE) learning and evidence building efforts by providing innovative, context-specific research on strategies for MUS operation, access, reliability and sustainability in Zimbabwe for BHA partners and other key stakeholders. The project was designed to study specific examples of MUS in two Resilience Food Security Activities (RFSAs) in Zimbabwe – Takunda and Amalima Loko[3] – and from their predecessor projects (ENSURE and Amalima)[4] to provide data for providing actionable recommendations for interventions designed to increase the reliability, resilience, and overall success of MUS in the implementation areas, as well as in other USAID BHA-funded projects in other countries.

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[1] For a detailed discussion and references on the development of the MUS concept and its implementation globally and in Zimbabwe, please see the Literature Review attached to this Report as Annex C.

[2] International Water Management Institute (IWMI), IRC, and Rockefeller Foundation. 2014. Upscaling Multiple use water services: accountability in the water sector. London: Practical Action.

[3] Takunda is a five-year Resilience Food Security Activity that is funded by USAID/BHA and implemented by a consortium primed by CARE in Zimbabwe. The project commenced on October 1, 2020. Takunda's goal is to achieve sustainable, equitable, and resilient food, nutrition, and income security in Masvingo and Manicaland provinces of Zimbabwe. The program is implemented in the Buhera and Mutare Districts (in Manicaland Province), and in Chivi and Zaka Districts (in Masvingo Province). Amalima Loko is a five-year (2020-2025) USAID/BHA-funded program designed to improve food security in Zimbabwe through increased food access and sustainable watershed management. The program is implemented by a consortium primed by Cultivating New Frontiers in Agriculture (CNFA) and builds on its predecessor project, Amalima, a seven-year Resilience Food Security Activity (also implemented by CNFA) that worked to sustainably improve food security and nutrition for vulnerable Zimbabwean households. Amalima Loko works across five districts in Matabeleland North Province: Binga, Hwange, Lupane, Nkayi, and Tsholotsho.

[4] Enhancing Nutrition, Stepping Up Resilience and Enterprise (ENSURE) was a five-year programme designed to improve the nutrition of women of reproductive age and children under the age of five, increase and improve agricultural production and marketing, and increase communities' resilience and response to disasters and shocks. The projected was implemented by World Vision Zimbabwe in partnership with CARE, SNV, and Safire with funding from USAID. See https://www.wvi.org/food-assistance/ensure-zimbabwe. Amalima was a seven-year (2013-2020), $60 million USAID Development Food Aid Program (DFAP), worked with over 118,000 vulnerable households to sustainably improve household food security and nutrition in Zimbabwe's districts of Bulilima, Gwanda, Mangwe (Matabeleland South), and Tsholotsho (Matabeleland North). See https://www.cnfa.org/program/amalima/.

The core research team[5] for the project included the Environmental Law Institute (ELI), the International Water Management Institute (IWMI) and Dr. Emmanuel Manzungu, Professor of Agri-landscapes, Waterscapes, and Irrigation/Water Management in the Department of Soil Science and Environment in the Faculty of Agriculture, Environment, and Food Systems at the University of Zimbabwe. Dr. Manzungu acted in his individual capacity for this project.

1.2 Research Questions of the Study

The main research question guiding the implementation of this project is: What are the institutional and organizational factors that are important in designing, implementing, and sustaining MUS in Zimbabwe, and what promising interventions (based on the experiences of the Takunda and Amalima Loko RFSAs and their predecessors) can be identified bearing in mind the timeframe, resources, and scope of RFSA programs? Given the focus on institutional and organizational factors and the need to uncover promising interventions both in the context of the RFSA programs and beyond, the core research team focused on the following research sub-questions to effectively unpack and analyze the factors relevant to MUS design, implementation, and sustainability. These questions were vetted with the consortium stakeholders through the inception workshops and follow-on consultative process.

1. How can local government be better integrated into MUS planning and operation in RFSA projects and what are the gaps and challenges with local government integration?
2. What institutional mechanisms or principles can be shown to be successful in facilitating more effective organizational cooperation and sustainable MUS implementation?
3. How well do the existing governance frameworks (laws, policies, and institutional mandates and capacities) facilitate and support different MUS interventions and what are the key gaps?
4. What principles can be derived from the ways in which various financial arrangements have been implemented to support MUS, and what steps are needed to bring them to scale?
5. How is the sustainability of water (particularly groundwater) resources addressed in planning for, implementing, and sustaining MUS?
6. What factors and mechanisms ensure that MUS interventions drive more equitable allocation of water service provision and can effectively target historically vulnerable and persistently marginalized populations, including gender and youth equality?
7. What management systems ensure continued functionality and sustainability[6] of established MUS, from a users' point of view?

The first six questions were developed by the core research team at the beginning of the process and further verified through the two inception workshops. The seventh question was added through these consultations.

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[5] The core research team included: Jessica Troell, JD (ELI), who acted as project manager and governance expert; Dr. Emmanuel Manzungu, who coordinated the field research and provided expertise on Zimbabwe's water and agricultural sectors; Dr. Barbara van Koppen (IWMI), who provided MUS technical expertise; and Dr. Everisto Mapedza (IWMI), who provided both Zimbabwe water sector and governance technical expert. Two additional experts were brought in to focus on specific aspects of the research and analysis: Dr. Emmanuel Mwakiwa as the financial and economic expert and Dr. Tamuka Nhiwatiwa as the water quality expert. Jude Cobbing, Nicole Weber, Jennifer Mayer, and Kristin Lambert provided expertise and guidance as the PRO-WASH/SCALE focal points, while Egnes Muchanyukwa of CARE and Louise Nkomo of Dabane provided expertise on MUS focal points for Takunda and Amalima Loka respectively. Tinashe Nyaboko and Elly Beckerman (ELI) provided research, editorial, and administrative support throughout the project.

[6] Sustainability of MUS includes four dimensions: (1) financial sustainability, or sufficient resources to support operations and maintenance from both technical and institutional perspectives; (2) technical sustainability of the infrastructure/technologies used; (3) institutional sustainability, where the MUS systems in place are governed to ensure equitable access to services and effective conflict resolution; and (4) resource sustainability, where the water resource is capable of meeting the demands of the MUS system in a sustainable manner over time without compromising the ecological integrity of the resource.

The workshops also raised key issues and considerations around these topics implemented in the study, which helped to inform the research and analysis by shaping the specific questions asked in the research protocols. [7]

1.3 Structure of the Report

After this introductory section, the next section of this report provides an overview of MUS typologies and approaches to provide a conceptual context for the findings of the research presented here. This overview is based on a comprehensive literature review of published international, regional (particularly South Africa) and Zimbabwean resources. The methodology of the study is described in Section 3 incorporating the project approach, site selection, research protocols and ethical considerations, and data collection and analysis.

Section 4 provides the findings for this research. First the governance context is presented, describing the legal and institutional frameworks governing MUS in Zimbabwe and providing a brief assessment of the priority governance challenges facing MUS in Zimbabwe today. The project-specific findings for this research are then presented, including an overview of project characteristics and a description of MUS practices in the project areas followed by discussions of: (1) community involvement in various stages and aspects of MUS; (2) partnerships for MUS in Zimbabwe; (3) water quality analysis; and (4) financial and economic analysis. Chapter 5 presents the authors' conclusions and recommendations are provided in Chapter 6.

[7] The full list of these topics is included in the Inception Report which is attached as Annex A.

2. MUS: TYPOLOGIES AND EVOLVING APPROACHES

A MUS approach recognizes the disparities between the single-use mandates of water sub-sectors – namely WASH, irrigation, and water resource management – and the reality in low- and middle-income rural areas where water infrastructure, when available, is used for all priority water needs. Instead of trying to forbid such 'illegal' uses, typically in vain, external governmental or non-governmental support agencies have increasingly recognized the need to respect and protect communities' priorities for their diverse water needs. These more integrated approaches to water supply, informed by meaningful community participation, appeared to effectively generate broader and more sustainable benefits to people's multi-faceted livelihoods.[8] [9]

Yet, overcoming embedded legal, institutional, and financial siloes is challenging. Institutional mandates related to (and mechanisms for financing) water service interventions often create path dependencies, or reliance on "business as usual" and resistance to change. Another reason why it is difficult to overcome legal and administrative silos is the nature of water itself and the specialized expertise needed to manage and administer the resource. Besides engineering expertise to deliver water for any use, other expertise is also needed to turn that use into a livelihood benefit. The latter include measures to ensure water safety and hygiene by the WASH sector or seeds, skills, inputs, and markets for agricultural production that agricultural professionals can provide. This expertise tends to dominate the institutional set up of governments and support agencies in the form of line agencies or departments. The mandates of these sectors and decisions about their funding are often taken at national or even international levels. As a result, intermediate- and local-level implementers and service providers often remain more upwardly accountable within their specified mandate than downwardly accountable to the communities they serve. A MUS approach aims to overcome these obstacles and unlock important expertise from their silos. Ideally, under a MUS approach, engineers and hydrologists can collaborate on infrastructure development and holistically consider water supplies to homesteads, fields, grazing areas, and other sites of water use, while accounting for all naturally available water resources flowing over or located under communities' socially defined territories. Health specialists also bring solutions, for example, point of use treatment devices, that agricultural extension workers can promote.[10] Agronomists can, provide support for both cultivation at and around homesteads and at distant fields.[11] Overcoming administrative silos also can open opportunities to match external support to rural communities' multiple water needs and priorities.

In the early 2000s, the United States Agency for International Development (USAID), the UN Food and Agriculture Organization (FAO), non-governmental organizations (NGOs) in Zimbabwe[12] and other national and international partners in both the WASH and irrigation sectors coined the concept of MUS.[13] Broadly speaking, two MUS modalities can be distinguished: "plus" approaches and community-led MUS. In "domestic-plus" or

[8] IWMI et al. 2014, *supra* n. 2.

[9] Kativhu, T., et al. 2021. Influence of multiple uses of water on the sustainability of communally managed rural water supply systems in Zimbabwe. Research Paper Journal of Water, Sanitation, and Hygiene for Development, 11.1, 2021.

[10] Sutton, S. and Butterworth, J. 2021. *Self-supply: Filling the gaps in public water supply provision*. Rugby, UK: Practical Action Publishing. Available at https://practicalactionpublishing.com/book/2530/self-supply; Mekonta, L., James, A.J., and Butterworth, J. 2018. *Baseline report of groundwater development in pilot watersheds Amhara, Ethiopia.* Report for REACH Water Security in Fragile Environments Observatory. Ethiopia, Addis Ababa: IRC.

[11] GC, R.K.; Hall, R.P. 2020. The commercialization of smallholder farming – A case study from the rural western middle hills of Nepal. *Agriculture* 10(5): 143. Available at: https://doi.org/10.3390/agriculture10050143.

[12] Robinson, P., Mathew, B., and Proudfoot. D. 2004. "Productive water strategies for poverty reduction in Zimbabwe" *in*: Moriarty, P., Butterworth, J., and van Koppen, B. (eds). 2004. *Beyond Domestic. Case studies on poverty and productive uses of water at the household level*. IRC Technical Papers Series 41. Delft: IRC, NRI, and IWMI.

[13] Van Koppen, B., Moriarty, P. and Boelee, E. 2006. *Multiple-use water services to advance the Millennium Development Goals*. IWMI Research Report 98. Colombo, Sri Lanka: International Water Management Institute, Challenge Program on Water and Food, and International Water and Sanitation Centre (IRC). A depository of MUS publications is available at www.musgroup.net. MUS is also a Theme of the Rural Water Supply Network.

"irrigation-plus", the focus of MUS remains on infrastructure development designed for the priority water use of the sector's mandate, but considers how other uses, which typically are happening already, are not only respected as people's priorities, but encouraged and planned for by infrastructure add-ons. Under the domestic-plus approach, service levels are increased to enable communities to 'climb the water ladder' by providing for both domestic uses and crop production (and/or livestock), while infrastructure typically remains at or adjacent to homesteads. By accounting for all water needs and ensuring that the distances to the infrastructure are manageable, the domestic-plus approach is inherently inclusive. For landless and land-poor households, the homestead is the main, if not the only, site where they can use water productively. Women also tend to have a stronger say over the outputs of homestead-based production than over production at distant fields.

The irrigation-plus approach has been commonly used in arid areas, where larger-scale irrigation schemes are the most important water source. [14] Examples of add-ons to irrigation schemes include pipes to residential areas; underground household tanks filled by canal water to store water for year-round domestic uses; cattle entry points to enable livestock watering and bathing; or washing steps for laundry. [15]

Early studies confirmed that low incremental costs to enable uses beyond a single-sector priority use generate high incremental benefits. [16] In addition to financial benefits accruing from the sale of produce, the plus approaches also offer improvements in multiple other dimensions of wellbeing. Importantly, these improvements mutually reinforce each other, even over generations. When women spend less time collecting water for domestic uses, they have more time for childcare and production and girls are more readily able to attend school. Consumption of home-grown eggs, milk, meat, and other nutritious food improves under-fives' nutrient intakes. Well-fed healthy adults are more productive, enabling more productive livelihoods and increased income. Additionally, income from sale can be spent on health care and other improvements of rural people's multi-faceted livelihood and can be reinvested in operation and management (O and M). [17]

However, when multi-purpose infrastructure remains top-down, the typical problems of any top-down development approach, as found in both the WASH and irrigation sectors, often remain. These include a weak, vaguely defined sense of ownership, problems in tariff collection and failures of both support agencies and communities to provide critical, post-construction support for O and M, and infrastructure replacement. [18] This often results in sub-optimal use of MUS infrastructure, if not collapse. Further, where communities' spatial scales are not accounted for, decisions around the siting of technology can undermine effectiveness and sustainability of MUS interventions. The WASH sector inherently focuses on homesteads whereas the irrigation-plus approach focused on broader spatial scales. Moreover, in the 2010s both sectors started paying

[14] Bakker, M., et al. (Eds). 1999. 'Multiple uses of water in irrigated areas: a case study from Sri Lanka.' SWIM Paper No.8. Sri Lanka, Colombo: International Water Management Institute; Boelee, E., Laamrani, H. and van der Hoek, W. 2007. 'Multiple use of irrigation water for improved health in dry regions of Africa and South-Asia', Irrigation and Drainage 56: 43–51.

[15] Renault, D.,Wahaj, R., and Smits, S. 2013. Multiple uses of water services in large irrigation systems Auditing and planning modernization The MASSMUS Approach. FAO Irrigation and Drainage Paper 67. Italy, Rome: FAO.

[16] Renwick, M. 2007. Multiple Use Water Services for the Poor: Assessing the State of Knowledge. Arlington, VA: Winrock International; Hall, R. et al. 2015. Upgrading Domestic-Plus Systems in Rural Senegal: An Incremental Income-Cost (I-C) Analysis. Water Alternatives 8(3): 317-336

[17] Ringler, C.; Choufani, J.; Chase, C.; McCartney, M.; Mateo-Sagasta, J.; Mekonnen, D.; Dickens, C. 2018. Meeting the nutrition and water targets of the Sustainable Development Goals: achieving progress through linked interventions. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Research Program on Water, Land and Ecosystems (WLE); Washington, DC, USA: The World Bank. 24p. (WLE Research for Development (R4D) Learning Series 7); Kativhu, T, Mazvimavi, D., Tevera, D. and Nhapi, I. 2021. Influence of multiple uses of water on the sustainability of communally managed rural water supply systems in Zimbabwe. Research Paper Journal of Water, Sanitation and Hygiene for Development. Jan. 1, 2021.

[18] Moriarty, P.; Smits, S.; Butterworth, J. and Franceys, R. 2013. Trends in rural water supply: Towards a service delivery approach. Water Alternatives 6(3): 329-349

attention to self-supply and farmer-led irrigation development. [19] In self-supply, individual households, self-organized subgroups, or entire communities design, finance, construct, operate and maintain water infrastructure. As might be expected, self- supply is often multi-purpose and readily sustained by those who have invested in it, especially if sited at or around homesteads. [20] Self-supply is rapidly expanding in many rural areas due to: the availability of new, affordable plastic tanks, pipes and other water infrastructure and energy sources; growing aspirations of growing populations; and new markets to sell water by informal vendors or outputs markets for irrigated produce. However, frequently, the most marginalized cannot afford self-supply and even where private owners share their water with neighbors or farmers at adjacent plots, inequities are widening. [21] Targeted, external support to self-supply can fill that gap by ensuring affordability of technologies, for example, rope-and-washer, (or 'elephant' pumps, as in Zimbabwe [22]) and financing facilities. [23]

Learning from the implementation of the "plus approaches" and the wider trends in MUS implementation has triggered expansion into a second, broader modality: community-led MUS. In this approach, communities are meaningfully engaged from the planning phase of MUS onwards, including identifying priorities for uses, appropriate infrastructure, siting of infrastructure, creation or building on existing management structures, financial planning, and planning for and implementing O and M. To facilitate and support such approaches, several guidelines (including one from Zimbabwe), were synthesized by the International MUS Group into a six-step approach: (1) establishing community structures; (2) diagnosis; (3) visioning; (4) fitting the financial framework; (5) implementation; and (6) use. [24] FAO concurrently developed "Mapping Systems and Services for Multiple Uses of Water Services (MASSMUS)" guidelines for large-scale infrastructure for irrigation and other uses. [25]

Community-led MUS starts with the participatory diagnosis of the multiple surface and groundwater sources and all infrastructure (including both self-supply and externally financed infrastructure), for the various uses by the various users in the community's highly localized geo-hydrological, socio-economic, and political setting. This may seem dauntingly complex for specialist professionals, but in practice, participatory resource mapping can enable communities to identify all these factors quickly and effectively on a map. [26] This holistic, integrated diagnosis provides the broad basis for communities to envision and prioritize solutions within the technical,

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[19] Izzi, G.; Denison, J.; Veldwisch, G.J. (eds.) 2021. The farmer-led irrigation development guide: A what, why and how-to for intervention design. Washington, DC, USA: World Bank. Available at https://pubdocs.worldbank.org/en/751751616427201865/FLID-Guide-March-2021-Final.pdf

[20] Sutton, S. and Butterworth, J. 2021, *supra* n. 10.

[21] Lefore, N.; Giordano, M.A.; Ringler, C.; Barron, J. 2019. Sustainable and equitable growth in farmer-led irrigation in Sub-Saharan Africa: What will it take? Water Alternatives 12(1):156–168. Available at https://www.water-alternatives.org/index.php/alldoc/articles/vol12/v12issue1/484-a12-1-10/file

[22] Robinson, P. et al. 2004, *supra* n. 13.

[23] Ferrero, G., and J. D. Briemberg. 2022. History and status of the rope pump in Nicaragua. - a success story about rural communal water supply and self-supply , Skat Foundation/SMART Centre Group , RWSN , St. Gallen, Switzerland.

[24] SADC/Danida. 2009. 'Guidelines for local level integrated water resource management: Based on experiences from integrated water resource management demonstration projects in Malawi, Mozambique, Namibia, Swaziland, and Zambia', Pretoria: SADC/Danida and International Water Management Institute. Available at www.iwmi.cgiar.org/Publications/Other/PDF/Guidelines_for_local-level_integrated_water_resource_management.pdf; ZIMWASH, EU, and UNICEF. 2010. Guidelines for Planning for Water for Livelihoods. Available at: https://www.rural-water-supply.net/_ressources/documents/default/1-1050-59-1646812084.pdf; Adank, M.; van Koppen, Barbara; Smits, S. 2012. Guidelines for planning and providing multiple-use water services. [CGIAR Challenge Program-Multiple-Use Water Systems (CP-MUS) Project guidelines]. Hague, Netherlands: International Water and Sanitation Centre (IRC); Pretoria, South Africa: International Water Management Institute (IWMI). 123p. Available at: http://ifad.org/english/water/pub/mus_guidelines.pdf.

[25] Renault, D. et al, 2013 *supra* n. 13.

[26] van Koppen, B. et al. 2021. Operationalizing community-led water services for multiple uses in South Africa. Report to the Water Research Commission by International Water Management Institute and Tsogang Water & Sanitation WRC Report No. TT 840/20 ISBN 978-0-6392-0238-9. Pretoria, Water Research Commission. Available at: http://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20840%20final%20web.pdf.

financial, and institutional support frameworks that partner agencies and NGOs can offer and transparently communicate. Water users' post-construction requirements and potential solutions are discussed early in the planning process. If those requirements appear unrealistic, solutions are adjusted. A community member in a MUS project in South Africa summarized community-led MUS as: 'nothing about us without us.' [27]

When agencies effectively include the most marginalized in the planning process, it is likely that water supplies to everyone's homesteads for basic domestic uses remain a top priority, in line with the UN General Assembly's commitment to meet those human rights. [28] Even below the internationally-accepted minimum levels of 25 litres per capita per day, households can prioritize giving water to small livestock, irrigating household gardens and fruit trees, and take laundry to streams. [29] Increasing the amount of water available to homesteads (or plots) contributes to realizing human rights to food and adequate standard of living. When effectively engaged in the planning process, communities also develop many additional solutions to access to water, including support to self-supply. Thus, community-led MUS not only taps the benefits of cost-effective and sustainable multi-purpose infrastructure, but also builds on already available technical, financial, and institutional capital according to people's priorities, which is even more cost-effective and sustainable. [30]

Finally, community-led MUS provides better opportunities for identifying, respecting, and protecting the customary norms, rules, and practices that communities have developed since time immemorial to prevent water resource pollution and to adapt allocation and water-sharing mechanisms to inevitable seasonal variability in precipitation and water resource availability, especially during dry seasons and droughts. Stewarding the water resources upon which they depend and fostering internal and external social cohesion are both needed for communities' survival. Accordingly, communities developed customary arrangements to deal with growing competition among community members and between communities when shared water resources and soils dry up and aquifers remain the only water resource still available, at least for those who have infrastructure to reach and lift those waters. Well before all surface or groundwater resources in the reachable surroundings have fully dried up, customary prioritization rules seek to manage growing competition. This competition is not between single-use sectors, but among men and women, young and old, marginalized and relatively powerful, farmers and pastoralists, each with multiple water needs. These customary arrangements will only become more important with growing populations, higher aspirations, increasingly available technical means for abstraction, and more extreme droughts under climate change. Yet, in current water legislation, external high impact water users can even over-ride communities' age-old water tenure. This emphasizes the importance of effective legal recognition and protection of customary water tenure to successful and sustainable MUS, as discussed in the section on Legal and Institutional Frameworks for MUS in Zimbabwe below. [31]

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[27] Id.

[28] UN General Assembly. 2010. Resolution Adopted by the General Assembly on 28 July 2010—The Human Right to Safe Drinking Water and Sanitation. A/RES/64/292. Switzerland, Geneva: Office of the United Nations High Commissioner for Human Rights (OHCHR).

[29] van Koppen, B. et al., 2021, *supra* n. 26s.

[30] Id.

[31] Troell, J. and Keene, S. 2022. Legal recognition of customary water tenure in Sub-Saharan Africa: Unpacking the land-water nexus. Colombo, Sri Lanka: International Water Management Institute (IWMI). 33p. (IWMI Research Report 182).

3. METHODOLOGY

This project focuses on the institutional and organizational factors that are important in designing, implementing, and sustaining MUS in Zimbabwe and on identifying promising interventions – based on the experiences of the Takunda and Amalima Loko RFSAs and their predecessors – that can be used to inform future MUS approaches in Zimbabwe and beyond.

3.1 Project Approach

Given the focus of this project on developing evidence-based recommendations for future RFSA implementation of MUS, the core research team worked collaboratively with a consortium of partners and under the guidance of PRO-WASH and SCALE to develop tailored research questions, site selection criteria, undertake site selection and develop research protocols and materials for field research.

In June 2022, two Inception Workshops were convened to gather consortium stakeholders to meet, share expectations, and kick off a co-creation process for core aspects of the project. Attendees were identified through consultations with PRO-WASH, SCALE, Amalima Loko, and Takunda. A list of 36 invitees was developed, including representatives from USAID Bureau for Humanitarian Affairs (BHA), USAID Zimbabwe, PRO-WASH, SCALE, and Amalima Loko and Takunda implementing organizations CARE, CNFA, Dabane, and International Medical Corps. In these workshops, participants were introduced to key concepts around MUS and Takunda and Amalima Loko's (and their predecessors') experiences with MUS. Participant feedback was solicited, and the team answered questions on key aspects of the project, including the project research questions, work plan and timing of key activities and deliverables. A summary of the relevant research questions and processes is provided below, and a copy of the Inception Report is attached to this Report as Annex A.

Following the Inception Workshops, the team worked with PRO-WASH and SCALE, Amalima Loko, and Takunda to finalize site selection criteria, select the research sites, and finalize the research protocols and questions. This was accompanied by a comprehensive literature review and analyses of: (1) the legal and governance frameworks for MUS in Zimbabwe; (2) the financial and economic frameworks for supporting MUS in Zimbabwe; and (3) an analysis of the water quality findings at the field sites studied.

Draft Research Tools and Protocols, including Ethical Safeguards, were produced, and circulated to the consortium partners for feedback. Comments were incorporated to produce the Final Research Tools and Protocols. This was followed by field data collection through two sets of field visits to the study sites. The first set of site visits focused on Takunda's (and ENSURE's) project area from September 27 to -October 8, 2022. Following these visits, the team reviewed the findings and made minor adjustments to the research protocols prior to the final field visits conducted between 1 and 14 November 2022 in the Amalima Loko (and Amalima) project area. A full description of the site selection process and data collection and analysis is presented in Sections 3.2 and 3.3 respectively.

The key steps of the project are captured in Figure 1, below.

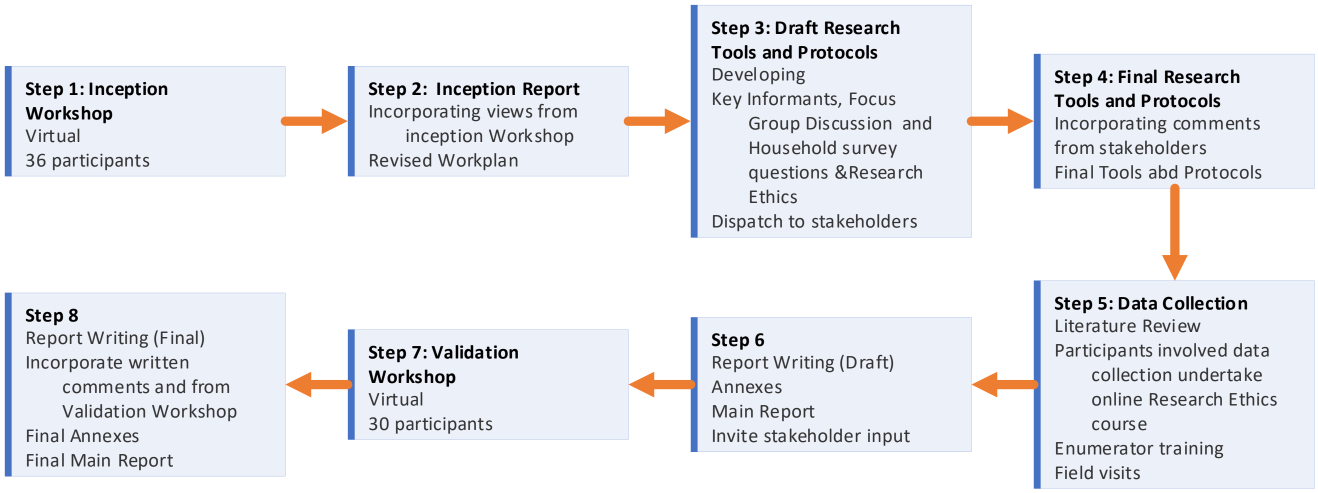

Figure 1. Key steps followed in the implementation of the study

3.2 Site Selection

Based on the research questions, the research team developed criteria for the selection of specific sites where MUS had been or was in the process of being implemented (or planned for). It was determined that most sites should be selected from interventions of the ENSURE and Amalima predecessor projects to Takunda and Amalima Loko, respectively, as they were farther along in implementation. However, additional sites were also selected to see how progress was being made. The following criteria were vetted and approved during and following the Inception Workshops:

1. Diverse representation of water scarcity (economic and physical);
2. Representation of different types of water sources (surface versus groundwater, pre-existing infrastructure, etc.) and abstraction technologies;
3. Purpose(s) for which water is being used;
4. Prevalence of (water) conflicts among users;
5. Diversity of intra-community stakeholders using MUS (including women, youth, and other potentially vulnerable populations); and
6. Presence of pre-existing government-supported schemes for WASH or irrigation.

The criteria were used as a basis for sampling frame to select 8 study sites from the ENSURE programme (predecessor of the Takunda RFSA), and 8 from Amalima (predecessor of the Amalima Loko RFSA). Two sites each from Takunda and Amalima Loko were added to the sample to assess how lessons in MUS planning and implementation from the predecessor projects are being incorporated in the current projects. The sites were chosen to represent as many provinces and districts as possible and included: Masvingo province in the ENSURE and Takunda project area with sites in the Chivi and Zaka districts; and Matabeleland South and North provinces in the Amalima and Amalima Loko project areas with sites in Gwanda, Bulilima, Tsholotsho, and Nkayi districts (Figures 2 and 3).

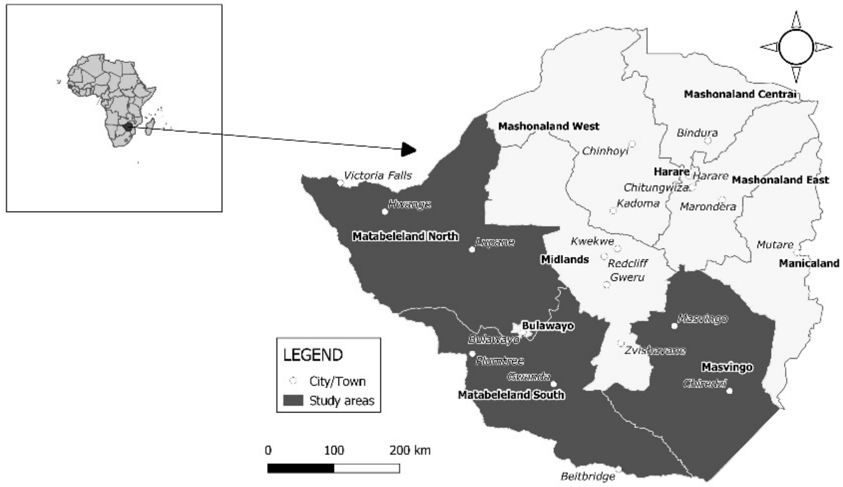

Figure 2. Location of study sites with the provinces

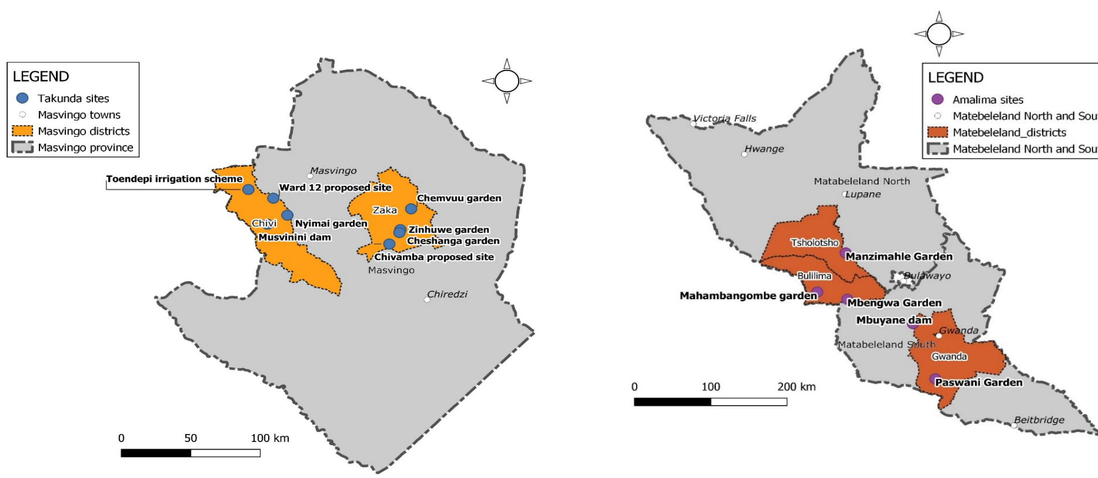

Figure 3. Location of ENSURE, Takunda, and Amalima sites

Based on the selection criteria and additional information provided by the Takunda and Amalima Loko staff (e.g., the main characteristics of the water source(s), methods of water abstraction/conveyance, relevant MUS typology and any special circumstances, such as the existence of water conflicts), the final project sites were selected. These are presented in Tables 1 and 2.[32]

[32] Due to logistical reasons, including early rains and impassable roads and availability of stakeholders, a total of 8 sites were visited in the Ensure/Takunda (Svondo and Barahanga were not visited). In the Amalima/Amalima Loko areas, five sites were visited (Tswelopele Borehole, Maya Dam, Didela irrigation, Pateni Dam and Magodi Borehole were not visited).

Table 1. Selected study sites in the ENSURE and Takunda areas

Name	Location			Water source	Method of water abstraction and conveyance	MUS typology	Special circumstances
	Province	District	Ward				
ENSURE PROJECTS							
Musvinini	Masvingo	Chivi	15	Dam and Irrigation	Gravity	Irrigation plus	Water scarcity leading to conflicts between irrigation domestic and livestock use
Nyimai	Masvingo	Chivi	16	Dam and Irrigation	Gravity	Irrigation plus	In-field conveyance rehabilitated and producer and marketing groups
Svondo	Masvingo	Chivi	Info. not available	Borehole	Manual	Domestic plus	Big catchment which raises issues of catchment protection
Toindepi	Masvingo	Chivi	7	Borehole	Solar powered	Domestic plus	Takunda will implement more similar projects
Chemvuu	Masvingo	Zaka	14	Dam and Irrigation	Gravity	Irrigation plus	Competition for water
Barahanga	Masvingo	Zaka	Info. not available	Dam and Irrigation	Gravity	Irrigation plus	Competition for water
Zinhuwe	Masvingo	Zaka	24	Borehole (Bush pump)	Manual	Domestic plus	Competition for water
Cheshanga	Masvingo	Zaka	25	Borehole (Solar)	Solar power	Domestic plus	Takunda will implement more similar projects
TAKUNDA SITES (under preparation)							
Mhazo	Masvingo	Chivi	12	Borehole (solar)	Solar powered	Irrigation plus	Lessons for solar-powered boreholes
Chivamba	Masvingo	Zaka	28	Boreholes (solar)	Solar power	Irrigation plus	Takunda will implement more similar projects

Table 2. Selected sites in the Amalima and Amalima Loko areas

Name	Location			Water source	Method of water abstraction and conveyance	MUS Typology	Special circumstance
	Province	District	Ward				
AMALIMA							
Paswana irrigation	Matabeleland South	Gwanda	17	Tuli River powered by a photovoltaic (solar) system	Solar power	Irrigation plus	(Re)developed to also enable non-irrigation purposes (e.g., livestock, domestic uses);
Tswelopele Borehole	Matabeleland South	Gwanda	24	Borehole	Manual	Domestic plus	Potential conflict between domestic and productive purposes
Mbuyane Dam	Matabeleland South	Gwanda	7	Weir	Manual	Domestic plus	Competition between domestic. Irrigation, livestock, and wildlife
Mbengwa Irrigation	Matabeleland South	Bulilima	1	Draws water from Quested Dam using Photovoltaic system	Solar power	Irrigation plus	Conflicts arise when water levels in the Dam go down and differences on water use arise
Maya Dam	Matabeleland South	Bulilima	20	Weir	Manual	Domestic plus	Competition for domestic, irrigation and livestock
Mahabangombe Garden	Matabeleland South	Bulilima	14	Borehole	Manual	Irrigation plus	Group received a matching grant to develop a borehole as water source for irrigation
Didela irrigation	Matabeleland North	Tsholotsho	16	Draws waters from Manz'amnyama river using photovoltaic system	Solar	Irrigation plus	(Re)developed to also enable non-irrigation purposes (e.g., livestock, domestic uses

Name	Location			Water source	Method of water abstraction and conveyance	MUS Typology	Special circumstance
	Province	District	Ward				
Manzimahle Irrigation	Matabeleland North	Tsholotsho	13	Borehole	Drip and tap stands	Irrigation plus	Water conflicts
Pateni Dam	Matabeleland North	Tsholotsho	19	Weir	Manual	Domestic plus	Competition between domestic and productive use
AMALIMA LOKO							
Magodi Borehole	Matabeleland North	Nkayi	19	Borehole	Solar	Domestic plus	Proposed Solarized system with tap stand

3.3 Data Collection and Analysis

3.3.1 Document Review

To contextualize and support the findings and enable the team to develop realistic and tailored recommendations, the team conducted both a Literature Review on MUS globally and in Zimbabwe, and a Legal and Institutional Analysis on MUS in Zimbabwe. A copy of the literature review is provided as Annex C.

3.3.2 Research Protocols and Ethical Considerations

Based on the Research Questions, the team developed the research tools for the field work. The main research tools included Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), a Household Questionnaire, and Participant Observations (including a consultative resource mapping process at site level). The various tools were used to triangulate the data. Table 3 shows the objective of the different tools and copies of the tools are provided in Annex B.

Table 3. Types, objectives, and focus of research tools

Research tool	Objective	Participant(s)	Reference	How data was analyzed
Key Informant Interviews (KIIs)	Understand the mandate and operational arrangements of the organizations in relation to how water supply projects are planned and implemented.	Representatives of national, provincial, and district level institutions and community leaders (traditional, ward, and local water institutions)	Annex B	Thematic analysis
Focus Group Discussions (FGDs)	Understand the issues pertaining to MUS planning, design, implementation, and sustainability.	12-15 members, made up of an (approximately) equal number of men and women at each site.	Annex B	Thematic analysis
FGDs –resource mapping	Determine the location of the project in relation to the villages and other water sources	5-6 community members familiar with the project (gender balance also attempted for these)	Annex B	Thematic analysis and farmer generated maps (into Word compatible versions)
Household survey questionnaire	Assess the general applicability of the issues raised in KIIs and FGDs	30 respondents from each site	Annex B	Statistical Social Package for the Social Sciences (SSPS) determine descriptive statistics
Participant observations	Appreciate what is happening at the project site	Transect walks done at each site	Annex B	Documenting key MUS issues
GPS location	Establish GPS coordinates of site	-	-	-

The ethical safeguards to be followed during field work were developed and ELI submitted all information to Save the Children in accordance with their mandated processes for ethical clearance. Due to changing policies internal to Save the Children, the project was required to undergo a more thorough ethics review process than initially anticipated. This included submitting revised versions of both our research protocols and information sheets, as well as the development of additional safeguards to ensure child safety during the field work portion of the project. Project Manager Jessica Troell consulted closely with Save the Children throughout this process to ensure adherence to policy while balancing with the unique security needs of Zimbabwe. This included adapting to the additional challenges related to the political environment in Zimbabwe related to the fact that elections are expected to take place in 2023, which has implications for the ability of field researchers to undergo ethical and security vetting to international standards. Such processes would pose a risk to field enumerators, and so ELI worked closely with Save the Children to develop and implement appropriate safeguards for the research, which included certification of all researchers (including enumerators) through the online UNICEF Introduction to Ethics in Evidence Course. Additional guidance materials were also provided to researchers to ensure the agreed safeguards were practiced effectively. Oversight was provided by Dr. Manzungu. Ultimately, a plan was finalized and approved. However, the process delayed the start of the fieldwork by approximately 6 weeks.

In addition to the online certification, enumerators were also provided with a training session to walk through the research materials and ethical requirements. Questions were posed in the local vernacular language and the responses captured in English.

At the national level, two KIIs were held while at the provincial three were held in Masvingo province, four in Matabeleland North, and two in Matabeleland South province. Two KIIs were held with sub-catchment councils in Masvingo province and one in Matabeleland South province. Five KIIs were held at district level in Masvingo and one in Matabeleland South province. Table 4 shows the details of FGDs and household survey questionnaire.

Table 4. Data collection methods across all project sites

Name	GPS coordinates	Number and composition of Focus Group Discussions	Number of household survey questionnaires administered	Remarks
ENSURE AND TAKUNDA SITES				
Musvinini	-20.45471, 30.53206	2	23	Turn out of farmers was good
Nyimai	-20.38307, 30.67225	2	24	Turn out of farmers was good
Toindepi	-20.18048, 30.39691	2	19	Turn out of farmers was good
Mhazo	-20.24953, 30.57309	1	0	The project was being planned; hence 1 focus Group Discussion took place, and no household questionnaires were administered
Chemvuu	-20.33311, 31.54751	2	8	Team was advised that farmers were busy fetching water from the dam because water no longer reached the fields because of the low water level in the dam

Name	GPS coordinates	Number and composition of Focus Group Discussions	Number of household survey questionnaires administered	Remarks
Zinhuwe	-20.49724, 31.4712	2	22	Turn out of farmers was good
Cheshanga	-20.5215, 31.46469	2	16	Practically all farmers were present for the interviews
Chivamba	-20.61049, 31.39322 691	1	0	Project was being planned; hence 1 focus Group Discussion took place, and no household questionnaires were administered
AMALIMA AND AMALIMA LOKO				
Paswana irrigation	-21.55546, 28.97734	2	11	There was a funeral in the community resulting in few people turning up for the meeting
Mbuyane Dam	-20.77167, 28.68837	2	19	Turn out of farmers was good
Mbengwa Irrigation	-20.42463, 27.83503	2	11	The team was advised that farmers were busy in the fields and had limited time
Mahabangombe Garden	-20.32244, 27.44394	1	0	Only leaders were available because no irrigation was taking place (the bush pump had broken down)
Manzimahle Irrigation	-19.76598, 27.81334	2	5	Interviews of household survey were cut short because of imminent rainfall

3.3.3 Water Quality Analysis

Water quality was analyzed for 21 variables [33] to determine both its suitability for drinking water, for other domestic purposes, and for maintaining the health of the ecosystem. For domestic water, water quality was classified into four types in relation to its suitability for human use:

1. Potable water: safe to drink, pleasant to taste, and usable for domestic purposes.
2. Palatable water: aesthetically pleasing and presence of chemicals do not cause a threat to human health.
3. Polluted water: contains unwanted physical, chemical, biological, or radiological substances, and it is unfit for drinking or domestic use.
4. Contaminated water: contaminated with pathogenic organisms and poses a threat to human health.

The quality of water used for domestic use was compared to the World Health Organisation (WHO) standards and Tables 5 and 6 show the details of water samples collected from the ENSURE (12 samples) and Amalima (7 samples) sites, respectively. Water from other water sources, where used by the community, was also sampled. Samples were prepared and analyzed according to standard processes, methods, and techniques. The full Water Quality Analysis is available as Annex D.

Table 5. Location and description of water samples collected from ENSURE sites

Name	Ward	Sample ID	Sample collected from
CHIVI DISTRICT			
Musvini	15	CHI-15	Main dam
Musvini	15	CHI-15-RIV	Tributary to dam
Nyimai Dam	16	CHI-16-Potable	Second tank located in the garden for drinking water, which is sand filtered and chemically treated
Nyimai Dam	16	CHI-16-Dam	Irrigation water from well points in the garden
Toendepi scheme	7	CHI-7-BP	Borehole equipped with Bush pump
Toendepi scheme	7	CHI-7-SP	Borehole equipped with solar pump, less than 2 meters from CHI-7-BP
ZAKA DISTRICT			
Chemvuu	14	ZAK-14-D	Dam, which is nearly empty
Chemvuu	14	ZAK-14-RED	Red floating substance in the dam
Zinhuwe	24	ZAK-24-P	Stream from which the community fetches water for various uses
Zinhuwe	24	ZAK-24-S	Irrigating water from well points
Cheshanga	25	ZAK-25-W	Natural well in the vicinity of the garden area
Cheshanga	26	ZAK-25-S	Irrigation water from taps

[33] Specifically, the water quality analyses measured: temperature; pH; turbidity; total suspended solids (TSS); electrical conductivity (EC); total dissolved solids (TDS); salinity; alkalinity; chlorides; sulphates; chemical oxygen demand (COD); dissolved oxygen (DO); total phosphorus; reactive phosphates; nitrates; total nitrogen; ammonia; and for microbiological presence of: total coliforms; Escherichia coli; TVC; and faecal coliforms. For full analyses, see Annex E.

Table 6. Location and description of water samples collected from Amalima sites

Name	Ward	Sample ID	Sample collected from
MATABELELAND SOUTH PROVINCE			
GWANDA DISTRICT			
Paswani sand abstraction	17	GWA-17-SAND	Well in sand river
Paswani Irrigation scheme	17	GWA-17-SCH	Tap water at scheme
Mbuyane dam	7	GWA-7-D	Dam water from Lower Mbuyane dam
Mbuyane dam	8	GWA-7-DU	Dam water from Upper Mbuyane dam
Bulilima district			
Mbengwa dam	1	BUL-W01-D	Dam water
Mbengwa dam	1	BUL-W01-SCH	Irrigation water from wellpoints in the garden
MATABELELAND NORTH PROVINCE			
TSHOLOTSHO DISTRICT			
Manzimahle Garden	13	TSH-13-SCH	Irrigation water supplied through a borehole

3.3.4 Financial and Economic Analysis

The financial and economic analysis of projects involved assessing incremental benefits (food security, income, health, poverty reduction, etc.) against costs (capital, operation and maintenance, and replacement) of the different types of MUS projects in this project. The analysis sought to determine the degree to which costs could be minimized and benefits maximized and sustained, considering the project characteristics described in Table 7.

Due to lack of and unreliable data for some of the parameters at project level – including crop yields and crop prices, investment costs, and operation and maintenance costs – on-line, published Zimbabwean data and other data sources were used as proxies for this analysis (Table 7). A full account of the scope and data collection methods used for this analysis is presented in Annex E.

Table 7. Sources of data

Data	Source
WATER	
Source of water	Key Informant interviews and Focus Group Discussions
Method of water abstraction	Key Informant Interviews and Focus Group Discussions
Method of water delivery and irrigation	Key Informant interviews and Focus Group Discussions
Irrigation water requirements	FAO Aquastat
Irrigation efficiency	FAO Aquastat
PROJECT INFRASTRUCTURE COSTS	
Investment/capital costs	FAO Aquastat
Annual operation and maintenance costs	FAO Aquastat
Replacement costs	FAO Aquastat
CROPS	

Data	Source
Types of grown	Household survey
Cropping intensity	Key Informant interviews
Crop yields	Potential yields from published data
Crop prices	Ministry data (maize) and online data for horticultural crops [34]
CROP DISPOSAL	
Per capita food consumption	Maize [35], leafy vegetables [36]
Surplus for sale	Difference between crop yield and food consumed [37]
PLOT AND HOUSEHOLD CHARACTERISTICS	
Number of plot holders	Household survey
Plot size	Household survey
Household size	Household survey
Household income	Household survey
Total Consumption Poverty Line (TCPL)	October 2022 data (ZIMSTAT) [38]

Financial analysis was assessed in terms of the Benefit Cost Ratio (BCR), repayment period/payback period and willingness and ability to pay compared to the Total Consumption Poverty Line (TCPL). Economic Analysis was assessed in terms of Net Present Value (NPV) and Internal Rate of Return. To illustrate how different values of an independent variable affect a particular dependent variable under a given set of assumptions, a sensitivity analysis was done, considering the operational capacity of the irrigation projects (25%, 50%, 75% and 100%) and proportion of profits invested into operation into maintenance and replacement costs (100%, 50% and 10%).

The discussion of sustainability of projects is presented using the above assumptions. Annex E provides a full set of results across all operational capacity and proportion of profits invested into operation, maintenance, and replacement costs.

Other benefits, which did not lend themselves to quantitative analysis were qualitative description using relevant literature. These included effects/impacts of the water projects on human welfare in terms of health particularly as regards to access to safe water, women and girls, livestock watering, irrigation development and prospects for community development and sustainable rural development.

[34] https://zimpricecheck.com/price-updates/fruit-and-vegetable-prices/

[35] Muzhingi, T., Gadaga, T. H., Siwela, A. H., Grusak, M. A., Russell, R. M., & Tang, G. (2011). Yellow maize with high β-carotene is an effective source of vitamin A in healthy Zimbabwean men. *The American Journal of Clinical Nutrition,* 94, 510–519. https://doi.org/10.3945/ajcn.110.006486

[36] Zimbabwe Vegetables consumption, 1992-2007 - knoema.com (opendataforafrica.org)

[37] Sales estimates were based on yields, production costs, and prices of the three most important crops as identified by farmers i.e. maize, leafy vegetables (covo/rape) and tomatoes.

[38] Nizbert Moyo Food poverty line up 3.1%: ZimStat, Newsday 26 October 2022. The quoted figure was Zimbabwe $28 144.07 per person and was converted to United States dollars using a rate of 700.

4. FINDINGS

4.1 Legal and Institutional Findings

4.1.1 Background

After Zimbabwe's independence in 1980 and the influx of donors and NGOs, efforts were undertaken to provide water for drinking and other domestic uses in collective systems, in line with the UN's International Drinking Water and Sanitation Decade. The Integrated Rural Water Supply and Sanitation Programme (IRWSSP) was initiated in response to the 1985 National Water Master Plan as an inter-ministerial programme aimed at improved access to safe water and sanitation in communal areas of Zimbabwe.[39] The programme brought together ministries and departments whose mandates and portfolios related to mobilization of communities, promotion of local government, planning and finance, land use planning, and water supply provision and maintenance under the coordination of the ministry responsible for local government.[40] Initially, a National Action Committee (NAC) for rural water supply and sanitation was created that had a National Coordination Unit with sub-committees at provincial and district levels, but under decentralization, the programme was delegated to the Rural District Councils (RDCs). These water and sanitation committees, which have focused on the social value of water in community livelihoods and maintained linkages with community groups and non-governmental organizations, provide an important platform for coordination of MUS in Zimbabwe.

With respect to irrigation, by Independence in 1980 Zimbabwe had approximately 150,000 hectares under 'formal' irrigation schemes: large-scale, mostly white-owned commercial farms accounted for 68% of this land; 27% was linked to commercial estates and outgrower areas.[41] Government subsidized expansion of small dams and irrigation areas, but only 3.4% of the irrigated area was devoted to smallholder irrigation at this point.[42] The government therefore focused on expanding smallholder schemes in the communal areas by establishing block schemes with 0.1 ha plots, managed with support of a Ministry of Agriculture extension officer (AGRITEX) stationed on the scheme, directing the planting of crops and allocation of water.[43] Many of these schemes, however, were unsuccessful, due, among other things, to institutional failures and challenges related to recurring costs.[44]

Zimbabwe's land reform of 2000 resulted in the redistribution of the approximately eight million hectares previously held by white-owned, commercial farms to smallholder farms.[45] This massive reform of the agrarian landscape resulted in a need for support for irrigated dryland agricultural production at smaller scales in ways that are responsive to multiple different social, technical and governance arrangements and capacities.[46] While a number of approaches have been undertaken, many of these schemes have failed to account for the prevalence of farmer-led irrigation, which recent

[39] Government of Zimbabwe (GoZ). 2003. Zimbabwe Water and Sanitation Sector HIV/AIDS Response: Programmes, Strategies, and Guidelines.

[40] Id.

[41] Scoones, I. et al. 2019. Irrigating Zimbabwe after Land Reform: The Potential of Farmer-Led Systems. Water Alternatives 12(1): 88-106.

[42] Manzungu, E. and van der Zaag, P. 1996. The practice of smallholder irrigation: Case studies from Zimbabwe. Harare, Zimbabwe: University of Zimbabwe Publications.

[43] Scoones, *supra* n. 5.

[44] Studies showed that the government covered 100% of capital costs for these schemes and 89% of recurrent costs. When government funding was stopped, therefore, the schemes collapsed. Id.

[45] Id.

[46] Id.

research indicates could be much more prevalent than previously estimated and provides significant benefits in terms of responsive and flexible approaches and technology choices that are more readily sustained by small- and medium-scale farmers. [47]

4.1.1.1 Legal and Institutional Frameworks Governing MUS

There is no explicit framework governing MUS under the current policy and legislative framework in Zimbabwe. The 2012 National Water Policy highlights aspects of MUS as related to implementing integrated water resources management (planning and managing freshwater for all multi-sectoral uses). It states that large-scale infrastructure should be designed, operated, and managed on a multi-purpose basis with benefits for local communities through irrigation projects where possible, and states that collaborative, multi-sectoral approaches to WASG service delivery should be pursued "with clear roles for all players." [48] These provisions indicate support for a MUS approach to rural water services development, but do not specifically articulate a definition of MUS or a clear policy commitment to its implementation.

As elaborated below, the water governance framework in Zimbabwe currently consists of a number of different laws and institutions across various water sub-sectors (and other related sectors) and levels of government. A key challenge to effective MUS approaches in Zimbabwe, therefore, is the current division – legally, institutionally, and financially – of water services provision for domestic uses, water resources planning (for allocation and use) and management, and irrigation water resource planning and management. The following sections provide an overview of the current legal and institutional frameworks governing water service provision, water resources management, and irrigation in Zimbabwe as they relate to the planning, implementation, and sustainability of MUS interventions. Ongoing reorganizational and reform efforts are also highlighted where they might provide windows of opportunity for improved MUS in Zimbabwe, but also may undermine its effective implementation and sustainability if not tailored effectively.

Box 1. Multi-level Government

The 2013 Constitution of Zimbabwe sets up three tiers of government: (1) the national government, which provides overall guidance and coordination of socio-economic development in the country; (2) the provincial government, which coordinates development activities between national and local government; and (3) local government (rural and urban local authorities), which is responsible for implementing national requirements at local level (including water services) through integrated development planning. Development at the provincial and district levels are coordinated by councils and committees (Figure 4; Table 8).

4.1.1.2 Legal and Institutional Frameworks Governing Water Resource Planning, Management, and Allocation

Water resource development and management is governed by the Water Act and the National Water Authority Act (ZINWA Act), both passed in 1998. **The 1998 Water Act** vests all water in the State (represented by the President) and provides that water can no longer be privately owned, as it is a public resource. The previous system of permanent water rights was replaced with an administrative allocation system that requires all water uses beyond those allocated for primary (or domestic) uses to be permitted by the government on a renewable basis. The Act further governs water resources

[47] Id.

[48] GoZ. 2012. National Water Policy. Ministry of Water Resources Development and Management, Secs. 6.12; 7.5.2; Annex 1.

planning and development, regulates its allocation and use, provides for quality control and environmental protection of freshwater ecosystems, and dam safety.

An important development under the 1998 Water Act is the decentralization of many aspects of water planning and management to the catchment and sub-catchment levels. Pursuant to the Water Act, the country is divided into seven catchments (Gwayi, Sanyati, Save, Mzingwane, Runde, Mazowe, and Manyame), each of which is now governed by a Catchment Council (CC) and Sub-Catchment Councils (SCCs) that oversee planning, water use permitting, regulation and supervision of water use, dispute resolution, and compliance assurance in their areas.

At the national level, water resource management is governed by the Ministry of Lands, Agriculture, Fisheries, Water, Climate, and Rural Development, which develops policy and plans for water resources development, use, and protection. The 1998 **Zimbabwe National Water Authority Act** (ZINWA Act) established the **National Water Authority (ZINWA**), a parastatal responsible for surface and groundwater resource planning at national level and for building and maintaining large dams[49] from which it sells bulk water to local authorities and farmers.[50] The Act provides that ZINWA's functions relevant to MUS include:

- advising the Minister on the formulation of national water policies and standards;
- assisting on any matter pertaining to the planning of the development, exploitation, protection, and conservation of water resources;
- providing water on a cost-effective basis;
- mitigating the impacts of droughts, floods, and other hazards;
- promoting equitable, efficient, and sustainable allocation and distribution of water resources;
- assisting RDCs with water resources development and management;
- overseeing catchment councils and catchment management planning;
- operating and maintaining water works in small urban and rural centers;
- technical assistance, training and information services to government, local authorities, and catchment councils; and
- maintaining a database on hydrological issues.[51]

ZINWA therefore has a critical role to play in terms of developing policy and overseeing the planning and implementation of MUS due to its planning, allocation, and regulatory functions, as well as its oversight and provision of water from large infrastructure. Its role is now heightened further under a key government initiative to drill a borehole and provide multiple use services in each of the 35,000 villages in Zimbabwe. For a full description of this initiative, see Section 4.1.1.3, below.

Water quality is regulated under the **2002 Environmental Management Act** (EMA), which mandates the Environmental Management Agency to set quality standards and permit effluent discharges into waterbodies.[52] The **2018 Public Health Act** also provides that every local authority must provide and maintain a sufficient supply of "wholesome water" for drinking and domestic purposes and that potable water standards under EMA and the Water Act apply.[53] The Ministry of Health is charged with monitoring the quality of potable water supply.

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[49] In Zimbabwe small dams have a dam wall height that is 8 m or less and an impounded volume of 1 million m^3 or less.

[50] It also provides clear water to small towns and rural service centres.

[51] GoZ. 1998. National Water Authority Act, Sec. 5.

[52] EMA, Sec. 10.

[53] Public Health Act, Secs. 86(1); 86(5).

Catchment and Sub-Catchment Councils

In line with global practice, Zimbabwe's 1998 Water Act decentralized many aspects of water planning and management to the catchment and sub-catchment levels. ZINWA oversees the CCs and SCCs. ZINWA and CCs, in consultation with local authorities, are mandated with preparation and implementation of Outline Water Development Plans for each river system. Outline Plans set priorities for water use and allocation, considering national policy guidelines and must include an inventory of the resources in the catchment area or areas of the river system, identify the major water uses in the system, and determine how water should be allocated between different economic sectors in the catchment. The Plans also must: provide a list of priority developments in the catchment and the likely impacts of these developments; set maximum permissible pollution levels; specify any dam development sites; and plan for changes in priorities for use, development, and allocation if necessitated by changes in availability or socio-economic priorities. [54]

Once put into effect, Outline Plans must be considered by all persons (including the State) when undertaking development in any catchment area. Catchment councils cannot grant permits for use of water if it exceeds the allocation for the sector of the economy concerned in the Plan. [55] Pursuant to the Water Act, CCs also have the authority to allocate water within existing schemes (including irrigation schemes) for primary purposes, agricultural purposes, or other purposes within the area of the scheme for the benefit of the participants in the scheme. [56] CCs can also determine what specific quantities of water fall under the definition of "primary" for the purposes of a scheme. [57] The Water Act defines "primary water use" as "the reasonable use of water for basic domestic human needs in or about the area of residential premises," for the support of animal life, other than fish in fish farms or animals or poultry in feedlots; brickmaking for private use; or for dip tanks." [58] These uses are free and do not require a permit in order to promote and facilitate access and use of water for domestic and small-scale livelihoods purposes. As such, CCs can determine whether communities require a permit for water allocated under a MUS project and how much communities must pay for water. This determination is discretionary.

SCCs may be established by the Minister for any part of a river system, and these regulate and supervise the exercise of water rights in their area and may levy permit rates and charge service fees. [59] Pursuant to the 2000 Sub-catchment Council Regulations, SCCs are, among other duties, required to regulate and monitor water use permits; monitor water flows and water uses; assist in data collection and participate in planning; and collect sub-catchment rates, fees, and levies. [60]

Taken together, CCs and SCCs have significant mandates related to the planning and allocation of water for MUS in each catchment (or sub-catchment). They are also meant to provide the main mechanisms for engaging stakeholders (including communities) in planning and decision-making around water resources, although significant resource constraints have prevented this from happening effectively. Ideally, CCs should be coordinating with local government structures (RDCs) to ensure that water and development policies and priorities are aligned in ways that support and facilitate MUS. Further discussion on the challenges around this relationship are provided below.

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[54] GoZ. 1998. Water Act, Ch, 20:24, Sec. 13.

[55] Id. at Sec. 18.

[56] Id. at Sec. 91.

[57] Id. at Sec. 90

[58] Id. at Sec. 2.

[59] Id.

[60] GoZ. 2000. Subcatchment Council Regulations, Sec.11.

Water Tenure Rights and MUS

Water tenure is the relationships, whether legally or customarily defined, between people, as individuals or groups, with respect to water resources.[61] Water tenure defines who has rights to access, use, impact, and develop water resources (and infrastructure), for how long, and how those rights relate to other rightsholders. Legal recognition of Zimbabwe's local communities' (often customarily governed) freshwater tenure rights can provide a critical basis for ensuring that they are able to protect those rights in the face of these increasing threats and is critical to ensuring that MUS interventions are equitable and sustainable. Improved recognition and protection of community-based water tenure could also provide a significant basis for not only articulating priorities for MUS interventions (i.e., ensuring primary uses are interpreted to support community priorities) but also for addressing any conflicts that may arise in their implementation and over time. Additionally, where customary practices have given rise to institutional mechanisms, rules, and enforcement measures, these can be leveraged for more effective and locally appropriate MUS structures.

In Zimbabwe, communities' water rights emanate both from formal legislation and from customary practices that are not explicitly recognized in national law. Zimbabwe thus has a dual legal system that recognizes both customary and statutory law as equal sources of law. While customary rules are well-known, adaptive, often effective, and still followed to varying degrees throughout Zimbabwe, in cases of conflict, statutory law usually takes precedence. Additionally, customary law institutions are generally regarded as answerable and inferior to statutory institutions.

The Constitution and the Traditional Leaders Act recognize the institution and role of traditional leaders in managing natural resources using customary law.[62] However, broadly speaking, allocation of water to communities for multiple uses and situations where conflicts arise over who has rights to water are governed under the Water Act. As noted above, primary water uses are excluded from permitting requirements, although the precise contours of the definition of "primary uses" remains somewhat unclear and left to the discretion of catchment councils. This creates a situation where legitimate water rights practiced by a community under customary law may or may not be recognized as primary water uses and exempted from permitting. Moreover, when conflicts arise, rights that are exempted from permitting often have less practical legal standing than permitted rights. Thus, communities are left with little tenure security.

4.1.1.3 Legal and Institutional Frameworks Governing Rural Water Supply

Rural water supply and service provision is regulated by the **Rural District Councils Act**[63], which grants **Rural District Councils (RDCs)** the authority to regulate and provide for supply and distribution of water and create bylaws to regulate relevant matters (including maximum levels of consumption of water on properties and the purposes for which water may or may not be used), and can provide for rational or

[61] FAO. 2020. Unpacking water tenure for improved food security and sustainable development. Italy, Rome: FAO.

[62] Customary law is recognized in the Constitution of Zimbabwe and traditional courts and traditional leaders can resolve disputes in accordance with customary law (GoZ. 2013. Constitution of Zimbabwe, Secs. 174; 176; 282 (1)(e)). Under the Traditional Leaders Act, Chiefs are responsible for "ensuring that the land and its natural resources are used and exploited in terms of the law" and prevent "degradation, abuse or misuse of land and natural resources in his area" (GoZ. 1998. Traditional Leaders Act, Ch. 29:17, Sec. 5). It is the duty of Village Heads to "lead his village in all traditional, customary and cultural matters," "settle disputes involving customary law and traditions…", ensure the security of water points and report any damage or potential damage to any such property to the police (Traditional Leaders Act, Sec. 12). The functions of the village assembly include "to consider and resolve all issues relating to land, water and other natural resources within the area and to make appropriate recommendations in accordance with any approved layout or development plan of the village or ward" (Traditional Leaders Act, Sec. 15(1)(c)).

[63] GoZ. 1988. Rural District Councils Act, Ch. 29:13.

restricted use of water in times of shortage.[64] RDCs also have the authority to provide and maintain supplies of water for domestic, irrigation, industrial or mining purposes in sufficient supply for the inhabitants of the council area.[65] Importantly, RDCs are also the focal institution for coordinating local government agencies and for integrated development planning at the District level. They thus play a critical role in planning for, siting, and ensuring coordinated local government support for MUS implementation and sustainability.

RDCs supply water through its committee structures, particularly the **Rural District Development Committee (RDDC)**, which has the mandate to consider ward development plans and prepare and implement an annual district development plan. One of the functions of the RDDC is to coordinate water and sanitation through the **District Water and Sanitation Sub-Committee (DWSSC)** and other committees (such as the Food and Nutrition Committee) and the NGO forum (Figure 4; Table 8).

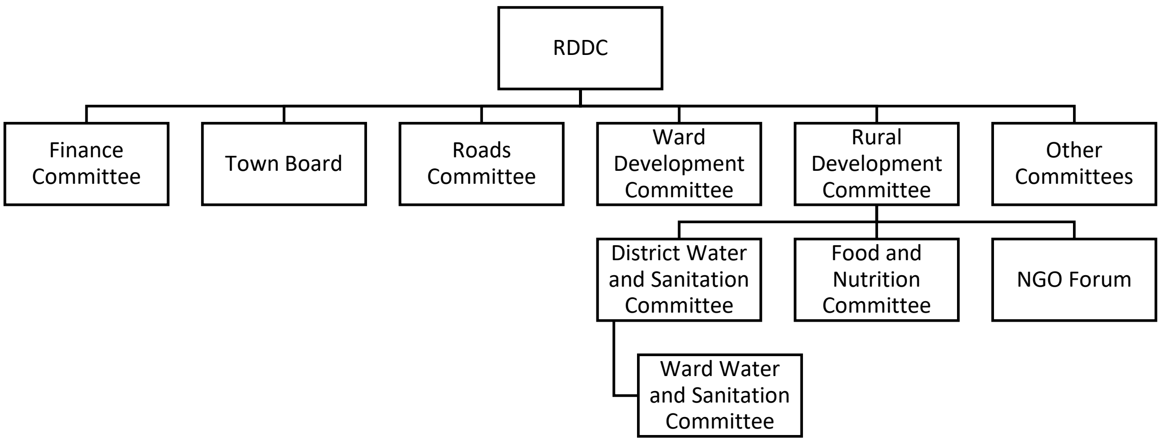

Figure 4. Main committees of the RDDC and the committees responsible for water and related services[66]

Table 8. Committees of the Rural District Development Committee

Committee	Composition	Functions
District Water and Sanitation Committee	District Development Fund (DDF) (Chair); Heads of Public Health; AGRITEX; Veterinary Department; Social Welfare; Environmental Management Agency; ZINWA; Ministry of Youth; Ministry of Women Affairs; Ministry of Environment; NGOs active in WASH	Coordinates and supervises water development activities in the district.
Ward Water and Sanitation Committee	Water Councilor (Chair), villagers and other government officials	Identifies and monitors water development plans and projects at ward level.
District Food and Nutrition Committee	AGRITEX (Chair); DDF; Heads of Public Health, Veterinary Department, Social Welfare, Environmental Management Agency; ZINWA; Ministry of Youth, Ministry of Women Affairs; Ministry of Environment	Coordinates and supervises agricultural and nutrition activities in the district
NGO forum	DDC (Chair); all NGOs in the district	A platform for NGOs to meet and discuss issues that relate to development activities in the district

[64] RDC Act, Sec. 66.

[65] RDC Act, Sec. 71, Section 28.

[66] Adapted from Chigwata, T.C. (2014).

The **District Development Fund (DDF)** is a parastatal agency that falls under the Office of the President and Cabinet (OPC) and its operations are governed by the District Development Fund Act. [67] DDF has a Water Division at the national, provincial, and district levels and its mandate is to site, drill, install, and rehabilitate boreholes, as well as train communities on how best to manage boreholes. [68] It also conducts surveying (provided by provincial hydrogeologist), drilling, operation, and maintenance of boreholes. Its District Maintenance Teams (DMTs) partner with community water point committees to provide technical assistance, training ward, and village pump mechanics to support O&M. At the District level, it is a member of the **Rural District Development Committee (RDDC)** and chairs the **District Water and Sanitation Sub-Committee (DWSC).**

Interviews with DDF staff at the project sites (Provincial and District levels) revealed that DDF subscribes to MUS because it empowers communities for domestic water, livestock watering, and gardening. However, DDF does not independently implement MUS because it lacks financial means, so it supports partners to implement MUS. For example, there is only one (currently non-functional) drilling rig in Matabeleland South province.

The provision of water to the districts is coordinated by the **Provincial Water and Sanitation Sub-committee (PWSSC)**, which falls under the **Provincial Development Committee (PDC)**. The mandate of the PDC is to coordinate development planning and implementation of the Provincial Development Plan (which must reflect approved District Development Plans in the Province). The PWSSC is chaired by DDF and includes heads of government departments and state agencies with a mandate for water development and management. The structure of the PDC is provided below.

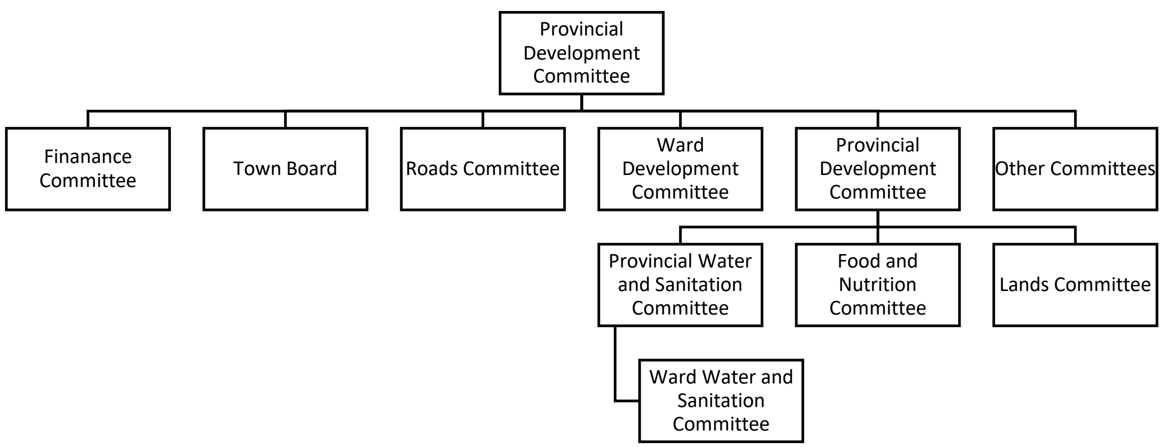

Figure 5. Committees of the Provincial Development Committee responsible for water and related services [69]

RDCs supply water through the RDC structures, particularly the Rural District Development Committee (RDDC), which has the mandate to consider ward development plans, identify issues that need to be included in annual development and other long-term plans, and prepare and implement the annual district development plan. The RDDC is chaired by the District Development Coordinator, a senior civil servant responsible for coordinating development activities in the district.

[67] GoZ (Government of Zimbabwe) (1982) District Development Fund. Chapter 29: 006. Harare: Zimbabwe.

[68] The mandate for design and construction of small dam mandate was shifted to the province and is shared by the Department of Irrigation.

[69] Adapted from Chigwata, T.C. (2014).

One of the functions of the RDDC is to coordinate water and sanitation through the District Water and Sanitation Sub-Committee (DWSSC) and other committees (such as the Food and Nutrition Committee) and the NGO forum (Figure 4; Table 8 above).

4.1.1.4 Legal and Institutional Frameworks Governing Irrigation

While there is no national legal framework governing irrigation in Zimbabwe, there are a number of provisions that are relevant to its regulation in the **Water Act**, the **Agricultural, and Rural Development Authority Act** (ARDA Act), and the **Rural District Councils Act**. The Water Act gives Catchment Councils the authority to permit water for agricultural water purposes. In doing so, they must have regard to the extent and nature of the irrigable land, its suitability for irrigation, and the efficiency of the proposed method or possible methods of using the water concerned. [70] This has potential to influence decisions on infrastructure investments and land selection under MUS initiatives that require permitting. The ARDA Act grants ARDA powers to constrict, maintain, and operate dams, reservoirs, canals, and irrigation and to develop, engage in, operate, or manage irrigation schemes and provision of water for irrigation. This provides a clear role for ARDA as a technical partner in MUS interventions.

The Department of Irrigation (now the Department of Water Resources Planning and Irrigation Development) was established in 2002 with the overall mandate for irrigation development and is responsible for planning and design. The DoI falls under the Ministry of Lands, Agriculture, Fisheries, Water, and Rural Development. DoI now partners with ZINWA, which was recently appointed as the implementing agency for irrigation development.

This mandate was the result of an important new initiative, the Presidential Borehole Programme (or Presidential Rural Development Programme), which was initiated in 2021 and has significant implications for ZINWA's role with respect to oversight of irrigation development and management under MUS. The Programme aims to drill 35,000 boreholes across the country – one borehole in each of the country's 35,000 villages (a target set in the National Development Strategy). Borehole drilling rigs are in the process of being sourced for this work and the drilling is coordinated by the office of the Minister of State for Provincial Affairs and Devolution. The boreholes are meant to provide water for all community needs, including domestic water, horticultural production, aquaculture, and water for non-range animals such as poultry and goats. To this end, demonstration sites or centres of excellence for multiple water use (MUS) are being set up in each rural province. In Masvingo, for example, authorities interviewed noted that the demonstration site is the Sipambi Project and that the project defines all of the water uses as primary water and therefore do not require payment for use or of water levies. A full-time ARDA manager will be employed to manage the scheme while the Agricultural Marketing Authority (AMA) will provide marketing services and AGRITEX will provide extensions services.

The new mandate for irrigation development will also be operationalized by the establishment of a Department of Irrigation within ZINWA. The aim is to ensure that all water in government dams is used for irrigation. It is understood that ZINWA is mandated to impound water, release, and convey to night storage facilities, as well as into primary and secondary canals/units. Tertiary canals/units are managed by farmers or their representatives. ZINWA has set up Service Centers to provide local services. The Centers develop irrigation schemes in cooperation with ARDA, provide potable water to rural areas on demand from local authorities, and process permits for "agreement water." [71]

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[70] Water Act, Sec. 23.

[71] Water uses beyond "primary" uses require either a permit, when the water is removed from a public stream governed by the Catchment Council, or via an agreement with ZINWA where water is abstracted from ZINWA-operated infrastructure. Primary uses are defined under the Water Act as "reasonable use(s) of water for basic domestic human needs in or about the area of residential premises," for the support of animal life, other than fish in fish farms or animals or poultry in feedlots; brickmaking for private use; or for dip tanks." Therefore, any commercial use of water for irrigation or other productive livelihood requires a

Through this national initiative, ZINWA (along with ARDA, AMA, and AGRITEX) is promoting MUS in practice, if not in name. However, the role of communities (including women and youth and other vulnerable stakeholders) and their level of engagement in the process of siting, planning for O and M and other aspects of MUS is unclear. There is no evidence of guidance on this or other MUS-related considerations for this Initiative. It appears that solar boreholes have been selected as a common technology to be applied across communities. Borehole siting and drilling have been exempted from normal source assessment requirements, which raise issues regarding effective management and sustainability of water resources and infrastructure.

Other institutions with relevant mandates are the Soil and Water Conservation Department of the **Department of Mechanisation (DoM)** and the **Agricultural and Rural Development Authority (ARDA)**. The DoM provides technical expertise for construction, design, and supervision of small dams. DoM does not have its own budget for these services, but assists NGOs in the province in their development. The DoM has no district officers yet, so operates only at provincial level. According to those interviewed for this project, the DoM actively promotes MUS because it not only benefits communities, but also increases the likelihood that the infrastructure will be maintained and protected, as all community members have a stake in the project. To this end, small dams are built to provide water for both livestock and gardening; in formal irrigation projects, nutrition gardens are provided for to cater for community members who are not engaged in the formal project. The Soil and Water Conservation Department is not yet fully operational.

Pursuant to the **Agricultural and Rural Development Authority Act**, the ARDA has powers to construct, establish, acquire, maintain, and operate dams, reservoirs, canals, irrigation works and hydro-electric power stations and to develop, engage in, operate, or manage schemes for the irrigation of land or the provision of water for the irrigation of land. [72] Interviews with ARDA staff highlighted their focus on increasing food security in accordance with the National Development Strategy I (2021-2025) (NDSI). The NDSI promotes irrigation to increase crop and livestock productivity and has a target of over 350,000 ha of expanded land under irrigation, drilling of 35,000 boreholes (see discussion on Presidential Rural Development Programme above) and reviving the Irrigation Fund. [73]

4.1.2 Key Governance Challenges for MUS in Zimbabwe

4.1.2.1 Water Allocation and Use

As noted, the 1998 Water Act vests all water in the State and replaces the previous system of permanent water rights with permitting system to regulate all water uses except "primary" uses, which are exempted from permitting requirements. Primary water is defined as a right for all Zimbabweans under the National Water Policy (2012), which is in line with Section 76 of the Zimbabwean Constitution, which recognizes that every person has a right to safe, clean, and potable water and to sufficient food. [74] The National Water Policy further prioritizes water for primary purposes, stating that it "shall be given the first and highest priority" in the provision of water and sanitation services. [75] Under the Water Act,

permit or an agreement. Agreement water is water supplied through ZINWA owned/operated infrastructure that is subject to the conclusion of an agreement setting the amount, price, and conditions of abstraction and use. Mainly this applies to irrigation water drawn from ZINWA-operated dams.

[72] GoZ. 1972 (as amended). Agricultural and Rural Development Authority Act, Ch. 18:01, First Schedule.

[73] Further discussion of the specific role of ARDA in the project interventions is provided in Annexes G and H, the detailed research findings.

[74] GoZ. 2013. Zimbabwe's Constitution of 2013. Available at https://www.constituteproject.org/constitution/Zimbabwe_2013.pdf

[75] GoZ 2012, supra, n. 1 at Sec. 6.7.

people cannot be deprived of water for primary use by a permit for other water uses.[76] These provisions provide an important basis for recognizing that primary uses must be prioritized by all local authorities in allocation and permitting decisions.

While RDCs are mandated with provision of water services to rural communities, the Water Act also enables catchment councils to allocate the quantities of water for various purposes and to regulate the maximum volume of water which can be abstracted, including defining primary water within the catchment. Sites visited for this project revealed that catchment councils vary in their definitions of primary uses, resulting in similar MUS interventions requiring payment from some communities and not others. There is therefore a clear need for guidance, whether in the form of regulations or other policy guidelines, to ensure equity in allocation of water for MUS and ensure that communities are not unduly burdened with administrative and financial requirements that prevent them from effectively participating in, benefitting from, and sustaining MUS.

A key issue that incentivizes a more restrictive definition of primary water is the fact that catchment and sub-catchment councils rely on user fees to finance their operations.[77] This is exacerbated by the fact that many catchments and sub-catchments face extreme challenges in achieving their mandates because they are expected to oversee vast territories with very limited personnel, financial and other resources. The Tokwe sub-catchment in Chivi district, for example covers 7, 400 km^2, six districts, and 66 wards in parts of Midlands and Masvingo provinces. Despite its size, the sub-catchment only has seven employees and no vehicles. Lack of revenue has been exacerbated by failures to revise rates for applicable levies and account for intervening inflation and exchange rates.

Another potential limitation on the amount of water available for MUS is where ZINWA, in consultation with the relevant catchment council, determines the scheme to be in a water shortage area.[78] The declaration of a water shortage area (which can last for 12 months) enables Catchment Councils to limit the availability of water by suspending or amending water use permits or making orders related to the abstraction, appropriation, control, diversion or any other use of water in the area.[79] While this is an important mechanism for ensuring resource sustainability over time and in response to climate impacts, it is notable that there are no requirements for community or user consultations prior to the declaration of a water shortage area, which limits communities' ability to raise objections in advance. Persons who are aggrieved by declaration of a water shortage area can appeal the decision to the Administrative Court, but this is often a costly and time-consuming process that communities are frequently not even aware of.

Broadly speaking, the limited resources available to the catchment and sub-catchment councils limits their ability to effectively assess and monitor the status of water resources in their catchment and to undertake truly participatory planning that reflects the needs of the communities and effectively aligns with development priorities in the catchment. The limited presence and capacity of the catchment and sub-catchment councils at the district level and below are likely why the communities consulted at MUS project sites were unaware of their role and mandates and why they are currently not seen as valuable partners in MUS.

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[76] Water Act, Sec. 51.

[77] Manzungu, E. and Derman, B. (2016). Surges and ebbs: National politics and international influence in the formulation and implementation of IWRM in Zimbabwe. Water Alternatives 9(3) 495-514.

[78] These are areas in which believes the flow of water has ceased; the level of water in storage works has fallen or is likely to fall below the level of the usual flow or acceptable levels; or it appears that abstraction of water from boreholes and wells in the area is likely to unduly diminish the ground water resources in the area or adversely affect the flow of surface waters. Water Act, Sec. 61.

[79] Id. at Sec. 62.

4.1.2.2 Community-Based and Women's Water Tenure

Another key challenge, related to the unclear legislative definition of primary water, is the high level of uncertainty around community-based water tenure in Zimbabwe. Rights to use, manage, and develop water resources, among others, are created and protected by legislative and customary frameworks which may or may not be aligned. Secure water tenure is a prerequisite for communities' livelihoods and food security, climate resilience, health, and cultural integrity.[80] Yet, the water rights that constitute communities' water tenure face increasing threats from unsustainable development, increasing pollution, land use changes, and major demographic shifts – all of which are exacerbated by climate change.

A practical mechanism for increasing communities' water tenure security within the existing legal frameworks is to improve the rights that enable community members to access information about potential threats to their water rights, to participate in decision-making that could impact their water rights and to access justice where their water rights are infringed or extinguished. Yet, Zimbabwe's water legislation provides few meaningful opportunities for such "due process" rights to be exercised. For MUS to be equitable and sustainable, it is critical to leverage the existing due process provisions[81] for communities to exert and protect their rights, but also to provide additional opportunities for meaningful participation throughout MUS interventions. This could take the form of guidance on community-led MUS that ensures equitable and meaningful participation in decision-making from planning onward.

Such guidance should ensure that the women within communities have specific opportunities for meaningful participation in consultative processes. Women and men have differentiated knowledge, needs, management responsibilities, priorities, and uses for water resources that are lost where women are not represented in decision-making. Women also constitute more than 50 percent of Zimbabwe's agricultural labor force, but often lack access to land, financial services, technologies, and decision-making around water, land, and natural resources.[82] Moreover, rural women and girls are disproportionately impacted by the negative consequences of resource tenure insecurity and climate change, including floods, droughts, and famine. They also face different risks while implementing their unique responsibilities, such as wildlife encounters while collecting water and fuelwood.

Women's tenure rights are directly linked to their increased participation in household and community decision-making.[83] Zimbabwe's legal frameworks guarantee equal legal rights to land and property for women, yet women continue to have less access to and control over land and natural resources than men.[84] This is due partly to the failure of Zimbabwe's water laws to include any explicit requirements for women's participation in decision-making or to prioritize and protect women's water tenure rights. These inequities are reflected in the male-dominated decision-making processes of many communities

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[80] Rights and Resources Initiative (RRI) and Environmental Law Institute (ELI). 2020. Whose Water? A Comparative Analysis of National Laws and Regulations Recognizing Indigenous Peoples', Afro-descendants', and Local Communities' Water Tenure. Washington, DC: RRI.

[81] For example, the Water Act enables communities to participate in a "notice and comment" process when Outline Plans (river basin management plans) are drafted (Water Act. Sec. 15) and where a water development restriction area (areas set aside to protect certain catchment areas from overdevelopment) is declared (Water Act, Sec. 58). These processes provide access to the draft documents and enable communities and their members to provide feedback and contest aspects of the drafts prior to their finalization. Additionally, the 2020 Freedom of Information Law establishes both voluntary and required mechanisms and procedures to enable access to information held by public entities, including water agencies at all levels.

[82] Zimbabwe Human Development Index, 2017.

[83] This section draws on a soon to be published Community Environmental Governance Manual, drafted by ELI for the USAID-funded Resilience ANCHORS project in Zimbabwe.

[84] Kurebwa, J. (2016). Political Participation of Rural Women in Decision-making at the Local Government Level in Zimbabwe. International J. of Education, Culture, and Society 1(2): 33-43 (2016).

so that, even where women are represented in community water governance structures, they often do not feel free to share their opinions or their opinions and needs are not taken seriously. [85] The recognition of women's specific rights to use and govern community water resources is essential for ensuring that women have a meaningful voice in decision-making so they can benefit from those resources and substantively contribute to both their own prosperity and that of their families and communities. [86]

4.1.2.3 Sectoral Siloes, Coordination, and Overlapping Mandates

A primary obstacle to integrated planning, implementation, and sustainable financing of MUS in Zimbabwe is the silos that persist around water sub-sectors, including WASH, agriculture/irrigation, and water resource planning and management. For example, catchment councils are charged with overall planning, prioritization, and administration of water allocation and use in their areas, but water services, irrigation, and development planning are taking place at the district and provincial levels. Clarity of mandates and coordination are thus essential and at both provincial and district levels. There are existing institutional mechanisms to facilitate coordinated implementation of MUS in the form of the Provincial Development Committees and District Development Committees, which bring together government departments, state agencies, provincial and local authorities, and NGOs with mandates for water and related service provision. These platforms, however, are compromised by the lack of a regulatory framework guiding these cooperative efforts, clarifying mandates related to MUS, and ensuring that they are not competing for funding and other resources in planning for and implementing MUS. Interviews with the Department of Irrigation, for example, highlighted the fact that the different institutions, when faced with challenges, tend to revert to their narrow mandate.

The reorganization of relevant agency mandates around irrigation is also causing considerable uncertainty. For example, the Government has expanded the mandate of ZINWA, which is now responsible for developing irrigation and drilling community boreholes, and formed new organizations, including the Department of Soil Conservation. This has exacerbated the need for clarity with respect to how overlapping mandates should be addressed, such as where ZINWA's new mandate for implementing the Presidential Borehole Initiative overlaps with Department of Irrigation (which has the irrigation mandate) and DDF, which has had the mandate to drill boreholes in rural areas. It is also important to note that ZINWA currently lacks the technical capacity to carry out its new mandate and there are ongoing efforts to hire irrigation engineers to work under service centers. Finally, the dual role played by ZINWA, namely that of regulator of certain aspects of water development and management and an implementer of water development projects (such as borehole drilling and irrigation development) has now been exacerbated.

Ideally, planning for MUS should be embedded in District Development Plans (DDPs), which could then guide the investment and activities of all partners on priority interventions. These plans are meant to capture local priorities for development, including water infrastructure and use, as they are based on Ward Development Plans (WDPs). They also feed into Provincial Development Plans, which could ensure financial and technical support is leveraged from that level. At the same time, it is critical to also align DDPs with the Catchment Councils' Outline Plans that determine priorities for sectoral allocations of water and water-related developments in the relevant catchments and sub-catchments. Improved engagement of the sub-catchments in district planning could facilitate this process, but the sub-catchments consulted have stated they lack the necessary resources to effectively engage at this level, despite their mandate to do so.

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[85] Zikhali, W. (2017). Participation of Women in Development Issues in Nkayi District, Zimbabwe. Research on Humanities and Social Sciences Vol. 7, No. 10.

[86] RRI and ELI, supra n. 62.

4.1.2.4 Institutional Capacity Challenges

Ultimately, once projects have finalized their investments in MUS and hand over to communities, there is an ongoing need for continued support to ensure sustainability of the infrastructure, the governance structures, and the resource. Across the board, local government agencies that act as partners in MUS projects have noted a severe level of financial constraints to their operations, lack of staff, and other capacity challenges that have undermined ongoing partnerships with communities. DDF noted that it supports MUS but lacks the financial resources to conduct its own projects and must partner with NGOs. Complicating the situation further are the changes underway that have located technical agencies farther from the community level. For example, the Departments of Irrigation and Mechanisation no longer have district-level presence and is only at the provincial level.

As noted above, the mandates of some of the agencies are also not matched to their capacities. In the case of catchment and sub-catchment councils, these severe resource constraints are compounded by the fact that sub-catchments are meant to function on the basis of user fees, which are difficult to capture, particularly in rural areas. This structure also incentivizes catchment councils to limit their definition and allocations for primary water uses to only domestic uses, rather than enabling them to support small-scale livelihoods in line with the right to food and national poverty alleviation goals.

Community level institutions also face several challenges such as lack of capacity to enforce regulations especially at the asset management level, which is used for a variety of water uses, and cover operation and maintenance costs supported by an operational and maintenance plan.

4.2 MUS at Project Level

This section describes how MUS was planned, implemented, and sustained across all projects that were visited (see Tables 1 and 2). The data presented in this section is derived from the Focus Group Discussions, household survey questionnaires, and participant observations conducted at the project sites (see Tables 3 and 4), as well as from the Key Informant Interviews conducted with local Takunda and Amalima Loko staff. The data presented in tables and figures was computed from household survey data, except for tables under Section 4.2.1 which were based on Focus Group Discussions. The full data sets are captured in the Field Reports (Annexes F and G).

The data presented in this section draws from across all the data sources, and is triangulated. The MUS practices are preceded by an overview of the project characteristics to provide a context of the description and discussion of the findings at the sites.

4.2.1 Overview of Project Characteristics

Tables 10 and 11 show the sources of water used at each of the sites, the status of water supply, and how water was abstracted, conveyed, and used in irrigated lands. Dams, including five small dams and Quested Dam – a ZINWA dam from which Mbengwa Garden drew water – were the main source of water at six of the project sites. Solarized boreholes accounted for three additional sites, and the remaining two used a bush pump-equipped borehole and a solarized sand river abstraction system, respectively. Surface irrigation was the dominant method of irrigation across all sites. Drip irrigation was introduced in Cheshanga and Manzimahle, but later abandoned.

4.2.1.1 Water Availability

Assessment of water availability in the projects were based on Focus Group Discussions and participant observations. On this basis, water shortage was categorized as presented in Table 9.

Table 9. Categories, Narratives, and Implications of Water Shortage in the Projects

Category	Water Shortage Narrative	Implications for Irrigation
1	No water shortage	Water is readily available and does not limit irrigation at all
2	Minor water shortage	There is negligible water shortage that limits irrigation very little
3	Moderate water shortage	Water shortage for irrigation is between 75 and 90 percent and negatively affects irrigation for some crops
4	Critical water shortage	There is significant reduction in the water available for irrigation resulting in only 25% -40% of the area being irrigated

As indicated in Tables 10 and 11, seven projects face critical water shortage (Toindepi, Cheshanga, Chemvuu, Mahabangombe, and Manzimahle). Except for Chemvuu, water shortage was due to operational challenges (mainly due to inadequate pumping capacity) and not a result of physical shortage of water.

Table 10. Water supply characteristics of ENSURE and Takunda projects

Name of project	Water source	Main water use		Year commissioned	Water delivery system	Water shortage	
		Use	Method			Status	Reason(s)
Musvinini Irrigation	Musvinini Dam	Irrigation	Piped surface	2018	Water is delivered from the dam by gravity through a steel pipe to rectangular wellpoints in the irrigation scheme from which farmers irrigate using buckets	Minor	Leaking pipes
Nyimai Garden	Nyimai Dam	Irrigation	Piped surface	1998	Water is delivered from the dam by gravity through a plastic and steel pipe to rectangular wellpoints in the irrigation scheme from which farmers irrigate using buckets	Minor	Leaking pipes
Toindepi Irrigation Scheme	Solarized borehole	Irrigation	Piped surface	2015	Water is pumped by solar pump to storage tanks and gravitated through a buried pipe to water taps in the irrigation scheme. In reality, water is pumped into the taps due to missing return pipe from tanks and low pump capacity	Critical	Small pump and incomplete irrigation design
Mhazo proposed borehole	Under discussion	Under discussion	N/A	N/A	Under discussion	N/A	N/A
Chemvuu Garden	Chemvuu Dam	Irrigation	Piped surface	2016	Water is gravitated to the garden through a buried steel pipe to	Critical	Dam dried up

Name of project	Water source	Main water use		Year commissioned	Water delivery system	Water shortage	
		Use	Method			Status	Reason(s)
					wellpoints in the garden from which farmers irrigate using buckets		
Zinhuwe Garden	Zinhuwe Dam	Irrigation	Piped surface	2018	Water is delivered to wellpoints in the garden from which farmers irrigate using buckets	Minor	Leaking pipes
Cheshanga Nutrition Garden	Solarized borehole	Irrigation	Drip irrigation changed to piped surface irrigation	2018	Water is pumped by solar pump to two 10, 000-liter PVC tanks and gravitated through a buried PVC pipe to drip system. This was changed - water is channeled to a tap initially meant for drinking water in the irrigation scheme from which farmers irrigate using buckets.	Critical	Small pump
Chivamba proposed borehole	Under discussion	Under discussion	N/A	N/A	Under discussion	N/A	N/A

Table 11. Water supply characteristics of Amalima projects

Scheme	Water source	Main water use		Year commissioned	Water delivery system	Water shortage	
		Use	Method			Status	Reason
Paswana Irrigation	Tuli River	Irrigation	Piped surface	2018	Water is delivered from a wellpoint in the Tuli River by a solar pump into 6 Jojo 10,000-liter tanks from which water is conveyed into taps in the irrigation schemes. Farmers collect water by buckets and irrigate their plots.	Minor	Leaking tanks and broken-down pump
Mbuyane Dam	Mbuyane Dam	Livestock	Direct from the dam	2016	There is no irrigation. Dam is only used for livestock watering.	Moderate	Dam dries at the peak of the dry season

Scheme	Water source	Main water use		Year commissioned	Water delivery system	Water shortage	
		Use	Method			Status	Reason
Mbengwa Irrigation	Quested Dam	Irrigation	Piped surface	2014	Water is pumped by solar pump to a 10,000-litre Jojo tank and gravitated to wellpoints from which farmers get water by buckets for irrigation.	Moderate	Small pump and modified water delivery system that does not work as anticipated
Mahabangombe Garden	Borehole equipped with Bush pump	Irrigation	Piped surface	2014	Water is pumped into a small trough from which farmers fetch water for irrigation using buckets.	Critical	Bush pump frequently breaks down
Manzimahle Irrigation	Solarized borehole	Irrigation	Piped surface	2019	Water is pumped by solar pump to a 10,000-litre Jojo tank and gravitated to wellpoints from which farmers get water by buckets for irrigation.	Critical	Small pump

4.2.1.2 Project, Plot Size, and Cropping Characteristics

Tables 12 and 13 show the size of the irrigation project, plot size, and cropping characteristics in all the projects. As can be seen from the tables, the size of the irrigated projects ranged from 1 to 5 hectares while plot size ranged from 81 to 724 m^2. The plot size was determined by the number of plot holders in the irrigation project. Across the board, a wide range of crops were grown with some projects growing as many as ten crops. Land utilization, as indicated by a cropping intensity of 300%, was the maximum possible with three crops grown on the same piece of land per year. As will be shown under Financial and Economic Analysis, the plot size affects profitability and sustainability of projects.

Table 12. Project, plot size, and cropping characteristics in ENSURE projects

Name of project	Size (ha)	Number of plot holders	Plot size (m^2)	Crops grown	Cropping intensity (%)
Musvinini Irrigation	3	86	234	Groundnuts, covo, tomatoes, carrots, butternuts, and maize	300
Nyimai Garden	5	84	156	Covo, tomatoes, onions, butter nuts, and beans	300
Toindepi Irrigation Scheme	5	56	150	Maize, tomatoes, and covo.	300

Name of project	Size (ha)	Number of plot holders	Plot size (m^2)	Crops grown	Cropping intensity (%)
Chemvuu Garden	1.2	56	90	Leafy vegetables, carrots, onions, shallots, garlic, broccoli, beetroot, beans, okra, watermelons, and butternut.	300
Zinhuwe Garden	1.5	67	81	Cabbage, covo, rape, onions, maize, shallots, and tomatoes	300
Cheshanga Nutrition Garden	5	40	90	Leafy vegetables, maize, beans, and tomatoes.	300

Table 13. Project size, plot size, and cropping characteristics in Amalima projects

Name of project	Size (ha)	Number of plot holders	Plot size (m^2)	Crops grown		
				Range of crops	Three most important crops	Cropping intensity (%)
Paswana Irrigation	2.7	30	724	Maize, tomatoes, leafy vegetables, butternuts, watermelons, sugar beans, sweet potato, and onions.	Leaf vegetables, tomatoes, and butternut.	300
Mbuyane Dam	-	-	-	-	-	-
Mbengwa Garden	1.4	50	154	Beans, vegetables, onions, carrots, maize, sweet potato, and butternuts.	Leafy vegetables, tomatoes, and onions.	300
Mahabangombe Garden	1	36	63	Leafy vegetables, tomatoes, beetroot, carrots, sugar beans, and garlic.	Leafy vegetables, tomatoes, and onions.	300
Manzimhale Irrigation Scheme	1	26	384	Leafy vegetables, tomatoes, onions, maize, carrots, butternuts, and sugar beans.	Leafy vegetables, onions, and tomatoes.	300

4.2.1.3 Respondents and Household Characteristics

The majority of respondents for the household surveys were female: 90% and 78% in ENSURE and Amalima projects, respectively (Tables 14 and 15). The average household size was similar across all projects, with an average of 5-7. The average household size also affected Financial and Economic Analysis since it impacts on the quantity of agricultural produce for household consumption and for sale. In both ENSURE and Amalima projects, most head of households were male. It is not clear why the number of male-headed households was greater in Amalima, as the areas is known as one from which many men migrate to South Africa seeking employment.

Table 14. Characteristics of respondents and households across ENSURE projects

Name	Household size	Sex of respondent (%)		Head of household (%)	
		Female	Male	Male	Female
Musvinini Irrigation	7	100	0	75	25
Nyimai Garden	5	87.5	12.5	46	54
Toindepi Irrigation Scheme	6	87.5	12.5	31	69
Chemvuu Garden	6	100	0	75	25
Zinhuwe Garden	7	67	31	67	33
Cheshanga Nutrition Garden	6	100	0	69	31
Average	6	90.3	9.7	60.5	39.5

Table 15. Characteristics of respondents across Amalima projects

Name	Household size	Sex of respondent (%)		Head of household (%)	
		Male	Female	Male	Female
Mbuyane dam	6	15.8	84.2	68.4	31.6
Paswana Irrigation	6	27.3	72.7	63.6	36.4
Mbengwa Garden	6	20.0	80.0	80.0	20.0
Manzimahle	6	25.0	75.0	75.0	25.0
Average	6	22.0	78.0	71.2	28.3

4.2.2 Multiple Waters Use at Projects and MUS Typologies

Key Informant interviews with personnel who were part of ENSURE and Amalima projects revealed different understanding in relation to whether the projects selected for study were designed and implemented as “MUS projects.” Amalima staff noted that, while the projects were ultimately meant to provide water for multiple uses, the specific interventions by the projects were not conceptualized and designed as MUS projects. Rather, they were designed as single-use interventions such as irrigation and livestock watering. In Paswana Irrigation, Mbengwa, Mahabangombe, and Manzimhale, the infrastructure was designed only for irrigation and not for other uses such as domestic and livestock watering. The Mbuyane dam was only for livestock watering. During Focus Group Discussions community members noted that they had requested Amalima to install irrigation but was told that there was no budget for that.

Despite the lack of MUS focus, the projects still yield lessons for MUS in practice, as communities prioritized multiple uses from the infrastructure provided. Additionally, consultations with project staff revealed that boreholes for domestic water were meant to be developed by another program in concert with the Amalima water interventions to provide for multiple uses for communities in the area. The lack of coordination at the community level across these two programmes, however, limited the ability to realize the true benefits of an integrated, MUS approach.

On the other hand, staff noted that the ENSURE projects were designed and implemented as MUS projects. In Musvisvini, Nyimai, Chemvuu, and Zinhuwe, for example, water was provided for both irrigation and drinking through small water treatment plants, but only providing drinking water in the fields and not at households. The communities at these sites noted that women and girls still must travel long distances to fetch water for household uses from community boreholes as the irrigation gardens were not close to homesteads. ENSURE staff agreed that not all water uses were catered for in the project design, mainly because of budget constraints and incomplete technical assessments where the pumps were too small, as was the case in Toindepi, Chetsanga, and Manzimahle, as well as in Chemvuu, which was dried up at the time of the visit. Regardless of whether the projects were designed for multiple uses, communities at the sites indicated in the household surveys that water for irrigation, domestic and livestock watering were all priorities, albeit to varying degrees (Figures 6 and 7).[87]

The FGDs and household surveys also noted that there was insufficient water even for the priority single use planned for in Amalima projects or for the limited multiple water uses planned for in ENSURE projects (see Tables 9 and 10).

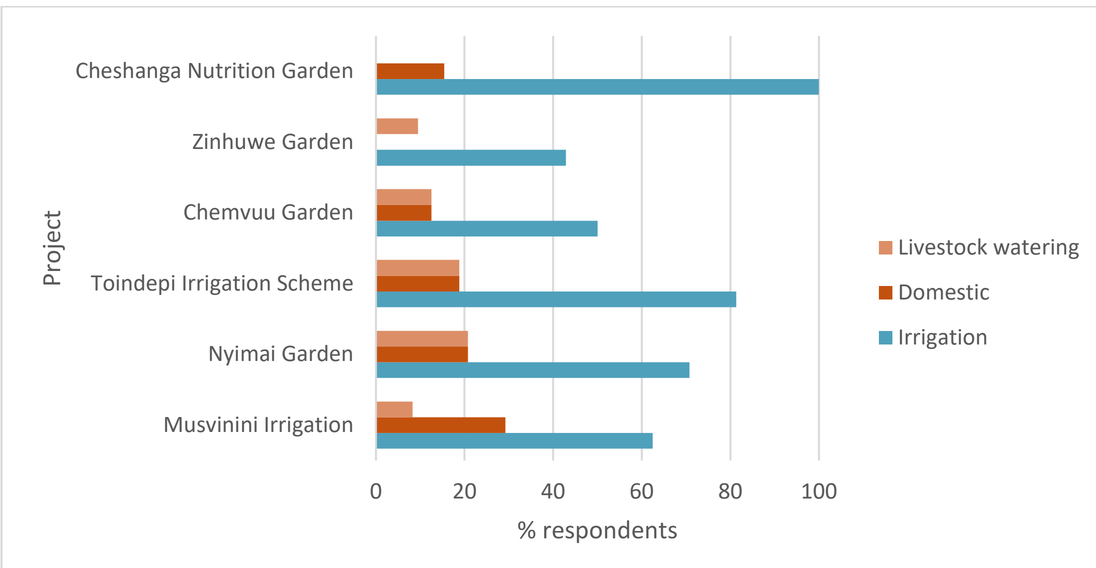

Figure 6. Priority of water use in ENSURE sites

[87]The figures do not add to 100% because of different rankings by the respondents.

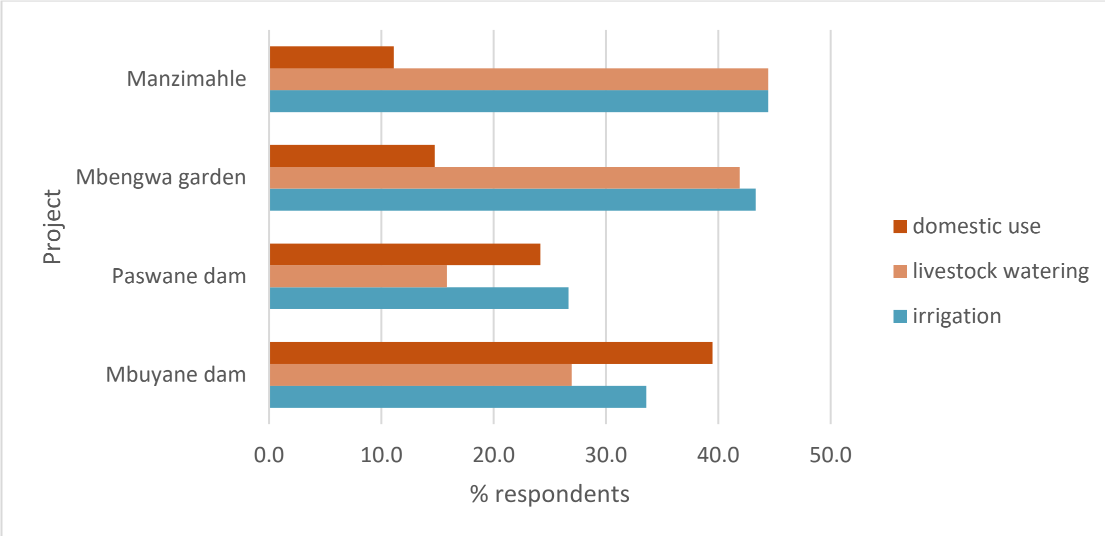

Figure 7. Priority of water use in Amalima sites

Interviews with government departments and state agencies including the Department of Irrigation, the Department of Mechanisation, AGRITEX, DDF, ZINWA, and Rural District Councils revealed that these agencies acknowledge that communities use available water sources for uses other than those they were designed for. According to the DDF, piped water schemes for domestic water use are also provided at institutions, such as schools and clinics, as well as for irrigation. RDCs expected that all water projects implemented in their districts would cater for various community water needs. However, it was also acknowledged that achieving this goal is often challenging because of budget constraints and the lack of a clear strategy to guide MUS planning, design, and implementation. The research team could not find any document at the national, provincial or district level that provides guidance on how MUS projects can or should be implemented in line with government policies.

This is also true for Presidential Borehole Programme (also referred to as the Presidential Rural Horticulture Scheme). The goal of this Programme is to drill 35,000 boreholes, one in each of the country's villages, to provide water for domestic use, irrigation, aquaculture, and for watering small livestock, such as poultry and goats. While this is an example of MUS intervention, there is no written account regarding its planning, design, and implementation. The team could not find answers to the critical question of how it can and will be sustained from a biophysical (whether there are enough groundwater resources), financial (whether communities can finance after the project after commissioning) and social (equity considerations in terms of who will benefit and who will not benefit at household, community, or national level) point of view.

The question of which MUS typology (from among the "plus" approaches) applied across the different projects was difficult to pinpoint. While ENSURE projects (Musvinini, Nyimai, Chemvuu and Zinhuwe) are readily characterized as "irrigation-plus" due to the prominence of irrigation, this would not account for the fact that livestock watering was the main driver for the projects and drove the participation of the wider community. Such projects could also be labelled as "livestock-plus." Boreholes provided less flexibility in this regard because of limited water availability for livestock watering.

Surprisingly, there was no project that could be actually designated as "domestic-plus," whether from a design perspective or from a practical point of view. While ENSURE projects provided for drinking water within irrigation schemes through small water treatment plants in Nyimai, Chemvuu, Zinhuwe and Musvisvini), this did not meet the criteria for provision of domestic water because the amount involved is too small and does not meet household domestic use needs. It appears that in both projects there was an expectation by the project that domestic water would be provided by government or other NGOs active in the WASH sector in the region.[88]

4.2.3 Community Involvement

An assessment of community involvement in each water project was undertaken. Community involvement is widely regarded as key contributor to project ownership and sustainability. It was assessed in terms of the project cycle, namely planning and site selection, labor construction and financial contribution, operation and maintenance, choice of infrastructure/technology, and post-construction phase including hand-over of projects through use of household survey, FGDs and KIs. It is important to make the observation that the views here presented are essentially those of women. Women constituted the majority of respondents at project level as captured by the household survey (see Tables 14 and 15) and FGDs.

4.2.3.1 Planning and Site Selection

In both ENSURE and Amalima projects, respondents of the household survey rated community participation in the planning and selection of projects respondents as high to very high. ENSURE project respondents rated community participation as ranging between 56 and 100%. In the Amalima sites it rated as 100 percent except for Manzimhale where it was estimated to be 56%. The respondents highlighted the importance of community leaders, such as traditional leaders and Ward Councilors, in mobilizing communities as well as facilitating entry of organizations (such as ENSURE and Amalima) into the communities.

FGDs and KIIs at the project and district levels also confirmed high levels of community participation in the projects, and provided details of the process that was involved. It is important to note that community engagement only occurs after the necessary consultations have been made with the Rural District Council (RDC) and all non-state entities/partners have been cleared to work in the district, courtesy of a signed Memorandum of Understanding (MOU). This process also includes identification of possible sites for interventions through the District Water and Sanitation Committee. The entry point at community level is always the ward, after which traditional leaders at village level can be approached.

At community level, the process starts with potential investors/partners consulting the relevant RDC and Ward Councilor to determine the number and location of villages that should be part of the project. In the preliminary stages, more villages are usually involved to ensure the ownership of the broader community. Thereafter, communities are engaged in a visioning process to identify development priorities and then feasible projects are identified to address those priorities. Invariably the chosen possible projects tend to fall within the mandate of the organization that is seeking to develop the projects. DDF and RDC Key Interviewees expressed the view that such compromises were inevitable.

Interviews with CARE staff in Chivi and Zaka districts (also confirmed by DDF officials in the two districts) revealed that while communities can make suggestions regarding the siting of a project, ultimately site selection depends on the availability of water based on technical assessments. Such assessment is normally undertaken by government agencies: DDF provides expertise for siting boreholes while DoM provides expertise for small dam siting and construction. Where the government department is not able to provide the necessary technical expertise, private contractors are hired. The site has also to meet other criteria, such as availability of uncontested land for irrigation if the project includes an irrigation component.

[88] Comment made during project staff consultations.

In most of the projects assessed for this project, dedicated committees were formed to spearhead the planning and implementation of the water project (as opposed to existing committees). There is a strong incentive for the creation of specific structures to carry out funded projects, as they are almost all dependent on volunteers under a cash or food for assets programme. In the case of small dams, which involves multiple villages, the number of volunteers can exceed 100. The practice in these cases is to set up an Asset Management Committee to manage and protect the small dam while an Irrigation Management Committee is mandated with management of issues pertaining to an irrigation scheme. The irrigation scheme caters for fewer people than those participate in dam construction. There is no evidence this caused conflict in the community because the community members collectively agreed on a set of criteria during the planning meetings. The fact that some villages were far away from the irrigation plots meant that not everyone wanted to take up a plot in the irrigation.

Women tend to volunteer in large numbers because of their social roles of providing water and food for families. It was, however, not clear whether young women who are not married could volunteer and participate since volunteers are selected at a household, rather than individual level. Communities keep a record of meetings through the Secretary of the Asset Management Committee or Irrigation Management Committee. It is also common to develop a Constitution for these Committees, which is kept at the project level along with as any other project-related documents.

For both ENSURE and Amalima projects, this process was followed. However, while most of the information regarding the process could be obtained from the communities, information regarding project costs and technical specifications (such as pump size) was generally not available at community level. The exception was Pasvani, where the community was given receipts of items purchased for the project, and Manzimahle, where the Secretary of the Irrigation Management Committee had all the information available.

4.2.3.2 Labor for Construction and Financial Contributions

For both ENSURE and Amalima projects, the community contributed labor for construction, mainly as “general hands”. In some cases, community members with specific skills were identified and trained. For example, ENSURE trained local builders at Zinhuwe so that they would participate in small dam construction as skilled labor. The labor they contributed was compensated in cash or in kind. Under ENSURE, individuals representing households who worked on the project received 50 kilograms of red sorghum per month. According to participants in the FGDs, this was very welcome since it was a drought year. In Amalima projects, community members received USD2 per day.

Generally, communities were not expected to make direct financial contributions, but did provide food for workers and were subject to a joining fee if they were not part of the initial proceedings but later wanted to join project activities (such as an irrigation scheme). The exceptions were in Mahambangombe and Manzimhale, where community members were asked to contribute 50 percent of infrastructure development costs under a matching grant programme. In Mahambangombe, the community contributed USD$3,000, while in Manzimahle it contributed R30,000 (equivalent to USD2,000). The matching grant programme was only implemented in Amalima and only in projects that were already operating as it was expected that communities could raise the matching funds. During the FGDs in Mahambangombe and Manzimahle, it was established that substantial amount of the financing from the community actually came through remittances from family members in the diaspora.

4.2.3.3 Operation and Maintenance

The household survey and FGDs established their rules regarding operation and maintenance of the main asset such as a small dam and irrigation garden where it was in existence. First to be discussed are operational rules.

In all ENSURE projects there were rules regarding water allocation, which mostly emanated from the "committee." Village heads played a minor role. The rules covered water rationing, proper water management of water sources, and irrigation duties in that order of priority. The rules were mostly written down and kept by the Secretary on behalf of the committee. The record was mainly in the local Shona vernacular language. Some schemes such as Nyimai had very strict rules about behavior of the irrigators. In Amalima projects, there were also rules for water allocation. The rules originated from Irrigation Management Committees and were mainly about water rationing. The Secretary of the Irrigation Management Committee kept the record of rules in the local Ndebele vernacular language. In Mbuyane only 15.8% of respondents agreed that rules were in place. This was perhaps because the dam only catered for livestock watering which was difficult to enforce and therefore there were no rules to speak of.

Generally, rules about managing assets (i.e., small dams) were more difficult to enforce than those related to irrigation schemes. This is perhaps because irrigation is a continuous activity and requires close attention, has significant financial consequences on plot holders, and involves comparatively fewer people.

Information from the household surveys and FGDs indicate that community members contributed to operation, maintenance, and replacement costs, and were willing to continue to do so (Figure 8). Most respondents in ENSURE projects said that they contributed to operation and maintenance of irrigation projects with households contributing between USD1-2 per month as determined by the Committee. It is significant that the majority of respondents also noted that the USD1-2 per month was adequate to cover the relevant costs. The positivity also extended to willingness to pay full operation and maintenance costs, mobilize funds in the case of a breakdown, and replace the infrastructure (Figure 9). The community was said to have capacity to replace infrastructure and that the project would continue to work after the donor withdraws. Similar results were obtained for Amalima projects (Figures 10 and 11).

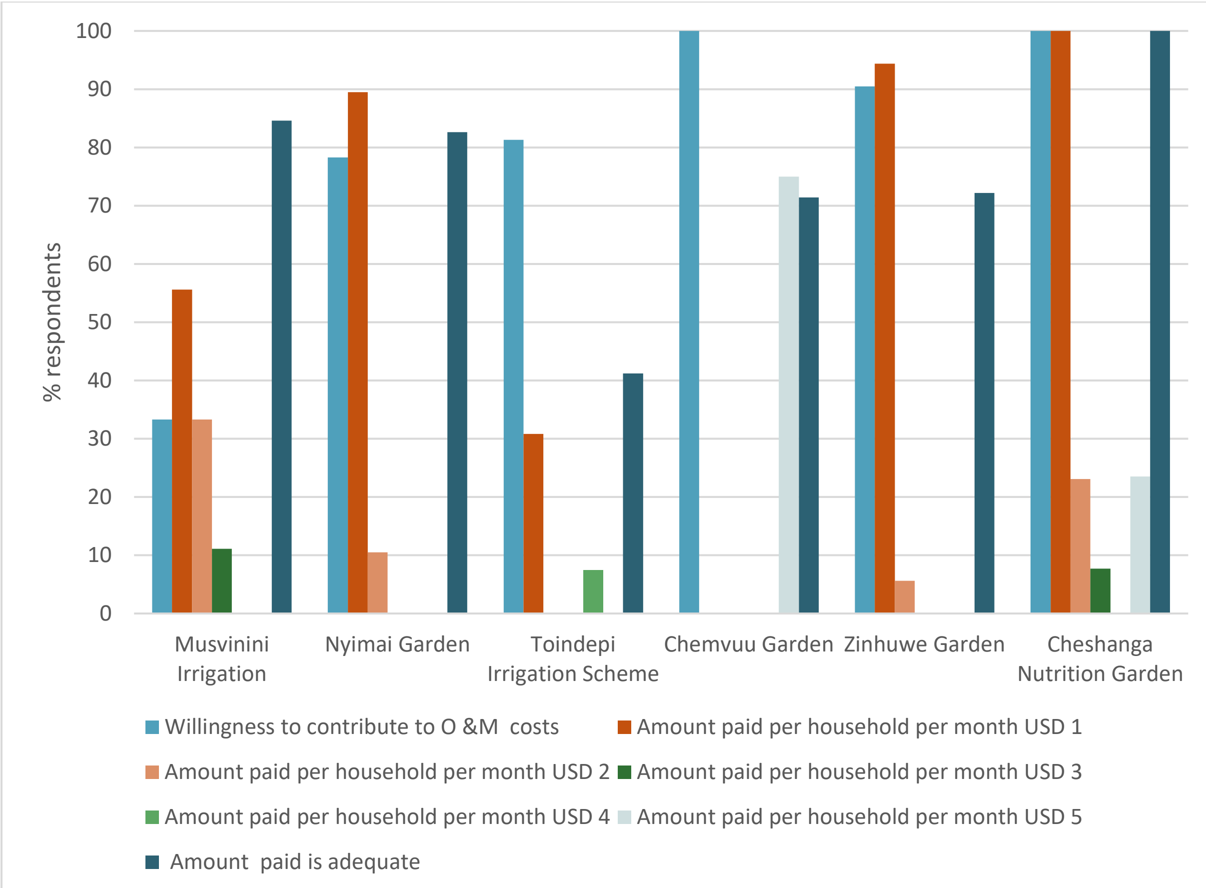

Figure 8. Community perceptions regarding contribution to operation and maintenance costs in ENSURE projects

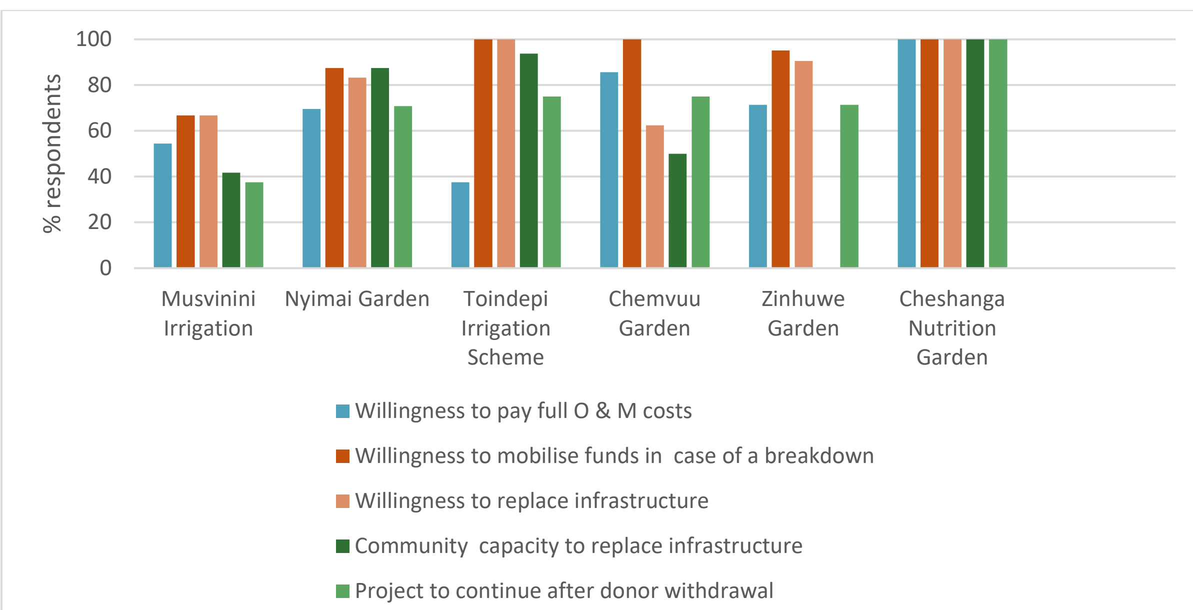

Figure 9. Willingness and capacity to fully contribute to operation, maintenance, and replacing costs in ENSURE projects

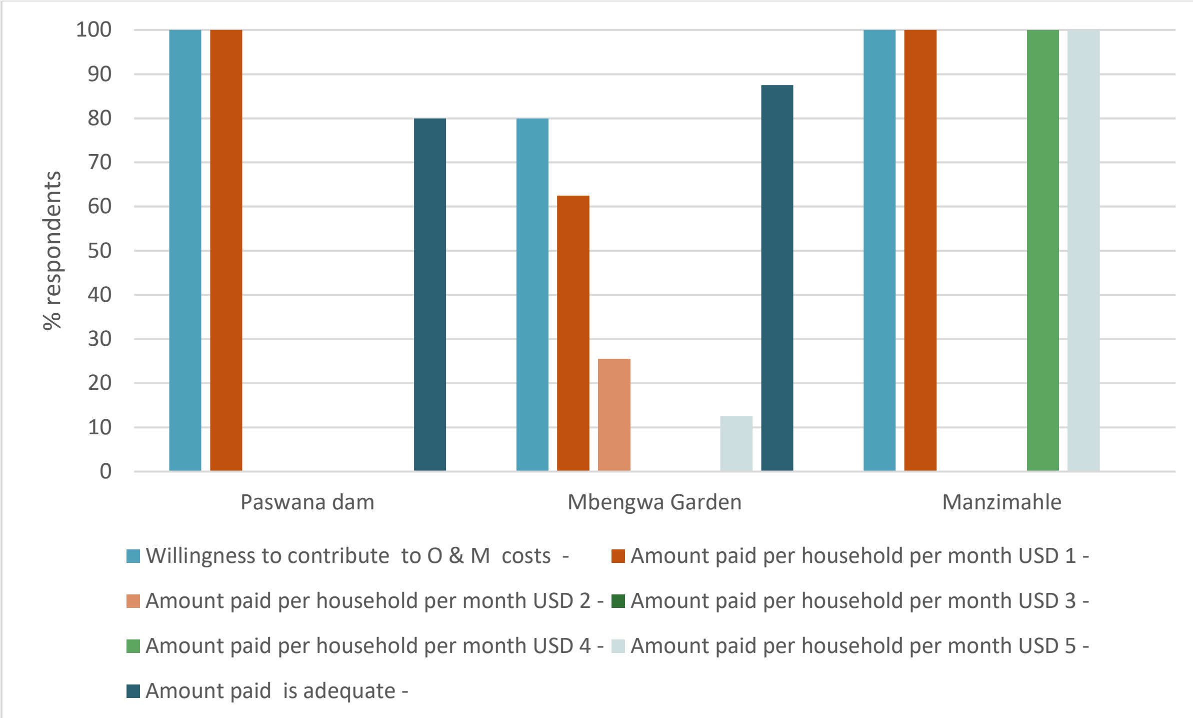

Figure 10. Community perceptions regarding contribution to operation and maintenance costs in Amalima sites

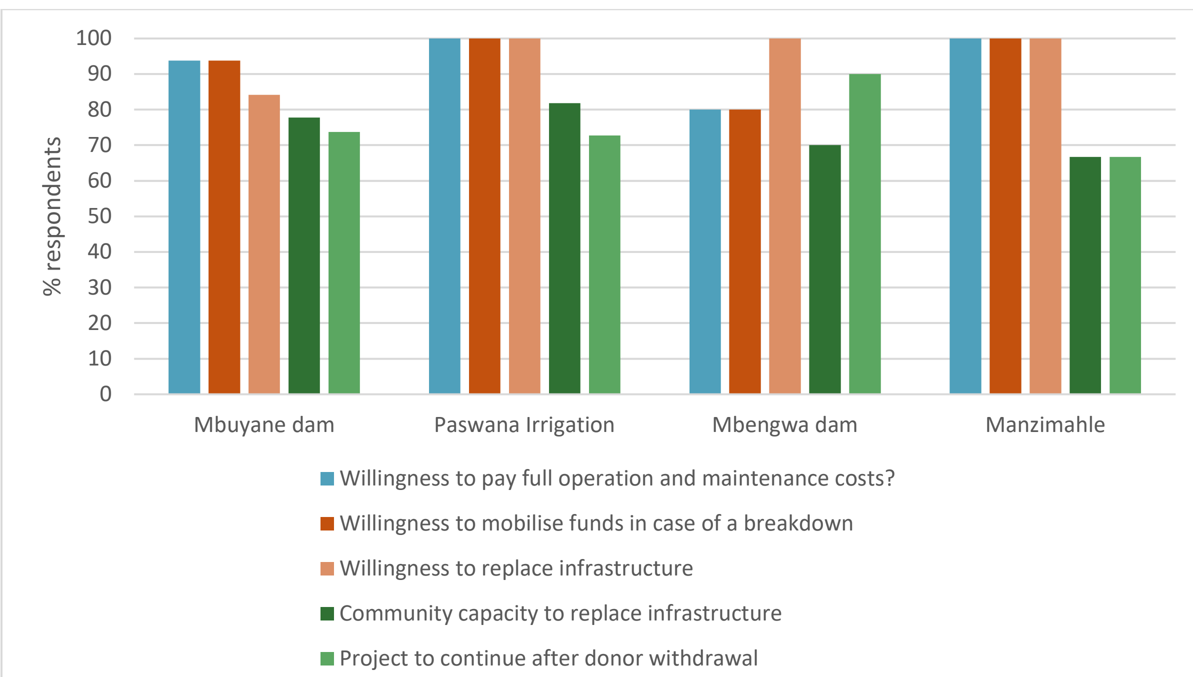

Figure 11. Willingness and capacity to fully contribute to operation, maintenance, and replacement costs in Amalima sites

4.2.3.4 Irrigation Infrastructure/Technology

Surface irrigation was dominant across all projects (see Tables 10 and 11). The systems involved fetching irrigation water using buckets from wellpoints except in Pasvana, Toindepi, and Cheshanga where taps were installed. The team observed attempts in Mbengwa to install taps instead of wellpoints because the existing system was labor intensive and not suitable for "ageing" community members. The attempt failed, however, because the person they hired was technically incompetent. The community in Mahambangombe was also planning to replace the system with a less labor-intensive irrigation system and the same complaints were voiced in Manzimhale. However, according to staff who were part of ENSURE and Amalima, the systems were very robust and easy to operate.

Striking the appropriate balance between the articulated needs and priorities of communities and the constraints related to technology choice and resource sustainability can be a complex undertaking. This challenge was illustrated by the introduction of drip irrigation under ENSURE and Amalima in Chetsanga and Manzimahle, respectively. For ENSURE and Amalima, the drip irrigation technology was an important option to save scarce water resources, but the farmers rejected the technology and ultimately replaced it, as they felt it did not provide sufficient water for their preferred irrigation practices. They were used to flood irrigation where the soil would be wet throughout.

Another technology which makes a lot of sense technically but has operational challenges for farmers is the solarized borehole, which is replacing boreholes equipped with Bush pumps, a Zimbabwean technology that has been in popular use for decades. Interviews with DDF officials confirmed this and highlighted that the popularity of solarized boreholes appears to be based on the perception that bush pumps are labor intensive. For example, all the 35,000 boreholes that will be drilled under the Presidential Rural Development Programme will be solar.

However, it appears that the introduction of the solar boreholes was not accompanied by assessment of communities' capacity to manage them. In the four sites where solar boreholes were installed (Toindepi, Chetsanga, Paswana, and Manzimahle), the community faced challenges in keeping the pumps functional because the technology is complex and costly. If this technology is to be upscaled significantly in a sustainable way, both communities and public agencies will need to be capacitated on how best to manage the technology and repair and replacement costs will need to be considered. This will be critical for both Takunda and Amalima Loko, which unlike under ENSURE and Amalima, are also planning to utilize solarized boreholes. As it stands, due to limited learning, the four projects equipped with solarized boreholes were the most water insecure. Out of the five projects that were fell under the category of critical water shortage, four were equipped with solar boreholes.

4.2.3.5 Conflicts and Conflict Resolution

The household surveys revealed that in both ENSURE and Amalima projects, conflicts around water use were acknowledged by less than half of the respondents. Those that acknowledged conflicts attributed them to: (1) water shortages; (2) irrigation water management system failures; and (3) issues with payment arrangements for the different services.

The low reportage of water conflicts does not mean that the conflicts do not exist as revealed the FGDs. First, it often the case that the conflicts cannot be resolved and therefore become less of conflicts. For example, in Musvinini, Zinhuwe, Nyimai, and Mbuyane dams, the Asset Management Committees failed to prevent unsanctioned fishing and livestock from drinking directly from the dams. There were also cases where personal security resulted in the community failing to enforce rules. This was the case in Musvisvini and Mbengwa where the dam rules could not be secured because the dam was far from homesteads such that security personnel had to be hired. The result was these challenges were downgraded to non-conflicts and the status quo continued. It was only in Manzimahle where the community prevented irrigators from pumping water from the local dam resulting in a borehole being drilled to serve the irrigation garden.

In other cases, negotiations prevented full blown conflicts. For example, in Toindepi, the community agreed on a schedule that balanced the needs for domestic use, irrigation, and livestock to manage the severe water shortage. There were also successful negotiations led by the Irrigation Management Committees regarding the amount to be paid for operation and maintenance costs in irrigation, although the amounts were not sufficient for the schemes over the long-term.

Finally, community cohesion was sometimes more important than resolving the conflicts. For community members who refused to pay anything towards maintenance of the dams, were barred from watering their livestock. In Mahambangombe, some community members who did not pay a great amount of money to access drinking water continued to access the water because "no-one should be denied drinking water."

4.2.3.6 Post-Construction Phase/Hand-Over of Projects

Staff who were part of ENSURE and Amalima explained the process regarding the post-construction phase. To indicate that the projects has been completed, a Completion Certificate and Commissioning Certificate are generated. The former indicates that all the work and activities were completed in accordance with the technical specifications. The specifications are checked by both ENSURE and Amalima, and relevant government departments.

When the project has been completed, each project is handed over to the community, Rural District Council, and government institutions such DDF, AGRITEX or Department of Irrigation and Department of Mechanisation depending on the type of the project. This is indicated by the commissioning certificate. The community also receives all remaining materials and Directory of Suppliers where the community could buy the required parts. Operational and Maintenance Plans were also left with the community. However, at the time of the site visits, it could not be established whether the communities had copies of the documents and to what extent the hand-over process was available in writing.

4.2.4 Partnerships

MUS projects, like other water projects, require the coordination and cooperation of a number of state and non-state institutions, which provide a variety of services that relate to political leadership, water resources and irrigation, water supply and agriculture (Table 16). As can be seen from Table 16 these involve no less than 10 institutions.

Table 16. Institutions involved in community water projects

Institution	Mandate
POLITICAL LEADERSHIP	
Rural District Council (RDC)	Made up of elected ward councilors and responsible for planning, coordinating, implementing, and monitoring of WASH projects at district level.
District Development Coordinator (DCC)	Civil servant responsible for coordinating development activities in the district.
Ward Councilor	Coordinates development activities at ward level.
WATER RESOURCES AND IRRIGATION	
Zimbabwe National Water Authority	Water resource planning, development, and management; more recent mandate (beginning last year) of water-based community rural development and irrigation.
Department of Irrigation	Irrigation development in the country.
Department of Mechanisation	Provides technical expertise in small dam planning and construction.

Institution	Mandate
Catchment councils	Issue permits for commercial abstraction of surface water in public streams and ground water, responsible for catchment planning, allocation of water across uses and setting limits for primary water use.
Sub-catchment councils	Monitor water use, catchment protection, and levy commercial water use.
COMMUNITY WATER SUPPLY	
Rural District Engineer	Executes implementation and monitoring of WASH projects at district level.
District Development Fund	Coordination of WASH activities in the district by providing specialist services such as borehole siting.
NGOs	Development of water supply (including MUS) projects.
District Environmental Health Officer	Water quality testing and monitoring water quality in WASH facilities.
AGRICULTURE	
AGRITEX	Provides agricultural extension services.
Agricultural and Rural Development Authority	Provides managerial and business services to community irrigation projects.
Agricultural Marketing Authority	Coordinates marketing of agricultural produce.

The institutions perform their activities through the RDDC under which are the District Water and Sanitation Committee (see Figure 4 and Table 8 for the structure of the RDDC and the committees of the RDC related to water and sanitation).

The process, however, does not always work as it should. For example, in some cases government departments and agencies lacked the necessary resources to provide support services to farmers. There are also cases when services are available at provincial, but not at district level. The Department of Irrigation and Mechanisation, for example, has no staff at the district level to provide support in irrigation and small dams respectively.

4.2.5 Water Quality Analysis

Water quality tests indicated that the water from the majority of water sources was not safe to drink. Out of the ten sites that were sampled, only water from three sites (Toindepi, Cheshanga, and Paswani) was found to be potable. For all the three sites the source was boreholes. Water from Manzimahle borehole was contaminated, likely due to poor water handling, but there was no provision for domestic water from that borehole. It is worth noting that the high ionic activity in the borehole water samples indicate a potential salinity threat, which could render the water unsuitable for some domestic water uses, such as laundry.

All samples taken from surface water sources were contaminated except for the water from the second tank of the water treatment plant in Nyimai. However, the treatment tanks were so small that they provided limited drinking water that was only for use within the scheme during irrigation.

Water quality assessment and monitoring is critical in rural water supply at the commissioning of the water infrastructure and quarterly thereafter. However, it was found that monitoring and testing is inconsistent (sometimes nonexistent) due to financial and material resource limitations of the relevant agencies (EMA and Ministry of Health).

The findings indicate a need for cost-effective mechanisms to supply safe water to communities. While the most effective option seems to be drilling boreholes, because communities consistently rely on other sources, there is also a need for other interventions, such as point of use or household level treatment technologies.

4.2.6 Financial and Economic Analysis

The summary of the Financial and Economic Analysis that is presented here draws from the full Financial and Economic Analysis (see Annex E), and is based on the operational capacity levels of different projects as shown in Table 17, and that farmers will invest 10% of their profits into operation, maintenance, and replacement costs.

Table 17. Capacity level of different projects

Capacity level	Projects
75%	Musvinini, Nyimai, Pasvana
50%	Mbengwa, Mbuyane
25%	Toindepi, Cheshanga, Chemvuu, Manzimahle, Mahambangombe

Profitability and sustainability

Table 18 shows selected indicators of the profitability and sustainability of the different water projects. Across all projects, households can make a profit at the current production level and invest 10% of profits into operation maintenance and replacement costs. However, there is a smaller benefit cost ratio for some projects (e.g., Cheshanga).

It is worth mentioning that economic performance of the project is affected by a combination of:

- Water availability – acute water shortage compromises profitability;
- Crops grown –high value crops are better but there are risks associated with markets;
- Size of the scheme and plot size -the bigger irrigated gardens/plots the higher the total crop revenue but irrigation overheads do not change much between the range of plot size that existed in the projects; and
- Household size and income (see below).

Table 18. Indicators of profitability and sustainability of different projects

Name of project	Profit per household per year (USD)	Benefit cost ratio/year	Repayment period
ENSURE			
Musvisvini	303	5.52	11.5
Nyimai	518	5.52	11.5
Toindepi	209.68	3.08	42.6
Chemvuu	50.32	3.08	42.6
Zinhuwe	195	5.52	11.5
Cheshanga	215.42	1.98	75.4
AMALIMA			
Pasvana	1,604	8.29	9.5
Mbengwa	306	2.01	9.1
Mahambangombe	152	4.80	18.3
Manzimahle	206	4.08	18.7

Profitability, however, does not guarantee sustainability as measured by the repayment period. All projects but two (Pasvana and Mbengwa) have a repayment period of greater than 10 years. This means that, at current production levels, it will take more than 10 years to raise enough capital to meet operation, maintenance, and replacement costs. This will almost certainly result in deterioration of the infrastructure. While Pasvana and Mbengwa have lower repayment periods, the figures are close to 10 years, and therefore will likely suffer the same fate as the other projects. It is significant that the most affected projects are those facing critical water shortage (Toindepi, Cheshanga, Chemvuu, and Cheshanga). For these projects the repayment period was over 40 years.

The perceptions of community members/farmers were also assessed by determining their willingness and ability to pay. Figures 12 and 13 show that farmers are willing to pay, but progressively less willing when the amount is doubled, trebled, and quadrupled. Currently, farmers are paying very small amounts (~USD$1-2 per month per household). This results in under-investment in operation, repair, and maintenance and is a threat to project sustainability.

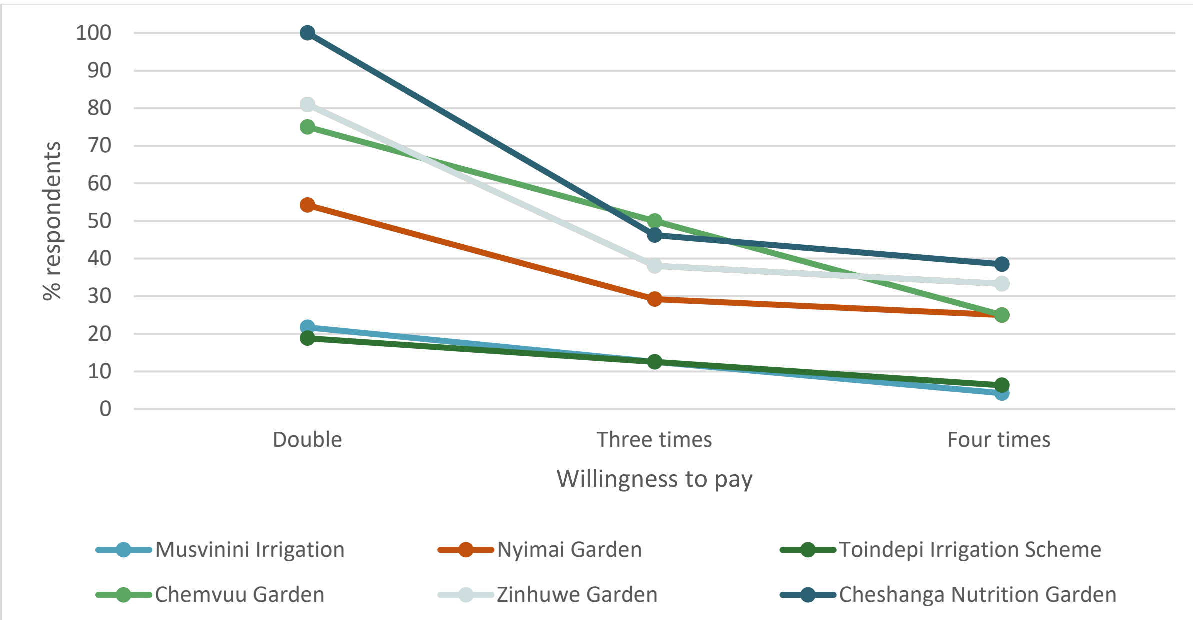

Figure 12. Willingness to pay for operation and maintenance as current amount of money contributed is increased by twice, three time, and four times in ENSURE sites

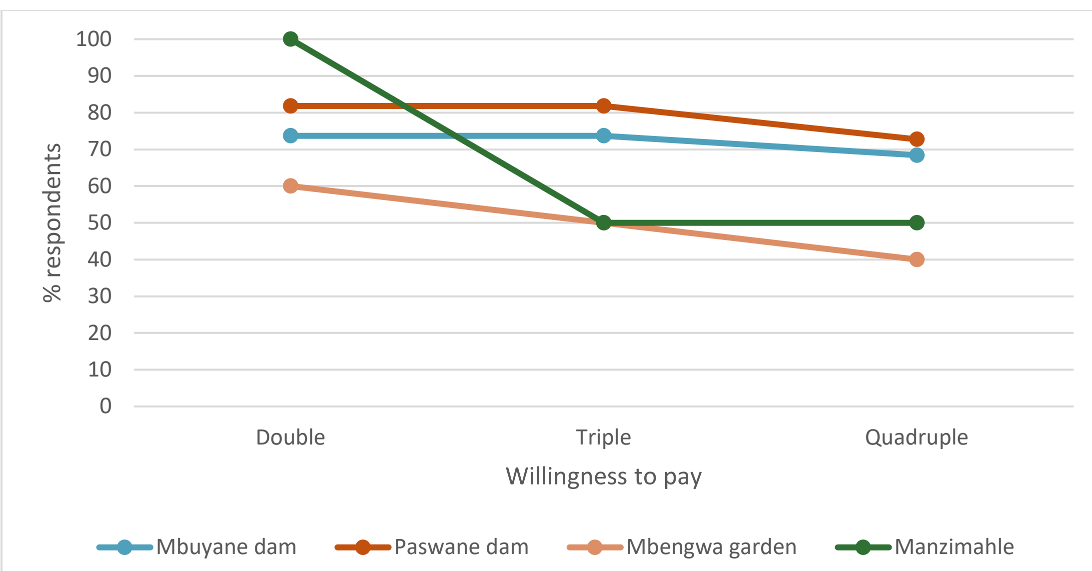

Figure 13. Willingness to pay for operation and maintenance as current amount of money contributed is increased by twice, three times, and four times in Amalima sites

The willingness to pay is better appreciated when average household income is taken into account, which is an indicator of the ability to pay. The average household income for the majority of respondents falls within the up to USD50 per month (Figures 14 and 15). As can be seen from the graph, this is significantly lower than the Total Consumption Poverty Line (TCPL). This suggests that the households are not able to meet the operation, maintenance, and replacement costs.

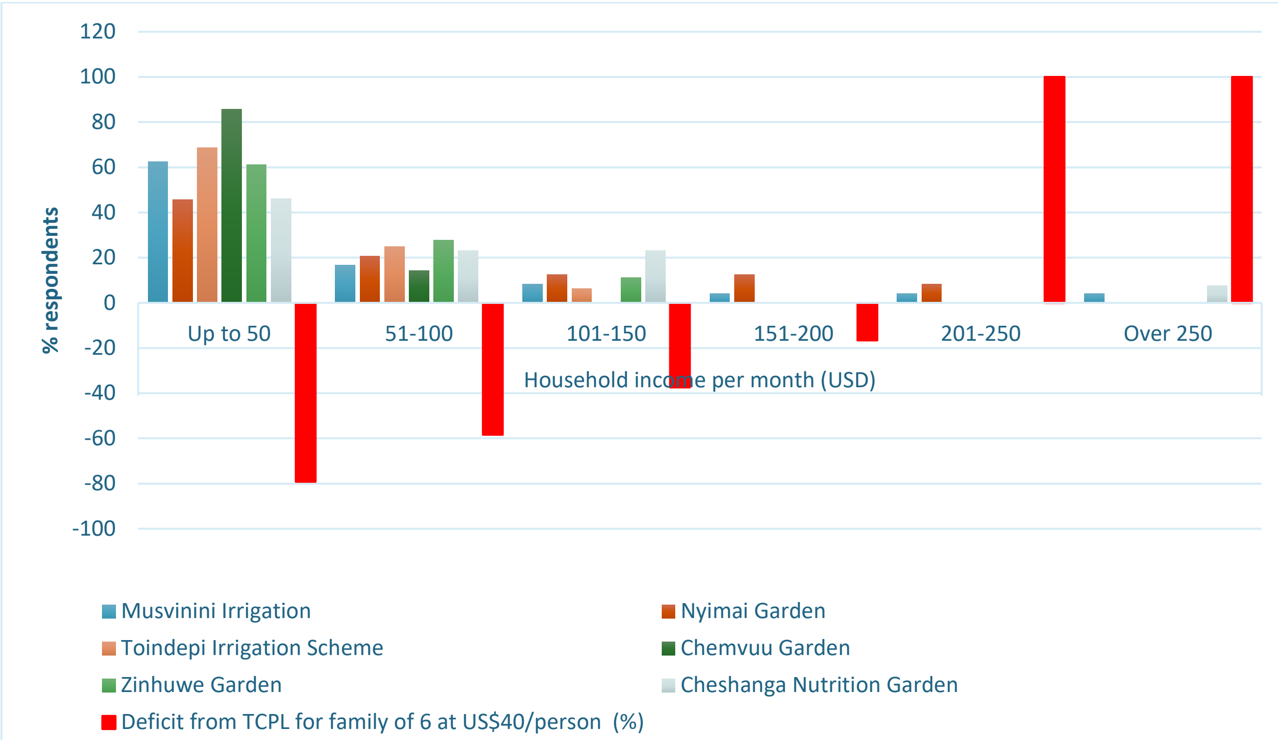

Figure 14. Average household income as a proportion of the Total Consumption Poverty Line and % deficit from TCPL in ENSURE sites

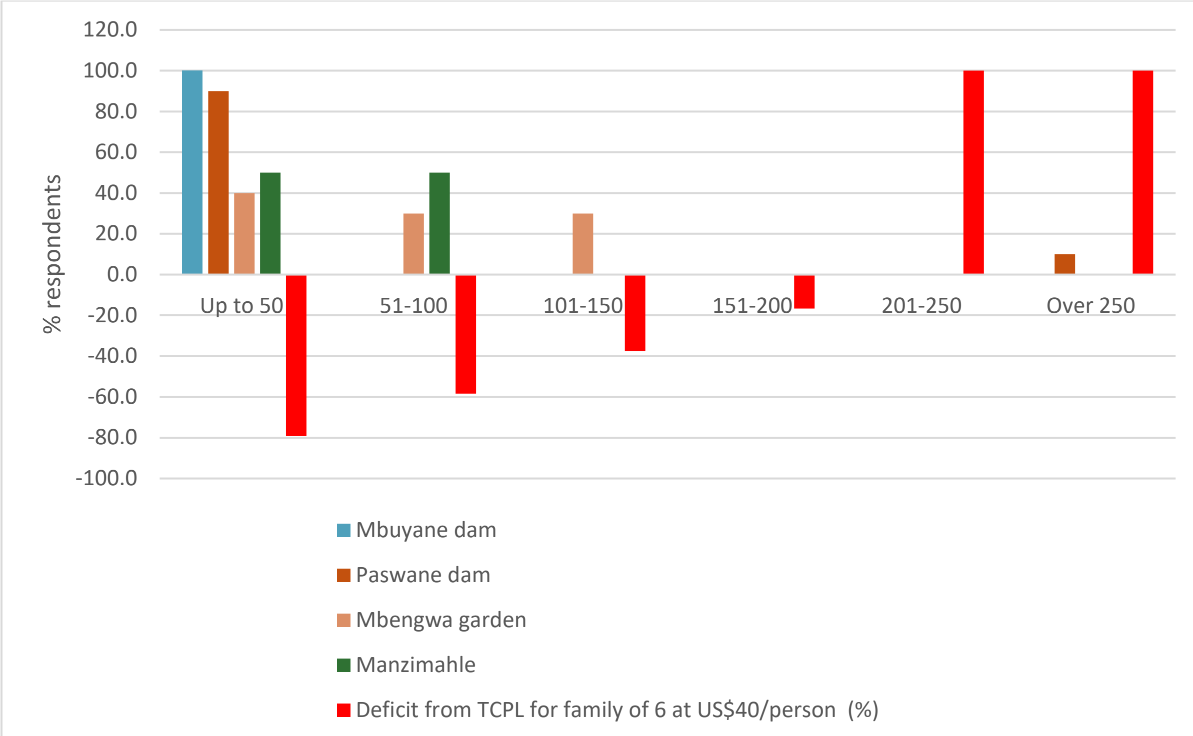

Figure 15. Average household income as a proportion of the Total Consumption Poverty Line and % deficit from the TCPL in Amalima sites

Other benefits: Food security, incomes and livelihood diversification and poverty reduction

Farmers grow a wide variety of crops, which include maize, tomatoes, groundnuts, covo, rape, carrots, butternuts, onions, beans, garlic, broccoli, beetroot, okra, and watermelons. This provides a diverse source of foodstuffs including carbohydrates, proteins, and other nutritional requirements. Given the variety of crops grown in the schemes by the households, this should contribute to improving the health and nutritional status of project households, as they are now consuming a wider variety of food products.

Crop yields are also increased when there is higher availability of water. Maize, which is normally grown under rainfed conditions, has improved yields when irrigation water is available. In addition to food and nutrition benefits, community members can also sell surplus to earn household income, which can be used to meet various household needs, as well as the operation, maintenance, and replacement costs of MUS. Provision of water also reduces vulnerability of communities to climate-related and other shocks (i.e., Covid) by reducing poverty and facilitating more diversified livelihood strategies supported by increased household income and food security.

Impacts on human health

Out of the ten sites that were sampled, only water from three sites (Toindepi, Cheshanga, and Paswani) were found to be potable. For all the three sites the water was boreholes. This confirms why borehole water is regarded as safe water to drink water. Water from Manzimahle borehole was infected probably because of poor water handling -there was no direct provision water for domestic purposes from the borehole. The high ionic activity in the water samples from the boreholes indicate salinity threat, which could lead to other challenges such as suitability for other domestic water uses such as laundry. All samples from surface water sources were infected except for the water from the second tank of the water treatment plant in Nyimai. The fact that surface water can be treated effectively is a positive development, but the cost of the treatment is high, making is a less viable option.

The morbidity and mortality impact of unsafe water are quite significant. It is estimated that a child born in Europe, or the United States is 520 times less likely to die from diarrhea disease than an infant in sub-Saharan Africa, where only 36% of the population can access hygienic sanitation. [89]

Impact on women and girls' welfare

The majority of respondents (among whom the majority were women), except for Musvinini and Nyimai, regarded the amount of water as inadequate for household water uses. This was cited as being due to unreliability of water sources and operational challenges.

The inadequate amount of water in Toindepi, Zinhuwe, and Cheshanga, coupled with poor quality water in all but Toindepi and Cheshanga, had a negative impact on the women and girls who fetch domestic water, forcing them to walk extra kilometers in addition to their irrigation responsibilities. When looking at internationally accepted indicators for acceptable water provision, the case for a MUS approach in these communities becomes clear. [90] While the maximum number of people per water sources across all water projects (Table 3) was within the recommendations, the challenges related to low discharge rate, which affected queuing time due to water sources and systems that were not well designed and maintained.

Box 2. Key indicators of acceptable water provision

- Average water available for drinking, cooking and personal hygiene in any household is at least 15 liters per person per day;
- Maximum distance from any household to the nearest water point is 500 meters;
- Queuing time at a water source is no more than 15 minutes;
- It takes no more than three minutes to fill a 20-litre container;
- Water sources and systems are maintained, and appropriate quantities of water are available consistently or on a regular basis;
- Maximum numbers of people per water source depends on the yield and availability of water at each source:
    - 250 people per tap based on a flow of 7.5 liters/minute
    - 500 people per handpump based on a flow of 16.6 liter/minute
    - 400 people per single-user open well based on a flow of 12.5 liter/minute

Irrigation technology choice

There is a need to balance the preferences of communities with efficiencies of technology choice (and sustainability considerations). For example, the use of buckets for irrigating from water troughs was considered to be labor intensive while the introduction of drip irrigation in Cheshanga was met with disinterest to the extent that it was replaced. This reinforces the need for meaningful community

[89]https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/Sphere/SPHERE2%20 %20chapter%202%20 %20Min%20standards%20in%20water,%20sanitation%20and%20hygien.

[90]These are qualitative in nature and specify the minimum levels to be attained in the provision of water. Available at: https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/Sphere/SPHERE2%20 %20chapter%202%20 %20Min%20standards%20in%20water,%20sanitation%20and%20hygien; Signals that show whether the standard has been attained, which provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used , which may be quantitative or qualitative. Available at: https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/Sphere/SPHERE2%20 %20chapter%202%20 %20Min%20standards%20in%20water,%20sanitation%20and%20hygien

engagement in technology choice to effectively balance between the potential efficiencies and the capacity and preference of users to operate and maintain the technology. Participatory irrigation planning, design, and management are therefore key for MUS project sustainability.

Livestock development

Livestock watering was among the three most important uses according to communities. Indeed, the need to provide water for livestock was one of the drivers for the construction of the Musvinini, Nyimai, and Zinhuwe dams. Attributing the number of livestock saved by increased water provision is difficult because the number of livestock that was served by each water source is unknown and because this is conflated with availability of grazing. However, small dams are more suitable to livestock watering as they respond rapidly to precipitation and runoff and harness sporadic, spatial, and temporal rainfall that are common in semi-arid environments. If small dams are to make a sustainable contribution to livestock development in the country, there is a need to ensure that the design matches the small catchments the water requirements. Boreholes also provide water for livestock production, but this competes with other uses, such as irrigation and domestic water provision.

Community development

By its nature, collective irrigation in all its dimensions –planning, design, and management –requires a community to come together. All communities involved in water projects co-operated across many aspects from constructing small dams to community-led and managed irrigation management. Selection of beneficiaries in the irrigation was based on volunteering but also considered contribution to construction of the water source and inclusion of disadvantaged community members.

5. CONCLUSIONS

This section presents the conclusions of the study as a step towards providing actionable recommendations for interventions designed to increase the reliability, resilience, and overall success of MUS in the implementation areas, as well as in other USAID BHA-funded projects in Zimbabwe and in other countries. The conclusions speak to the research questions of the study (see Section 1.2) in a consolidated manner.

5.1 MUS by Default and Not Design

The ENSURE program specifically included some design elements for MUS (i.e., irrigation-plus by building in-scheme water treatment plants to provide drinking water, but not domestic water) in Musvinini, Nyimai, Chemvuu and Zinhuwe. There were no similar efforts under Amalima. As a result, communities resorted to using existing projects for non-designed uses and relied on other water sources for domestic needs.

Both in the projects that were designed for multiple uses and those that focused on a single use, there were difficulties related to the chosen technology, its use, the siting of interventions and seasonal or climate-induced scarcity that have limited the ability of communities to receive the full benefits of MUS interventions at the project sites. In some cases, the projects attempted to balance the sustainability of the resource with community priorities by selecting water-saving technologies, such as drip irrigation or smaller pumps, which were eventually rejected by the community. This indicates a need for additional awareness raising during the planning phase both related to the resource capacity and the options for technologies that are acceptable to the community. This, in turn, points to the need for more comprehensive guidance on the process to be undertaken for community-driven MUS.

The Presidential Borehole Program presents a potential opportunity for clarifying how projects can best be designed, implemented, and sustained for community-led MUS. The program is clearly designed to provide for multiple uses (domestic needs, irrigation, livestock watering, and aquaculture schemes). However, it also appears to be quite top-down with respect to the selection of technology (solar boreholes) and the siting of infrastructure. There is also a need to uncover whether and how these interventions are accounting for and providing an opportunity to build on self-supply and farmer-led irrigation where those exist, to recognize customary practices that can help sustain MUS interventions, and to ensure financial sustainability over time. As indicated in Section 2.1 of this Report, lessons from South Africa and globally have indicated that truly community-led approaches to MUS provide the greatest opportunities for identifying ways to embed MUS in and build on existing community structures, saving resources and promoting sustainability in doing so. At the same time, there is also a critical need to ensure that vulnerable members of communities, including women and youth, are also engaged in MUS from the beginning to ensure that outcomes are equitable and tailored to achieve gender equitable poverty alleviation.

5.2 Improving the Legal and Policy Framework for MUS

The analysis of legal frameworks governing MUS in Zimbabwe (presented in Section 4.1 of this report) highlight that there are no explicit provisions governing MUS planning and implementation. Rather, the mandates for various aspects of MUS – generally coming from sub-sectoral, single-use perspectives – remain scattered across various pieces of legislation and regulations. This presents a key issue in terms of the ability of the relevant institutions to be able to coordinate effectively as evidenced by the failure to align catchment operational plans that allocate water (and define primary water exempted from permitting) with district and provincial development plans that determine which MUS interventions will be financed and supported. Existing funding opportunities under the current legal framework (such as the Irrigation Fund and the Water Fund) have failed to achieve their potential, leaving agencies with few resources to support a coordinated and strategic approach to MUS. Climate impacts and potential for leveraging climate finance for MUS has been largely overlooked to date. Rather, donors and NGOs have attempted to fill these gaps, resulting in interventions that are guided by these partners' strategic priorities and funding rules.

Another significant challenge related to the operationalization of MUS in Zimbabwe is related to the failure of the Water Act (and other legislation) to recognize the full range of water tenure rights that should be accorded to communities if they are invest in sustaining MUS over time. The Water Act recognizes primary water uses as being exempted from permitting requirements, but the precise contours of the definition of "primary uses" is left to the discretion of catchment councils. This creates a situation where legitimate water rights practiced by a community under customary law may or may not be recognized as primary water uses and exempted from permitting. It also creates a situation where some communities may be entitled to water resources for livelihoods and food security purposes, where others must obtain a permit and pay for the management of water resources. Moreover, when conflicts arise, rights that are exempted from permitting often have less practical legal standing than permitted rights. Thus, communities are left with little tenure security.

This issue is compounded by the fact that some sub-catchment councils, which have the power to levy commercial water use (any uses above primary) have labeled primary uses as commercial to obtain user fees. This has been aggravated by Statutory Instrument 291 of 2000, which requires communities to pay registration and authority to drill fees for boreholes. [91]

Another clear gap in existing legislation is the need for more robust stakeholder and community consultation requirements. Currently, communities are required to be engaged through representatives in planning and decision-making and are provided with opportunities to comment when planning

[91]GoZ (2021) Statutory Instrument 291 of 2020: Water (Subcatchment Councils) (Rates) (Amendment) Regulations, 2020 (No. 8). Harare: Zimbabwe.

documents are drafted. These opportunities are rarely tailored to communities' needs or capacities. Moreover, women's water rights are not recognized, either as a priority for ensuring equal access for primary use rights or for mandating women's inclusion in decision-making.

The ongoing process to revise the Water Act, the ZINWA Act, and the Rural District Councils and Urban Councils Acts could provide a key window of opportunity to address these gaps, specifically:

- More clearly recognizing MUS as a policy priority, defining its scope and applicability in Zimbabwe, and linking MUS to use prioritization decisions and development priorities;
- Clearly defining institutional roles, finance streams, and coordination mechanisms for MUS planning, implementation, and ongoing support;
- Clearly defining primary water and aligning the definition with goals for poverty alleviation and water and food security;
- Clear recognition of communities' customary water tenure rights and how those relate to legislative rights;
- Democratization of the catchment and sub-catchment councils to ensure they are engaged with communities and their representatives to reflect their needs, priorities, and capacity limitations in planning for allocation; and
- Developing alternative funding mechanisms for catchment and sub-catchment councils to enable them to operate more effectively without relying on users' fees.

5.3 Partnerships for MUS

Empirical evidence showed that there is a robust institutional framework, which brings all the partners involved in rural water supply together in the form of the Provincial and District Water and Sanitation Committees as well the Provincial and District Food and Nutrition Committees. The framework is, however, compromised by a lack of adequate financing and coordination.

Inadequate finances also compromise the operations of state agencies, such as RDCs, DDF and AGRITEX, the Department of Irrigation, and the Department of Mechanisation, all which provide expertise that is vital to MUS planning, implementation, and sustainability. A related challenge is the fact that the Departments of Irrigation and Mechanisation, and services such as borehole surveying, which are not represented at District level, further compromising their ability to support communities with MUS.

As noted above in the discussion on legal frameworks, there is also a need to better capacitate Catchment Councils and Sub-Catchment Councils to be able to discharge their mandates related to resource assessment and monitoring, as well as planning, allocation, and management of water resources. These institutions should be able to provide critical data and structure the priorities for MUS in ways that are responsive to communities needs and priorities and aligned with district and provincial development plans. In order to achieve these mandates, however, substantial financial and technical capacity support will need to be provided so that they do not fund their operations solely from user fees.

Additionally, while efforts have been made to operationalize decentralization and some funds are being provided at RDC level, each department still has its siloed, core mandate and each is required to report to and maintain accountability to provincial and national levels. It is important that the powers are devolved to the local levels so that their priorities will inform water investment decisions. Powers could be decentralized to the tiers below the sub-catchment council level to the ward or water user association level.

The above challenges indicate the need to develop a clear partnership framework that defines MUS and clarifies what is required from an institutional perspective for state and non-state agencies to effectively support its implementation.

5.4 Community-Led Approaches

Community participation was regarded as a critical foundation for all the projects. However, there are several challenges faced by the projects assessed that indicate a need for a more consistent, in-depth engagement of communities throughout the planning, implementation, and post-construction phases of MUS projects. This has been recognized by the RFSAs, which are now including a “community visioning” process as an integral component of their planning process, including for MUS interventions.

While there must be a balance under community-led MUS that respects community priorities while recognizing financial constraints and the need for ensuring resource sustainability, there should also be mechanisms for engendering more community-led approaches that help community members determine those balancing factors with a full understanding of the implications of the decisions being made. This includes managing expectations where budgetary constraints may limit the extent of possible responses. Examples of where this may have been a limiting factor was in projects that introduced drip irrigation technologies that farmers ultimately rejected, the lack of or limited provision for water at and near homesteads to meet domestic needs, and the installation of low-capacity pumps in irrigation schemes. In the end, each of these choices appears to have undermined sustainability of MUS interventions. While there may be solid technical or financial reasons for introducing these technologies at the selected sites, increased investments in awareness raising and community capacity building around these choices could avoid the perception that only one, predetermined solution is possible and being imposed from the outside. Additionally, such engagement can elicit additional effective, community-proposed, or agreed alternatives. It is not clear whether these challenges were a result of limited resources for more intensive community participation, particularly in the planning and design phases.

Additional investment in more community-led approaches can also help to more clearly define the actual capacities and resources available to support and sustain MUS over time. While most respondents at the community level indicated a willingness to pay for additional infrastructure costs (including operation and maintenance), the extremely limited income levels of most community members and the long time horizons for repayment of costs for MUS (between 10 and 40 years in this case) constrain what is actually possible. Such an assessment with the community early in the planning process can help to identify what financing gaps need to be filled by government (or other) partners.

Finally, community-led approaches may help to identify the range of specific social benefits that should be accounted for in assessing the viability of various MUS approaches. For example, where an increased focus on domestic source improvement could enable nutrition and health benefits for women and children or increased income diversity for women where such sources become “domestic plus” in ways that save labor and time spent fetching water for various uses.

5.5 Financing MUS

The financial analysis showed that communities failed to meet O and M costs across all projects, despite an expressed willingness to pay. This was partly due to optimistic assumptions regarding the capacity of communities to meet the full operation maintenance and replacements costs, which was not the case. This underlines the need for a clearer understanding during the project planning phase of what costs communities can feasibly cover, the resulting the level of support required, the partners available to provide such support over time and any reasonable alternatives. A common approach to such assessment should be created and applied consistently to all MUS projects across the country, including those funded by the state and non-state actors, as well as self-supply schemes.

Additionally, it appears that more investment must be made in the planning phase of MUS to ensure that not only financial planning and alternatives can be clearly identified, but the necessary community engagement and capacity building can be undertaken (see 5.4 above). This indicates a need for more flexible funding mechanisms overall from both national and partner funding sources.

5.6 Domestic Water Uses

The lack of central focus on provision of water for domestic water uses (or primary uses) across the projects indicates a need for more holistic approaches to MUS that place such uses at the center of all planning. While it was expressed that there was an expectation that domestic uses would be addressed by other partners operating in the area of the projects, the failures to achieve actual MUS with provision for primary uses indicates the need to engage all partners at the community level to ensure a truly integrated, community-driven and strategic approach to MUS. Such an approach is particularly critical for ensuring that women's and other vulnerable stakeholders' water needs and priorities are met.

5.7 Water Quality

Provision of potable water is critical. Water quality analysis proved that boreholes were source of safe water, but that other sources required treatment. While surface water treatment is possible, the cost is often prohibitive and is not necessarily required for all uses, not even all domestic uses (such as laundry, sanitation, etc.). It is therefore important to explore point of use treatment options and assess their financial and cultural viability.

Additionally, it was clear that water quality monitoring is not taking place at most sites. This indicates the need for exploring alternative mechanisms for monitoring, such as training community members to take and process samples. This is critical not only for drinking water, but also for fisheries, aquaculture, growth of reeds for crafts and other direct uses of surface water bodies.

5.8 Water Resources/Supply and Climate Change

Climate change is already impacting the availability of and uncertainty around availability of water resources in Zimbabwe, including both surface and groundwater. Climate impacts include increasing levels of extreme weather events (droughts and floods), higher levels of evapotranspiration, and changes to precipitation patterns. MUS provides a clear mechanism for promoting resilience to these impacts where it provides benefits related to livelihoods and income diversity, food security, and improved community water security and water management.

Currently, however, climate is not mainstreamed into water resources management decisions and planning. Institutions responsible for water resources management (i.e., ZINWA and the catchment and sub-catchment councils) need to coordinate with EMA and other agencies responsible for climate planning and finance to coordinate responses under MUS. For example, there is a need to revise parameters for irrigation development and water supply under different climate scenarios that required coordinated action from across multiple water and agricultural agencies, in addition to climate actors.

MUS interventions should also consider the adaptability of technology to increasingly scarce or sporadic availability under climate change and build capacity of communities to undertake adaptive management approaches.

Another key aspect of ensuring that MUS is climate-resilient is ensuring appropriate source assessment processes prior to siting infrastructure and selecting technology. Communities must also be trained in water efficient technologies and practices and climate smart agriculture. Ongoing initiatives in Zimbabwe could readily be leveraged to promote these aspects of MUS.

The harder question is how to garner sufficient technical and financial resources to ensure ongoing water resource assessment and monitoring. The available data on groundwater resource quality, availability, and recharge is especially critical for investments in MUS where groundwater is the only source of water left in the dry season. The Presidential Borehole Programme, which aims to drill 35,000 boreholes without any comprehensive assessment of aquifers, could pose a risk to groundwater resources. Where data is lacking, local knowledge can be leveraged through community-led MUS.

6. RECOMMENDATIONS

Based on the literature review, field data collection, observations and validation feedback, the following recommendations are proposed to improve multiple dimensions of wellbeing in cost-effective and sustainable ways. The recommendations are layered to provide more specific interventions that can be undertaken to address the gaps as identified in the Zimbabwean context and more generally applicable planning and programmatic interventions that can be undertaken by BHA, RFSAs and implementing partners to increase the reliability, resilience, and overall success of MUS in the implementation areas, as well as in other USAID BHA-funded projects in Zimbabwe and other countries.

Recommendations for the Zimbabwean Context

National level water sector agencies should:

- Articulate a clear policy commitment to community-led MUS that is coordinated at the district level and aligns with integrated development and water planning goals.
- Create clear guidance on community-led MUS that:
    - Clarifies institutional roles and mandates for MUS planning, technical and institutional/governance support, financing, and resource sustainability;
    - Clearly articulates mechanisms for meaningful community engagement from planning onward;
    - Recognizes, accounts for, and, where appropriate, builds on existing customary rights and practices around water allocation, management, and conflict resolution;
    - Recognizes, accounts for, and, where appropriate, builds on existing self-supply and farmer led irrigation investments, practices, and infrastructure;
    - Integrates resource sustainability assessment and management from planning onward, including accounting for likely climate impacts on the resource over time;
    - Includes water quality assessment and monitoring options tailored to community practices and resource availability.
- Seek improved coordination mechanisms across relevant agencies and non-governmental partners for more effective, efficient, and inclusive MUS interventions.

These developments should be made through a consultative process engaging stakeholders from all water sub-sectors and other relevant sectors (i.e., agriculture, land, environment), and including local government, civil society, and community representatives, to create a national MUS policy that clearly articulates a definition of and commits to a rights-based, community-led MUS approach that is coordinated at the district level and aligns with development and water plans. Such a process could be embedded in the ongoing policy and legislative reform process in the water sector.

Additionally, this reform process should provide a platform for undertaking additional, specific actions to further support more effective planning, implementation, and sustainability of MUS in Zimbabwe. These include:

1. Clarifying the legal definition of "primary water" uses to include small-scale productive uses and align with the Constitutional rights to water and to food and integrated development goals;
2. Clearly defining institutional mandates with respect to MUS planning, implementation and ongoing support and incentives for improved coordination across sub-sectors;
3. Assessing options for ensuring that Catchment and Sub-Catchment Councils can achieve their mandates and support MUS by, for example: creating new finance mechanisms for their operations; building capacity for resource assessment, data collection, and ongoing monitoring; seeking ways to limit the geographic scope of sub-catchments to align better with resource availability; revising the registration and authority to drill fees for boreholes to reflect policy priorities for MUS in rural communities;
4. Elaborating more detailed and meaningful community and stakeholder participation requirements for policymaking, legislative and regulatory drafting and amendments, planning processes, and other decisions and processes (such as permitting large users) that could impact communities' water rights;
5. Exploring ways in which recognition of customary tenure and other existing practices (including self-supply and farmer led irrigation) can support effective allocation, use and management of water under MUS and facilitate conflict resolution;
6. Explicitly recognizing and protecting women's water rights by, for example: requiring the creation of gender sensitive by-laws and committee constitutions that recognize and affirm women's rights to participate in local-level resource governance and setting legal quota requirements to ensure that women hold a certain percentage of leadership roles in relevant decision-making and governance bodies;
7. Mandating the creation and maintenance of a data and information management system to document existing water projects especially on how MUS can be incorporated and inform future projects. Such a database should draw upon and complement the current Zimbabwe's Rural WASH Information Management System (RWIMS); and
8. Providing a clear mandate for creation of detailed and tailored MUS guidance that promotes rights-based, community-led MUS and can be adapted at the District level to align with district and catchment operational plans.

Recommendations for BHA, RFSAs, and Implementing Partners

The overarching recommendation for BHA and implementing partners is to **develop a more specific set of steps and guidance for completing those steps when undertaken MUS interventions**. A set of recommended steps and tools proposed is provided below. These draw not only on the findings from Zimbabwe, but also from experiences in implementing MUS in other countries. These steps and tools are structured to foster increased community engagement and to account for critical assessment needs that can assist donors and implementing partners determine whether and how MUS can be sustained beyond project interventions based on the specific financial and technical capacities of communities and local partners and the status of the water resource itself. Additional, specific recommendations for BHA and implementing partners include:

1. **Donor/implementing partner coordination.** The results of the Zimbabwe assessment demonstrate that reliance on various partners to undertake pieces of MUS planning and implementation do not provide the integrated set of benefits to communities that a singular, community-driven approach could. Specifically, in Amalima projects, domestic use needs were deliberately not included, as it was expected that other organizations functioning in the region would fill those needs. Where possible, it is recommended that BHA and implementing partners work closely with other donors and partners to coordinate MUS interventions at the local level to leverage complementary funding and expertise that can benefit specific communities in an integrated way.

2. **Investment in planning phase and flexibility.** As demonstrated in the recommended steps below, the planning phase for MUS requires several components that require additional resources. MUS projects should be designed to account for these needs and to maintain flexibility in allocating project resources to be able to respond to the outcomes of more cooperative (community-led) planning approaches.
3. **Accounting for multiple dimensions of well-being as project goals/outcomes.** A key issue in Zimbabwe is the financial sustainability of MUS, given extremely high poverty rates and constraints in government resources/capacity. While infrastructure and O and M costs must be met for MUS to be viable, it is important to account for the multiple dimensions of well-being that can be improved through increased access to water for various priority uses and the ways in which these benefits contribute, in turn, to increased livelihoods viability. Ultimately, such benefits can contribute to MUS financial sustainability, albeit through less direct pathways. Moreover, the uses addressed under MUS often are priority needs in the absence of better alternatives. Meeting those needs also enhances users' ability and willingness to maintain the infrastructure. Accordingly, it is recommended that BHA and implementing partners develop mechanisms for identifying and accounting for such benefits, such as increased nutritional diversity, health outcomes, diminished labor and time costs for women and girls, and so on.
    a. Where funding or agency mandates require prioritization of specific uses, implementing partners can cost-effectively enable additional uses by leveraging "plus" approaches, such as the "irrigation-plus" or "livestock-plus" approaches demonstrated in the cases studied in Zimbabwe. A "domestic-plus" approach can be leveraged to help communities "climb the water services ladder" and achieve multiple, reinforcing benefits as described above.
4. **Addressing water quality.** Support agencies designing water infrastructure for productive uses raise the valid concern that this water might not be safe for drinking. However, it is important to note that drinking water quality is not needed for the higher volumes of water for other domestic uses (e.g., hand washing, cleaning, bathing, laundry) and thus relates only to a smaller quantity of water. Regardless of the source of contamination (even in surface water systems designed for domestic uses, treatment often fails, or contamination occurs in transport, storage, and use) there are an increasing number of solutions available to address water quality concerns that can be targeted specifically to the quantities needed for drinking. It is recommended that implementing partners account for water quality assessment (see more on this in process recommendations below) and treatment needs by exploring the cost-effectiveness and social acceptability of point-of-use treatment (e.g., filters, chemicals, solar disinfection). Where regular monitoring is uneven or missing, communities could also be trained to test local sources on an ongoing basis.
5. **Building on community visioning to achieve community-led MUS**. As evidenced by the Takunda community visioning outcomes,[92] this process can provide an important first step in planning for and implementing MUS. Embedding MUS goals into a Community Action Plan can help determine how various MUS interventions can achieve multiple community goals simultaneously. It is recommended that BHA and implementing partners take up this visioning process and the lessons learned from the Zimbabwe RFSAs as a first step in planning for community-led MUS. This should then be complemented and built on by the recommended steps and assessment tools below.

Recommended Steps and Assessments for Community-led MUS

[92] See Takunda Community Visioning Culmination Report, December 2021. This report highlights several MUS-related priorities for achieving the communities' vision for development.

Community-led MUS operationalizes well-known community participation tools for the specific case of water infrastructure. This includes life cycle considerations, professionalization, and embeddedness in local government structures (as applied by the WASH sector) or local arms of line agencies (as in the irrigation sector). Moreover, a community-led MUS approach goes beyond a pre-determined focus on one specific, externally designed infrastructure. Instead, the project cycle is rearranged to ensure that communities **co-design** the solutions according to their priorities considering communities' entire spatial scales. The following recommendations are framed according to common steps that have been used successfully for MUS planning and implementation in a number of contexts. [93]

Step One: develop multistakeholder MUS institutional forum and develop mutually agreed expectations and process

The first step is to identify and engage with MUS stakeholders, including future users, community leaders, relevant local government and line agencies, and basin or catchment institutions, etc. Purposive inclusion or explicit targeting of the most vulnerable (including women and youth) is imperative at this earliest planning stage to be able to include perspectives from these stakeholders from planning onward.

Whether in a workshop setting or multiple, smaller forums, mutual expectations should be discussed and endorsed by all parties. Governmental and non-governmental support agencies can indicate at this stage what capacities they can contribute. This should consider engineering, hydrological, and technical expertise and financial resources for water infrastructure, but also expertise to help communities identify and realize the full range of benefits from MUS. For example, ensuring safe water and hygiene measures, accounting and recordkeeping skills for water/infrastructure management, inputs for nutritious livestock and crops for food security, and expertise on markets for sustainable income generation.

If the range of technical options, financial resources, priority uses, or timelines for support by implementing partners is limited, this is the stage at which agencies can transparently explain those limitations and the implications for developing options for MUS. Implementing partners can also clearly stipulate any technical, financial, or institutional conditions for support from individual end-users, local technicians, and government agencies that will be necessary for sustainably managing the collective system. This "meeting each other half-way" should continue from planning and implementation to post-construction.

Next steps in the participatory process should be outlined at this stage, as these processes may be new to communities. If these broad conditions and commitments are not agreeable to any party, the project ends here, or is adjusted.

Step Two: Participatory diagnosis of existing assets and problems

At this stage, communities are engaged in 2–3 facilitated meetings and transect walks during which communities map and explain their land and waterscapes. These meetings should consider whether to break down participants by gender for women to feel free to express their perceptions, needs, and

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[93] ACP EU Water Facility Project. 2010. Guidelines for Water for Livelihoods: Addressing water and sanitation needs of the rural poor in the context of HIV and AIDS in Zimbabwe. Water Facility Project 2006-2011. EU, UNICEF and ZimWash;
Adank, M, van Koppen, B., and Smits, S. 2012. Guidelines for planning and providing multiple-use water services. [CGIAR Challenge Program-Multiple-Use Water Systems (CP-MUS) Project guidelines]. Hague, Netherlands: International Water and Sanitation Centre (IRC); Pretoria, South Africa: International Water Management Institute (IWMI). 123p. http://ifad.org/english/water/pub/mus_guidelines.pdf; van Koppen, B.; Molose, V.; Phasha, K.; Bophela, T.; Modiba, I.; White, M.; Magombeyi, M. S.; Jacobs-Mata, I. 2020. *Guidelines for community-led multiple use water services: evidence from rural South Africa.* Colombo, Sri Lanka: International Water Management Institute (IWMI). 36p. (IWMI Working Paper 194).

priorities. These maps identify: (1) residential, crop land, grazing areas, forests, and roads; (2) the dispersed, multiple surface and groundwater sources accessed and used by the community that vary with the seasons; (3) consumptive and non-consumptive (e.g., fisheries) water uses; and (4) all existing infrastructure used to store and convey water for multiple water uses to meet diverse livelihood strategies. Infrastructure is likely to be multi-purpose, and either public infrastructure or owned by individual households or self-organized sub-groups for self-supply. Mapping enables issues to be clearly diagnosed (including gender inequities), revealing available community assets (including often-ignored self-supply or geo-hydrological knowledge), primary and secondary water sources, historical and current coping strategies against droughts and shortages, prioritization of water uses, conflict resolution mechanisms, customary practices, and possibly already ongoing negotiations with upstream and downstream communities. This broadens the range of interventions and sustainable solutions.

Step Three: Envisioning and prioritizing sustainable, cost-effective, life-cycle solutions/technology choices

At this stage, communities are asked to identify and rank the range of possible solutions and technology choices, including the life cycle requirements of each option. If basic domestic uses are not yet met, this is likely to emerge as priority. This may be expanded upon to include homestead-based production. Solutions can include support to self-supply by individual households or sub-groups. Co-funding arrangements, as also found in the study, should also be identified for the most robust and inclusive design options.

Solutions should explicitly consider gender equity goals and strive to support the recognition and protection of women's water rights, needs, and priorities. For example, solutions can include requiring the creation of gender sensitive by-laws and committee constitutions that recognize and affirm women's rights to participate in local-level resource governance and setting legal quota requirements to ensure that women hold a certain percentage of leadership roles in relevant decision-making and governance bodies.

Support agencies and implementing partners facilitate this process and provide technical and institutional advice, checking and – where necessary – improving the feasibility and sustainability of proposed solutions. Full transparency about costs is assessed and provided to future users. Siting decisions should be based on considerations of resource availability, sustainability, and inclusivity – i.e., sited on land and at a distance that provides tenure security and accessibility to all. Ex-ante assessments of post-construction technical, financial, and institutional requirements by all parties at this stage can support timely adjustment, or even rejection of certain solutions, in favor of other solutions. This identification, screening, and ranking of solutions may take 2-3 additional community meetings. Moreover, sufficient time is needed to allow communities to consider options among themselves.

Communities' identification and ranking of their preferred solutions, with the necessary technical advice, contributes to: (1) cost-effective mobilization of all existing natural, technical, financial, institutional, and social capital, including self-supply; (2) realistic expectations and commitments to post-construction requirements; (3) capacity development; and (4) last but not least, ownership.

At this stage, it is useful to identify and assess any requirements that may accompany various options. This includes administrative requirements (including applicable fees) for ensuring the necessary water rights and other permissions are feasible and affordable. In Zimbabwe, for example, the discretionary definition of primary water by Catchment Councils has led to some communities being required to pay for MUS interventions where others remain exempted from those costs. Implementing partners could also seek to establish dispensation for all MUS projects by negotiating with the relevant government agency. In Zimbabwe, rather than seek permission on a case-by-case basis, the RFSAs could seek special dispensation for all MUS projects they are implementing through the District Water and Sanitation Committees and the Provincial Water and Sanitation Committees.

Security of tenure may also require additional permission(s) from landowners or landholders where irrigation schemes, gardens or other new land uses are required. BHA could facilitate this process by creating a checklist of potential activities that need to be undertaken to ensure the relevant administrative permits (or other processes) and permissions are acquired. In Zimbabwe, for example, the current practice of seeking written permission from the landowner counter-signed by the Village Head and Rural District Council, should be strengthened by making this part of the check list of activities that should be undertaken. Of critical importance is the need to ensure that land which is used by vulnerable persons such as women is not granted without explicit and freely given permission of those persons. It is also important that the land is close to the homesteads as possible so that women, who tend to be in the majority in the projects, do not have to travel long distances.

A full financial sustainability assessment based on the full life cycle costs of the options provides additional, critical insights into which options are most viable and where partners will need to support communities in sustaining MUS. Life cycle costs are the aggregate costs of ensuring the equitable and sustainable delivery of adequate water services, and include the cost of constructing infrastructure, maintenance over short- and long-term, replacement costs, and indirect support costs of the enabling environment such as capacity building, planning, and monitoring. Box 2 shows the cost elements that relate to operating and maintaining a water infrastructure.

Box 3. Elements of life cycle costs

Capital expenditure (CapEx) - hardware and software includes infrastructure and community mobilization, awareness raising and capacity development programme.

(***Operating and Minor Maintenance Expenditure (OpEx):*** are the requirements for recurring regular, ongoing expenditure viz. labor, fuel, c material, and purchases of parts.

Capital Maintenance Expenditure (CapManEx): focus on depreciation, replacement, and rehabilitation; works other than routine repair and maintenance and replacements

Cost of Capital (CoC): refer to the cost of financing a programme/project and include. the cost of accessing the funds needed to construct a system

Expenditure on direct support (ExDs) includes expenditure on both pre-and post-construction support activities,

Expenditure on indirect support (ExIDS) include the macro-level support, capacity building, policy, planning and monitoring that contribute to the sector working capacity and regulation but are not particular to any programme or project,

Total Expenditure (TotEx) is determined based on fixed assets and aggregates of the costs of all the components indicated above.

Step Four: Fitting the Financial Framework

Final decisions on site and technology selection and fund allocation among prioritized solutions of communities are in implementing partners'/support agencies' hands. They also remain accountable to their funders for transparent procurement and establishment of contracts with competent private or public implementers. However, criteria for decision-making need to be transparent and communicated to those who 'lose.' The rejected solutions may still attract other public or private funders or be funded in the future.

Community-led co-design of prioritized solutions offered for funding differs from conventional approaches. Especially for larger-scale, high-tech infrastructure, pre-feasibility and feasibility studies and designs that precede any funding, are done with minimal user participation. Implementers only continue with implementation on the ground once budgets are guaranteed. If this approach is applied in low-income rural areas, implementers mainly need to get approval in a community, to know the naturally determined geo-hydrological options and find a site, including changes in land titles to ensure public infrastructure is accessible for all. After construction, supporting agencies 'hand-over' and withdraw, assuming that communities and local government will take care of all post-construction requirements. Interactions with village leaders and limited documentation may do.

In contrast, for the smaller-scale infrastructure in community-led MUS, communities' co-design may save time compared to external feasibility and planning studies and detailed designs for approval of funding. However, separate funding may be needed for community-led design, and ultimate funding cannot be guaranteed upfront. Expectations need to be managed. Further, funding to communities needs to be transparent and well-documented to avoid rumors and accusations that certain people 'eat money.' This indicates a need for BHA and implementing partners to develop a list of necessary documentation and integrate capacity building for local institutions on record-keeping and other necessary skills to ensure that costs, materials and other critical inputs and outputs are monitored and shared transparently with all users.

Step Five: Implementing Construction

Procurement of materials and labor for implementation tends to be more cost-effective if done locally, where possible. This also develops capacities and relevant contacts with suppliers. When private companies are contracted, communities can be involved, for example in labor provision and final approval of performance before payment.

Box 4. Operation and Maintenance Planning

Operation and maintenance plans are key to sustainability of projects. Operation refers to routine work, which encompasses direct access to the system by the user (e.g., operating the hand pump), to the activities of any technical operational staff as a routine function relating to operating headworks, motorized pumps, conveying and distribution of water. Maintenance is the art/act of keeping the components in an optimum working order. Both operation and maintenance require skills, tools, and spare parts.

Key steps in developing an Operation and Maintenance Plan include:

- Step 1: identifying the key operation and maintenance activities. These should be quantified in terms of the expert and semi-skilled and unskilled labour and should eventually lead to an Operation and Maintenance Manual.
- Step 2: assess the capacity of the community to undertake operation and maintenance activities. This should result in a Training Manual based on a capacity needs assessment.
- Step 3: determine the financial implications of the activities identified in Step 1. An important output is to identify the financing gap and how it can be closed rather than assume that the community can meet the full Operation and Maintenance costs. Ultimately, a fully costed Operation and Maintenance Financing Plan should be produced.

Voluntary or modestly remunerated construction labor by community members and local artisans create ownership of the infrastructure. In that sense there is no 'hand-over' but finalization of the construction phase to start the use. Completed works and agreements about the organization of operation and maintenance and user contributions need to be documented.

Step Six: Post-construction Support

Operation, maintenance, and small repairs should follow earlier agreements and updated as needed. To facilitate handover and ensure ongoing transparency and accountability, BHA and implementing partners could create a list of necessary documentation, roles for post-construction support, and additional capacity needs to supplement the project outcomes. Where, as for major repairs and rehabilitation, external support may remain needed, this should be clearly indicated in the plans, including identifying the relevant partners who will supply that support.

Following implementation, a final consideration is to ensure ongoing exchange and learning from across MUS interventions. It is recommended to require documentation and develop platforms for sharing experiences with *de facto* multiple uses, the "plus" approaches and community-led MUS among support agencies and with all relevant local and national government institutions to continue to learn and improve MUS on an ongoing basis.

ANNEX A: LITERATURE REVIEW

INTRODUCTION, AIM, AND STRUCTURE

The concept of 'Multiple use water services' (MUS) was coined in the early 2000s, when government, non-state support agencies, and researchers of both the Water, Sanitation and Hygiene (WASH) sector and irrigation sector came together to share their common observation: the infrastructure systems they had designed primarily for the single use of their mandate, was, in reality, also used for other purposes (Bakker et al 1999; Meinzen-Dick 1999; Renwick 2001; Meinzen-Dick and Van der Hoek 2001; Van der Hoek et al 2002; Pérez de Mendiguren 2004: Moriarty et al 2004; Boelee et al 2007). This observation started a joint journey to explore benefits of cross-sectoral collaboration, and, in any case, to avoid possible damage because of these unplanned uses. A MUS Group of over 20 international development organizations, including USAID, NGOs, national governments, and research organizations active in over 30 countries facilitated these synergies and created a depository (www.musgroup.net). In 2014, the MUS Group joined the Rural Water Supply Network, where MUS became one of the Network's themes.

At the heart of the interpretation of MUS by these and other partners, all focusing on low- and middle-income countries, is the strong participation by beneficiary communities in interventions, ideally from the planning phase onwards. Instead of ignoring, if not categorically rejecting, these non-planned uses as 'illegal', the evolving MUS approach appreciates and builds on what works well on the ground. This includes a growing appreciation of the many ways in which rural communities have sought to meet their multiple water needs since time immemorial. This focus on community-led intervention is echoed in the most common definition of MUS as 'a participatory approach that takes peoples' multiple water needs as the starting point of planning and designing water services' (Van Koppen et al 2006; Renwick 2007; FAO 2010).

Based on literature from around the globe, this report aims at identifying patterns and conceptual angles. As also reflected in the report's structure we found three angles, each expanding the earlier one: first, support to the development of multi-purpose infrastructure; second, moving up to the community scale to support infrastructure development considering people's priorities; and third, support to integrated community-based water tenure. The first modality (multi-purpose infrastructure) is elaborated in Section 2. This modality focuses on infrastructure, in particular externally financed infrastructure development by the WASH or irrigation sector (or livestock or aquaculture sectors). While still prioritizing the single use of the sectoral mandate, infrastructure is adjusted. In the so-called domestic-plus modality, small-scale productive uses, typically near or at homesteads are enabled. The irrigation-plus modality not only enables irrigation but also facilitates livestock watering, or laundry and other domestic uses, and, depending on the safety of water, also water for drinking. Both sectors also support self-supply – which people typically already use for multiple purposes.

Instead of focusing on a particular piece of infrastructure, the second modality of community-scale MUS found in the literature still focuses on infrastructure but considers the spatial community-scale and involves communities in a participatory process. This second modality considers communities' multiple sources for multiple uses through, usually, multi-purpose infrastructure, both externally financed and supported infrastructure and self-supply, as starting point for infrastructure development. In participatory processes, communities are in the driver's seat to set priorities in the planning, design, construction, and use (Section 3). Recent literature also mentions a third modality, which has hardly been explicitly implemented as yet: support to integrated community-based water tenure. This not only focuses on community-led infrastructure development but also includes communities' governance and tenure of the naturally available surface and groundwater resources that flow into the infrastructure. This modality integrates support agencies' focus on infrastructure development and the growing global momentum to legally recognize customary water tenure in sub-Saharan Africa and elsewhere (RRI/ELI

2020; FAO, 2021) (Section 4). Section 5 focuses specifically on MUS literature in Zimbabwe from the early 2000s onwards.

For each modality, literature is cited that ‘makes the case’ and corroborates the proven and plausible ways in which that modality contributes more effectively to common global goals such as the Sustainable Development Goals 1, 2, 3, 5, 6 and 13. The review further analyzes opportunities and barriers in upscaling each modality at the institutional interface between communities and local, intermediate, and national government, NGOs and other national and international development partners. The conclusions based on global and national secondary literature provide the context in which to place the findings of the simultaneous primary data collection of the project ‘Successful partnerships for Multiple-Use Water Services (MUS) in the Takunda and Amalima Loko intervention areas of Zimbabwe.’

MULTIPURPOSE INFRASTRUCTURE: DOMESTIC-PLUS AND IRRIGATION-PLUS

De facto Multiple Uses of Single Use Designed Infrastructure

Water infrastructure services have long been at the centre of the global water sector, including MUS. Besides the relatively few direct uses of surface waters (for example, fisheries, livestock watering, reeds, or laundry and bathing in streams or lakes), water can only lead to wellbeing through equipment or technologies. In short, infrastructure is needed to ensure that water becomes available in the right quantities and qualities at the right site and right moment. Storage infrastructure, which ranges from soil moisture retention (Kahinda et al 2007) to large dams, stores water during the wet season or periods for use during dry season, dry spells, and droughts. Storage has always been important to buffer climate variability and unpredictability, but climate change renders storage even more important. Conveyance infrastructure brings water where and when needed. Lack of infrastructure is often the limiting factor for rural people’s livelihoods in low- and middle-income rural areas. Without infrastructure, nature’s surface water sources flow by, or groundwater remains underground.

In this literature review report, we distinguish two main types of infrastructure at both ends of a continuum: externally designed and financed infrastructure (in short ‘public’ infrastructure), which is typically collective with various forms of customer or community participation at the one end, and self-supply, when individual households or self-organized subgroups, or entire communities plan, design, finance, construct and operate individual or collective infrastructure at the other end. In the widespread informal water economies in low- and middle-income rural areas, self-supply can be more widespread than externally supported public water infrastructure. Self-supply is accelerating as a result of new, more affordable infrastructure and energy sources, higher aspirations, growing populations and markets for produce. The wide spread of self-supply is well recognized for farmer-led irrigation development (Giordano et al 2012; Woodhouse et al 2016; Izzi et al 2021). The WASH sector also increasingly acknowledges how self-supply can provide a temporary solution for domestic water provision where government schemes are unreliable or have failed to reach an area, or even a permanent solution when households are remote and scattered and when centralized infrastructure is too expensive (Sutton et al 2012; Sutton and Butterworth 2021). The literature is unanimous that large proportions, if not the majority, of rural people need water for multiple uses. Accordingly, infrastructure is used for multiple purposes as the rule, and single purpose as the exception, whether the projects and their engineers designed for such multiple uses or not. We call the reality in the latter case ‘*de facto’* uses. This important proven or plausible link between people (their uses for livelihoods) and water (mostly through infrastructure, besides direct uses) underpins the focus of the first MUS modality: is infrastructure exclusively designed for the single use of the sector's mandate, or with other uses in mind as well?

At larger scales, governments or other external support agencies typically design for multiple uses of public infrastructure. Large-scale infrastructure, such as dams, is multi-purpose: it would be a waste of resources to have one dam for, for example, hydropower, one for irrigation, and one for domestic uses serving the same people in the same area. In the large-scale government irrigation systems, as in Morocco (Boelee et al 2007) or Pakistan (Van der Hoek et al 2002), these schemes are the main source of water for entire areas. So, irrigation of command areas remains the priority, but infrastructure is at least partially also designed for year-round domestic uses or livestock watering. In such cases temporary alternatives for domestic uses and livestock watering are needed when flows in the canals are interrupted during maintenance of canals. Newly constructed village dams in Ghana, Zambia and other African countries (Venot et al 2012; Auantunde et al 2016) are also mostly designed and constructed with multiple uses in mind.

However, at the smaller scales of rural household-, hamlet-, or community-scale infrastructure, public infrastructure supported by either the WASH or irrigation designed for the single use of their respective mandates. Yet, they are *de facto* also used for other purposes. These *de facto* uses have been widely documented for 'domestic' systems in Latin America, Africa, and Asia, both in gravity systems (see, for example, GC et al 2019 for Nepal; Restrepo Tarquino 2010 for Colombia) and in pumped systems (Pérez de Mendiguren 2004 for South Africa).

For self-supply, multiple uses are the rule and single uses the exception at any scale. Medium-scale communal reservoirs, such as the ancient cascading tanks in India or Sri Lanka (Palanisami and Meinzen-Dick 2001) are multiple use. Especially around homesteads, where everyone needs water for domestic uses, a majority uses water from the same infrastructure for livestock, crops, vegetables, crafts, small-scale enterprise, or combinations as well (Sutton and Butterworth 2021).

Hence, organizations that support a market-led uptake of small-scale affordable technologies, for example rope-and-washer pumps (Alberts and Van der Zee 2004; Ferrero and Briemberg 2022), immediately saw the benefits of a MUS approach – MUS highlights how adoption of self-supply technologies would achieve even more benefits. In contrast, MUS proponents within the WASH or irrigation sector who explored tapping the potentials of these *de facto* multiple uses, met resistance within their sectors, as discussed next.

2.1 From Problem to Solution

MUS proponents seeking to upscale MUS within their sectors, whether the WASH or irrigation sector, met barriers, ranging from active rejection of any *de facto* other uses than their sector's mandate, to respect and acknowledgement of benefits for the user, ultimately leading to purposive planning for multi-purpose infrastructure. Renault (2008) captured these steps in officials' responses to *de facto* non-irrigation uses in irrigation schemes to full buy-in, as seen in Figure 1. Experiences of MUS proponents in the WASH sector appeared remarkably similar.

Figure 1. Officials' responses to *de facto* multiple uses of single use designed infrastructure (Renault 2008)

As in Figure 1, officials' most drastic response to any *de facto* uses that diverge from the single use of the sector's mandate and intended design of the schemes is to actively reject. For example, officials can pull out any vegetables seen at homesteads supposedly watered from the 'domestic' supply. A milder response is just to tell those users that their water uses are illegal but giving up on any action. Alternatively, officials can simply turn a blind eye and ignore the observed multiple uses. Achieving their single-use goals is already complex enough, as an irrigation project leader in Nepal said (personal communication 2018). Alternately, officials are inclined to provide some ad hoc support. However, they are discouraged to act because their job description and performance evaluations only count benefits within the sector's mandate. Yet, others may incidentally just help. The next step is to start explicitly appreciating the livelihood benefits brought by such *de facto* uses. After all, these benefits are also returns on external agencies' investments in infrastructure. Various MUS studies have corroborated this argument of a high benefit-cost ratio (see 2.3.1). The last step is tapping the opportunity and proactively planning for such multiple uses from the onset. The sector's mandate remains the priority, but other uses are included in the design as well in so-called domestic-plus or irrigation-plus modalities (or livestock and aquaculture-plus). The + plus approaches are about water volumes and infrastructure, which are similar and, as such, neutral to any use. Support to self-supply is also the same in both sectors: promoting affordable technologies and energy sources through supply chains that, at longer term, can be market-led, training of local artisans, financing facilities, or the bundling of public and private services.

The main technical difference regards the siting and lay-out and the water availability of the infrastructure, which implicitly reflect the priority use of the water provided. Accordingly, the implicit assumption of domestic plus is year-round water availability near or at homesteads. In contrast, the siting and lay-out of irrigation-plus include in any case farming fields, which can also be at a distance from residential areas, besides other uses. Volumes per user are higher and water availability is more flexible as crop choices can be adjusted. If any water is used for drinking, a minimum of three litres per capita per day should be safe for drinking (Howard et al 2020).

Hence, the upscaling of domestic-plus or irrigation-plus modalities boils down to gradually moving incrementally, until planning for MUS if reached. Planning for MUS also anticipates and solves the problems of *de facto* uses which were not designed for, especially in the WASH sector. The opportunities to tap in upscaling are well documented in terms of both high benefit-cost ratio (2.3.1) and gender and social equity, leaving no-one behind in water-dependent production (2.3.2). Common barriers to planning for MUS are discussed in 2.4. These include embedded assumptions about impact pathways, the lack of attention to equity issues in the productive water sectors, and prioritization and infrastructure sustainability issues that hold for any externally financed infrastructure.

2.2 Opportunities of the +Plus Approaches

2.2.1 High Benefit-Cost Ratio

The classic financial MUS study by Renwick et al (2007) corroborated the benefits of moving from single use to multi-use designs of either new infrastructure or rehabilitations and upgrading of existing infrastructure designed for a single use. For infrastructure designed for domestic uses, the notion of 'climbing the water ladder' (DWAF 2003) is widely used. By increasing the service levels from basic domestic uses of about 5-20 litres per capita per day (lpcd) to medium-scale MUS of 50 – 100 lpcd, productive activities become well possible, such as livestock watering, homestead cultivation, or small-scale enterprise. Income gained can repay the incremental costs within half to three years, *cross-subsidizing* domestic uses. Detailed empirical studies of these engineering and operational changes in infrastructure capital and operational costs elsewhere confirmed the same: water pays for water, as calculated in Senegal (Hall et al 2015).

Renwick et al (2007) found the same outcomes for incremental costs and benefits of irrigation schemes. Relatively low-cost add-ons such as washing steps or livestock entry points bring high livelihood benefits and avoid problems and damage when it happens anyhow.

In all documented cases of MUS implementation that highlight how this high benefit-costs ratio of infrastructure can be achieved, water resources that flow into the infrastructure are sufficient, for example groundwater resources (as in Zimbabwe, see Moriarty 2003) or mountainous streams (as in Nepal, see Mikhail and Yoder 2008; GC 2019; Rautanen et al 2014; or Colombia, see Restrepo 2010).

2.2.2 Domestic-Plus: Gender and Social Equity

People are even seen as having the right to use available water as they themselves prioritize (Mekonta et al 2018). Small-scale productive water uses for universal basic livelihoods are vital lifelines in low- or middle-income agrarian settings. Even at basic levels of domestic water services, people give livestock watering and other productive water uses a higher priority than 'luxury' domestic uses, such as doing laundry weekly at home, as shown in Ethiopia (Jeths 2006) and South Africa (Van Koppen et al 2021).

The simultaneous consideration of domestic and productive spheres is also key to achieving more gender equity. Women's roles as farmers are increasingly recognized, but as long as women shoulder heavy labour burdens of domestic chores, their time for productive activities remains limited. Domestic-plus approaches that bring sufficient water near or at homesteads are particularly women-friendly. Women's control over the fruits of their investments and labor is often stronger at homesteads than distant fields. In Ethiopia, therefore, women preferred new individual solar water systems to be sited at homesteads (Nigussie et al 2017).

Domestic-plus also narrows significant inequalities in the productive spheres. Homestead based production includes landless and land-poor households for whom the homestead is the only site of productive water uses. Even for land owning households, cultivation, and livestock keeping around homesteads is nearer, safer, and usually more intensive than on distant fields or when livestock wanders around. Some national policies already fully tap the potential of promoting homestead production for food and income, for example, Thailand's self-sufficiency (Penning de Vries and Ruaysoongnern 2009). Elsewhere as well, there is much potential to move beyond seeing homestead-based production merely as so-called kitchen gardens for own consumption and nutrition, ignoring existing practices and potential for sale and income to buy nutritious foods and pay for health care.

Indeed, the logic of multi-purpose infrastructure may seem a no-brainer. Yet, its upscaling and institutionalization within the WASH sector, either by designing higher service levels as 'domestic-plus') or by promoting 'irrigation-plus' especially for smaller irrigation systems, has been less successful. As Clement et al (2019) analyze for Nepal, where iDE and many other NGOs have shown the merits of MUS for decades, including its sustainability (GC et al 2021a) and pro-actively provided ideas for upscaling (GC et al 2021b), institutionalization in planning appeared difficult. Even though MUS is anchored in rural Nepal's local realities and needs, MUS remained seen as 'a foreign concept' (Clement et al 2019). This echoes global trends. In spite of three decades of integrated water resource management, the divides persist between the WASH sector and all productive uses, including the water energy food nexus. What are some of those barriers? How can these barriers be overcome, and which role can the second MUS modality of community-led infrastructure development play in this?

2.3 Barriers to Upscaling the + Approaches

2.3.1 Narrow Impact Pathways in Institutional Silos

One reason why it is difficult to overcome the administrative silos is the specific nature of water. Water is only one input into human wellbeing. In addition to the engineering expertise necessary to deliver water for any use, other expertise is also needed to turn that use into a livelihood benefit. These are measures to ensure water safety and hygiene in the WASH sector or seeds, skills, inputs and markets for agricultural production. This other expertise (hygiene, agronomy, etcetera) than engineering tends to dominate the shaping of the institutional set up of governments and other support agencies into line agencies, departments, and sections. The structuring of these administrations into mandates and decisions about their funding are taken at national or even international levels. As a result, the intermediate- and local-level staff and, ultimately, even the frontline staff who deliver the services, remain more accountable upward within the specified mandate than downward to the end-user.

Global narratives about explicit impact pathways or implicit mindsets linking water to wellbeing illustrate how silos continue to work. We take the example of child nutrition (Ringler et al 2018; e.g., Lopez 2021). As captured in Figure 2, when the emphasis in structuring the sectors is on the expertise to change a water use into a livelihood benefit, there is not much consideration anymore of how the water to be used is made available. Moreover, envisaged impacts by the WASH sector tend to narrow the wide range of domestic water uses down to only one use: drinking. Even Sustainable Development Goal 6.1 only mentions drinking water, prioritizing health expertise. In this way, the pathway to improved child nutrition is via clean drinking water that protects against diarrhoea and enables the absorption of nutrients in under-fives' intestines. Any other domestic uses, such as cooking for food or cleaning, washing, laundry, or bathing for hygiene take a back seat. The WASH sector also expanded into hygiene by adopting sanitation, moving further into health and hygiene related issues of behavioural changes and safe water-efficient or dry toilets. Training and education continue being focused on mothers, reinforcing gender stereotypes.

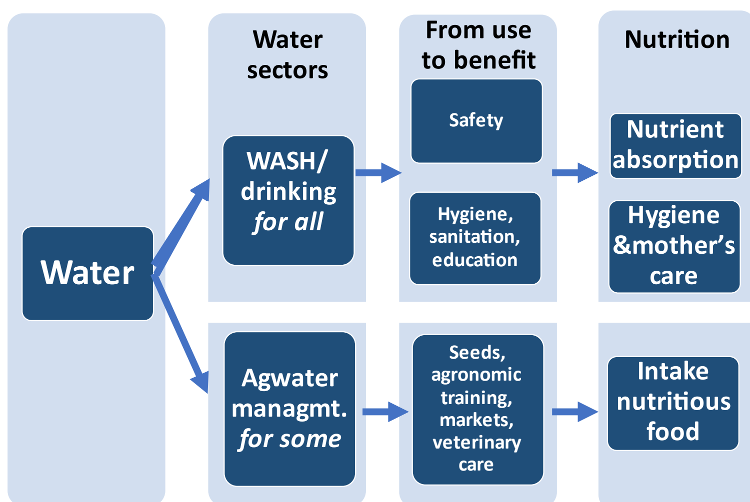

Figure 2. Siloed pathways from water to nutrition

Figure 2 also shows how the agricultural sector follows its own parallel impact pathway from available water, which can be the same household water source to homesteads, to nutrition. After all, the child needs to take in nutrients before the intestines can absorb them. Here again, water is just one input besides all other factors and expertise needed to grow food: seeds, agronomic skills, inputs, or veterinary care for livestock. Markets are crucial to sell water-dependent produce and generate an income.

This suggests that impact pathways emphasize ultimate benefits but narrow down the many ways to get there, in order to highlight the importance of specific expertise at stake. Professional expertise is organized in silos, of university specializations, health care, agricultural departments, and municipal water supply facilities. Societal impacts are key in justifying experts' claims to a share of finite national budgets, where different domains of expertise inevitably compete.

Figure 3 shows a hypothetical impact pathway from water to child nutrition and wellbeing that is more holistic, as reality is. The links between water and people start with the water resources and infrastructure, with the required formal or informal geo-hydrology and water engineering skills, as a different, independent step in the pathway to bring water as needed to meet people's own priority water needs (see also, for example, Feed the Future (n.d.) on such more holistic pathways).

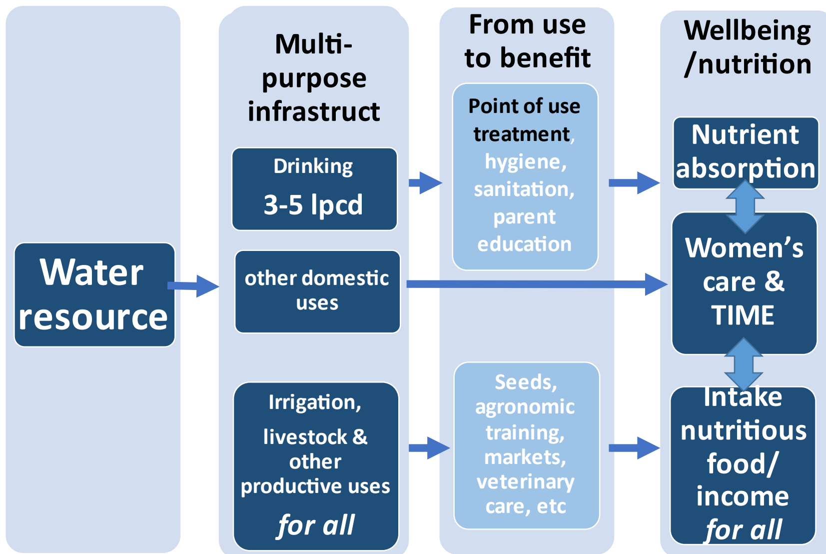

Figure 3. MUS pathways, from water resource to infrastructure to nutrition

These holistic pathways open up the benefits of cost-effective multi-purpose infrastructure in which each use contributes to a different dimension of wellbeing. In this case these are both nutrient intake and absorption. Importantly, the recognition of multiple uses for multiple dimensions of water-dependent wellbeing highlights how dimensions of wellbeing mutually reinforce or undermine each other, even over the generations. Without being healthy and well-fed, one cannot be productive. Food produced can be directly consumed, or generate an income, to pay for health care and buy nutritious food. Also, holistic pathways recognize *all* domestic water uses, which, in volume are much more than just drinking (food preparation and cooking, washing, cleaning, bathing, laundry). The alleviation of domestic chores is key to have time for any productive activities or childcare, certainly for women, but also for men and other children.

Importantly, the opportunity for the WASH and other sectors to join forces, as in Figure 3, maintains the clear need for sector-specific expertise. In fact, it unlocks this expertise from its current silos. Instead of being confined to a silo, expertise can be provided where and when needed, resources permitting. For example, concrete solutions on how to ensure that at least three litres per capita per day are safe for drinking from the WASH sector will encourage irrigation staff to engage in water quality issues. Otherwise, as already noted by Yoder (1983), irrigation officials have little other choice than turning a blind eye to people's *de facto* drinking when people lack better alternatives. For example, in Ethiopia, agricultural extensionists make simple suggestions to families on how to keep the wells that are also used for drinking clean (Mekonta et al 2018). The reverse also occurs. In Nepal, iDE provides water mostly to homesteads where domestic uses maintain a priority, but the systems also enable productive water uses. For this, iDE pro-actively provides various types of agricultural and agronomic support to increase productivity at the same time (GC and Hall 2020).

In other words, a MUS approach that starts with people's domestic and productive water needs focuses on holistic livelihoods: every woman and man irrigator or pastoralist also needs water for domestic uses.

However, livelihoods are diverse, apart from quite universal domestic water needs. Livelihoods are embedded in diverse local contexts, calling for localized approaches.

2.3.2 Barriers to Upscaling Equity in Productive Uses

As mentioned above, inclusivity, gender equity, and leaving no one behind are strong features of the WASH sector and domestic-plus modality. The WASH sector has made major strides since the 1980s to place the most basic aspect of everyone's livelihoods, drinking water, and other domestic uses, on the global agendas. The WASH sector successfully lobbied for the UN General Assembly's adoption of a human right for every human being to reliable, near, and affordable access to water for basic domestic uses (which includes a right to both infrastructure and to the water resources that flow into the infrastructure) (UNGA 2010). Governments also committed as duty bearers, typically through local government for its implementation according to various institutional arrangements, including community management with post-construction support, supported self-supply, and professionalization of water service provision whether linked to local government or entirely private (Moriarty et al 2013). This human right commitment for domestic uses is a firm institutional basis to promote domestic-plus to also enable, in any case, productive activities near and at homesteads. Unambiguously, this contributes to realizing the right to food and an adequate standard of living, which is equally recognized as a human right (Hall et al 2015; Hellum et al 2015).

However, this still leaves the potentials untapped for more equity in irrigation-plus and other productive water uses. Homesteads are not the only site of productive water uses. The potential contribution of water to realize the human rights to food and an adequate standard of living is diverse. Water-dependent productive activities greatly vary and the proportions of the people undertaking vegetable growing, or chicken rearing, or small-scale enterprise, or any other specific water-dependent activity at homesteads or elsewhere, are highly diverse. Much depends on local context.

Unlike the WASH sector, there is no straightforward government duty bearer for infrastructure for the range of productive water uses. Agricultural or other departments that support the change of a water use into food production and income are vital, but they reach only part of the farmers. Support is biased towards larger land holders when sufficient access to land is assumed to be a condition for irrigation productivity. Self-supply for irrigation is also biased towards the somewhat larger-scale farmers (Lefore et al 2017). These issues go beyond the development of one piece of infrastructure only but need to consider the wider local context.

2.3.3 Competition within Collective Public Domestic Schemes?

Once systems are designed for domestic uses only, and even just a few people start using water for productive activities, which generally do require (much) more water, there is no water left to ensure that everyone has access to water for basic domestic uses. This compounds often already existing competition, especially in the dry season. Understandably, WASH professionals seek to avoid such competition from productive uses for the limited water supplies designed. One of the few empirical corroborations of such competition comes from Nepal. Upstream productive uses in a piped gravity systems caused the tail-end to run dry, so users there had to shift to another source (Clement et al 2015). The distribution of too limited volumes of water to equitably meet everyone's needs is always complex. Even if rules exist, e.g., the number of containers each household (with or without consideration of the household size) is allowed to take from the collective water point, implementation of these rules is yet another issue. However, everyone's affordable access to basic volumes of water near to, or preferably at, everyone's homestead, before some can take more is an important equity principle, particularly for women and other marginalized groups.

Unfortunately, the WASH sector's refusal of any productive uses sets one basic need (domestic uses) against the other (basic productive uses). In addition to the most structural solution to design systems to meet multiple needs in the domestic-plus modality, issues of solutions to competition for water can also be explored otherwise, because access to water is not confined to one particular infrastructure system and one water source. This even holds at homesteads, which are the preferred sites of domestic uses and, as mentioned above, many unmet productive water needs of landless, land poor and land-owning households. In Thailand, which has a strong emphasis on self-sufficiency through homestead water management, a study found up to nine water sources to homesteads: bottled water; rainwater as harvested roof water, run-off into homestead ponds, run-off from roads diverted to paddy fields; and soil moisture for cropping; groundwater lifted from shallow wells or with electric pumps from boreholes; and public water systems when available as piped 'domestic' systems or adjacent irrigation canals. Most households combined at least six of these sources (Penning de Vries and Ruaysoongnern 2010).

At community-scale, there is even more diversity in (options for) collaboration or conflict. There are often multiple streams, ponds and lakes and other surface water sources and aquifers, and multiple distant fields and other sites of use, for example, for cattle drinking and laundry. The ability to combine various water sources at different sites, especially during droughts, provides water security. Hence under competition negotiations are about preferences out of a range of available alternatives. Gender and other social differentiation within the entire community strongly affect such negotiations and competition as well. Funder et al (2012) documents, for example, how in Zambia a wealthy livestock owner who was also traditional chief negotiated that a new pump be installed near his house. His stock got the first priority. Poor women gave up challenging his behaviour and went back to their earlier source. Community-scale diversity and hierarchies warrant inclusive community participation even more strongly.

2.3.4 Sustainability of Top-Down Infrastructure Development

Implementation of multi-purpose infrastructure can still face the same challenges as any externally supported infrastructure, whether for domestic uses or irrigation or livestock watering, if design and implementation is top-down and schemes are handed-over to communities expecting they will operate and maintain without sufficient post-construction support. Moreover, engineering expertise can also be top-down and siloed when programs can only delivery specific types of infrastructure, for example, exclusively boreholes or exclusively village dams, whatever the local situation.

Across any sector well-known problems of top-down designs include: lack of ownership, lack of maintenance and small repairs, and dilapidation, if not abandonment. Multi-purpose infrastructure is even riskier, given the diversity of productive uses. The design of facilities for certain productive uses, for example cattle troughs, cannot be standardized as there are areas without much livestock or with alternative livestock watering sites.

Fee collection is another notorious problem. While domestic-plus systems can well provide income, as shown in 2.3.1, it cannot be assumed that particular income issued for fee payment. Fees can also be paid from other sources than homestead production, as found in Nepal (Clement et al 2015). Regardless, the assumption in a domestic-plus modality that income generation automatically leads to fee payment and sustainability is refuted by the reality that part of the operation and maintenance costs of many income-generating irrigation systems still need to be subsidized, on top of subsidies for capital costs, as well documented for India (Malik et al 2014). A wide range of factors contribute to this underperformance of public water infrastructure. A lack of community participation from the planning phase onwards is one of these factors.

In sum, Section 2.3 showed the high benefit-cost ratio of domestic-plus and irrigation-plus modalities in low- and middle-income rural settings, as well as the powerful contribution of the domestic-plus modality to the equitable simultaneous realization of the human right to water for domestic uses, food, and an adequate standard of living. Section 2.4 tried to identify barriers to why wider uptake of these

MUS modalities is still limited. All four identified sets of barriers to wider upscaling suggest that moving away from the focus on just one piece of infrastructure to consider the people and spatial lay-out of an entire community may help overcoming these barriers. First, instead of water provision guided by one single dimension of wellbeing, water development can seek to meet multi-faceted livelihoods encompassing both universal domestic and diverse productive water needs. Second, the equity dimensions of the domestic-plus modality to reach everyone can open a profound debate with regard to productive water uses requiring much higher volumes. A community-scale approach can identify even more options to realize the human right to food within highly diverse local contexts. Third, a community scale approach highlights many more ways to meet both basic domestic and productive needs and can avoid awkward choices between basic domestic and basic productive needs. Fourth, community participation is a necessary condition for any infrastructure development. This all is addressed in the second MUS modality: participatory community-scale MUS.

3. PARTICIPATORY COMMUNITY-SCALE MUS

3.1 Evidence

In participatory community-scale MUS, external support to communities fully recognizes the local diversity of multiple sources for multiple uses through multi-purpose infrastructure as the rule, and single-purpose infrastructure as the exception. This is the starting point for inclusive community-led prioritization, planning, and implementation of improvements in infrastructure, whether self-supply or publicly financed infrastructure. This may sound daunting for specialized professionals. However, communities can swiftly map this complexity and explain details in a couple of hours, and some transect walks (Van Koppen et al 2022). Unlike top-down planning, in which consults are limited and confined to leaders, marginal groups are included, if not prioritized, from the start onwards in the participatory process. However, this requires funding earmarks that allow for a participatory design process and sufficient assurance that funding will be available for the collectively set priorities and designs.

Various sets of guidelines for community-led MUS have been published, which synthesize lessons learnt in such community-led planning, among other by AWARD (2004) and Cousins et al (2007) in South Africa; the Southern African Development Community (SADC 2009); ACP EU Water Facility Project in Zimbabwe (2010); and the MUS Group (Adank et al 2012). FAO compiled an in-depth methodology for large-scale ‘irrigation’ systems: Mapping Systems and Services for Multiple Uses of Water Services (MASSMUS) (Renault et al 2013).

In South Africa, the Water Facility of the African Development Bank supported the Water Research Commission and implementing partners in the action-project ‘Operationalizing community-led multiple use water services in South Africa’. Figure 4 indicates the six steps followed for small-scale new infrastructure or augmentation (Van Koppen et al. 2020). Workers were paid with stipends of the same amounts as the South African government sets for Community Works Programs.

Figure 4. Six steps of participatory planning (Van Koppen et al 2020)

The benefits of community participation throughout the project cycle included: cost-effectiveness of multi-purpose infrastructure (as in the + approaches), but also: the mobilization of local innovation, knowledge, skills and investments in self-supply; modestly remunerated employment creation during construction; mobilization of voluntary contributions; the creation of ownership for sustainability ("we worked hard for it"); and diligent use of the available budget by the community for cost-effective improvements in water infrastructure. If materials had been procured locally instead of following the national procurement process, costs would have been less in almost all cases, varying from -3% to 39%. A MUS committee member summarized the merits of participatory planning: *"It enables communities to do whatever they can do, and which is often easiest and simplest for government anyhow"* (Van Koppen et al 2021). A blog about this project is at: Empowering rural women with multiple-use water services: IWMI Success Story (cgiar.org) or https://www.iwmi.cgiar.org/success-stories/empowering-rural-women-with-multiple-use-water-services/

An example of a government program that creates even more space to align next incremental improvements with communities' priorities is India's Mahatma Ghandi National Rural Employment Guarantee Scheme (MG-NREGS). This participatory program contributes to the realization of the right to work by creating meaningful assets. Communities and local authorities co-decide on how to allocate funding for materials and labour in order to create priority assets. Communities appeared to opt most often for water and drought proofing assets, for a total value of USD 3 billion. Not surprisingly, in most cases, communities opted for multi-purpose infrastructure, holistically tapping into multiple sources, including groundwater recharge (Verma et al 2011). Hence, by being designed to create assets according to communities' priorities, MG-NREGA became the world's largest rural water supply and MUS program.

3.2 Upscaling: Accountability Triangle

The upscaling and institutionalization of community-led MUS in government, as convincingly proven in MG-NREGS, follows general features of service provision. A useful conceptualization is the accountability triangle (World Bank 2011). The triangle (Figure 5) distinguishes the main parties: citizens (poor and non-poor), the state (politicians and policymakers), and service-provider organizations with managers and 'front line staff' factually delivering the service.

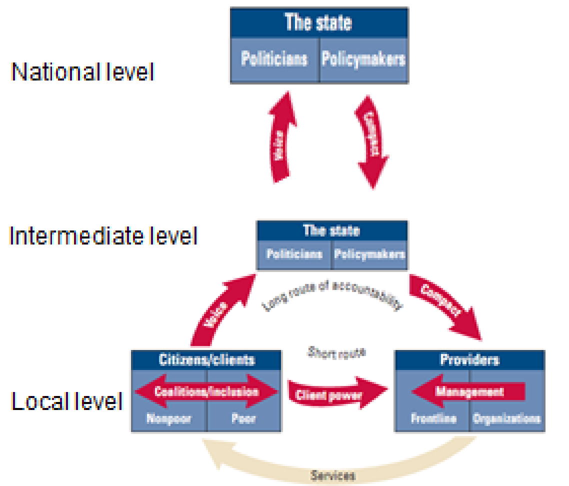

Figure 5. Accountability triangle (adapted from World Bank 2011)

The mutually reinforcing nature of the components shown follow both a long and short route to accountability. The long route has two legs. In the first leg, citizens hold their politicians to account by expressing their needs and suggestions for solutions and following up if not delivered. In the second leg, politicians liaise with the policymakers who set the rules and shape the organizational set-up to provide those services. Services can be provided through internal 'compacts' with own staff or by outsourcing through tenders with external 'contracts', or by combinations. Compacts and contracts clarify performance agreements and rewards. In the short route to accountability, the 'frontline staff' on the ground directly interact with communities to deliver on promises, with more or less autonomy or discretion. Community-led planning, design, and construction takes place in this short route, aided by socio-technical facilitators and trainers. For tasks that communities cannot do themselves, they can monitor performance of government or external contractors and service providers.

When a community implements the first three of the six steps (Figure 4), whether facilitated or fully community-led, it can be holistically grounded in the existing water situation and envision and prioritize a more or less detailed proposal for financing and other government support from the intermediate level in the long route to accountability (Figure 5). For example, the NGO AWARD implemented a project Securing Water to Enhance Local Livelihoods (SWELL) in South Africa and finalized the first three steps of community-led planning and prioritization in 11 wards in Bushbuckridge, Mpumalanga. However, when presented to local government, local government ignored and failed to allocate funding to implement the proposed activities, prioritizing other projects (Maluleke et al 2005; Dlamini and Cousins 2009).

In Step 4 at this intermediate level, local government with support of line agencies and NGOs have to make hard choices to fit the infinite needs and requests for support within the financial framework and technical and institutional expertise available. Accountability upward to national programs, often with siloed funding earmarks largely shape these decisions as well.

However, convergence of external funding streams is possible in MUS, as shown in Nepal (Van Koppen et al 2022). As MUS meets various goals, it can fit the mandate of various funders. Hence, in addition to required community contributions in cash and kind, a WASH department can make a contribution to a proposed scheme because of the domestic water needs that will be met, while a Forestry Department can contribute to support conservation of forest springs. Agricultural departments appreciate and contribute to enable more irrigation. NGOs can contribute according to their goals. However, convergence becomes especially difficult when the planning cycles of each of the potential contributors fail to overlap.

Broader programs with less stringent funding earmarks, such as employment generation programs, as above for MG-NREGS, but also climate change adaptation or disaster reduction, give more discretionary powers to intermediate level administrations and political governance structures, including community representation. More discretionary power enables financing integrated proposals that go beyond one ministry's single mandate. However, transparency, accountability, participation, and anti-corruption about intermediate level decision-making is key. Proposal improvement and approval or rejection, and labor and material procurement for implementation are indispensable but prone to the self-interest of officials and technical private sector service provider (WIN and Corruption Watch 2020).

The above-mentioned +plus approaches for infrastructure and the participatory community-scale MUS modality are about water infrastructure services. Infrastructure is often the limiting factor in accessing water local or professional engineers should have assessed water resource availability before investing in infrastructure. However, this is hardly ever explicit part of communities' participation in the planning. The integration of this component leads to the third modality: support to integrated community-based water tenure.

4. INTERGRATED COMMUNITY-BASED WATER TENURE

When communities map their multiple sources and infrastructure for multiple uses, as suggested in the second MUS modality, this includes the water resources that flow over or are located under their socially defined territories. Naturally available water resources are variable and unpredictable, which is worsening under climate change. Water resources may dry up and stop flowing into infrastructure during dry seasons, dry spells, or droughts. When storage infrastructure is limited, as often the case in low- and middle-income countries, this risk is even higher. Drought-related competition for remaining resources increases within communities and between communities. Increasing water uptake for self-supply by growing populations with higher aspirations can significantly compound this nature-induced competition. When water resources stop being abundant, legal-institutional arrangements are needed. External engineers need insights in physical availability to take out, for example, which sites are appropriate for drilling boreholes or village dams, and, hence, which land needs to be taken from the title holder for the public good. However, the third MUS modality opens up communities' and national legal-institutional arrangements in much more depth. We are not aware of interventions that explicitly considered integrated community-based water tenure in their planning and implementation processes, so the following is to highlight its potential importance in low- and middle-income rural areas.

Community-based water tenure can be defined as the relations among community members and between community members and others with regard to the water resources that flow over or are located under their socially defined territories (FAO 2018). Across especially rural sub-Saharan Africa and Latin America, age-old customary normative frameworks have been documented (Boelens and Vos 2014; van Koppen 2022). Customary notions commonly see water resources as 'given by god' and to be shared by all. Community members have birth rights to these water resources, but outsiders are to be respected as well (Van Koppen 2022). A 'bundle or rights' to use, govern and solve conflicts, exclude, transfer (alienate), and due process with regard to naturally available water resources and the relation to customary lands can be distinguished (RRI/ELI 2020). These are entitlements to naturally available water resources that are either directly used, as in washing laundry in streams, fisheries, and navigation, or that flow into infrastructure. Note that the various types of rights to water stored and conveyed by infrastructure are slightly different: these latter rights are also shaped by the continued efforts of infrastructure construction, operation, and maintenance for the deferred benefits of water availability at sites of use when and where needed, as physically enabled by the same infrastructure. The ones who make these efforts have stronger claims than others, and 'create hydraulic property' (Coward 1986; Boelens and Vos 2014). If government invests in construction, but fails to arrange proper operation and maintenance, hydraulic property is 'extinguished'.

Given the physical nature of surface water resources and large aquifers, water resources are not only 'shared within' a community, but also often 'shared out' with others outside these territories. When these outsiders are similar customary communities, the 'sharing out' of water resources with neighbouring customary communities is also found to be governed by customary law (Komakech 2013). However, outsiders can also be powerful third parties who risk infringing on communities' water tenure by taking upstream water sources or drilling the deeper boreholes so shallow hand-dug wells dry up. Or a powerful third party, for example mining, enters communal areas to tap into water resources. I 2020). This raises the issue of legal pluralism and the question whether and how statutory water law regulates the customary 'sharing in' of water resources and the 'sharing out' of water resources between customary communities and especially high-impact third parties. For implementation, the question is how responsible sections in water departments or catchment management agencies are organized and interact, or fail to interact, with infrastructure development and management agencies for domestic water supply and other water-relevant agricultural, environmental, and other departments.

States increasingly claim custodianship, if not ownership of water resources in a public interest. Unfortunately, unlike the statutory recognition of the wide prevalence and importance of customary land, forest and other resource tenure, pastoral law and constitutional and international human law frameworks which all recognize customary governance and indigenous peoples' rights, water legislation tends to lag behind in such recognition (RRI/ELI 2020; Troell and Keene 2022). Even worse, where the main legal tool is permitting or being exempted from an obligation to apply for a permit, low- and middle-income countries are logistically simply unable to implement that law among tens, if not hundreds of thousands small-scale users. Yet, even though most small-scale users abide to their customary arrangements, they are using water illegally according to statutory water law and can, officially, be punished by fines and even imprisonment. The micro-uses that are exempted from an obligation to apply for a permit remain invisible, even if customary arrangement may well include social safety nets to protect the most vulnerable users. This renders both categories of users extremely water insecure in sharing out water resources with powerful third parties.

Moreover, powerful, administration-proficient high impact users can get the strongest formal entitlements of permits, even just by filling a form to apply for a permit when the water authorities want to know water uses and possibly charge fees for water entitlements but lack the capacity to implement the prescribed due process to check potential infringements of planned investments on existing water users. This perpetuates the colonial origins of permit systems, especially in Latin America and Africa, which were designed to over-ride customary water tenure (Van Koppen and Schreiner 2018).

A suite of legal tools is currently explored to decolonize permit systems (Schreiner and Van Koppen 2018). The due process for any new water uptake by national or foreign high impact users remains vital. So, permitting remains an important tool, but water authorities should target their limited regulatory capacities to ensure due process to check any potential infringements before these relatively few high impact users are partly or fully allowed to invest in new infrastructure. Other tools can regulate the sharing of water resources among all other users. An immediate tool is to finally recognize customary water tenure, linked to customary land, as collective held water resources, and define these collective rights in the sharing out of water resources with powerful third parties. For example, research in South Africa proposes a priority of these collectively held water resources in former homelands vis-à-vis high impact water users upstream, downstream or entering these customary areas (Mukuyu et al 2022).

A recognition of the sharing in of water resources within customarily governed territories not only serves this collective interest in the sharing out of water resources, but also reflects the subsidiarity principle of devolvement of water resource management to the lowest appropriate level. This is not to romanticize these internal customary arrangements. Gender equality in both patrilineal and matrilineal (Van Houweling 2022) communities, or participatory decision-making are constitutional rights. However, amalgamation between customary and statutory law would require a transparent, participatory process based on a common understanding of living customary water tenure.

Other potential tools that regard the 'sharing in' of water resources within customary territories can well apply more generally, including other types of informal water economies of rapidly increasing self-supply, alongside some externally supported infrastructure. These also occur in peri-urban settlements or rural areas without customary traditions (Shah 2007). A Basic Human Needs Reserve, for example, would commit government to ensure that core minimum volumes of water resources remain available to meet constitutional or human rights to water for basic domestic uses, but also rights to food and an adequate standard of living. This is a stronger formal commitment than declaring water uses as 'primary' water uses, which gives at least some priority. In some water laws, uses that are exempted from an obligation to apply for a permit can get such status as 'primary'. Note that a basic human needs reserve to water resources for food and income leaves any commitment to the required infrastructure to the users as self-supply. This differs from the UNGA (2010) human right to water for domestic uses, which is a right to reliability, nearness, and safety, of infrastructure, and water resources that flow into the infrastructure.

Prioritization can well go beyond just core minimum volumes. In South Africa, for example, the legally binding National Water Resource Strategy (DWA 2013) defines five categories, from highest to lowest priority: 1) basic human needs reserve, 2) international obligations, 3) water for poverty eradication, livelihoods and gender and racial equity, 4) strategic uses (mainly electricity) and 5) high impact permitted uses. The higher priority of water for poverty eradication, livelihoods and gender and racial equity than for high impact permitted users is ground-breaking, requiring implementation.

5. LITERATURE: MUS IN ZIMBABWE

5.1 Domestic-Plus

Literature about MUS in Zimbabwe starts in the WASH sector, expanding to the domestic-plus modality as probably the first in sub-Saharan Africa (Lovel 2001; Robinson et al 2004; Katsi 2006; Katsi et al 2007), together with similar innovation of domestic-plus in South Africa by the NGO AWARD (Pérez de Mendiguren 2004). After Zimbabwe's independence in 1980 and the influx of donors and NGOs, vibrant efforts were undertaken to provide water for drinking and other domestic uses in collective systems, in line with the UN's International Drinking Water and Sanitation Decade (Katsi 2006). By then, the standard technology for basic domestic uses was a borehole or deep well fitted with a reliable, locally manufactured, hand-pump (called bush pump). Rules were strict that these supplies could only be used for basic domestic uses, and, if a cattle trough was added, also for livestock watering.

However, in the 1990s, donors and NGOs moved to domestic-plus, spearheaded by the DFID-funded Bikita Integrated Rural Water Supply and Sanitation [BIRWSS] Project from 1996 to 2002. They realized that these water supplies could easily enable small-scale productive uses as well, provided the strict rules of exclusive use for domestic purposes were relaxed, and more agronomic and marketing support was provided. Water resources were generally abundantly available to enable such more intensive pumping. The added value of productive uses would sufficiently incentivize the users to ensure sustainability of the infrastructure. Productive uses would be equitable: in the new collective gardens to be established, the poorest households were included. To that end, participation of the entire community, also in the siting of the collective garden, was to be promoted, moving towards the second MUS modality of inclusive, participatory community-scale action, even though for one specific piece of infrastructure (Lovel 2001; Robinson et al 2004).

A further expansion of this 'domestic-plus' modality was championed by Mvuramanzi Trust and other donors and NGOs by supporting households' own investments in infrastructure for self-supply, in particular the widespread hand-dug family wells. Lessons learnt in supporting households' own investments in the case of individual households' latrines inspired to expand to other infrastructure as well. These are clear cases of lower initial investment costs with a higher degree of assurance on sustainability over the long run. In one decade, support in lining wells helped 33,000 households to upgrade their hand-dug wells (Robinson et al 2004).

A combination of both more intensive pumping and support to self-supply emerged in the promotion of the higher-capacity rope-and-washer pumps not only for collective supplies but also for individual households. In the Mvuramanzi Trust's personalised project strategy, each householder becomes central to the design of his or her water supply project.

Other NGOs, including World Vision, Plan International, and CARE (Makoni and Smits 2006; Guzha et al 2007), had already started or joined these efforts with various designs, including rope-and-bucket and windlass. Pump-aid, in particular, developed the so-called 'elephant pump', and the improved version of the bicycle-like Chibhasikoro pump (Katsi 2006). Hosepipes attached to the pump would convey water to the plots, which replaced labour-intensive irrigation with buckets (Robinson et al 2004; Katsi 2006). Other newly introduced affordable technologies were treadle pumps, with at least three companies in Zimbabwe manufacturing localised versions by the mid-2000s.

A range of projects providing agronomic and marketing support, especially for high-value crops, complemented the uptake of collective and individual pumps, for example by the USAID promoted project called "Linkages for the Economic Advancement of the Disadvantaged" [LEAD]. Various NGOs tried to disseminate drip irrigation, with mixed success though.

For all these cases of multi-purpose infrastructure, combined with agricultural support, Robinson et al (2004) made convincing calculations on the benefits of investment by external support agencies: the benefit-cost ratio of productive uses in community gardens and supported self-supply appeared to be significantly higher than this ratio for conventional government-subsidized irrigation schemes, which, moreover, only benefitted a small proportion of community members.

The high expectations that multiple-use systems are more sustainable and can be equitable were met, as confirmed by Katsi (2006). The recent study by Kativhu et al (2021) assessed sustainability over an even longer period. This study compared 40 systems used for domestic uses only and 40 systems also used for gardening. Based on key informant interviews and 150 household surveys for each modality, they found that, overall, domestic water systems used for multiple purposes include the poorest households because of explicit targeting. Further, multi-purpose systems are more sustainable compared to systems used for domestic uses only. Financial contributions to operation and maintenance were often paid with the money earned from selling garden produce. However, they also found an increased frequency of water use conflicts and water point breakdowns. However, breakdowns were repaired more quickly. The downtime of water points used for domestic purposes only was two months. In contrast, this was one week for water points used for multiple uses, as there were no alternative water sources for their crops. There were more conflicts in multi-purpose systems, where households without plots refused to contribute to repairs of breakdowns, allegedly caused by intensive pumping for gardening. Competition between domestic and productive uses during the dry season were another source of conflict. The authors recommend providing additional management skills to solve conflicts and expedite repairs.

The above-described innovation and outscaling of this domestic-plus modality and affordable communal and household technologies to that end were mainly initiated and supported by donors and NGOs, in communication with Districts. At national level, UNICEF promoted its further upscaling, for example by encouraging provisions for livestock drinking troughs, washing slabs in its water supply programmes and promoting gardens (Makoni and Smits, 2006). UNICEF also participated in the national-level synthesis of growing experiences in community-led planning for domestic-plus in 'Guidelines for participatory planning for water for livelihoods', together with Zimbabwean Water and Sanitation Development, Mvuramanzi Trust, IRC Water and Sanitation, ACP and EU (ZIMWASH, EU, and UNICEF 2010).

These early experiences in Zimbabwe contributed to the global journey on MUS mentioned in the introduction, as facilitated by IRC Water and Sanitation (Moriarty et al 2004; Van Koppen et al 2009). Vice versa, MUS became a common concept among donors and NGOs in Zimbabwe. The Water and Environmental Sanitation Working Group (WES-WG), chaired by UNICEF, was established in 2003, bringing together the main NGOs, UN bodies, donors and government agencies, initially to coordinate humanitarian assistance. MUS was one of the learning components to its agenda (Van Koppen et al 2009).

Institutionalization of the domestic-plus modality into government has been limited, except for the statement in the Zimbabwe National Water Policy of 2013 (GoZ 2013) which says: 'Where water supply from a water point is abundant enough to permit productive uses, rural Water Supply Sanitation and Hygiene (WASH) programs will be integrated with productive uses such as irrigation to assist in raising funds for management of water points.'

Scant literature on the institutionalization of domestic-plus or MUS in Zimbabwe's government structures refers to coordination and pooling funds from donors and governments through the Integrated Rural Water Supply and Sanitation Programme (IRWSSP), but this is focused on the expansion of WASH services in rural areas (Ncube 2021). Other literature lists the segmented ministries, departments, and organizations addressing water services at national, district and local levels. In the 2000s, these included: the Ministry of Health and Child Welfare (responsible for sanitation and shallow wells); the Ministry of Water Development with the District Development Fund under the Ministry of Local Government) (responsible for communal boreholes and deep wells); the Ministry of Agriculture with the Department of Agricultural and Technical Services [AGRITEX] (responsible for productive water). Together with the Ministry of Local Government and of Community Development they are responsible for land use planning, mobilisation, finance and co-ordination of water and sanitation projects at national, provincial and district level). Coordination is pursued through an inter-ministerial National Action Committee for Water and Sanitation [NAC] based in the Ministry of Local Government. At sub-national levels, there are Provincial and District Water Supply and Sanitation Sub-committees. The latter is part of the district level the Rural District Development Committee of the Rural District Councils (Katsi 2006; Robinson et al 2004; Ncube 2021). Updates about recent recentralization are presented in the primary data reports. A recent innovation is the Rural WASH Information Management System (RWIMS).

At national level, administrative silos continue to direct fiscal financing streams, positioning one segment against the other. As Ncube (2021) found, between 2017 and 2019 budget votes to WASH declined by at least 16.5% with most funding being directed to the rehabilitation of irrigation infrastructure.

5.2 Irrigation and Livestock-Plus

The multiple uses of Zimbabwe's 7000 small dams have always been seen as normal. However, the study by Senjanze et al (2008) is one of the first to quantify these uses of four dams. They find in order of relative importance: livestock watering, domestic use, irrigation, fishing, brick making, and collection of reeds used for roofing. Livestock consume on average over 70% of water for consumptive uses. The *de facto* non-irrigation uses of irrigation schemes are generally well known.

5.3 Water Resource Management

No specific literature was found that makes the explicit link between MUS and the issues mentioned in section 4 play in Zimbabwe. However, discussions about the new water law and IWRM are found, for example, in Manzungu, E. 2001; Derman et al 2007; Manzungu and Machiridza 2009; Hellum et al 2015; Manzungu and Derman 2017.

6. CONCLUSIONS

This report reviewed global literature on MUS in low- and middle-income rural areas, according to a common definition of MUS as 'a participatory approach that takes peoples' multiple water needs as the starting point of planning and designing water services' (Van Koppen et al 2006; Renwick 2007; FAO 2010). The review aimed at distilling generalizable lessons from past experiences in the innovation and implementation of MUS. At the heart of MUS is a stronger involvement of the end-users, including women and the most vulnerable households. Or, as a community member in the South African MUS project expressed: "nothing about us without us" (Van Koppen et al 2022). Three modalities were identified, which each reflected a more holistic consideration of these end-users by external governmental and non-governmental support agencies. Accordingly, the financial, technical and institutional support packages that these agencies offer are increasingly flexible, so moving from predesigned top-down infrastructure installation to co-planning, design and construction according to people's priorities.

In the first MUS modality, agencies focus on supporting a specific infrastructure. Instead of categorically rejecting people's other uses than those in the mind of the designers according to the agency's single-use mandate, people's priorities are respected, and agencies optimize the proven high benefit-cost ratio of adding other uses in order to simultaneously improve multiple, mutually reinforcing facets of livelihoods. Accordingly, in the domestic-plus approach, everyone's domestic uses maintain the priority. The strong commitment to leave no-one behind by the WASH sector and by global human rights frameworks is exemplary for the productive water sector on how to pay more attention to equity and everyone's wellbeing. For example, more support to homestead-based production is likely to better meet the needs of women and the land-poor or landless. For affordable technologies that individual households or self-organized groups can adopt for self-supply, it is intrinsic that they meet priority uses at priority sites.

In the second MUS modality, participatory community-scale MUS, future users are further placed in the driver's seat. Instead of involving communities mainly after the design and construction phases for handover of new, repaired, or rehabilitated infrastructure, communities participate from the planning phase onwards. This opens up communities' entire space, so including the age-old ways in which communities use multiple surface and groundwater sources appurtenant to their territories to meet their multiple needs through combinations of externally supported infrastructure and self-supply. Interventions start with holistic, inclusive community visioning and prioritization of problems and solutions (including supported self-supply). Solutions are to be fitted with available financial, technical, and other resources that are contributed by both water users and external government or non-governmental support agencies, throughout the life cycle of the infrastructure. Agreement about mutual post-construction contributions as part of the planning shapes the choice of technology and its siting and lay-out. Such timely and inclusive participatory design ensures that external support meets priority needs, and mobilizes and builds on existing human, technical, social, and institutional assets. These are all necessary conditions for sustainability.

The third MUS modality of support to integrated community-based water tenure adds another dimension to the first two modalities, so is even more encompassing: it also recognizes hitherto ignored dimensions of community arrangements to govern and share the water resources that flow into infrastructure. When competition for water resources increases during dry season, dry spells, and droughts, communities need to mitigate conflicts both within their communities, but also in sharing water resources with upstream or downstream customary communities or third parties. This raises important new questions at the interface between customary law and statutory water and other resource legislation.

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ANNEX B: WATER QUALITY ANALYSIS

Water quality tests from 10 sampled sites indicated that the water from the majority of water sources was not safe to drink using the four categories that indicate the suitability of water for human use, namely potable (safe to drink, pleasant to taste, and usable for domestic purposes), palatable (aesthetically pleasing and the presence of chemicals do not cause a threat to human health), contaminated or polluted (contains unwanted physical, chemical, biological, or radiological substances, and it is unfit for drinking or domestic use) and infected (contaminated with pathogenic organisms).

Out of the ten sites that were sampled, only water from three sites (Toindepi, Cheshanga, and Paswani) were found to be potable. For all the three sites the water was from boreholes. This confirms why borehole water is regarded as safe water to drink. Water from Manzimahle borehole was infected, probably because of poor water handling – there was no direct provision of water for domestic purposes from the borehole. The high ionic activity in the water samples from the boreholes indicate a salinity threat, which could raise other challenges such as suitability for other domestic water uses such as laundry.

All samples from surface water sources were infected except for the water from the second tank of the water treatment plant in Nyimai. The fact that surface water can be treated effectively is a positive development, but the cost of the treatment is high, which makes it not a viable option. Drilling a borehole may be a cheaper option.

Water quality assessment and monitoring is critical in rural water supply at the commissioning of the water infrastructure and quarterly thereafter. The fact that the testing is not consistent because limitations of financial and material resources points for finding solutions to this challenge.

There is also a need to find cost-effective ways of supplying safe water to communities. While the most effective option seems to be drilling boreholes, there is also a need to improve hygiene practices such as household-level water treatment using water tablets which are available. There is also a need to train communities with respect to handling and storage of drinking/domestic water.

1. INTRODUCTION

Water quality, just like water quantity, is an important dimension in MUS projects. Water quality refers to the physical, chemical (physio-chemical), and biological characteristics of water based on the standards of its usage. The most common standards used to monitor and assess water quality convey the health of ecosystems, safety of human contact, and condition of drinking water.

This report focuses on the condition of drinking water and the health of ecosystems. For domestic water, water quality can be classified into four types in relation to its suitability for human use:

- potable water: It is safe to drink, pleasant to taste, and usable for domestic purposes.
- palatable water: It is esthetically pleasing; the presence of chemicals does not cause a threat to human health.
- contaminated (polluted) water: It contains unwanted physical, chemical, biological, or radiological substances, and it is unfit for drinking or domestic use.
- infected water: It is contaminated with pathogenic organisms.

The assessment of the water quality for domestic water use is compared to the World Health Organisation (WHO) standards. The health of ecosystems is discussed in terms of chemical oxygen demand and Dissolved oxygen (DO). Chemical oxygen demand (COD) is the amount of oxygen required to break down the organic material via oxidation. The parameters are indicated in the Results section.

2. METHODS AND SITES DESCRIPTION

Water samples were collected from each project site and complementary water sources where available. In the Takunda area, a total of 12 samples, 6 from Chivi and Zaka districts respectively. In the Amalima Loko area, a total of 7 samples were taken (Table 1). Samples were prepared and analysed according to standard processes, methods, and techniques. The results were compared to WHO standards.

Table 19. Location and description of water samples collected from Takunda sites

Name	Ward	Sample ID	Water sample collected from
CHIVI DISTRICT			
Musvini	15	CHI-15	Main dam
Musvini	15	CHI-15-RIV	Tributary to dam
Nyimai Dam	16	CHI-16-Potable	Second tank located in the garden for drinking water, which is sand filtered and chemically treated
Nyimai Dam	16	CHI-16-Dam	Piped direct from dam
Toendepi scheme	7	CHI-7-BP	Borehole equipped with Bush pump
Toendepi scheme	7	CHI-7-SP	Borehole equipped with solar pump, less than 2 m from the Bush pump
ZAKA DISTRICT			
Chemvuu	14	ZAK-14-D	Dam which is nearly empty
Chemvuu	14	ZAK-14-RED	Sample of red floating stuff in the dam
Chimhure	24	ZAK-24-P	Taken from riverside well that community uses
Chimhure	24	ZAK-24-S	Chimhure garden irrigating water from troughs, water has low temperature
Cheshanga	25	ZAK-25-W	Well used by greater garden area
Cheshanga	26	ZAK-25-S	Cheshanga drip irrigation water supply

Table 20. Location and description of water samples collected from the Amalima sites

Name	Ward	Sample ID	Water collected from
MATABELELAND SOUTH PROVINCE			
GWANDA DISTRICT			
Paswani sand abstraction	17	GWA-17-SAND	Well in sand river
Paswani scheme	17	GWA-17-SCH	Tap water at scheme
Mbuyane dam	7	GWA-7-D	Dam water lower Mbuyane
Mbuyane dam	8	GWA-7-DU	Dam water upper Mbuyane
BULILIMA DISTRICT			
Mbengwa dam	1	BUL-W01-D	Dam water

Name	Ward	Sample ID	Water collected from
Mbengwa dam	1	BUL-W01-SCH	Scheme water
MATABELELAND NORTH PROVINCE			
TSHOLOTSHO DISTRICT			
Manzimahle garden	13	TSH-13-SCH	Irrigation water supplied through a borehole

3. RESULTS

3.1 Takunda sites

3.1.1 Chivi District

Table 3 shows the results of water quality analysis that was done for water samples obtained from Chivi district project sites.

Table 21. Water quality results for water samples collected from Chivi district

Variables	Units	CH1-15	CH1-15- RIV	CH1-16-P	CH1-16-Dam	CH1-7-BP	CH1-7-SP	WHO GUIDELINES
PHYSICO-CHEMICAL								
Temperature	°C	32.4	28.3	26.11	31.7	31.3	30.9	
pH	-	7.61	7.37	7.25	7.1	7.33	7.46	6.5 – 8.5
Turbidity	NTU	29	45	70	20	25	17	< 5
Total Suspended Solids (TSS)	mg/l	21	44	61	19	19	16	-
Electrical Conductivity (EC)	µS/cm	54.9	54.6	166.7	179	720	694	-
Total Dissolved Solids (TDS)	mg/l	37.9	38.9	121	128	508	490	<1000
Salinity	ppt	0.03	0.03	0.08	0.09	0.35	0.34	-
Alkalinity	mg/l	64	62	136	152	880	792	-
Chlorides	mg/l	21.27	14.18	21.28	14.18	21.28	28.37	<250
Sulphates	mg/l	13.93	19.52	25.96	11.78	11.35	12.64	<250
Chemical oxygen demand (COD)	mg/l	133	118	34	2	0	0	-
Dissolved oxygen (DO)	mg/l	6.08	5.07	1.67	1.1	2.12	4.59	-
Total phosphorus	mg/l	0.019	0.022	0.028	0.006	0.021	0.016	-
Reactive phosphates	mg/l	0.004	0.003	0.006	0.004	0.007	0.004	-
Nitrates	mg/l	0.026	0.002	0.003	0.074	0.246	0.193	-
Total nitrogen	mg/l	0.124	0.050	0.045	0.152	0.452	0.432	-
Ammonia	mg/l	0.010	0.011	0.011	0.010	0.010	0.010	<1.5
MICROBIOLOGICAL								
Total coliforms	c.f.u/ml	150	1100	20	150	0	0	0
Escherichia coli		Positive	Positive	Negative	Positive	Negative	Negative	-
TVC	c.f.u/ml	TNTC	TNTC	1010	880	150	TNTC	-
Faecal coliforms		Positive	Positive	Negative	Positive	Negative	Negative	-

*TNTC = Too Numerous To Count

For physico-chemical variables, all other water quality variables were within acceptable limits except for those indicated in Table 4. Chemical oxygen demand (COD) is the amount of oxygen required to break down the organic material via oxidation.

Table 22. Trends of physio-chemical characteristics of water sample in Chivi district

Parameter	Trends	Remarks
Turbidity	All samples, to varying degrees, and exceeded the WHO Drinking Water Guideline of NTU < 5.0. Sample CH1-16-P was the most turbid while CH1-7-SP was the least turbid.	Sample CH1-7-SP was the least turbid because it was from a borehole. The identity of CH1-16-P is not clear as there is no sample labelled as such in Table 1.
Electrical Conductivity, TDS & Salinity (the three variables are interrelated).	Samples CH1-7-BP (Toindepi Scheme Bush Pump) and CH1-7-SP (Toendepi Scheme Solar Pump) had comparatively high ionic conductivity and TDS levels. More salinity was also registered for these two samples.	The two boreholes are at the same site, which shows that there are inherent salts in the water at that site.
Chemical Oxygen demand (COD)	Samples CHI-15 (Musvisvini dam) and CHI-15-RIV (Tributary to Musvisvini dam) had elevated levels for COD.	Although not stipulated under WHO Drinking water standards, this indicates some measure of pollution at this source. This may negatively affect the fish in the dam.

Samples CHI-15 (Musvisvini dam), CHI-I5-RIV (Tributary to Musvivini dam), and CHI-16-Dam (Nyimai dam) failed to meet WHO Drinking Water Guidelines for potable water. This is not surprising that these were samples from open water sources, the Musvinini, and Nyimai dams. Only samples CHI-7-BP and CHI-7-SP from Toindepu boreholes met the acceptable WHO criteria for microbiological assessments. However, the Total Viable Count (TVC) suggests overall cleanliness and hygiene at water source needs to be improved. TVC is a test that estimates the total numbers of microorganisms, such as bacteria, yeast, or mould species, which are present in a water sample. A high TVC count indicates a high concentration of micro-organisms which may indicate poor quality for drinking water or foodstuff. Sample CHI-16-P (water from the water treatment tank in Nyimai Garden) was also very good in terms of microbiology but had a low count of Total Coliforms of 20 – WHO Drinking Water Guidelines state that it must be 0. It could be a sampling artefact or contamination during sample collection given a rather high TVC count of 1010.

Other samples had positive indications for faecal coliforms and *Escherichia coli*. The presence of faecal coliform in a drinking water sample often indicates recent faecal contamination, meaning that there is a greater risk that pathogens are present than if only total coliform bacteria is detected. *Escherichia coli* is a type of faecal coliform bacteria that is commonly found in the intestines of animals and humans. *Escherichia coli* in water is a strong indicator of sewage or animal waste contamination. Sewage and animal waste can contain many types of disease-causing organisms. In Toindepi boreholes livestock were watered in the vicinity of the boreholes.

Consumption may result in severe illness; children under five years of age, those with compromised immune systems, and the elderly are particularly susceptible.

3.1.2 Zaka District

Results of the water quality of samples collected from Zaka district are indicated in Table 5.

Table 23. Water quality results for water samples collected for Zaka sites

Variables	Units	ZAK-14-D	ZAK-14-RED	ZAK-24-P	ZAK-24-S	ZAK-25-W	ZAK-25-S	WHO GUIDELINES
PHYSICO-CHEMICAL								
Temperature	°C	29.6	-	31.5	25	29.1	31.8	
pH	-	8.69	6.39	7.47	6.75	6.83	7.58	6.5 – 8.5
Turbidity	NTU	2038	877	19	103	5	4	< 5
Total Suspended Solids (TSS)	mg/l	894	624	12	74	3	3	-
Electrical Conductivity (EC)	µS/cm	106.2	102.4	175.8	226	249	442	-
Total Dissolved Solids (TDS)	mg/l	79	73.4	124	163	178	314	<1000
Salinity	ppt	0.05	0	0.09	0.12	0.13	0.22	-
Alkalinity	mg/l	60	128	192	128	280	364	-
Chlorides	mg/l	14.18	21.27	21.27	35.46	21.27	28.36	<250
Sulphates	mg/l	58.80	82.76	82.71	28.54	89.58	86.14	<250
Chemical oxygen demand (COD)	mg/l	248	535	19	78	22	58	-
Dissolved oxygen (DO)	mg/l	8.49	2.09	3.89	2.61	2.72	4.64	-
Total phosphorus	mg/l	0.275	0.268	0.013	0.47	0.025	0.03	-
Reactive phosphates	mg/l	0.026	0.107	0.007	0.027	0.016	0.025	-
Nitrates	mg/l	0.100	0.097	0.004	0.017	0.105	0.009	-
Total nitrogen	mg/l	0.197	0.192	0.024	0.16	0.165	0.11	-
Ammonia	mg/l	0.04	0.052	0.013	0.017	0.013	0.01	<1.5
MICROBIOLOGICAL								
Total coliforms	c.f.u/ml	240	N/A	1100+	460	1100+	0	0
Escherichia coli		Positive	N/A	Positive	Positive	Positive	Negative	-
TVC	c.f.u/ml	550	N/A	TNTC	970	TNTC	690	-
Faecal coliforms		Positive	N/A	Positive	Positive	Positive	Negative	-

*TNTC = Too Numerous To Count

For physico-chemical variables, all other water quality variables were within acceptable limits except for those indicated in Table 6.

Table 24. Trends of physio-chemical characteristics of water sample in Zaka district

Parameter	Trends	Remarks
pH	Sample ZAK-14-RED was below 6.5 while pH for sample ZAK-14-D exceeded the upper limit of pH 8.5. The rest of the water samples were within stipulated WHO Drinking Water Guidelines limits.	The samples from Chemvuu dam, which was almost empty of water, were above the limits, which may explain the uncharacteristic pH.
Turbidity and Total Suspended Solids	Samples ZAK-14-D and ZAK-14-RED were extremely turbid which was also explained by an extremely high number of suspended solids. ZAK-25-W (from Cheshanga garden) and ZAK-25-S (from complementary water source to Cheshanga garden) had low values, which were within the stipulated WHO Drinking Water Guidelines.	The turbidity of water from Chemvuu dam was higher than water from the Cheshanga borehole and water from wells in the vicinity of the borehole.
Electrical Conductivity, TDS & Salinity	All samples were within the stipulated WHO Drinking Water Guidelines. Sample ZAK-25-S had the highest values for all these variables.	Since the sample was from Cheshanga borehole, it may indicate high amount of salts at the borehole site.
Chemical Oxygen Demand (COD)	Samples ZAK-14-D and ZAK-14-RED had very high COD values which suggests some organic pollution in these water sources.	Samples from Chemvuu dam which was almost empty of water

For the Zaka samples, only sample ZAK-25-S was compliant for microbiology criteria of WHO Drinking Water Guidelines. This is the Cheshanga drip irrigation water supply. The other samples were heavily contaminated.

3.2 Amalima sites

All the results of the water quality of samples collected from Amalima sites are indicated in Table 7.

Table 25. Water quality results for Amalima sites

Variables	Units	BUL-W01-D	BUL-W1-SCH	GWA-W7-D	GWA-W7-DM	GWA-17-SCH	GWA-17-SAND	TSH-13-SCH	WHO GUIDELINES
PHYSICO-CHEMICAL									
Temperature	°C	31.6	32.4	28.6	-	27.3	29.8	31.1	-
pH	-	8.79	8.28	7.83	7.32	7.71	7.69	7.55	6.5 – 8.5
Turbidity	NTU	74	103	7	81	0	258	22	< 5
Total Suspended Solids (TSS)	mg/l	42	60	0	50	0	191	5	-
Electrical Conductivity (EC)	µS/cm	131.6	139.4	122.1	83.3	194.7	167.4	409.0	-
Total Dissolved Solids (TDS)	mg/l	93.5	96.0	87.0	59.3	139.0	119.0	293.0	<1000
Salinity	ppt	0.07	0.07	0.06	0.04	0.10	0.08	0.21	-
Alkalinity	mg/l	160	168	140	92	128	136	352	-
Chlorides	mg/l	28.36	35.46	35.46	28.36	21.27	28.36	21.27	<250
Sulphates	mg/l	37.57	56.05	8.76	27.68	1.89	50.03	15.65	<250
Chemical oxygen demand (COD)	mg/l	62	92	1	115	109	19	58	-
Dissolved oxygen (DO)	mg/l	6.55	6.57	6.46	4.72	6.09	5.77	6.07	-
Total phosphorus	mg/l	0.031	0.105	0.043	0.018	0.006	0.101	0.049	-
Reactive phosphates	mg/l	0.009	0.085	0.013	0.009	0.003	0.037	0.025	-
Nitrates	mg/l	0.004	0.008	0.001	0.003	0.023	0.224	0.052	-
Total nitrogen	mg/l	0.136	0.082	0.150	0.161	0.100	0.385	0.148	-
Ammonia	mg/l	0.012	0.013	0.012	0.012	0.010	0.011	0.012	<1.5
MICROBIOLOGICAL									
Total coliforms	c.f.u/ml	1100	93	9	1100+	4	1100+	150	0
Escherichia coli		Positive	Positive	Negative	Positive	Negative	Positive	Positive	-
TVC	c.f.u/ml	TNTC	2000	1600	TNTC	1300	TNTC	1500	-
Faecal coliforms		Positive	Positive	Negative	Positive	Negative	Positive	Positive	-

3.1.2 Physico-Chemical Properties

Table 8 shows an overview of chemical characteristics of water sample in the Amalima sites.

Table 26. Trends of physio-chemical characteristics of water samples in the Amalima sites

Parameter	Trends	Remarks
Turbidity and Total Suspended Solids	GWA-17-SCH (Tap water at scheme) was the only sample fully compliant for turbdity. Sample GWA-17-SAND was the most turbid. Suspended solids concentrations corresponded to the turbidity values which implies they contributed significantly to the measured turbidity. Suspended solids were also not present in the water samples. GWA-W7-D (Dam water lower Mbuyane) was marginally higher than 5 NTU but TSS was zero. The rest of the samples exceeded to varying degrees the WHO Drinking Water Guideline of NTU < 5.0.	Borehole abstracting water from a sand river was the most compliant while water from well in the Tuli river was the most turbid suggesting that the reliance on the latter source of water (which was reported to be high) poses threat to the communities.
Electrical Conductivity, TDS & Salinity	TSH-13-SCH had the highest conductivity, TDS & salinity and GWA-W7-DM had the lowest.	Borehole abstracting groundwater shows the highest figures.
Alkalinity	TSH-13-SCH had the highest alkalinity and GWA-W7-DM had the lowest alkalinity. Interestingly, there as a correlation between electrical conductivity and alkalinity.	Borehole abstracting groundwater shows the highest figures.
Chemical Oxygen demand (COD)	Samples GWA-W7-DM and GWA-17-SCH had elevated levels for COD while GWA-W7-D had the least value.	Surface water from the dam or sand river had elevated levels (although not stipulated under WHO Drinking water standards, this indicates some measure of pollution at this source).

3.2.2 Microbiological Properties

Samples GWA-W7-D (Dam water lower Mbuyane) and GWA-17-SCH (Tap water at scheme) had the best microbiological water quality and almost met WHO Drinking Water Guidelines for potable water except for Total Coliforms (TC). TVC values were 9 and 4 cfu/ml, respectively. The recorded Total Viable Counts (TVC) suggests overall cleanliness and hygiene at all water source needs to be improved.

The rest of the samples had positive indications for faecal coliforms and *Escherichia coli*. The presence of faecal coliform in a drinking water sample often indicates recent faecal contamination, meaning that there is a greater risk that pathogens are present than if only total coliform bacteria is detected. *Escherichia coli* is a type of faecal coliform bacteria that is commonly found in the intestines of animals and humans. *Escherichia coli* in water is a strong indicator of sewage or animal waste contamination. Sewage and animal waste can contain many types of disease-causing organisms. Consumption may result in severe illness. Children under five years of age, those with compromised immune systems, and the elderly are particularly susceptible.

4. CONCLUSIONS

Tables 9 and 10 show the status of water quality in Takunda and Amalima Loko sites respectively**.** The conclusion is based on the four categories in relation to its suitability for human use, namely potable (safe to drink, pleasant to taste, and usable for domestic purposes), palatable (aesthetically pleasing and the presence of chemicals do not cause a threat to human health), contaminated or polluted (contains unwanted physical, chemical, biological, or radiological substances, and it is unfit for drinking or domestic use), and infected (contaminated with pathogenic organisms).

Table 27. Status of water quality of samples collected from Takunda sites

Name	Status of water quality
CHIVI DISTRICT	
Musvini	Water is infected. The complementary water source (tributary of the dam) is more infected than the dam.
Nyimai Dam	The water from the dam thorough the pipes is infected while water from the second tank of the treatment plant is potable.
Toindepi scheme	Potable water but has comparatively high ionic conductivity and TDS levels.
ZAKA DISTRICT	
Chemvuu	Water is infected
Zinhuwe	The complementary water source (water from a well) from the riverside) was more infected than the dam water.
Cheshanga	Water from the drip irrigation pipes is potable water while from the complementary water source (the well) is not.

Table 28. Status of water quality of samples collected from the Amalima sites

Name	Status of water quality
MATABELELAND SOUTH PROVINCE	
GWANDA DISTRICT	
Paswani scheme sand abstraction	Water from the tap is potable while water from the well in the sand river is infected.
Mbuyane dam	The upper dam is more infected compared to the lower dam.
BULILIMA DISTRICT	
Mbengwa dam	Both the dam water and water from the taps is infected.
MATABELELAND NORTH PROVINCE	
TSHOLOTSHO DISTRICT	
Manzimahle garden	Water is infected

Out of the ten sites that were samples only water from three sites (Toindepi, Cheshanga, and Paswani) were found to be potable. For all the three sites the water was from boreholes. This confirms why borehole water is regarded as safe water to drink water. It is, however, surprising that the water from Manzimahle borehole was infected. This could be because of poor water handling. There was no direct provision water for domestic purposes from the borehole. The high ionic activity in the water samples from the two boreholes may indicate threat some water uses such as laundry.

All the samples from surface water sources were infected except for the water from the second tank of the water treatment plant in Nyimai. The water from the treatment tanks in in Chemvuu and Zinhuwe could not be tested because of lack of water and a dysfunctional system respectively. The fact that surface water can be treated effectively is a positive development, but the cost of the treatment is high, which makes it not a viable option. Drilling a borehole is a better option because of the relative costs.

This study has illustrated that water quality assessment and monitoring is critical in rural water supply at the commissioning of the water infrastructure and quarterly thereafter. Unfortunately, testing is not consistent because limitations of financial and material resources. There is a clearly a need to find cost-effective ways of supplying safe water to communities. While the most effective option seems to be drilling boreholes, which tends to supply water, there is also a need to improve hygiene safe practices such as household-level water treatment using water tablets which are available. There is also a need to train communities with respect to handling and storage of drinking/domestic water.

ANNEX C: FINANCIAL AND ECONOMIC ANALYSIS REPORT

1. INTRODUCTION

1.1 Background and Scope of Study

It is generally acknowledged that multiple-use services (MUS) projects cost more than single-use services, but also generate more income and benefits, decrease vulnerability, reduce poverty, and increase sustainability of water services.[94] While MUS projects have been implemented in Zimbabwe since the early 2000s, little is known about their incremental costs and benefits at the household, community, and national levels.[95] This underlines the importance of undertaking a financial and economic analysis of MUS projects in Zimbabwe.

Broadly speaking, financial, and economic analysis estimates the benefits of a project investment based on the difference between the with-project and without-project situation to determine the costs incurred and benefits gained from investing in the project. This involves determining the net present value (NPV) of a project, based on its estimated discounted present and future cash flows. While financial analysis compares benefits and costs to a specific enterprise, economic analysis compares the benefits and costs to the whole economy.

The scope of this analysis included assessing the incremental benefits (food security, income, health, poverty reduction, etc.), and costs (capital, operation and maintenance, and replacement) of different types of MUS projects, as well as the degree to which costs could be minimized and benefits maximized and sustained. This considered:

- Types of water sources (e.g., surface water in rivers or dams, or groundwater) and water availability, reliability, and quality of water supply.
- Water uses, including irrigation, drinking/domestic water, and livestock watering. We looked specifically at whether all the priority uses were adequately provided for and whether and how they are interlinked.
- Methods of water abstraction (such as gravity, Bush pumps, or solar pumps).
- Method of water delivery/supply for the various uses, which directly affects project costs.
- Methods of irrigation (such as with buckets, from drip technology, etc.) which directly affects project costs and the effort required by farmers to irrigate.
- Types and quantities of crops grown for household consumption and for sale vis-à-vis the availability of markets and viable crop prices.
- Plot size, which determines the quantity of crop yields that can be achieved and the quantity of produce available for household consumption and for sale.
- Household characteristics, including household size and income, which help determine the capacity of farmers to use water.
- Sources and levels of investment costs contributed by donors, government agencies, NGOs, and communities in community and self-supply projects.
- Ability and willingness of water users to contribute to operation, maintenance, and replacement costs.

[94] Renwick, et. Al. 2007. Multiple use water services for the poor: Assessing the state of knowledge, Winrock International: Arlington, VA.

[95] Senzanje, A., Boelee, E. and Rusere, S. 2008. Multiple use of water and water productivity of communal small dams in the Limpopo Basin, Zimbabwe, *Irrigation and Drainage Systems*, 22:225–237.

The results of this financial and economic analysis provide insights into the broader questions related to MUS effectiveness and sustainability in Zimbabwe, including:

- What technologies, access to finance and financial services are best suited and available for individuals and communities to implement MUS?
- Which MUS projects (domestic-plus; Irrigation-plus, livestock plus) are most suitable and under what circumstances?
- What role can user fees play in ensuring continued functionality and sustainability of MUS projects, and under what conditions can these be implemented and managed successfully?
- What are the most effective mechanisms for organising financial arrangements to support MUS at project level and what is the optimum operation scale for projects funded by the Government of Zimbabwe, donors, NGOs, and communities to be able to cover capital, operations, and maintenance costs?

It is hoped that this financial and economic analysis of MUS projects in Zimbabwe will not only provide insights into the performance of the individual MUS projects assessed in ENSURE and Amalima RFSAs, but also will show how best MUS projects can be implemented sustainably in the future.

1.2 Structure of the Report

Section 2 describes the approach and methods that were used to collect and analyze data. Section 3 provides an overview of the water projects in terms of water supply, irrigation technology, crops grown, plot holdings, and important household characteristics, such as size and level of income. Section 4 presents the financial analysis of the various water projects. Section 5 describes the economic impacts of the water projects. The conclusions of the study are presented in Section 6.

2. APPROACH AND METHODS

2.1 Data and data sources

There were several challenges related to availability of the necessary data for this analysis. First, due to lack of and unreliable data for some parameters at project level, such as crop yields and crop prices, investment costs, operation and maintenance costs, on-line published Zimbabwean data was used. Therefore, a mix of data from the household survey and Focus Group Discussions, and on-line sources was used (Table 1).

Table 1. Sources of data

Data	Source
WATER	
Source of water	Key Informant interviews and Focus Group Discussions
Method of water abstraction	Key Informant Interviews and Focus Group Discussions
Method of water delivery and irrigation	Key Informant interviews and Focus Group Discussions
Irrigation water requirements	FAO Aquastat
Irrigation efficiency	FAO Aquastat
PROJECT INFRASTRUCTURE COSTS	
Investment/capital costs	FAO Aquastat
Annual operation and maintenance costs	FAO Aquastat
Replacement costs	FAO Aquastat
CROPS	
Types of grown	Household survey
Cropping intensity	Key Informant interviews
Crop yields	Potential yields from published data

Data	Source
Crop prices	Ministry data (maize) and online data for horticultural crops [96]
CROP DISPOSAL	
Per capita food consumption	Maize [97], leafy vegetables [98]
Surplus for sale	Difference between crop yield and food consumed [99]
PLOT AND HOUSEHOLD CHARACTERISTICS	
Number of plot holders	Household survey
Plot size	Household survey
Household size	Household survey
Household income	Household survey
Total Consumption Poverty Line (TCPL)	October 2022 data (ZIMSTAT) [100]

Computation of figures for financial analysis was prorated to the size of the irrigated project area as well as plot and household size.

Obtaining data on the number of people using water for domestic purposes at a particular facility was also problematic, including determining the number of women and girls (who traditionally shoulder the burden of providing domestic water). The same challenge applied to the total number of livestock that were watered from each water facility. The fact that the water projects were not designed to provide water for multiple water uses also meant that it was not possible to distinguish quantitative financial and economic impacts of these dimensions. A qualitative approach was therefore taken.

2.2 Assessing benefits and costs

The benefits derived from the water projects were determined through Focus Group Discussions (FGDs) complemented by insights from the household survey. These FGDs helped to identify and prioritize benefits differentiated by water use (domestic, livestock watering, and irrigation). The benefits accruing to households participating in irrigation were quantified in terms of total agricultural produce, quantity, and proportion of agricultural produce earmarked for household consumption, and household income derived from the sale of surplus agricultural produce. Production costs were deducted from the crop revenue to determine disposable income. Such income could be returned into the MUS system to cover operation and maintenance (O and M) and infrastructure replacement costs. The adequacy of the household income derived from crop production from the irrigation schemes was assessed in terms of its potential for poverty reduction as measured against the Total Consumption Poverty Line (TCPL). Additional benefits, such positive health outcomes from accessing safe water, are described qualitatively.

Additional project costs were calculated, including: the cost of irrigation infrastructure (excluding costs related to the dam); cost of borehole drilling; cost of abstraction of water (e.g., solar pump, bush pump); and costs of in-field irrigation infrastructure, such as pipes and taps. Total and annual O and M and replacement costs were also determined.

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[96]See https://zimpricecheck.com/price-updates/fruit-and-vegetable-prices/

[97] Muzhingi, T., Gadaga, T. H., Siwela, A. H., Grusak, M. A., Russell, R. M., & Tang, G. 2011. Yellow maize with high β-carotene is an effective source of vitamin A in healthy Zimbabwean men. *The American Journal of Clinical Nutrition,* 94, 510–519. https://doi.org/10.3945/ajcn.110.006486

[98] Zimbabwe Vegetables consumption, 1992-2007. Available atknoema.com.

[99] Sales estimates were based on yields, production costs, and prices of the three most important crops as identified by farmers (i.e., maize, leafy vegetables (covo/rape), and tomatoes).

[100] Nizbert Moyo Food poverty line up 3.1%: ZimStat, Newsday 26 October 2022. The quoted figure was Zimbabwe $28 144.07 per person and was converted to United States dollars using a rate of 700.

2.3 Cost-benefit analysis

Based on data described in Section 2.2, benefit-cost ratio (BCR), repayment period, Net Present Value (NPV), payback period, and internal rate of return (IRR) were determined for each of the irrigation schemes.

The BCR, which summarizes the overall relationship between the relative costs and benefits of a proposed project, was calculated by dividing the total monetary benefit of a project by the proposed total monetary cost of the project. A project with a BCR greater than 1.0, indicates that the project is expected to deliver positive returns for the investment. Less than 1 indicates negative returns.

The payback period is the number of years needed to pay back an initial investment with positive net income. Payback period is an effective indicator of investment risk. This was compared to the standard replacement period for different irrigation technologies.

The NPV indicates the viability of the investments, and is assessed by relaxing the assumption that discount rate is equal to zero. The NPV is given by the following equation:

$$NPV = \frac{B - C}{(1 + r)^t}$$

Where t is the time period from 0 to 10; r is the discount rate; *B* are benefits; and *C* are costs. We analyse discount rate scenarios where r = 10%. An investment that has positive NPV given a certain discount rate implies that the investment is worthwhile.

IRR is defined as the discount rate beyond which the investment makes more returns than its actual cost. IRR should exceed the cost of capital for the project to be attractive from a financial perspective. The higher the IRR of a project, the larger the amount by which it exceeds the cost of capital and the higher the net cash flows to the investor. This means that those projects with higher IRR have capacity to return investment costs more quickly, taking into consideration the time value of money. [101]

Sensitivity analysis was done to demonstrate the effects of different levels of production scenarios taking into account reliability of water supply and functionality of the irrigation infrastructure. Four scenarios were assessed, namely:

- Optimal production -100%
- Near optimal production -75%
- Average production -50%
- Below average production -25%

This was complemented by assessing users' willingness and ability to pay for operation maintenance and replacement costs, followed by a qualitative description of effects/impacts of the water projects on human welfare in terms of health particularly as regards to access to safe water, women and girls, livestock watering, irrigation development and prospects for community development and sustainable rural development.

3. OVERVIEW OF PROJECT CHARACTERISTICS

[101] The time value of money is the supposition that there is benefit in receiving a certain amount of money now rather than an identical amount at some point in the future.

3.1 Water sources, water availability, and irrigation technology

3.1.1 ENSURE projects

The analysis was done for six water projects under the ENSURE project. These consisted of four small dams and two boreholes, each characterized by their own methods of water abstraction, water delivery, and irrigation technologies (Table 2). All projects that drew water from small dams (Musviini, Nyimai, Chemvuu, and Zinhuwe) were fully gravity systems. They were operationally simple and relatively inexpensive to operate and maintain, unlike the projects that depended on solar boreholes (Toindepi and Cheshanga). Water security is described in four categories: 1 = no water shortage; 2 = minor water shortage; 3 = moderate water shortage; and 4 = critical water shortage.

In Toindepi, Chemvuu, and Cheshanga, water shortage was critical. However, it was only in Chemvuu where this was due to a physical shortage of water. In the other two schemes, water shortage was due to abstraction challenges. In all projects (except Cheshanga where drip irrigation was in place), pipe surface irrigation was practiced.

3.1.2 Amalima projects

Table 3 shows that only one project (Pasvana) was water secure. The other three projects faced water shortage because of challenges of abstracting water.

Table 2. Water supply characteristics of projects visited in the Takunda area in Masvingo province

Name of project	Water source	Main water use		Year commissioned	Water delivery system	Water shortage	
		Use	Method			Status	Reason(s)
Musvinini Irrigation	Musvinini Dam	Irrigation	Piped surface	2018	Water is delivered from the dam by gravity through a steel pipe to rectangular wellpoints water troughs in the irrigation scheme from which farmers irrigate using buckets	Minor	Leaking pipes
Nyimai Garden	Nyimai Dam	Irrigation	Piped surface	1998	Water is delivered from the dam by gravity through a plastic and steel pipe to rectangular wellpoints in the irrigation scheme from which farmers irrigate using buckets	Minor	Leaking pipes
Toindepi Irrigation Scheme	Solarised borehole	Irrigation	Piped surface	2015	Water is pumped by solar pump to storage tanks and gravitated through a buried pipe to water taps in the irrigation scheme. In reality water is pumped into the taps due to missing return pipe from tanks and low pump capacity	Critical	Small pump and incomplete irrigation design
Mhazo proposed borehole	Under discussion	Under discussion	N/A	N/A	Under discussion	N/A	N/A
Chemvuu Garden	Chemvuu Dam	Irrigation	Piped surface	2016	Water is gravitated to the garden through a buried steel pipe to wellpoints in the garden from which farmers irrigate using buckets	Critical	Dam dried up
Zinhuwe Garden	Zinhuwe Dam	Irrigation	Piped surface	2018	Water is delivered to wellpoints in the garden from which farmers irrigate using buckets	Minor	Leaking pipes
Cheshanga Nutrition Garden	Solarised borehole	Irrigation	Drip irrigation changed to piped surface irrigation	2018	Water is pumped by solar pump to two 10,000 litre PVC tanks and gravitated through a buried PVC pipe to drippers. This was changed - water is now channelled to a tap initially meant for drinking water in the irrigation scheme from which farmers irrigate using buckets.	Critical	Small pump
Chivamba proposed borehole	Under discussion	Under discussion	N/A	N/A	Under discussion	N/A	N/A

Table 3. Location and water supply characteristics of community water projects visited in Matabeleland North and South provinces

Scheme	Water source	Main water use		Year commissioned	Water delivery system	Water shortage	
		Use	Method			Status	Reason
Paswana Irrigation	Tuli River	Irrigation	Piped surface	2018	Water is delivered from the sand in the Tuli River dam by a solar pumps into 6 Jojo 10, 000 litre tanks from which water is conveyed into taps in the irrigation schemes. Farmers collect water by buckets and irrigate their plots.	Minor	Leaking tanks and broken down pump
Mbuyane Dam	Mbuyane Dam	Livestock	Direct from the dam	2016	There is no irrigation. Dam is only used for livestock watering	Moderate	Dam dries at the peak of the dry season
Mbengwa Irrigation	Quested Dam	Irrigation	Piped surface	2014	Water is pumped by solar pump to a storage tank and 10,000 litre Jojo tank and gravitated to wellpoints from which farmers get water by buckets for irrigation.	Moderate	Small pump that serves part of the garden
Mahabangombe Garden	Borehole equipped with Bush pump	Irrigation	Piped surface	2014	Water is pumped into a small trough from which farmers fetch water for irrigation using buckets	Critical	Bush pump frequently breaks down
Manzimahle Irrigation	Solarised borehole	Irrigation	Piped surface	2019	Water is pumped by Bush pump to a 10,000 litre Jojo tank and gravitated to wellpoints from which farmers get water by buckets for irrigation.	Critical	Small pump

3.2 Plot sizes, plot holders, and crops grown

3.2.1 ENSURE projects

The size of the irrigated gardens ranged from 1.2 to 5 ha while plot size was no more than 2% of a hectare (Table 4). Household size was more or less the same at 6 to 7. As can be seen from the table, as many as ten crops were grown in schemes and even in one scheme. Financial analysis was based on the three major crops - maize, covo/rape (leafy vegetable) and tomatoes. This assumed that land was fully utilized as indicated by a cropping intensity of 300 %. It was assumed that the three crops were grown sequentially per year on the same plot.

3.2.2 Amalima projects

The size of irrigated gardens ranged from 1 to 2.7 ha (Table 5). Household size was the same (6). As shown in Table 5, as many as five crops were grown in schemes. Financial analysis was based on the three major crops – leafy vegetables (covo/rape), onions, and tomatoes. This analysis assumed that land was fully utilized (as indicated by a cropping intensity of 300%) and that the three crops were grown sequentially per year on the same plot.

Table 4. Scheme size, plot holders and plot holding characteristics, priority of water use and irrigation in ENSURE projects

Name of project	Size (ha)	Number of plot holders	Household size	Number of households served by project	Number of people served by project[102]	Priority of water use (%)			Plot size (m^2)	Crops grown	Cropping intensity (%)
						Irrigation	Domestic	Livestock watering			
Musvinini Irrigation	3	86	7	400	2800	62.5	29.2	8.3	234	Groundnuts, covo, tomatoes, carrots, butternuts, and maize	300
Nyimai Garden	5	84	5	400	2000	70.8	20.8	20.8	156	Covo, tomatoes, onions, butter nuts, beans	300
Toindepi Irrigation Scheme	5	56	6	500	3000	81.3	18.8	18.8	150	maize, tomatoes, covo	300
Chemvuu Garden	1.2	56	6	56	336	50	12.5	12.5	90	Leafy vegetables, carrots, onions, shallots, garlic, broccoli, beetroot, beans, okra, watermelons, and butternut.	300
Zinhuwe Garden	1.5	67	7	120	840	42.9	42.9	9.5	81	Cabbage, covo, rape, onions, maize, shallots, tomatoes	300
Cheshanga Nutrition Garden	5	40	6	50	300	100	15.4	-	90	Leafy vegetables, maize, beans, tomatoes.	300
Average	3.5	65	6	254	1546	68.3	21.2	14.0	133.5	N/A	300

[102] This was obtained by multiplying the number of households and average household size.

Table 5. Scheme size, and plot holder and plot holding characteristics, priority of water use and crops in Amalima projects

Name of project	Size (ha)	Number of potholders	Household size	Priority of water use			Plot size (m^2)	Crops grown	Three most important crops	Cropping intensity (%)
				Irrigation	Domestic	Livestock watering				
Paswana Irrigation	2.7	30	6	1	2	3	724	Maize, tomatoes, leaf vegetables, butternuts, water melons, sugar beans, sweet potato, and onions.	Leafy vegetables, tomatoes and butternut	300
Mbuyane Dam	-	-	6	2	1	3	-	-	-	300
Mbengwa Garden	1.4	50	6	1	3	2	154	Beans, vegetables, onions, carrots, maize, sweet potato, butternuts.	Leafy vegetables, tomatoes and onions	300
Mahabangombe Garden	1	36	6	1	2	3	63	Leafy vegetables, tomatoes, beetroot, carrots, sugar beans, and garlic.	Leafy vegetables, tomatoes, and onions	300
Manzimhale Irrigation Scheme	1	26	6	1	2	1	384	Leafy vegetables, tomatoes, onions, maize, carrots, butternuts, sugar beans.	Leafy vegetables, onions, and tomatoes.	300

3.3 Capital, operation and maintenance and replacement costs

Projects costs in the analysis included capital, operation, and maintenance (O & M), and replacement costs (Table 6). These were based on the type of irrigation technologies in place (Appendix 1). The replacement period was taken to be 10 years for all technology except for the drip irrigation in Cheshanga garden, which was estimated at 5 years. The capital costs do not include the cost of developing the source of water.

Table 6. Capital, operation and maintenance and replacement costs of ENSURE and Amalima projects

Name of project	Irrigation technology	Size (ha)	Capital costs (USD)	O&M costs (USD$/yr	Replacement costs (USD/yr)	Total O & M and replacements (/yr)
ENSURE PROJECTS						
Musvinini Irrigation	Surface	3	30, 000	1,125	1,350	2,475
Nyimai Garden	Surface	5	50, 000	1,875	2,250	4,125
Toindepi Irrigation Scheme	Surface	5	50, 000	1,875	2,250	4,125
Chemvuu Garden	Surface	1.2	12, 000	450	540	990
Zinhuwe Garden	Surface	1.5	15,000	563	675	1,238
Cheshanga Nutrition Garden	Drip	5	65, 000	1,250	6,000	7,250
AMALIMA PROJECTS						
Paswana Irrigation	Surface	2.7	27,000	1,012.50	1,080	2,092.50
Mbuyane Dam	-	-	-	-	-	
Mbengwa Garden	Surface	1.4	14,000	525	630	1,155
Mahabangombe Garden	Surface	1	10,000	375	450	825
Manzimhale Irrigation Scheme	Surface	1	10,000	375	450	825

3.4 Crop revenue

Crop revenue was computed by multiplying the crop yield per unit area by the crop price as follows: maize (US$390 per tonne); covo (US$538 per tonne); tomatoes (US$389 per tonne); and onion (US$690 per tonne).

3.5 Household income

The average household income for majority of the households was used to assess the ability to pay for O&M and replacement costs as an indicator of project sustainability.

4. FINANCIAL ANALYSIS

This section presents a financial analysis of irrigated gardens based on the crop production, crop revenue, and profitability. Thereafter there is a presentation of the financial analysis in terms of benefit cost ratio, and repayment period. This is rounded off by a discussion of willingness and ability to pay.

4.1 Crop production and crop revenue

Table 7 shows the quantity and revenue of maize, covo, and tomato produced per year based on crop yields in ENSURE projects. As noted, the figures are based on the assumption that the three major crops (maize, covo, and tomatoes) are grown sequentially over the entire plot once per year, or at a cropping intensity of 300%. The assumption is that there are no limiting factors regarding crop production and crop revenue. These figures relate to optimal production (100%). The effects of the other scenarios are accounted for in the sensitivity analysis that is presented in Section 5.1.

Table 7. Crop production, crop venue and total revenue of ENSURE projects

Name of project	Production (t per year)			Crop revenue (USD) per year			Total revenue (USD) per year
	Maize	Covo	Tomato	Maize	Covo	Tomato	
Musvinini Irrigation	5.8	30	60	2,262	16,140	23,340	41,742
Nyimai Garden	9.67	50	100	3,770	26,900	38,900	69,570
Toindepi Irrigation Scheme	9.6	50	100	3,770	26,900	38,900	69,570
Chemvuu Garden	2.32	12	24	905	6,456	9,336	16,697
Zinhuwe Garden	2.9	15	30	1,131	8,070	11,670	20,871
Cheshanga Nutrition Garden	9.67	50	100	3,770	26,900	38,900	69,570

As shown in Table 7, the larger irrigated gardens (Nyimai, Toindepi, and Cheshanga) have the highest total crop revenue. Chemvuu is the smallest size and has the lowest revenue. As a high value crop, tomatoes accounted for the highest proportion of total crop revenue.

Table 8 shows the Pasvana, the largest irrigation scheme, had the largest total revenue while the lowest revenue was recorded in the smallest schemes (Mahabangombe Garden and Manzimhale Irrigation Scheme).

Table 8. Crop production, crop venue, and total revenue of Amalima projects

Name of project	Production (t per year)			Crop revenue (USD) per year			Total revenue (USD) per year
	Onions	Covo	Tomato	Onions	Covo	Tomato	
Pasvana Irrigation	54	27	54	37,800	14,526	21,006	73,332
Mbengwa Garden	28	14	28	19,600	26,900	38,900	38,024
Mahabangombe Garden	20	10	20	14,000	6,456	9,336	27,160
Manzimhale Irrigation Scheme	20	10	20	14,000	8,070	11,670	27,160

For the Amalima projects, the same pattern is observed, in which bigger schemes realize higher revenues than smaller ones with Pasvana having the highest revenue and Mahabangome and Manzimhale the lowest. Substitution of maize with onions for the Amalima project scheme meant they would realize more revenue than the ENSURE project scheme as onions are a higher value crop.

4.2 Household consumption and crop surplus for sale

Tables 7 and 8 shows the total benefits from irrigation in terms of crop yields and total crop revenue. It is important to differentiate between the proportion of the crop consumed at the household level (since the irrigated plots are a source of household food security [103]) and the surplus that is sold to contribute to household income. Tables 9 and 10 show the quantities of maize and vegetables consumed at household level and the surplus crop. The computation is based on the per capita maize and vegetable consumption per year (Appendix IV) and the average household size.

Table 9. Crop production, household consumption and surplus crop production of ENSURE projects

Project Name	Production (t) per year			Total consumption per year (t)			Surplus (t)		
	Maize	Covo	Tomato	Maize	Covo	Tomato	Maize	Covo	Tomato
Musvini Irrigation	5.800	30.000	60.000	72.51	8.35	8.35	-66.7109	21.65026	51.65026
Nyimai Garden	9.667	50.000	100.000	50.59	5.83	5.83	-40.9223	44.1746	94.1746
Toindepi Irrigation Scheme	9.667	50.000	100.000	40.47	4.66	4.66	-30.8045	45.33968	95.33968
Chemvuu Garden	2.320	12.000	24.000	40.47	4.66	4.66	-38.1512	7.33968	19.33968
Zinhuwe Garden	2.900	15.000	30.000	56.49	6.51	6.51	-53.5911	8.49497	23.49497
Cheshanga Nutrition Garden	9.667	50.000	100.000	28.91	3.33	3.33	-19.2413	46.6712	96.6712

Table 9 shows that all the projects under ENSURE area have the potential to produce enough tomatoes and covo for household consumption, but that there is a deficit for maize. This means that all the households must obtain extra maize to cover the deficit, which could be through rainfed crop production or using the cash proceeds from tomatoes and covo.

Table 10. Crop production, household consumption, and surplus crop production of Amalima projects

Project Name	Production (t) per year			Total consumption per year (t)			Surplus (t)		
	Onion	Covo	Tomato	Onion	Covo	Tomato	Onion	Covo	Tomato
Pasvana Irrigation	54	27	54	2.50	2.50	2.50	51.5034	24.5034	51.5034
Mbengwa Garden	28	14	28	4.16	4.16	4.16	23.839	9.839	23.839
Mahabangombe Garden	20	10	20	3.00	3.00	3.00	17.00408	7.00408	17.00408
Manzimhale Irrigation Scheme	20	10	20	2.16	2.16	2.16	17.83628	7.83628	17.83628

All the schemes in the Amalima project area have surpluses for onions, covo, and tomatoes after subtracting what is used for household consumption. This leaves surplus for the market where the schemes are operating at optimum capacity.

[103] Household food security is broader than availability of maize and vegetables, but these are used for illustrative purposes and to simplify the analysis.

When crop surpluses are converted to monetary terms and summarized (Table 11), Cheshanga, Toindepi, Nyimai, and Musvinini gardens show the highest positive surplus revenues in descending order. Zinhuwe and Chemvuu have negative surplus revenues. These gardens are also the smallest in size, suggesting that size of gardens is crucial for generating surplus revenue for financing operation, maintenance, and replacement costs.

Table 11. Crop surplus revenue of ENSURE projects

Project Name	Surplus Revenue (USD)			Total Surplus Revenue (USD)
	Maize	Covo	Tomato	
Musvinini Irrigation	- 26,017	11,648	20,092	5,723
Nyimai Garden	- 15,960	23,766	36,634	44,440
Toindepi Irrigation Scheme	- 12,014	24,393	37,087	49,466
Chemvuu Garden	- 14,879	3,949	7,523	- 3,407
Zinhuwe Garden	- 20,901	4,570	9,140	- 7,191
Cheshanga Nutrition Garden	- 7,504	25,109	37,605	55,210

Pasvana, the largest scheme in Amalima project area, had the largest total surplus revenue (Table 12). All the schemes in Amalima project area would realize surplus revenue if operating at full capacity.

Table 12. Crop surplus revenue of Amalima projects

Project Name	Surplus Revenue (USD)			Total Surplus Revenue (USD)
	Maize	Covo	Tomato	
Pasvana Irrigation	36,052	13,183	20,035	69,270
Mbengwa Garden	16,687	5,293	9,273	31,254
Mahabangombe Garden	11,903	3,768	6,615	22,286
Manzimhale Irrigation Scheme	12,485	4,216	6,938	23,640

7.1 4.3 Profitability and benefit cost ratio

To indicate the level of profitability of the crop enterprises, it is important to deduct the variable costs such as crop inputs and irrigation costs from the total crop revenue. In smallholder agricultural production, it is common practice to exclude the cost of labour because households use family labour for production rather than spend money to hire labour. Tables 13 and 14 show the benefits and costs with labour, while Tables 15 and 16 show benefits and costs without labour.

Table 13. Benefits and costs (without labour) for ENSURE projects

Project Name	Total Revenue (USD)	Variable costs	Operating & Maintenance costs Per year	Replacement cost USD per year	Profit per year	Profit per household per year	Benefit Cost Ratio per year
Musvinini Irrigation	41,742	3,662	1125	1350	35,606	414	6.80
Nyimai Garden	69,570	6,103	1875	2250	59,343	706	6.80
Toindepi Irrigation Scheme	69,570	6,103	1875	2250	59,343	1,060	6.80

Project Name	Total Revenue (USD)	Variable costs	Operating & Maintenance costs Per year	Replacement cost USD per year	Profit per year	Profit per household per year	Benefit Cost Ratio per year
Chemvuu Garden	16,696	1,465	450	540	14,242	254	6.80
Zinhuwe Garden	20,871	1,831	563	675	17,802	266	6.80
Cheshanga Nutrition Garden	69,570	6,103	1250	6000	56,218	1,405	5.21

If all the production costs are included in the analysis except for labour, all the schemes are profitable assuming that they are operating at 100%. If the schemes are operating at full capacity, they will be able to cover the variable costs, operating, maintenance, and replacement costs and still generate profits. Toindepi and Nyimai schemes have the highest profit of USD$59,242 while Chemvuu has the least profit of USD$14,242. However, when the profit is considered per household, Cheshanga scheme has the highest profit of USD$1,405. Chemvuu has the least profit of USD$254.

Table 14. Benefits and costs (without labour) for Amalima projects

Project Name	Total Revenue (USD)	Variable costs	Operating & Maintenance costs Per year	Replacement cost USD per year	Profit per year	Profit per household per year	Benefit Cost Ration per year
Pasvana	73,332	4,597	1125	1350	66,643	2,221	10.37
Mbengwa	38,024	2,384	1875	2250	33,136	663	5.84
Mahabango	27,160	1,703	450	540	24,558	682	10.09
Manzimhale	27,160	1,703	563	675	24,445	940	9.24

The same pattern is realized for the Amalima project schemes. All the schemes are profitable operating at full capacity. Pasvana would realize the greatest profit, followed by Manzimale, Mahabango, and finally Mbengwa. The higher profits by Amalima projects compared to Ensure projects are due to the fact that Amalima projects are utilizing onions, a higher value crop than the maize used for ENSURE projects. For the same reasons, Amalima projects have higher benefit cost ratio.

Given the profits that can be realized by the schemes if they operate at full capacity and in Zimbabwe's current economic environment, these results demonstrate a significant income improvement. The majority of the households engaged in the projects had a monthly income of up to USD$50, which translates to 20% of Total Consumption Poverty Line (TCPL). From the results, all the schemes in ENSURE's project area had a benefit cost ratio per year of 6.8 except for Cheshanga which is 5.21. This is explained by the high O & M costs of drip irrigation. On the other hand, all the schemes in Amalima project area had positive BCR with Pasvana having highest BCR and Mbengwa having lowest BCR.

When labour is included in the computation (Table 15 and Table 16), the profitability and benefit cost ratios for all the schemes drops by a magnitude of about 5%. This shows that when using their own labour, households will be saving about 5% of the production costs. However, complaints of high labour of current irrigation methods (bucket irrigation) and efforts for replacing bucket irrigation with more labour friendly irrigation in Nyimai and Mbengwa suggest that labour is an important factor and must be included in the financial analysis.

Table 15. Benefits and costs (with labour) for ENSURE projects

Project Name	Total Revenue (USD)	Variable costs	Operating & Maintenance costs Per year	Replacement cost USD per year	Profit per year	Profit per household per year	Benefit Cost ratio per year
Musvinini Irrigation	41,742	5,082	1,125	1,350	34,185	398	5.52
Nyimai Garden	69,570	8,470	1,875	2,250	56,975	678	5.52
Toindepi Irrigation Scheme	69,570	8,470	1,875	2,250	56,975	1,017	5.52
Chemvuu Garden	16,697	2,033	450	540	13,674	244	5.52
Zinhuwe Garden	20,871	2,541	563	675	17,092	255	5.52
Cheshanga Nutrition Garden	69,570	8,470	1,250	6,000	53,850	1,346	4.43

Table 16. Benefits and costs (with labour) for Amalima projects

Project Name	Total Revenue (USD)	Variable costs	Operating & Maintenance costs Per year	Replacement cost USD per year	Profit per year	Profit per household per year	Benefit Cost ratio per year
Pasvana	73,332	6,372	1,125	1,350	64,868	2,162.25	8.29
Mbengwa	38,024	3,304	1,875	2,250	33,565	671.30	5.12
Mahabango	27,160	2,360	450	540	23,975	665.97	8.11
Manzimhale	27,160	2,360	563	675	23,975	922.12	7.55

7.2 4.4 Repayment period

Since irrigation infrastructure will need to be replaced (rehabilitated) at some point, it is important to assess the replacement period (Table 17 and Table 18).

Table 17. Repayment periods across ENSURE projects

Project Name	Capital Costs (USD)	Profit (USD) per year	Repayment period in years		
			100% Profit	50% Profit	10% Profit
Musvinini Irrigation	30,000	35,606	0.8	1.7	8.4
Nyimai Garden	50,000	59,343	0.8	1.7	8.4
Toindepi Irrigation Scheme	50,000	59,343	0.8	1.7	8.4
Chemvuu Garden	12,000	14,242	0.8	1.7	8.4
Zinhuwe Garden	15,000	17,802	0.8	1.7	8.4
Cheshanga Nutrition Garden	65,000	56,218	1.2	2.3	11.6

Table 17 shows that the repayment period for the capital costs using 100% of the profits ranges from 0.8 to 1.2 years for schemes in the ENSURE's project area. Cheshanga has the longer period because of the drip expensive irrigation. Committing 100% of profits to offset capital costs is not realistic, however, because households will then receive no benefit. When farmers commit 50% of their profits to pay for capital costs, the repayment period increases and ranges from 1.7 to 2.3 years. When farmers use 10% of their profits, the repayment period significantly increases and ranges from 8.4 to 11.6 years. This seems the most plausible option since households will be able to benefit from crop sales but at the same time repaying the capital costs. However, this might not be appealing to a commercial creditor who might require a short period for repayment of debt. The option may be to source capital with a longer period for repayment or the capital is given as a grant in whole or in part. In all cases, Cheshanga has the longest repayment period because of the expensive drip irrigation. Since drip irrigation should be replaced after five years, this means that replacing the infrastructure at 10% of the profits is tantamount to under-investment towards replacing the infrastructure. For the rest of the projects which use surface irrigation, the replacement period is shorter than the replacement period of 10 years. The 10-year replacement period may be, however, too long in practice.

Table 17. Repayment periods across the water projects implemented by Amalima

Project Name	Capital Costs	Profit	Repayment Period in years		
			100% Profit	50% Profit	10% Profit
Pasvana	27,000	66,643	0.4	0.8	4.1
Mbengwa	14,000	33,136	0.4	0.8	4.2
Mahabango	10,000	24,558	0.4	0.8	4.1
Manzimhale	10,000	24,445	0.4	0.8	4.1

For the Amalima projects, when using all their profits to repay the capital costs, it would take them 0.4 years to payback. However, when they use 10% of the profit, the period for payback is increased to between 4.1 years and 4.2 years. The repayment period for the Amalima schemes is lower than the ENSURE schemes, due to crop combinations as already discussed in other sections of the report.

4.5 Willingness and ability to pay

The above analysis needs to be complemented by an analysis of the perceptions of farmers regarding willingness and ability to pay for the operation and maintenance costs. This is because all farmers are expected to meet the full O & M costs. The degree to which farmers were willing to pay for O & M costs was assessed using a household survey. In the survey, Chemvuu had the highest proportion (85.7%) of households who were willing to pay full operation and maintenance costs, followed by Zinhuwe Garden (71.4%), Nyimai (69.6%), Cheshanga (69.2%), Musvinini (54.5%) and lastly Toindepi (37.5%). This could be explained by the water security challenges in the various projects. At the time of the visit, Chemvuu was the least water secure project as the dam had dried up, hence the very high number of people willing to invest in the improvement of the water situation. While Toindepi was the second water insecure project, the high O % M costs and incomplete irrigation design and the small solar pump may have convinced the farmers that they had no capacity to improve the water situation, hence the lowest number of farmers willing to pay for O & M costs. While Cheshanga faced the same situation as Toindepi in terms of high O & M costs because of the small solar pump, the infrastructure was not as bad as in Toindepi (see Table 2).

Figure 1 shows the proportion of households willing to pay two, three, and four times the amount of money they currently contribute to operation and maintenance. As shown, willingness to pay progressively decreases across all the projects although the entry level and slope of decline varied. A gentler slope (Musvinini and Toindepi) means that farmers were less averse to the idea compared to steeper slopes. The responses may have been affected by current amounts being paid which are in the order of USD$1 and $2 for most projects from double to quadruple what would be required for O&M.

The willingness to pay was linked to the state of water security in the project. Toindepi and Cheshanga, the most water insecure projects, had the lowest willingness level starting at around 20% and decreasing to about 10% when asked to pay four times the amount. This point becomes clearer if projects with high and low water availability are grouped together. Households in water insecure projects, they were willingness to pay more across all scenarios (Figure 2). Households in low water availability projects, they were consistently willing to pay for O & M costs across all scenarios.

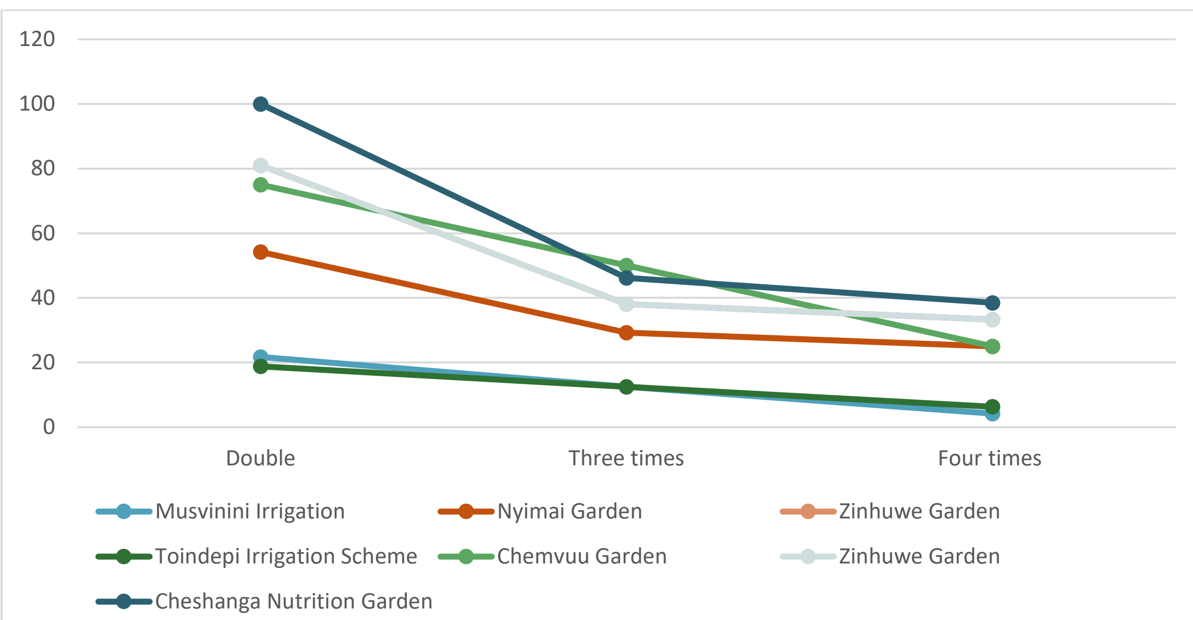

Figure 1. Willingness to pay for operation and maintenance as current amount of money contributed is increase by twice, three times and four times of ENSURE projects

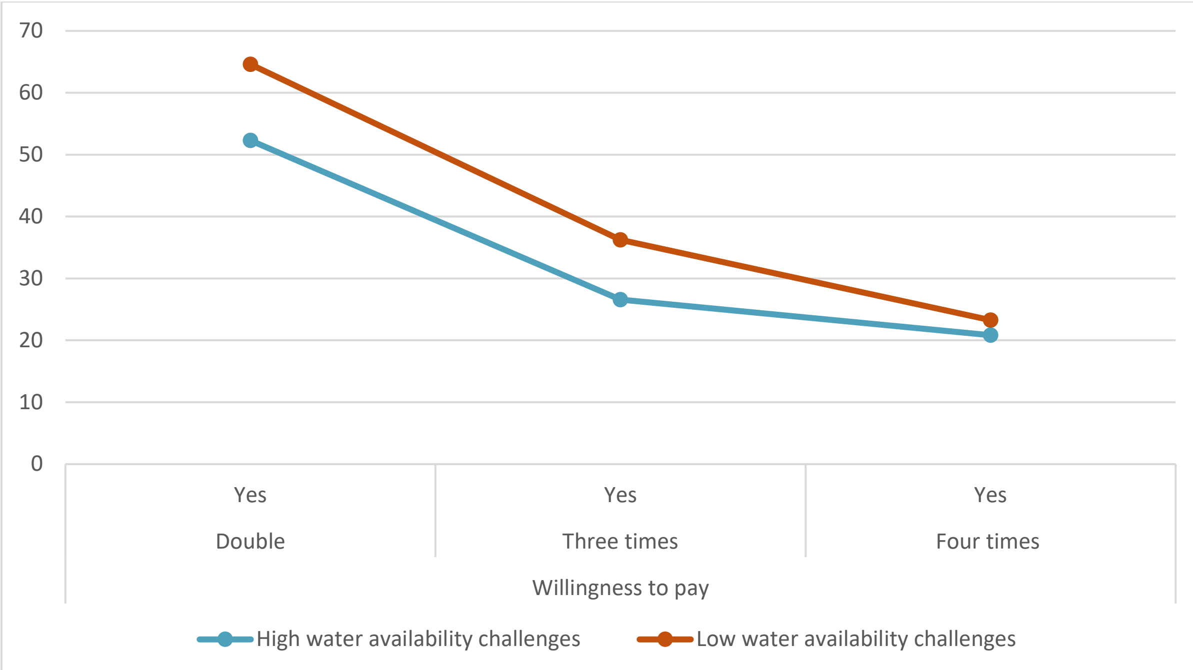

Figure 2. Willingness to pay for operation and maintenance by respondents in high and low availability of ENSURE projects

With respect to willingness to replace infrastructure, all respondents in Toindepi and Cheshanga indicated that they were willing to replace infrastructure, followed by Zinhuwe (90.5%), Nyimai (83.3%), Musvinini (66.7%), and Chemvuu (62.5%). The responses are counter-intuitive since the figures are higher than for willing to pay O &M costs. The fact that farmers in all projects were not aware of the project costs suggests poor understanding of the question.

Willingness to pay for operation and maintenance costs should be understood in the context of household income. The majority of the households (over 60%) had a monthly household income of up to USD$50, which was 20% of Total Consumption Poverty Line (TCPL).

5. ECONOMIC ANALYSIS

The economic analysis is discussed in the context of net present value and internal rate of return and sensitivity analysis of different production levels. This is followed by a qualitative description of effects/impacts of the water projects on human welfare in terms of health particularly as regards to access to safe water, women and girls, livestock watering, irrigation development and prospects of sustainability of the water projects.

5.1 Net present value and Internal rate of return

As shown in Table 18, all the ENSURE projects have positive NPV over the 10-year period. Nyimai garden has the highest NPV while Zinhuwe garden has the least NPV. For the Amalima projects, Pasvana has the highest NPV followed by Mbengwa, Mahabango, and then Manzimale (Table 19). On the other hand, Zinhuwe garden has the lowest IRR, which shows that it presents the relatively higher risk with regards to crop production. Pasvana, Mbengwa, Mahabango, and then Manzimale irrigation scheme have the highest IRR, implying they have the lowest risk amongst the schemes presented. This is mainly because these schemes have profits that surpass their capital, operating and maintenance, replacement, and variable costs during the project 10 years of their operations. However, in general, the IRR for all the projects is very high, an indication that when operations at full capacity, the financial risks in production for the schemes are negligible. As earlier indicated, projects with higher IRR have ability of returning cost of investment faster, taking into consideration time value of money.

Table 18. Net present value and Internal Rate of Return of ENSURE projects

Project Name	NPV (USD)	IRR
Musvinini Irrigation	164,341	1.33
Nyimai Garden	305,632	4.215
Toindepi Irrigation Scheme	310,201	22.5
Chemvuu Garden	60,558	1.035
Zinhuwe Garden	73,030	0.959
Cheshanga Nutrition Garden	285,425	1.989

Table 19. Net present value and Internal Rate of Return of Amalima projects

Project Name	NPV	IRR
Pasvana	384,606.6	Very High
Mbengwa	156,438.4	1.763
Mahabango	137,920.8	Very High
Manzimhale	135,832.8	Very High

5.2 Sensitivity Analysis

The analysis so far has assumed that all the schemes would be operating at full capacity. This is clearly not the case. The other scenario of operation is now going to be considered, 25% operation capacity (Tables 20 and 21). It is important to highlight the 25% refers to shortage of water either because the water source cannot provide enough water such as was the case in Chemvuu or the irrigation infrastructure, especially method of abstraction is not operating fully, such as was the case in Toindepi and Cheshanga.

Table 20. Sensitivity analyses results in the case without labour and operating at 25% capacity of ENSURE projects

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Musvinini Irrigation	7,045	81.92	3.08	4.3	8.5	42.6	4,103.9	0.0185
Nyimai Garden	11,742	139.78	3.08	4.3	8.5	42.6	38,569.5	0.15

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Toindepi Irrigation Scheme	11,742	209.68	3.08	4.3	8.5	42.6	43,138.6	0.181
Chemvuu Garden	2,818	50.32	3.08	4.3	8.5	42.6	-3,536.7	Not profitable
Zinhuwe Garden	3,522	52.57	3.08	4.3	8.5	42.6	-7,086.2	Not profitable
Cheshanga Nutrition Garden	8,617	215.42	1.98	7.5	15.1	75.4	34,724.0	0.128

Table 21. Sensitivity analyses results in the case without labour and operating at 25% capacity of Amalima projects

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Pasvana	15,091	503	5.06	1.789109	3.5782176	17.89109	64711.145	0.958
Mbengwa	6,405	128	2.01	2.18575	4.3714994	21.8575	-9433.345	0.042
Mahabango	5,464	152	4.80	1.830035	3.6600709	18.30035	19441.004	0.531
Manzimhale	5,351	206	4.08	1.868679	3.7373572	18.68679	17353.021	0.439

The data shows that when production is at 25%, profits decrease drastically and it becomes very risky to conduct business in the schemes as compared to the scenario at full capacity. At 25% capacity, schemes' profit per year differs by a range that is between 5 and 6 times if compared to operating at full capacity. In addition, the highest profit per household would be USD$215.42 per year realized at 25% capacity by Cheshanga, compared to USD$41,405 realized at full capacity for ENSURE project area. For Amalima, the highest profits per household is USD$503 realized by Pasvana, compared to USD$2,162 at full capacity. For ENSURE project area, the lowest profit per household would be USD$50.32 per year realized at 25% capacity by Chemvuu, compared to USD254 realized at full capacity. On the other hand, the lowest profit per household is USD$128 obtained by Mbengwa at 25% capacity, compared to USD$671 at full capacity.

The repayment period that would be required to pay the capital would be over 1.8 years for Amalima projects whereas for ENSURE schemes it would be over 4.3 years for all the projects except for Cheshanga, which would require 7.5 years assuming the schemes are using all their profits for repayment. It would be nearly impossible to repay the capital cost if the projects allocate 10% of their profit towards repayment of the capital costs, since this would require about 20 years for Amalima projects and over 40 years for all ENSURE projects except for Cheshanga, which would require 75 years.

Over the projected 10-year period, NPV for all the projects except for Mbengwa, Chemvuu, and Zinhuwe are positive, indicating that the projects will be profitable even when the operations are scaled down to 25%. However, operations for Mbengwa, Chemvuu, and Zinhuwe are never profitable over the 10-year period when operations are scaled down to 25%. This is mainly attributed to the small scale of their operations. The financial risks in production increases greatly at 25% capacity given the very low IRR, ranging from 0.0185 to 0.181 for ENSURE schemes and from 0.042 to 0.958 for Amalima projects when compared to operations at full capacity.

Sensitivity analyses for the capacity scenarios of 50% and 75% are shown in Tables 22 to 25 and show similar patterns.

This analysis suggests that many of the irrigation schemes are crisis-ridden and hardly able to operate beyond subsistence level,[104] which is not unique to smallholder irrigation. This is a function of structural challenges that farmers must be assisted to overcome. Subsistence farming is not a characteristic of smallholder irrigation but a symptom of these problems.

Table 22. Sensitivity analyses results in the case without labour and operating at 50% capacity of ENSURE projects

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Musvinini Irrigation	16,565	192.62	4.85	1.8	3.6	18.1	45,683	0.341
Nyimai Garden	27,609	328.68	4.85	1.8	3.6	18.1	107,868	0.678
Toindepi Irrigation Scheme	27,609	493.01	4.85	1.8	3.6	18.1	112,437	0.778
Chemvuu Garden	6,626	118.32	4.85	1.8	3.6	18.1	13,095	0.239
Zinhuwe Garden	8,282	123.61	4.85	1.8	3.6	18.1	13,701	0.208
Cheshanga Nutrition Garden	24,484	612.09	3.38	2.7	5.3	26.5	87,661	0.538

104 Duker, A.E.C., Mawoyo, T.A., Bolding, A., de Fraiture, C. and van der Zaag, P. 2020. Shifting or drifting? The crisis-driven advancement and failure of private smallholder irrigation from sand river aquifers in southern arid Zimbabwe. *Agricultural Water Management,* 241.

Table 23. Sensitivity analyses results in the case without labour and operating at 50% capacity of Amalima projects

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Pasvana	32,275	1,076	7.68	0.8	1.7	8.4	171,343	Very High
Mbengwa	15,315	306	3.58	0.9	1.8	9.1	45,857	0.384
Mahabango	11,829	329	7.38	0.8	1.7	8.5	58,934	3.591
Manzimhale	11,716	451	6.50	0.9	1.7	8.5	56,846	3.372

Table 24. Sensitivity analyses results in the case without labour and operating at 75% capacity of ENSURE projects

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Musvinini Irrigation	26,085	303	6.00	1.2	2.3	11.5	105,012	0.747
Nyimai Garden	43,476	518	6.00	1.2	2.3	11.5	206,750	1.905
Toindepi Irrigation Scheme	43,476	776	6.00	1.2	2.3	11.5	211,319	2.458
Chemvuu Garden	10,434	186	6.00	1.2	2.3	11.5	36,827	0.521
Zinhuwe Garden	13,042	195	5.99	1.2	2.3	11.5	43,365	0.461
Cheshanga Nutrition Garden	40,351	1,009	4.41	1.6	3.2	16.1	186,543	1.485

Table 25. Sensitivity analyses results in the case without labour and operating at 75% capacity of Amalima projects

Project Name	Profit per year (USD)	Profit per household per year (USD)	Benefit Cost Ratio per year	Repayment Period in years			NPV	IRR
				100% Profit	50% Profit	10% Profit		
Pasvana	48,128	1,604	7.58	0.5	1.1	5.5	277,975	Very High
Mbengwa	24,885	498	4.32	0.6	1.2	5.8	101,148	0.855
Mahabango	17,775	494	7.38	0.5	1.1	5.5	98,428	Very High
Manzimhale	17,775	684	6.77	0.6	1.1	5.5	96,340	Very High

Figures 4 and 5 shows the results of sensitivity analyses for the profit per year scenarios under 25%, 50%, 75% and 100% capacity of water projects implemented by ENSURE. The results show that as the capacity of the projects increases, the profit per year also increases. As expected, the larger projects are the ones with bigger profits.

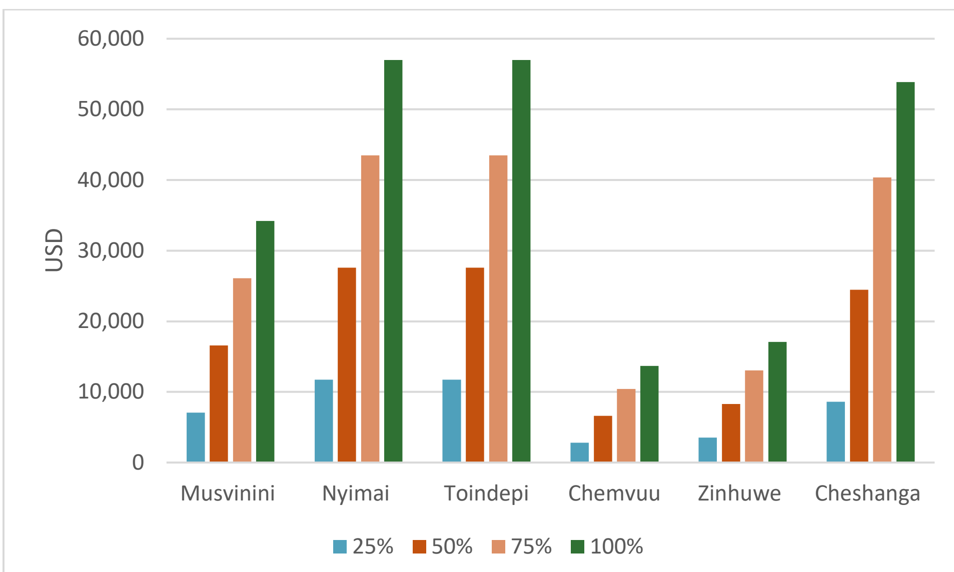

Figure 4. Sensitivity analyses results in the profit per year under 25%, 50%, 75% and 100% capacity of ENSURE projects

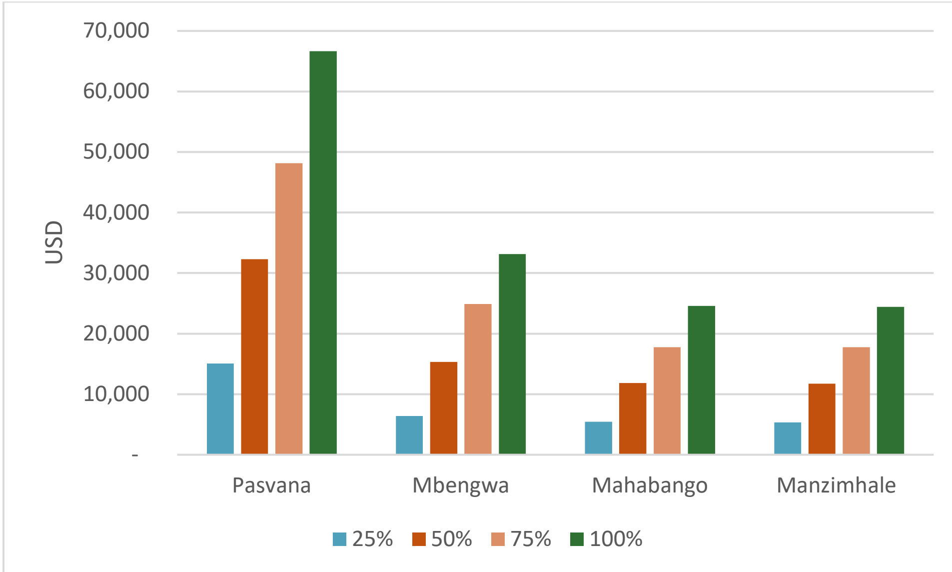

Figure 5. Sensitivity analyses results in the profit per year under 25%, 50%, 75%, and 100% capacity of Amalima projects

As relates to profit per household per year, Figures 6 and 7 show that as project capacity increases from 25% to 100%, household income per household increases. For Amalima, Pasvana has the highest dividends per household and for ENSURE, Cheshanga has higher dividends per household. The major reason for this is that of the average plot size per household for Amalima projects, Pasvava is highest having 0.09ha, followed by Manzimhale (0.04), Mbengwa (0.028ha), and Mahambango (0.027ha). For ENSURE projects Cheshanga is at 0.125ha higher than Toindepi (0.089ha), Nyimai (0.06ha), Musvinini (0.035ha), Zinhuwe (0.021ha), and Chemvuu (0.021). Profit per household is a factor of household profits.

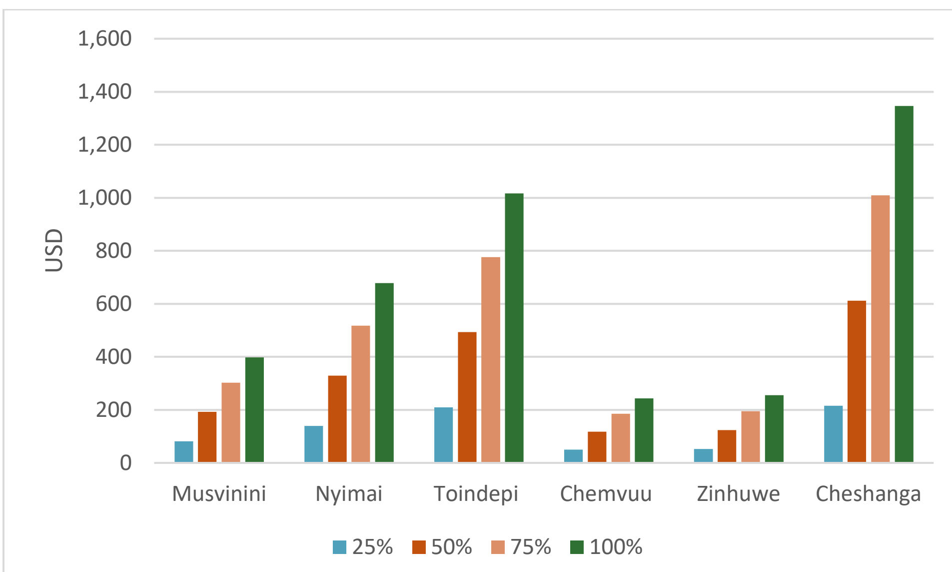

Figure 6. Sensitivity analyses results in the profit per household per year under 25%, 50%, 75% and 100% capacity of ENSURE projects

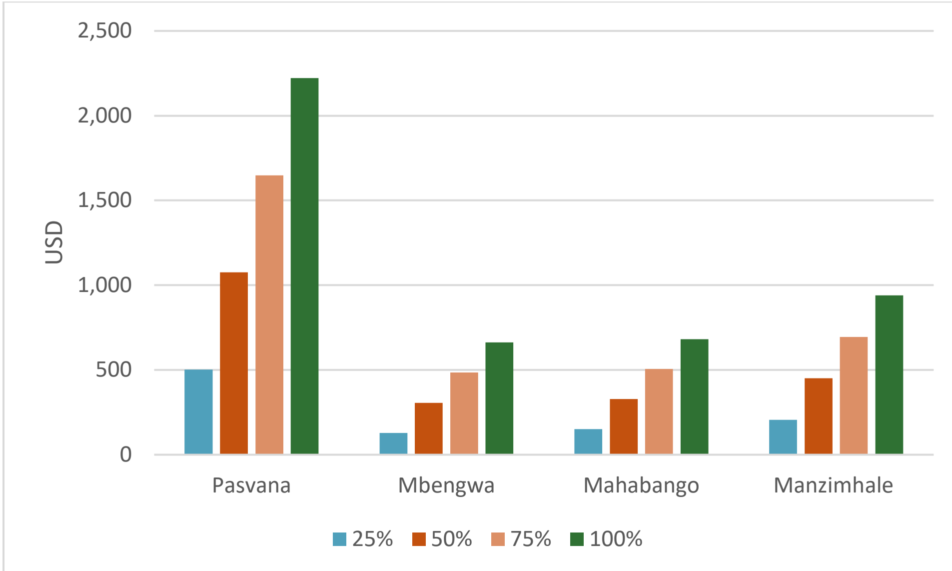

Figure 7. Sensitivity analyses results in the profit per household per year under 25%, 50%, 75%, and 100% capacity of Amalima projects

Overall, the NPV of analysed projects increases with an increase in capacity. Bigger schemes are viable in the long run at 25%, 50%, 75%, and 100% (Figures 8 and 9). However, smaller schemes, Mbengwa, Chemvuu and Zinhuwe, although they are viable in the long run at 50%, 75%, and 100%, they are not viable in the long run at 25%, at which they have negative NPVs. This means that the smaller schemes are not able to pay for capital costs, operation and maintenance costs, and replacement costs in the long run, if they operate at 25%. Specifically, Mbengwa is not able to cover capital, operation and maintenance, replacement, and variable costs, given time value of money over the 10-year period if it operates at 25%. To cover for the mentioned costs, they need to increase the operating capacity.

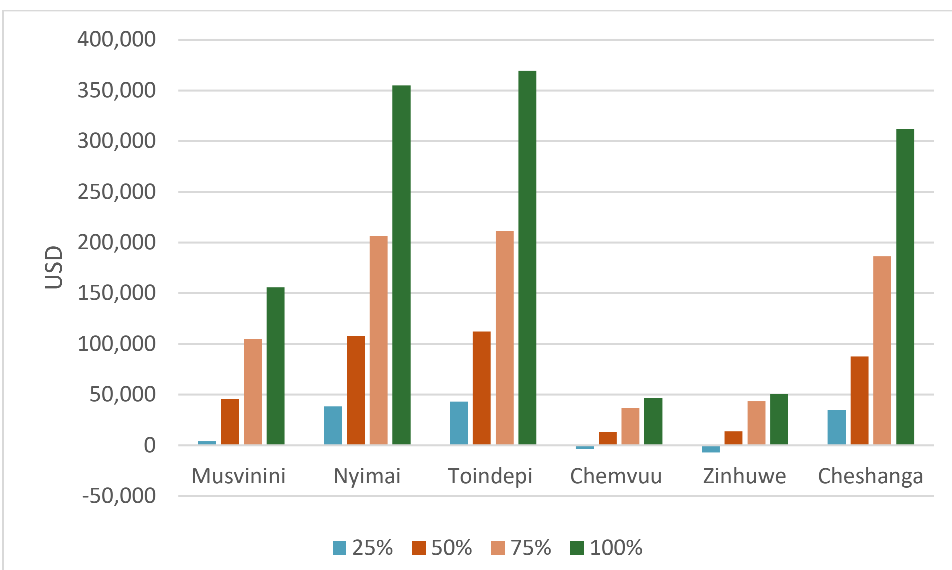

Figure 8. Sensitivity analyses results in the NPV under 25%, 50%, 75% and 100% capacity of ENSURE projects

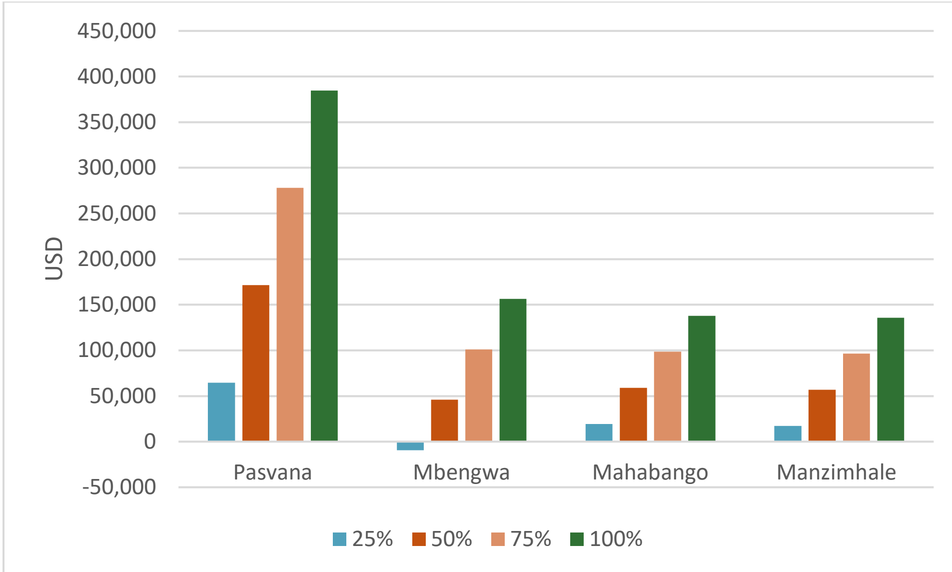

Figure 9. Sensitivity analyses results in the NPV under 25%, 50%, 75%, and 100% capacity of Amalima projects

A similar story is given by analysing the IRR as capacity of the projects changes from 25 to 100% (Figure 7 and Table 26). At 25% capacity, Chemvuu and Zinhuwe are not viable at all, meaning there is huge financial risk at that capacity. For all the schemes, as they increase their capacity, the IRR also increases. This means that at higher capacities, schemes' financial risks decrease as their capacity to repay capital costs over time goes up. Schemes need to be capacitated to operate at higher capacity if they are to sustain themselves in the long run. Otherwise, they will continually and perpetually require external support. Toindepi at 100% capacity has an IRR of 22, which is very large. This is because Toindepi has large area for crop production and a relatively smaller population, providing higher surplus revenue which would enable capacity to pay for the (relatively smaller) capital costs. For a project to be able to pay their capital costs, they would require a large surplus profit. Large surplus profits reduce projects' financial risks and make them attractive for financial credit. The operations for Pasvana at 50%, 75% and 100% the IRR is very high, the same applies for Mahambango and Manzimale at 75% and 100%. These projects at those capacities are able to achieve huge profits which are able to offset the capital costs, operation and maintenance costs, replacement costs and variable costs. Operation at higher capacities and production of high value crops is very crucial for sustainable management of irrigation schemes.

Table 26. Sensitivity analyses results in the IRR under 25%, 50%, 75%, and 100% capacity of Amalima projects

Name of project	25%	50%	75%	100%
Pasvana	0.958	Very High	Very High	Very High
Mbengwa	0.042	0.384	0.855	1.763
Mahabango	0.531	3.591	Very High	Very High
Manzimhale	0.439	3.372	Very High	Very High

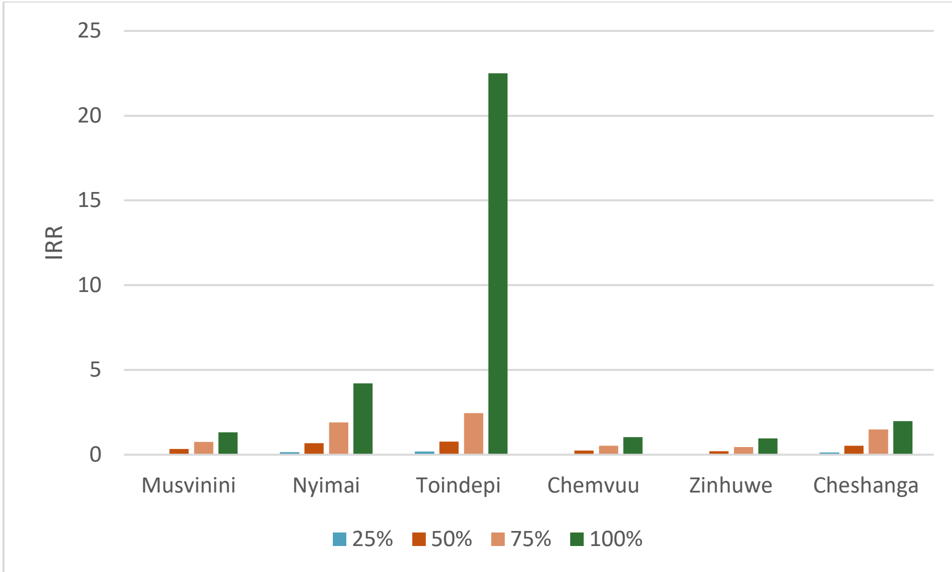

Figure 7. Sensitivity analyses results in the IRR under 25%, 50%, 75% and 100% capacity of ENSURE projects

7.3 5.3 Food security, incomes and livelihood diversification and poverty reduction

Farmers grow a wide variety of crops, which include maize, tomatoes, groundnuts, covo, rape, carrots, butternuts, onions, beans, garlic, broccoli, beetroot, okra, and watermelons. This provides diverse sources of carbohydrates, proteins, and other nutritional requirements. Given the variety of crops grown in the projects by the households, the projects have improved health and nutritional status of the households.

Crop yields are also increased because of availability of water. In the case of maize, which is also grown under rainfed conditions, irrigation leads to improved yields. In addition to food, community members sell surplus maize to earn household income, which can be used to meet various household needs and operation, maintenance, and replacement costs.

Provision of water also reduces vulnerability of communities to climate-related shocks and other shocks by reducing poverty and facilitating more diversified livelihood strategies and higher food security.

7.4 5.4 Impact on Human Health

The water in the projects is used for irrigation, domestic purposes, and livestock watering (in that order) despite the fact there is not enough water for all of these uses. This section focuses on the health impacts of drinking water quality.

Out of the ten sites that were sampled, only three sites (Toindepi, Cheshanga, and Paswani) were found to have potable water. All three of these sites use boreholes. Water from Manzimahle borehole was infected probably because of poor water handling - there was no direct provision water for domestic purposes from the borehole. The high ionic activity in the water samples from the boreholes indicate a salinity threat, which could result in other challenges such as suitability for other domestic water uses such as laundry. All samples from surface water sources were infected except for the water from the second tank of the water treatment plant in Nyimai. The fact that surface water can be treated effectively is a positive development but the cost of treatment must be accounted for. Drilling a borehole may be a cheaper option.

The impact of unsafe water is quite significant. It is estimated that a child born in Europe, or the United States is 520 times less likely to die from diarrhoea disease than an infant in sub-Saharan Africa, where only 36% of the population can access hygienic sanitation. [105] It is also important to consider the fact that waterborne diseases cause morbidity, which result in loss of economic production and productivity to the society.

5.5 Impact on women and girls' welfare

Since most respondents were women, it is important to assess the impacts of water provision on the welfare of women and girls. Most of the respondents, except for Musvinini and Nyimai, regarded the amount of water as inadequate. The reasons given for this were too few sources, the seasonal variability of water in those sources, unreliability of water sources, and operational challenges in that order. There was, however, no consistency in the reasons that were given. One would have expected a higher ranking for operational challenges in Toindepi and Cheshanga since these were prolific boreholes, which were fitted with small pumps.

The inadequate amount of water in Toindepi, Zinhuwe, and Cheshanga, coupled with poor quality water in all but Toindepi and Cheshanga, had a negative effect on women and girls who traditionally fetch domestic water. This greatly reduces the time they have for other productive work or for girls to attend school. [106] Across all the projects, the lack of or inadequate provision of domestic meant that women and girls had to walk extra kilometres after the exertions of irrigation to fetch domestic water. The case for a MUS approach is obvious so as to meet the minim standards [107] and the associated key indicators [108] (Box 1). While the key indicators were not on course to be achieved, this can be achieved with extra investment (see Main report). While the maximum number of people per water sources across all water projects (Table 3) was within the recommendations, the challenges related to low discharge rate, which affected queuing time due to water sources and systems that were not well designed and maintained.

Box 1. Key indicators of acceptable water provision

- Average water available for drinking, cooking and personal hygiene in any household is at least 15 liters per person per day;
- Maximum distance from any household to the nearest water point is 500 meters;
- Queuing time at a water source is no more than 15 minutes;
- It takes no more than three minutes to fill a 20-litre container;
- Water sources and systems are maintained, and appropriate quantities of water are available consistently or on a regular basis;
- Maximum numbers of people per water source depends on the yield and availability of water at each source:
    - 250 people per tap based on a flow of 7.5 liters/minute
    - 500 people per handpump based on a flow of 16.6 liter/minute
    - 400 people per single-user open well based on a flow of 12.5 liter/minute

[105] https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/Sphere/SPHERE2%20%20chapter%202%20%20Min%20standards%20in%20water,%20sanitation%20and%20hygien.

[106] https://www.newsday.co.zw/news/article/189509/water-crisis-girls-women-suffer

[107] These are qualitative in nature and specify the minimum levels to be attained in the provision of water. Available at: https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/Sphere/SPHERE2%20%20chapter%202%20%20Min%20standards%20in%20water,%20sanitation%20and%20hygien

[108] Signals' that show whether the standard has been attained, which provide a way of measuring and communicating the impact, or result, of programmes as well as the process, or methods, used , which may be quantitative or qualitative (https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/Sphere/SPHERE2%20 %20chapter%202%20 %20Min%20standards%20in%20water,%20sanitation%20and%20hygien

5.6 Irrigation technology and irrigation development

The provision of irrigation contributes to diversified community skills in irrigation technology and irrigation development, which can only be positive for the society. There is, however, a need to ensure that all aspects of irrigation are considered. For example, use of buckets for irrigating from water troughs was considered to be labour intensive while the introduction of drip irrigation in Cheshanga was met with disinterest to the extent that it was replaced. This reinforces the point that the choice of one particular irrigation technology over another is a fine balance between efficiencies that can be achieved and the capacity of users to operate and maintain the technology. Development and operational costs and 'efficient' irrigation technology alone do not determine financial and economic viability of irrigation. [109] Participatory irrigation planning, design, and management are therefore key for MUS projects.

5.7 Livestock development

As indicated in Table 3, livestock watering was among the three most important uses. Indeed, the need to provide water for livestock was one of the drivers for the construction of small dams such as Musvinini, Nyimai, and Zinhuwe. This is because livestock rearing is an important socio-economic activity in rural areas in Zimbabwe. Attributing the number of livestock that are saved due to water provision is difficult because the number of livestock that was served by each water source was unknown and because this is conflated with availability of grazing. However, small dams are more suitable as they respond rapidly to precipitation and runoff and harness the sporadic and temporal rainfall that are common in these semi-arid environments. If small dams are to make a sustainable contribution to livestock development in the country, there is a need to ensure that the design matches the water availability in the small catchments. Boreholes also provide water for livestock production, but this also often competes with other uses, such as irrigation and domestic water provision.

5.8 Sustainable rural development

The various benefits that have been described above should be sustained, and this can lead to sustainable rural development. For this to happen, communities themselves should take charge of the operations and maintenance and replacement of water projects. There was consensus that the project would continue to function after the end of donor support. All the respondents from Cheshanga were confident that the project would continue to operate after donor withdrawal followed by Toindepi (75%), Chemvuu (75%), Zinhuwe (71.4%), Nyimai (70.8%), and Musvinini (37.5%). The willingness to pay for operational and maintenance costs is another indicator of sustainability. The majority of people across all projects expressed willingness to mobilize funds for repairs and replacements of the water infrastructure. This is a strong indicator that the households would not let the water infrastructure lie idle without taking necessary action to repair and replace.

A number of conditions are, however, necessary. Given that the garden operations will be more profitable and pose less financial risk, if the schemes are at a larger scale, there is need to encourage and support them to operate at full capacity. For this to happen, the projects need to be water secure and transitioned into MUS projects rather than projects with MUS aspects.

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[109] Mupaso, N., Manzungu, E., Mutambara, J., and Hanyani-Mlambo, B. 2014. The impact of technology on smallholder irrigation on the financial and economic performance of smallholder irrigation in Zimbabwe. *Irrigation and Drainage*, 63(4): 430-439; Foster, T., Furey, S., Banks, B., and Willetts, J. 2019. Functionality of handpump water supplies: a review of data from sub-Saharan Africa and the Asia-Pacific region, *International Journal of Water Resources Development.*

6. CONCLUSIONS

The objective of this report was to provide a financial analysis of the six MUS projects implemented by ENSURE and four MUS projects implemented by Amalima by comparing benefits and costs of the projects and an economic analysis to assess the benefits and costs to the whole Zimbabwean economy/society. The underlying assumption was that the projects were designed to provide multiple water uses mainly water for drinking/domestic purposes as well as water for irrigation and livestock watering.

The analysis took into account the specific characteristics of the projects incorporating water supply (type of water source and method of water abstraction, delivery, and irrigation), landholding (project and plot size), crops grown for household consumption and for sale, and household characteristics in terms of household size and income. The sustainability of the projects was assessed in relation to the origin and level of investment costs contributed by the donor, government, and the community in community schemes and in self-supply projects (originated and funded by the community), and the ability of water users to contribute to operation, maintenance and replacement costs.

The financial and economic analyses estimated the benefits of project investments based on the difference between the with-project and without-project situation to determine the costs incurred and benefits gained from investing in the project through determination of the net present value (NPV) of a project, based on its estimated discounted present and future cash flows. Due to lack of and unreliable data for some parameters at project level, such as crop yields and crop prices, investment costs, operation and maintenance costs, on-line published Zimbabwean data was used. For this reason and the fact that the water projects were not designed for all the multiple water uses but incorporated aspects of multiple water uses, impacts of water provision on the welfare of women and girls and livestock watering were described qualitatively.

If all production costs are considered except for labour and the projects are operating at 100%, they will all be able to cover the variable costs, operating, maintenance, and replacement costs and still generate profits. Inclusion of labour results in profitability and benefit cost ratios dropping by about 5%. Labour shortage at the project level makes it necessary to include labour in the financial analysis. The repayment period for the capital costs using 100% of the profits ranges from 0.8 to 1.2 years but the repayment period significantly increases and ranges from 8.4 to 11.6 years when 10% of the profits are committed, which is more realistic. In all scenarios, Cheshanga has the longest repayment period because of the expensive drip irrigation -the repayment is almost double the recommended five years. For the rest of the projects which use surface irrigation, the replacement period is shorter than the replacement period of 10 years. There are, however, a few important caveats. First, for reasons which include low water availability and operational challenges, the water projects were operating below 100%. To this end, what happens at the worst-case scenario when the projects operate at 25% capacity? At 25% capacity:

- Profits decrease drastically with projects' profit per year differing by between 5 and 6 times if compared to operating at full capacity. The highest profit per household would be USD$215.42 per year by Cheshanga compared to USD$1,405 at full capacity. The lowest profit per household would be USD$50.32 per year in Chemvuu compared to USD$254 at full capacity for the ENSURE project area. For Amalima, the highest profits per household is US$D503 realized by Pasvana compared to USD$2,162 at full capacity.
- The repayment period would increase to over 40 years for all the projects (except for Cheshanga, which would require 75 years) for ENSURE project area. For Amalima project area, the repayment period would be about 20 years.
- NPV over the projected 10-year period for all the schemes except for Chemvuu and Zinhuwe (because of the small scale of their operations) indicate that the projects will be profitable.

- The financial risks in production increases significantly as indicated by the very low IRR, ranging from 0.0185 to 0.181 when compared to operations at full capacity.

Second, the scheme and plot size affects financial performance of the projects. The bigger the irrigated gardens, the higher the total crop revenue and financial performance. Third, there was not enough water for irrigation, domestic purposes, and livestock watering, which were the priority water uses in the projects.

The full benefits from the projects, can only be achieved if certain conditions are met, namely:

- Ensuring that the schemes operate at full capacity and have the appropriate scheme and plot size to make the project operations more profitable and pose less financial risk.
- The projects need to be water secure by addressing physical water shortage and operational challenges.
- Transitioning the projects into MUS projects rather than projects with MUS aspects, by making sure that all the water uses are provided for and ensuring that the water is safe to drink by conducting appropriate water tests before and at commissioning of the projects as well as routine testing.

Appendix I. Water requirements, efficiency and costs associated with different irrigation systems in Zimbabwe

Irrigation type	Irrigation water requirements m^3/ha	Efficiency (%)	Capital costs US$/ha	Rehabilitation/replacement costs US$/ha	O&M costs (US$/ha/yr
Surface	16 000	45	10, 000	4 500	375
Sprinkler	13 000	65-70	8500	3 000	500
Drip	9 000	80-90	13, 000	6 000	250

Source: FAO (2011)

Appendix II. Average yields of maize, rape, and tomatoes under irrigation in Zimbabwe

Crop	Yield (t/ha)
Maize	5.8
Covo/rape	30
Tomatoes	60
Onion	50

Appendix III. Prices of maize, Leafy vegetables (rape), tomatoes, and onions [110]

Crop	Price	
	Conventional	Per tonne
Maize Dried	US$5 per Bucket (20 kg)	US$390
Covo	US$3.5 per Bundle (6.5 kg)	US$538
Tomatoes	US$3.5 per Box (9 kg)	US$389
Onion	US$6.50 per 10 kg pocket	US$650 [111]

[110] Prices for covo/rape and tomatoes were obtained from https://zimpricecheck.com/price-updates/fruit-and-vegetable-prices/. The price of maize is announced by the Government of Zimbabwe.

[111] Mbare Musika Agriculture Market Price Update: 16 November 2018 | StartupBiz Zimbabwe.

Appendix V. Per capita consumption of maize and vegetables

Crop	Per capita consumption (g per person per day)
Maize [112]	330
Vegetables [113]	38

Appendix V. Production costs of maize, rape, and tomatoes

Crop	Production cost (US$) per Ha	
	Without labour	With labour
Maize Dried	199	278
Covo	681	944
Tomato	681	944
Onion	681	944

Source: For Maize dried, maize green and tomatoes USAID (2018)

[112] Muzhingi, T., Gadaga, T. H., Siwela, A. H., Grusak, M. A., Russell, R. M., & Tang, G. 2011. Yellow maize with high β-carotene is an effective source of vitamin A in healthy Zimbabwean men. *The American Journal of Clinical Nutrition,* 94, 510–519.

[113]Zimbabwe Vegetables consumption, 1992-2007 - knoema.com (opendataforafrica.org).

ANNEX D: FIELD REPORT FOR AMALIMA LOKO PROJECTS

1. INTRODUCTION

This report presents a summary of the findings of field research activities that were carried out between 1 and 14 November 2022 in the Amalima Loko Intervention Area in Gwanda and Bulilima districts of Matabeleland South province, and Tsholostho district in Matabeleland North province (Figure 1). The projects that were visited were implemented by Amalima which preceded the current Amalima Loko project.

Appendix I shows the schedule of consultations that were conducted at the provincial, district and community levels. The research team and enumerators all completed the UNICEF Introduction to Ethics in Evidence Generation (Basic) online course and received certification prior to the commencement of the fieldwork.

The report is organised as follows: Section 2 presents the approach and methods that were used to collect data; Section 3 presents the partners that were involved at the provincial and district levels; Section 4 describes the project characteristics; Section 5 presents findings of MUS across all sites in the three districts; and Section 6 presents the conclusions of the study. The fieldwork must be read in the larger context of the legal and institutional framework governing provision of services in rural areas as described in the full report.

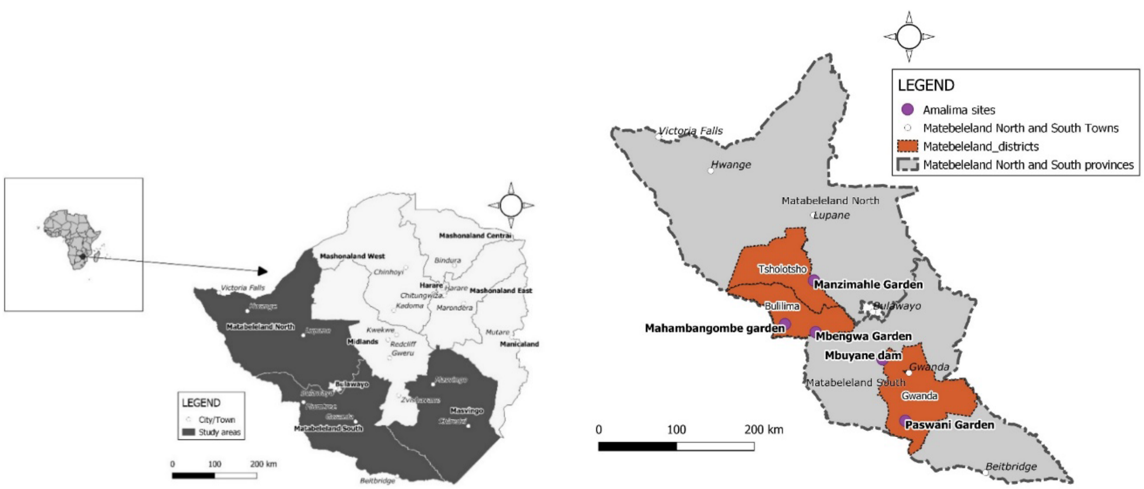

Figure 1. Location of projects visited in Matabeleland North and South provinces

2. APPROACH AND METHODS

The fieldwork in the Amalima Loko area took place from 1-10 November, 2022 (see Appendix I). Consultations at the provincial and district levels (see Section 3) and community level (see Section 4) were based on the agreed Key Informant Interview (KII) questions, Focus Group Discussions (FGDs), and administration of the household survey questionnaire. At the provincial level, KIIs were held with the relevant ZINWA Catchment offices (Mzingwane and Gwayi Catchments), the Department of Irrigation (DoI), the District Development Fund (DDF), the Department of Mechanisation (DoM), and the Department of Agricultural, Rural Development and Advisory Services (ARDAS) that operate in Matabeleland South and North provinces. The aim of these discussions was to understand the institutional mandates and mechanisms for coordination of the various organisations regarding provision of water in general and multiple use water services (MUS) in particular. A similar approach was used for district stakeholders. At the community level, consultations were based on KIIs, FGDs and administration of the household survey. 30 household survey questionnaires were administered individually to community members to understand water challenges and priorities at household level. The research team also undertook transect walks across the water facilities to observe water use practices in the company of community leaders. Additionally, water samples were taken from the water facility and complementary water source(s) to assess the quality of the water.

In Gwanda district, KIIs were held with Gwanda Rural District Council and representatives of organisations implementing the Amalima Loko projects. The aim of these interviews was to understand the mandate of the different organisations and operational arrangements in relation to how water supply projects were implemented. This was complemented by visits to community projects that were implemented by Amalima. In Gwanda, the team visited two sites, namely Paswana Irrigation Scheme in Ward 17 and Mbuyane dam in Ward 7.

FGDs with community leaders were held (instead of KIIs) due to time constraints and also because some leaders were not comfortable being interviewed individually. Invariably these included the Ward Councillor, Headmen, village heads, the Chairman of Asset Management Committee, the Chairman of the Irrigation Scheme/Garden, village health workers, and representatives of line ministries, principally the Agricultural Extension Worker and the Environmental Health Technician. This was complemented by an FGD consisting of 10 or less people to map the water resources and discuss water challenges in the area.

In Bulilima district, stakeholder consultations involved KIIs with Zaka Rural District Council, the District Development Fund, the District Agricultural Extension Officer, District the Environmental Health Officer, the Mutirikwi Sub-catchment Manager, and CARE. The aim of these interviews was the same as for Chivi district. The team visited a total of four sites in Chivi: three implemented by ENSURE (Chemvumuvu dam in Ward 14, Zinhuwe Irrigation in Ward 24 and Cheshanga Nutrition Garden in Ward 25), and the proposed Chivamba borehole in Ward 28. The team was unable to visit Baharanga because of communication challenges.

3. PARTNERSHIPS FOR WATER SERVICE DELIVERY AT THE PROVINCIAL AND DISTRICT LEVELS

3.1 Provincial Level

The provision of water to the seven districts of Matabeleland South province (Gwanda, Builima, Mangwe, Matobo, Beitbridge, Insiza, and Umzingwane) and the seven districts of Matabeleland North province (Binga, Bubi, Hwange, Lupane, Nkayi, Tsholotsho, and Umguza) is coordinated by the Provincial Water and Sanitation Sub-committee (PWSSC), which falls under the Provincial Development Committee (PDC). The PDC reports to the Minister of State for Provincial Affairs and Devolution in each province. The structure and functions of the PDC are the same as those in the Takunda area.

3.1.1 ZINWA – Mzingwane Catchment

Mandate

ZINWA's mandate includes provision of water in a sustainable and affordable way to small urban and rural service centres where there is no capacity to provide potable water. It is a non-profit making organisation and charges water tariffs to fund its operations. The charges for commercial water use are as follows:

- Agreement water for water in large government dams and gazetted dams[114] in the former white commercial farms that were re-distributed in the aftermath of the fast-track land reform programme. Owners of private small dams that are not gazetted must apply for permit to store water from the subcatchment council;
- A water levy; and
- A Subcatchment levy.

Generally, smallholder farmers pay for agreement water unlike the governed-owned parastatal Agricultural and Rural Development Authority (ARDA) and some commercial estates.

Primary water use is not charged. However, boreholes now (in accordance with the 2021 SI 38) require borehole registration fees and authority to drill fees. ZINWA was of the opinion that it was a small fee to pay. Once money is generated from any agricultural activity, the charges for commercial water use apply. It was agreed that there are legitimate questions about how best to implement the notion of primary water especially for vulnerable communities, recognizing that water is crucial for poverty alleviation.

Recently (in the last two years), ZINWA was given an additional mandate under the Presidential Borehole Drilling Scheme to develop new irrigation and drill community boreholes. This was in response to the fact that water in dams being built for irrigation were not being used for those purposes, so ZINWA is providing community boreholes for domestic purposes and installing centre pivots for climate-smart-irrigation.[115] However, this system is still to be validated as it is still a new concept being implemented.

Pursuant to the Borehole Drilling Scheme, ZINWA is required to sink 35,000 boreholes – one in each of the 35,000 villages in Zimbabwe. Siting and equipping the boreholes is deferred to the private sector. As part of its new mandate, ZINWA has decentralised its services and set up service centres, which are meant to better serve the communities at the local level. Service centres consist of a team leader supported by a technical team and support staff. This additional mandate is taking precedence over ZINWA's water resource management role, which is one of its priority focal areas according to the ZINWA Act.

Experience with MUS

The boreholes that ZINWA is drilling at village level are meant to provide water for multiple uses: domestic water, for a community garden (which will be managed by a business manager), for livestock watering, and other uses. There is, however, no clear policy and implementation plan regarding this MUS approach, which raises questions about its sustainability.

Partnerships

In the community gardens, ZINWA works with ARDS, the Department of Agricultural, Rural Development and Advisory Services (ARDA), the Agricultural Marketing Authority (AMA), the Agricultural Finance Corporation (AFC), Aquaculture, and ZIMPARKS, among others. The idea is to have in place a support structure for MUS. The service centres enable ZINWA to work with other actors at the district level. ZINWA's new mandate has potential overlaps with Department of Irrigation (which has the irrigation mandate) and DDF, which has had the mandate to drill boreholes in rural areas for a long time.

3.1.2 Department of Irrigation – Matabeleland north

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[114] These are dams greater than eight metres in height and therefore not categorised as "small dams," which are managed by DDF and NGOs at the district level.

[115] The efficiency of these pivots are as high as 85%. (Msibi et al., 2014)

Mandate

The Department of Irrigation (DoI) is responsible for irrigation development and rehabilitation of irrigation infrastructure in public schemes. DoI assesses water availability and plans, designs, and implements public irrigation systems. DoI more or less offers consultancy services to ZINWA, which now develops new irrigation schemes. In communal areas, DoI supervises construction of irrigation schemes.

DoI no longer has a presence at the district level, where Irrigation Technicians used to be stationed. District office personnel were removed in 2018 to reduce the number of employees. It was felt district level personnel did not have much work. Contractors were preferred to in-house staff unlike in the past when DoI undertook in-house construction.

Partnerships

DoI has the overall mandate for irrigation development responsible for planning and designing while ZINWA is now the implementing agency (Figure 2).

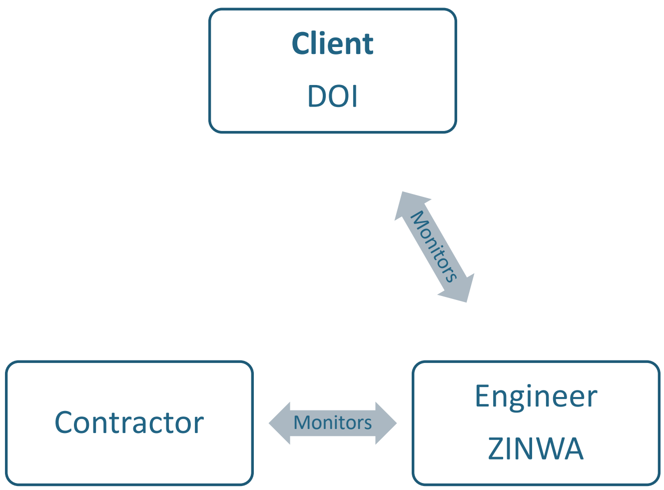

Figure 2. Relationship between Department of Irrigation and ZINWA

DOI has given ZINWA a target of developing the 35,000 hectares for irrigation.

DoI also participates in the Provincial Development Committee through the Provincial Water and Sanitation Sub-committee (PWSSC), the Food and Nutrition and Security Sub-committee, and others.

Experience with MUS

DOI works mainly on larger irrigation schemes as opposed to small gardens. As such, it is not really directly involved in MUS projects. However, their designs may include limited MUS depending on suggestions from feasibility studies.

3.1.3 DDF – Matabeleland South Province

Mandate

Among other its functions, DDF is tasked with providing water to rural communities through borehole drilling and constructing small dams for domestic purposes and livestock watering, but interviews with staff indicate that they are lacking the necessary resources to undertake these activities. For example, there is only one drilling rig in the province, which is not functioning. Borehole siting services are at the provincial level as is responsibility for small dam construction.

DDF also provides training for rural communities on borehole management for boreholes fitted with Bush pumps. There are two mechanics who provide these services: a Ward mechanic and a village mechanic who are backstopped by the District Maintenance Teams (who are also under-funded). Communities are encouraged to form a Water Point Committee (WPC) and develop a constitution that governs water use from the borehole. Ideally, Ward Maintenance Teams are also instituted tasked to deal with the repair and maintenance of water points.

DDF is further responsible for coordinating water and sanitation provision at the province and district levels, but not at the ward level (Figure 3). PWSC meets quarterly when resources permit. Women are mobilized through the Ministry of Women.

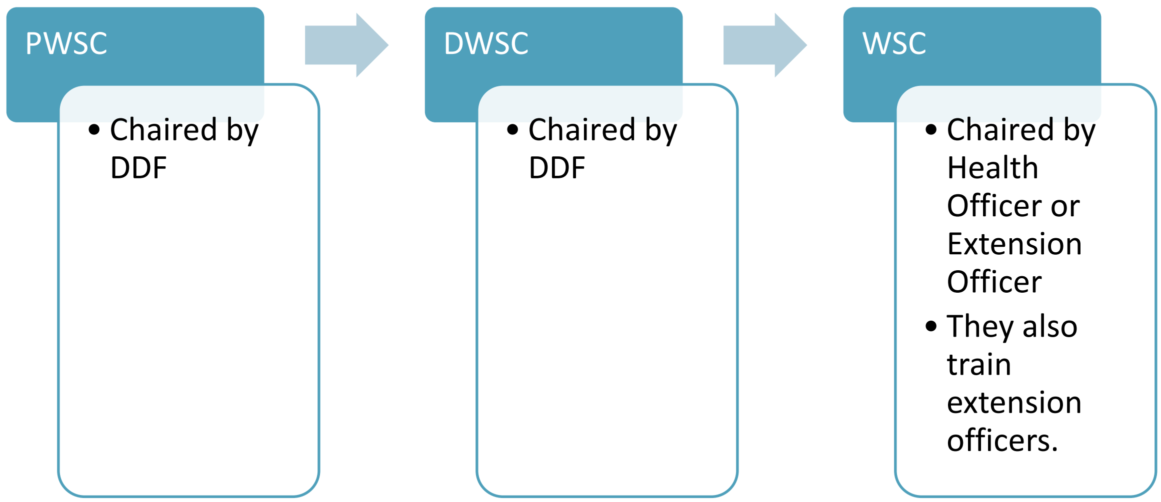

Figure 3. Coordination of water and sanitation provision at the provincial, district, and ward level

Experience with MUS

To ensure that water points cater for the various water uses, all boreholes are capacity tested so as to allow for projects that cater for all water uses. Water scarcity is an important consideration when designing MUS schemes. For example, in Gwanda North, groundwater is very scarce. To this end the idea of sand dams is being explored with a view to utilize sand abstracted water for MUS. Partners are being encouraged to use sand dams for water provision, as up to 75% of ordinary dams are silted or have no water. Well points in the sand are also used to obtain water.

More resources need to be spent on training communities to help them better respond to challenges in water provision in general and MUS in particular. There is currently a UNICEF training programme which cascades from the national level to the district and ward levels. It is important to observe that communities have knowledge that can be tapped into (including indigenous knowledge) that, if combined with technology, can be very beneficial.

Partnerships

While DDF works well with other state and non-state entities within the PWSSC and DWSSC structures, there are some challenges. There are questions about the role of Mechanisation in small dam development as this mandate has the potential to duplicate the efforts of ZINWA with regards to borehole drilling and Department of Mechanisation regards small dams.

Operation and Maintenance

It was the opinion of those interviewed that requiring payment tends to help with creating a sense of responsibility among the farmers, but that targeted subsidies were also necessary to help with O & M.

Community-owned and led projects may be a sustainable approach to water provision. For example, Bulilima farmers got together and used money sourced from remittances to drill a borehole and invest in other offshoot projects.

3.1.4 DDF – Matabeleland North Province

Mandate

DDF is mandated to provide water through drilling boreholes and constructing small dams. It provides water to the 7 rural districts in Matabeleland North and also to Hwange and Lupane, which are small towns and urbanising rural centres. DDF draws its mandate from the DDF Act. DDF used to have a portfolio that included boreholes, dams, small dams, and irrigation development. DDF drills boreholes in schools while ZINWA drills boreholes in communities.

The operations of DDF are similar to those in Matabeleland South province, namely:

- Surveying (provided by the provincial hydrogeologist), drilling, operation and maintenance of boreholes (but the single rig in the province is not enough);
- District Maintenance Teams (DMTs) partner with local communities through water point committees; and
- Training ward and village pump mechanics.

DDF also chairs the PWSC and DWSC, but it was felt that there is a need to strengthen the committees.

Experience with MUS

DDF has been involved in the provision of water sources that provide domestic water and water for livestock. There is however, a need to be more systematic in these interventions, which is undermined by very limited resources.

Partnerships

There are a number of departments with more or less the same mandates, which presents difficulties in determining responsibilities and ensuring that there is no duplication of effort and wastage of scarce resources. The WREMS is meant to the main information server, but only serves WASH facilities. There are also issues of outdated gadgets and limited updates, which has led to a dual system to cover for system shortfalls. The local authority is responsible for updating the data and gadgets. Limited resources have, in turn, limited data collection. There may be an argument for a new, MUS-based system that includes the recording and regular updating of different water sources, their use cases, challenges, community feedback, and status.

3.1.5 Department of Mechanisation – Matabeleland North Province

Mandate

Among other its other responsibilities, the Department of Mechanisation is responsible for small dams development by providing design and construction services.

No small dams are currently being funded from the fiscus, but projects are taking place that are funded through development partners. The process involves identifying sites by partners, surveying, designing, and construction. Runoff data for the catchment is determined from the ZINWA bluebook, but not enough information is available. Socio-economic issues are investigated by development partners. The Department of Mechanization is limited to implementing the engineering side of projects, but these are compromised by limited resources from the government or development partners resulting in a situation where no proper feasibility studies are conducted. While the Department is supposed to sign off on small dam construction, this is not happening. This limits what can be developed even from a MUS perspective as competition for water from newly installed boreholes (especially as they using solar pumps) may not be clear.

Experience with MUS

Because the Department in not represented at the district level, there is no opportunity to participate in the construction of small dams for MUS.

Partnerships

The Department participates in relevant committees of the PDC.

3.1.6 Agricultural, Rural Development, and Advisory Services [ARDAS] – Matabeleland South Province

Mandate

The Provincial Development Committee (PDC) is chaired by the Minister of Lands and includes thematic working groups such as agriculture and infrastructure (Figure 4). There is an economic development plan that the PDC uses.

The focus of the ARDAS is on increasing food security, though the conceptualization of food security may differ between parties. The National Development Strategy 1 (2021-2025) is being promoted as the reference for development of water resources, but there are challenges in unpacking the national strategy and applying it at the Provincial level (and below).

The ARDAS consists of the training, livestock, and agronomy sections. However the Ministry of Lands, Agriculture, Fisheries, Water Climate and Rural Development also includes ZINWA, WASH and Irrigation development, Vet services, Lands, ARDA, AFC, AMA, Mechanisation, DOI and the Surveyor General. ZINWA builds dams and boreholes together with conducting capacity testing. Some of the activities they conduct as ministry include the development of:

- Potable water sources (primary water use)
- Gardens (1ha/2ha)
- Climate smart solar power systems
- Livestock
- Social responsibility

There is a Ministry focus on development of fish ponds, removing Blair toilets, and developing ablution facilities. For example Paporohowo scheme has a garden, fish pond, potable water, and bathing facilities. To engage in these projects, farmers must form a business entity and then the entity employs the farmers. Money is set aside for O & M from the costs that are born by the garden through its commercial activities and a 10% commitment from farmers. AFC acts as a guarantor for the farmer's contribution. Farmers are encouraged to send their produce to Grain Marketing Board (GMB) so that the government can recoup some of the money farmers will owe from their 10%.

3.1.7 Agricultural, Rural Development and Advisory Services [ARDAS] – Matabeleland North Province

Mandate

AGRITEX was mandated with crop production and livestock while the new ARDAS has the following structure.

Presidential naming of programmes allows for better resource mobilization as there is and incentivisation to make sure the programmes work.

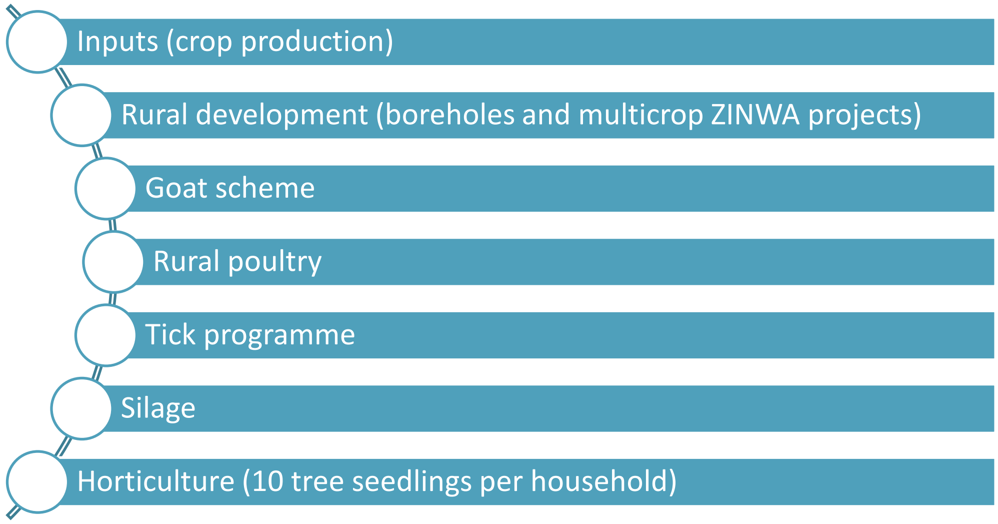

Figure 4. Structure and functions of Agricultural, Rural Development, and Advisory Services (ARDAS)

DDF drills boreholes in schools while ZINWA drills boreholes in communities. The ZINWA programme includes 4 new rigs per province for gardens and schools as part of their new mandate to drill 35,000 boreholes. DDF works under the OPC while ZINWA is under Water Development in the Ministry. DDF has a mandate for boreholes for community water supply hence the clarity on what extent each does what was not particularly clear. DDF chairs PWSC and DWSC.

The DDF reflected that Tsholotsho has limited surface water and relies on water pans which start to dry in June-July and are fully dry after August. Longer rainfall periods mean more pans and water. Borehole drilling is mainly for household consumption with high competition for water during the dry months. Cattle can sometimes be forced to drink water only once every 2 or 3 days to conserve the little water available.

Boreholes were mainly bush pumps, but now the focus is on solar to reduce the instances of dry or non-working boreholes. Depths of boreholes are between 90-120m. Where there are irrigation schemes, they are mostly supplied by dams with livestock being allowed access to the water. Domestic water is provided by DDF boreholes. Surface water is treated where communities supplied by ZINWA. Environmental Health Technicians are meant to collect water samples for E.coli and other tests. There are however questions about the quality of water from sand abstraction. Matabeleland North has the lowest coverage of toilets in Zimbabwe hence potential for contamination is high. The programme are organised according to clusters (Figure 5).

Figure 5. Developmental clusters at the provincial level

The Provincial council brings in elected officials to the above clusters so that each organisation is represented. The Power of provincial councils was usurped by the creation of provincial ministers and devolution agenda of government.

3.2 District Level

The structure and organisation regarding water provision at district level in the Amalima Loko Intervention Area is the same as that of the Takunda Intervention Area.

3.2.1 Gwanda Rural District Council

Gwanda generally has issues with underground water availability. NGOs sign MOUs to work in the district. MOUs are limited to allocated wards. The selection process depends on who and what informs the selection e.g. input from government departments. DWSC participates in selecting of places for development. Maintenance is dependent on borehole capacity.

4. PROJECT SITE CHARACTERISTICS

4.1 Overview of Water Projects

Two community water projects were visited in each of the Gwanda, Bulilima and Tsholotsho districts (see Table 1). As can be seen from the table, the number of respondents was smaller than the expected 30 per site. In Paswana, fewer people attended the meeting because of a funeral in the community. In Mbengwa, the farmers asked the team not to take too much time as they were busy in the fields. Due to absence of irrigation in Mahabangombe garden, no questionnaires were administered. The meeting was mainly attended by the leadership.

Table 29. Location and water supply characteristics of community water projects visited in Gwanda, Bulilima, and Tsholotsho Districts

Scheme	Ward Location	GPS Coordinates	No. of FGDs	No. of household questionnaires	Water Source	Year Commissioned	Water Delivery System	Irrigation Technology
GWANDA DISTRICT								
Paswana Irrigation	17	-21.55546, 28.97734	2	11	Tuli River	2018	Water is delivered from the sand in the Tuli River dam by solar pumps into 6 Jojo 10,000 litre tanks. From there, water is conveyed into taps in the irrigation schemes where farmers collect water by buckets and irrigate their plots.	Piped Surface
Mbuyane Dam	7	-20.77167, 28.68837	2	19	Mbuyane Dam	2016	There is no irrigation. Dam is only used for livestock watering.	Not applicable
BULILIMA DISTRICT								
Mbengwa Irrigation	1	-20.42463, 27.83503	2	11	Quested Dam	2014	Water is pumped by solar pump to a storage tank and 10,000 litre Jojo tank and gravitated to water troughs from which farmers get water by buckets for irrigation.	Piped Surface
Mahabangombe Garden	14	-20.32244, 27.44394	1	0	Borehole equipped with Bush pump	2014	Water is pumped into a small trough from which farmers fetch water for irrigation using buckets.	Piped surface
TSHOLOTSHO DISTRICT								
Manzimahle Irrigation	13	-19.76598, 27.81334	2	5	Solar borehole	2019	Water is pumped by Solar pump to a 10,000 litre Jojo tank and gravitated to water troughs from which farmers get water by buckets for irrigation.	Piped surface

4.2 Gwanda District

4.2.1 Paswana Irrigation Scheme

Research Activities

Paswana Irrigation Scheme in Ward 17 was visited on 3 November 2022. The Focus Group Discussion of traditional community leaders included committee members (1 man and 2 women) and the Ward Councillor, who joined later on. The resource mapping group was made up of five community members (2 men and 3 women). A total of 11 household survey questionnaires were administered. Water samples were taken from the water taps in the irrigation scheme.

History of the Irrigation Scheme

The irrigation scheme was initiated in 2017 when Dabane Trust encouraged the community to clear 0.5 ha for irrigation. In 2018, Amalima expanded the irrigation scheme to 3 ha, which eventually became 2.7 ha. Land clearing was done between August and December 2018. Water was to be obtained from the nearby Tuli River through a sand abstraction system using solar-powered, submersible pumps.

The community participated in the siting of the pump alongside the professionals from Dabane Trust. The community also participated in trenching via a cash for assets scheme to provide water for irrigation. Individuals were paid USD 2 for 4 hours of work and sixty plus people participated in the cash for assets programme (the target was 150 people). The project started operating from February 2019. Figure 6 shows the location of the irrigation scheme in the community.

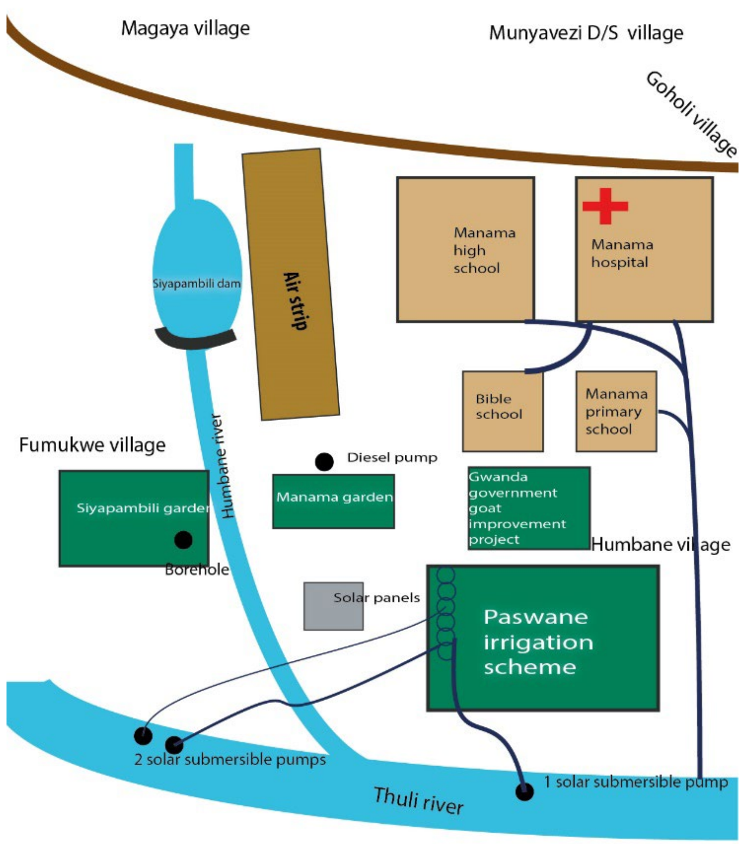

Figure 6. Location of Paswana Irrigation Scheme in the community

Water Uses

Irrigation: Water is extracted from Tuli River, which is heavily silted. Water is pumped into six 10, 000 litre plastic (Jojo) tanks. Four tanks are supplied with water from a system comprising 12 solar panels and 2 pumps (one is currently not working) and the remaining two from a system of 6 panels and 1 pump. It takes 2-3 hours to fill the tanks on a clear day.

Irrigation is carried out between 6-11 am. There are two irrigation groups, each made up of 15 members. Water is gravitated from the tanks into underground pipes from which rise taps to which are attached hose pipes for irrigation. Each member has a total of 6 plots which amount to 0.1 ha. Each plot is 20.74 x 1m in size.

Farmers grow maize, tomatoes, leaf vegetables, butternuts, water melons, sugar beans, sweet potato, and onions. The cropping calendar is as follow:

- Late July – December: maize (2 plots); butternut and water melons (1 plot); tomatoes (2 plots);
- February – May/June: vegetables (1 plot); tomatoes (1 plot); fallow (1 plot).

Some crops like tomatoes are grown three times a year. The three most important crops are tomatoes, leaf vegetable and butternut/watermelon in that order because of the cash these crops generate. The crop yields and prices that are obtained are as indicated in Table 2.

Table 30. Crops, crop yields, and prices in Paswana Irrigation Scheme

Crop	Yield per plot	Price
Tomatoes	20 buckets (20 kg per bucket)	R130 per 20 kg
Butternuts	360 butternuts	R100-150 per 10-15 kg
Vegetables	Not available	R10 per bundle
Water melon	380 water melons	R20 per butternut (2-3 kg)

Drinking/Domestic Water: Farmers drink water from the taps while irrigating. The water was tested, but farmers are not sure whether the water is safe to drink. In general, domestic water is obtained from boreholes in the community which are 1 -1.5 km from homesteads. These were drilled by DDF. Some people also obtain water from wells in the Tuli River.

To secure the water facility (i.e. abstraction system and taps at the scheme) community members were advised by Amalima to allow neighbouring communities to get water for domestic purposes and livestock watering particularly donkeys using a scotch cart. During the visit there was a donkey-powered cart that was being used to fetch water with the donkeys fed water as well.

Livestock watering: Livestock are watered from Siyapambili dam, which is built on a tributary of Thuli River. The dam is a heavily silted river, but there are boreholes and wells in the surrounding villages.

Operation and maintenance: Farmers pay R20 per member for security, R50 per member for harvest, and make contributions for repairs as and when required. After each and every harvest each contributes R50. In the end each farmers pays R900 -1000. Members also contribute R800 per month to meet the security salary.

The members patched the two water tanks that were leaking as the quotation they had obtained was too high. They are in the process of mobilising to replace the one pump which has broken down so far three times (they suspect it was wrongly installed). They got a quotation from South Africa of R29, 000 and are contributing USD10 (which will take 10 months to raise the entire amount). Farmers also mobilise money for emergencies and inputs.

The community was given receipts for all the items that were purchased for the water project. There is no dedicated fund for operation and maintenance. "We cannot afford to money aside when there are so many needs" remarked a committee member (a woman).

4.2.2 Mbuyane Dam

Research Activities

Mbuyane Dam in Ward 7 was visited on 4 November 2022. The Focus Group Discussion of traditional community leaders included two traditional leaders and four dam committee members (two men and two women). The resource mapping group was made up of four community members (two men and two women). A total of 19 household survey questionnaires were administered. Water samples were taken from the Lower and Upper Mbuyane dam.

History of the Dam

The origin of the dam goes back to 1982 when the Lutheran World Federation (an NGO owned by the Lutheran Church) tried to assist the community with a water source for the community by building a small dam on the Mbuyane river for livestock watering. A one-metre dam was constructed, but this failed to address the problem. Due to continuing water challenges, the Ward Councillor approached Amalima in 2016 and the project agreed to build the dam. Amalima provided surveying services and materials, such as cement, shovels, trowels, etc. The community provided labour (women fetched water while men did other activities, such as carrying stone) in exchange for USD2 per day for a total of 2 months. About 100 people were involved in building the dam to 3 metres. To increase the capacity of the dam, another dam (Lower Mbuyane dam) was constructed below the Upper Mbuyane dam with a height of 5 m. The second dam was completed in 2019. The dams were built in an area with good bedrock and potential for raising dam walls. Figure 7 shows the location of the dam in relation to the homesteads.

The purpose of the dam was for livestock watering. The community requested that Amalima also provide an irrigation scheme/garden, but the project refused because there was not enough water with the current level of the dam. The community also requested toilets in the vicinity of the dam, but this was not honoured. The dam provides water for at least three surrounding villages.

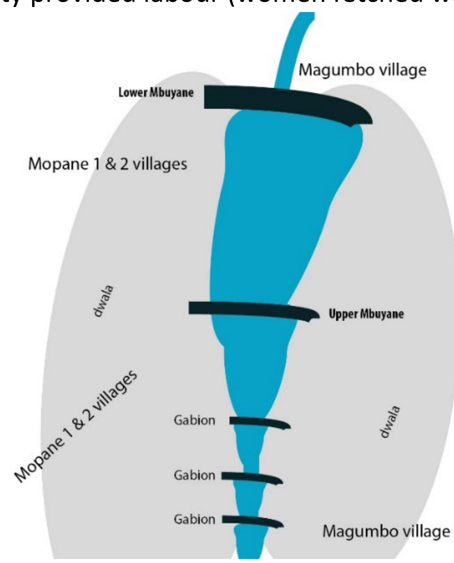

Figure 7. Location of Mbuyane dam

Water Uses

Livestock watering: The dam provides water for livestock to cattle in six villages, nearly all villages in the ward. The furthest village is 21 km away and serves about 5 000 head of cattle. Amalima provided one trough for livestock watering below the dam, but additional troughs are needed. Cattle from the nearby Matobo district also drink from the dam, as does local wildlife.

Drinking troughs built downstream of the lower dam are not used. Cattle mostly drink directly from the upper dam and cause siltation and pollution of the dam. This is worsened by the fact that there is no fence around the dam (Amalima did not provide).

Drinking/Domestic: Some people drink water from the dam, but many fetch water from the ~15 sand dam pumps that were installed by Dabane Trust, seven of which are still functional. The pumps are generally near the homesteads with the furthest at 2-3 km. The water does not run dry and it is felt that solar pumps would be better to reduce labour for pumping water. There are no places at the dam for laundry, so people fetch water from the dam and do laundry some distance away.

The water from the pumps in the river was tested twice in America through Dabane Trust and was found to be clean and safe.

Irrigation: A site was cleared for the irrigation scheme/garden using water pumped from the dam. Amalima argued against this because the water was not adequate (see above) and that, for irrigation, the dam wall would need to be raised.

The community used to fetch water from the dam to irrigate their garden, but this was discontinued because of the labour associated with the practice. To provide for their vegetables, the community have gardens that use water from the Mtshelele River. About nine of ten community members have small gardens and sell surplus vegetables to other community members.

Dam Management Rules

The dam is not fenced and is therefore poorly protected. There is a 7-member dam management committee in place, which is tasked with ensuring that cattle drink water downstream of the dam, but there are some violations of this rule. Children are also banned from playing in the dam. In the case of a violation of rules, the violator is referred to the traditional leaders and the size of the fine varies. However, this is not common because of the high degree of compliance.

There is no dedicated account for operation and maintenance and money is mobilised when there is a need, such as leakage in the dam wall. For example, members were asked members to contribute 5 rands for food during gully reclamation.

Partnerships

The community does not work with any government or RDC. Community members are not aware of the sub-catchment and catchment council. It is possible that government institutions came under the Amalima banner.

The community wishes for a fence to be constructed around the dam at least 200 m from the dam and for fish to be introduced to encourage local tourism. Roads and bridges should also be constructed to increase access to the dam.

4.3 Bulilima District

4.3.1 Mbengwa Irrigation

Research Activities

Mbengwa Garden in Ward 1 was visited on 7 November 2022. The Focus Group Discussion of traditional community leaders included one male traditional leader and 8 women committee members. The resource mapping group was made up of three women community members. A total of 11 household survey questionnaires were administered. Water samples were taken from the dam and from water troughs in the garden.

History of the Irrigation Garden

The Mbengwa Garden was started by a group of community members who were being trained in WASH. Two WASH groups (36 members) invested cash into a garden and the membership is now at 50. The original land was not being cultivated. In 2014, Amalima provided assistance in the form of materials and extended the 0.5 ha into a 1.4 hectare irrigation. The community provided land through the village head which was approved by the Bulilima Rural District Council. Figure 8 shows the location of the garden.

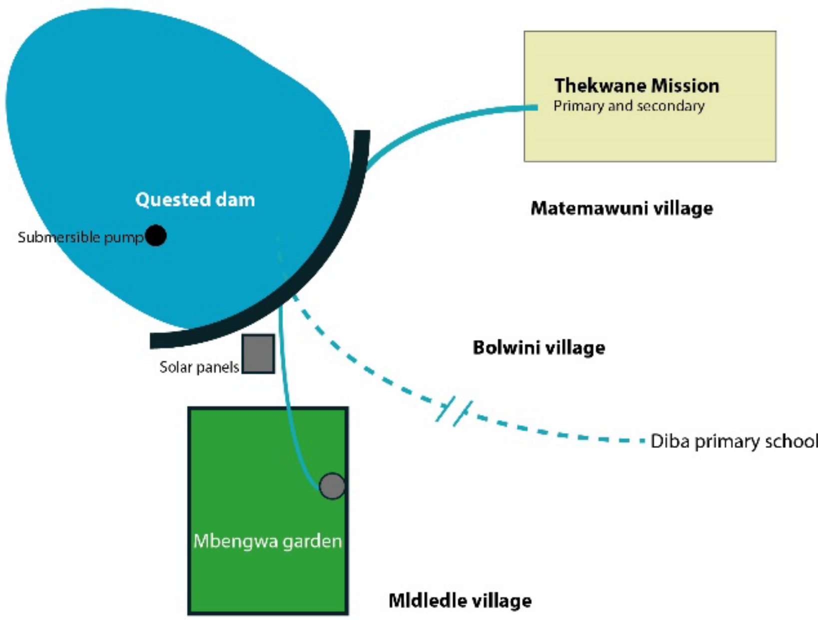

Figure 8. Location of Mbengwa Garden

Water Uses

Water is used for livestock watering and irrigation.

Irrigation: Water is pumped from Questead Dam, which was constructed before independence and used to supply water to Plumtree town. The dam now supplies water to the Mbengwa Irrigation, Tegwani Mission, and provides for livestock watering and the surrounding community. The dam overspills between December and March, indicating a good catchment for the dam.

Water is pumped from the dam using a solar pump into a circular cement tank. From this tank, the water gravitates to other small tanks from which farmers fetch water for irrigation using buckets. Water is also pumped into a 10, 000 litre Jojo container from which water flows into water troughs. The water is used to irrigate one third of the irrigated area.

The scheme is a piped surface scheme with below ground troughs for fetching water with buckets. The design is ergonomically straining for the farmers hence there were several complaints and proposals for a canal based system. Due to the high labour requirements for irrigation and the advanced age of some of the farmers, the farmers took steps to make the irrigation system more user friendly. To this end, farmers agreed to install pipes by diverting water from the Jojo tank. Six taps were installed in a line about a third of the width of the irrigation scheme. They engaged a plumber to install the pumps.

In 2021-22 they used a total of R10, 000 to install the taps, replace the solar panels that were stolen, and contribute to 6 months' security deposit. The security deposit has been exhausted and the people who used to provide security are no longer willing, citing fears for their personal safety.

The taps are not releasing the expected amount of water because of low pressure. The problem is not the pump –it takes one and half hours to fill up the Jojo tank. However, on overcast days less water is pumped.

There are two irrigation groups made up of 25 and each group irrigates twice a week every other day. Each farmer has 16 beds each measuring 1 x 4m and one bed 3x 30 m. Farmers grow beans, vegetables, onions, carrots, maize, sweet potato, and butternuts. The three most important crops are vegetables, tomatoes, and onions because of the cash they bring in. For example, farmers harvest 15 buckets of tomatoes and 3 buckets of onions in three months. A bucket of tomatoes costs R120 and one of onions sells for R200.

The farmers signed a form for the purchase of their water from the Gwayi Catchment in Bulawayo, depositing money into an account. They pay about ZWL$2000 Zimbabwe dollars but were not aware of how much water is due to them.

Regarding the future, some farmers think sprinklers would work better. When pointed out that this would cause pressure challenges, some farmers thought that canal irrigation would be better.

Livestock watering: Livestock (about 5,000 cattle) from three wards (1, 2, and 21) drink from the dam. The farmers have not set up rules because this is a ZINWA dam, but this has resulted in pollution and siltation of the dam.

Drinking/domestic: Farmers drink the untreated water in the garden. The irrigation scheme is 3 km from the homesteads and general domestic water is obtained from community boreholes drilled by DDF, which are about 1 km from the homesteads. However, the water from the boreholes is not enough and so people also collect domestic water from the dam. Anecdotal evidence showed community members directly drinking the water. There is a history of stomach aches and running stomachs due to open water consumption and the levels of contamination in the dam.

Fishing: EMA, RDC, and Zimparks introduced fish into the dam in October 2022 with a view to start fishing activities in April 2023. It was said farmers from the three wards would be allowed to fish after 6 months. Farmers from the three wards will be allowed to fish, but the rules governing fishing activities are not clear.

Operation and Maintenance

ZINWA is supposed to maintain the dam but were only seen in 2021 when they came to clear the dam wall, which is heavily laden with trees and bushes. Farmers reflected that ZINWA rarely comes to do maintenance works at the dam but that the community can only perform clearing on consent from ZINWA.

Farmers collected money to replaced stolen solar panels. They used to pay R1200/m for security but currently have no security due to inability to raise funds. Monthly O & M costs R10, and they raised R100/member for solar panel. Security was paid at R40/month. They pay R2 for access to the ZINWA dam (Questead dam). They do not maintain the dam because it is a ZINWA dam and there are many water users.

Partnerships

They work with Gwayi catchment but not with Department of Irrigation or RDC. They also work with AGRITEX.

4.3.2 Mahabangombe Garden

Research Activities

Mahabangombe Garden in Ward 14 was visited on 8 November 2022. Due to the fact that the Bush pump had broken down and there was no irrigation, the research team was hosted by committee members. It was therefore decided to hold one focus group discussion. At first there was one man and five women, but by the end of the discussion there were 11 women present.

History of the Garden

The garden was established in 1989 by a group of 12 farmers. Initially, the scheme irrigated using a well that filled during the rainy season and collected for use during the dry season when it dried. Amalima advised the farmers to drill a borehole in 2014 as a bushpump. Farmers raised US$3600 through Village Savings and Lending Club (VS & L) otherwise known as Mukando while Amalima contributed another US$3600 and helped with management of the construction process, including surveying, contracting, and drilling. The money was raised over time by contributions of R50 from sales from the garden.

Amalima discussed with farmers the possibility of a solar pump, but it was not implemented due to limited funds. Farmers were not informed of the potential cost.

Water Uses

Irrigation: The garden is one hectare in size and is cultivated by 36 farmers. Each farmer has 21 beds measuring 3 x 1 m (63 m^2). Farmers pump water into a small circular trough from which they fetch water for irrigation using buckets. Wheelbarrows and buckets are used for irrigation and this is ergonomically stressful, so farmers want to change to a more user friendly system. The community indicated willingness to shift to other systems, such as solar boreholes and plan to raise money to set up solar irrigation. The money for solar is also being funded by remittances from foreign based relatives.

There are two irrigation groups, which irrigate every other day. Irrigation is often disrupted because the borehole breaks down every 3 or 4 months, with the latest breakdown in the last week of October 2022. The Ward Pump Minder was contacted and determined that the capsule of the borehole needed replacing. The pump minder is trained by DDF and paid a fee of R500/workload for every job he does at the scheme. At the time of the visit the community was raising money for repairs. Lack of water security is due to the mechanism of abstracting water as there is evidence of a high water table (the depth of the borehole is 40m though water was first found at 20m).

Crops grown include leafy vegetables, tomatoes, beetroot, carrots, sugar beans, and garlic. Beetroot is sold and consumed within the surrounding community. Output is about 10 buckets of tomatoes over the growing period with a bucket going for R120/bucket. Chomolia turnover reaches about R400 for each farmer. Small tomatoes sold at R10 each for 86 packs resulting in R860. Beetroot (R10 for 3) x 36 = R360

Livestock watering: Donkeys and goats are provided with water from the borehole using buckets, while cattle are watered from the dam. However, because of breakdowns they are also watered at community boreholes.

Drinking/domestic water: The community gets drinking/domestic water from the borehole. The borehole is also used by the community members who are not part of the garden. Community members (including the irrigators) are allowed to fetch domestic water using buckets but not scotch carts, as the latter would result in water shortage. Community members are meant to pay a R500 access/joining fee to the borehole, but only 10 have actually paid. Even those that are not paid up are still allowed to access water but are encouraged to pay to ensure that there is enough money for repairs.

Due to frequent breakdowns, the community relies on community boreholes (which are far away and also break down). They also rely on water from the adjacent pond or Mbanga dam. The borehole provides water for livestock, drinking, irrigation, and washing.

Operation and Maintenance

Monthly contributions are pegged at R20/month. Money is also raised when there is a need through a variety of means including remittances.

4.4 Tsholotsho district

4.4.1 Manzimhale Irrigation Scheme

Research Activities

Manzimhale Irrigation Scheme in Ward 13 was visited on 10 November 2022. The Focus Group Discussion of Irrigation Committee members was made up of 6 women. Resource mapping was done by three women and 1 man. A total of 5 household survey questionnaires were administered. Water samples were collected from the scheme. The scheme benefits Mbizo village members specifically for the Mazimahle line (Figure 9).

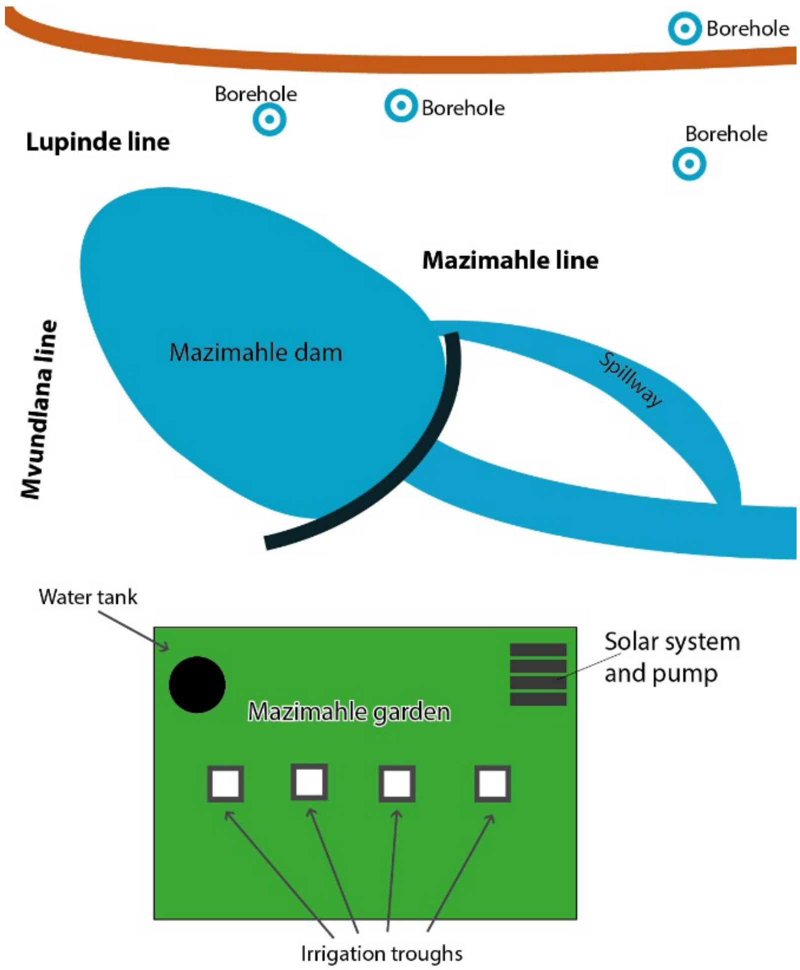

Figure 9. Location and characteristics of Manzimahle Irrigation Scheme

History of the Irrigation Scheme

In 2017, Amalima hosted a disaster risk reduction meeting at which the community indicated that it wanted a garden. The garden would use water from Manzimhale dam, which was constructed in the 1940s. Manzimahle dam is one of the shared water sources in the community that provides water for livestock. Six boreholes in the area provide domestic water to the community.

A solar pump was installed just below the dam wall. However, in 2019 there was a drought and conflicts arose over the use of dam water with competition from livestock. Irrigation using water from the dam was banned. Consequently, Amalima drilled a borehole in the garden fence and equipped it with a solar pump which was removed from near the dam. The borehole is 60 metres deep although water was first reached at 15m. Amalima also provided the fence around the 100 m x 100 m scheme.

The community contributed R30,000 which was 50% of the costs and Amalima contributed the balance. Each of the 26 members was given a target of raising R1900 to raise R30000 after 3 months [R200-300 every 2 weeks].

Water Uses

Irrigation: Water from the borehole is used for irrigation. Water is pumped to a 10, 000 litre Jojo tank, which is mounted about 2 metres from the ground and piped into 1 m x 1m water troughs from which farmers irrigate using buckets. Originally, drip irrigation system was installed without the consent of farmers but farmers agitated for replacement of drip irrigation so the water troughs were introduced. Exposed pipes are PVC and showing signs of ultraviolet damage.

It takes more than 2 hours to fill the tank when the day is clear. When it is cloudy it takes longer, to the extent that, at times, the farmers do not irrigate. Amalima (through Dabane Trust) told the community that the 0.55 hp was too small and that it needed to raise money to buy a 0.75 hp. The irrigators are trying to raise R16, 000 for this effort. The water supply was deemed not to be adequate to supply the entire 1ha garden. Half of the garden was observed to be dry or drying.

There are two irrigation groups of 8 farmers each who irrigate on alternative days. Each farmer has a 10 sub-plots of 0.0625 m^2. Farmers grow leafy vegetables, tomatoes, onions, maize, carrots, butternuts, and sugar beans. The three most important crops are leafy vegetables, onions, and tomatoes.

The garden has a ready market in Tsholotsho Centre since it is located in a peri-urban area and is the only garden in the ward. Profit per farmer can rise to R500 from sale of crops.

Domestic water: There is no provision for drinking/domestic water in the scheme. However farmers drink the water from the water troughs. The water was not tested. The farmers also fetch water from community boreholes, which are not near the homesteads. They were not aware of the water from the community boreholes being tested.

Livestock watering: The borehole does not provide water for livestock. Livestock are watered from community boreholes.

Operation and Maintenance

Operation and maintenance costs are subscribed at R20/month. The amount was reported to be adequate though this may be questionable. The farmers had a security person paid at US$100 but there were issues with poor availability by the person. No security is provided, but there has been no theft, “God provides the security.”

5. COMPARISON OF MULTIPLE WATER USE AT THE COMMUNITY LEVEL ACROSS SITES

5.1 Respondent and Household Characteristics

The majority of respondents (78%) were female (Table 3). The number of male- and female-headed households varied across the sites. On average, male-headed household accounted for 71.2% of all households. This is a surprising statistic given the high number of males who migrate to South Africa and Botswana. The average household size was 6.

Table 31. Characteristics of respondents and households across all project sites

Name	Household Size	Sex of Respondent (%)		Head of Household (%)	
		Male	Female	Male	Female
Mbuyane dam	6	15.8	84.2	68.4	31.6
Paswana Irrigation	6	27.3	72.7	63.6	36.4
Mbengwa Garden	6	20.0	80.0	80.0	20.0
Manzimahle	6	25.0	75.0	75.0	25.0
Average	6	22.0	78.0	71.2	28.3

5.2 General Water Use in the Community

The main water sources in the various communities were dams and boreholes, and these were shared by the majority of community members (Table 4).

Table 32. Sources of water in Amalima projects

Name	Water Source			Water Sources Shared with Other Villages (%)
	1	2	3	
Mbuyane dam	Dam	Borehole	Spring	95
Paswana Irrigation	River	Borehole	-	91
Mbengwa Garden	Dam	Borehole	-	70
Manzimahle Garden	Borehole	-	-	100

While self-supply was reported to be present across all projects (Table 5), the information seems to be inconsistent with Key Informant Interviews and Focus Group Discussions. It appears that this was conflated with community water sources.

Table 33. Presence and sharing of self-supply water facilities

Name	Presence (%)	Shared (%)
Mbuyane dam	16	16
Paswana dam	40	40
Mbengwa dam	80	80
Manzimahle	75	75

5.3 Water Management at Project Sites

5.3.1 Water Uses

In general, livestock watering and irrigation were the main water uses but this varied from site to site (Figure 10). In Paswana and Mbuyane, water for domestic uses and livestock watering were more important.

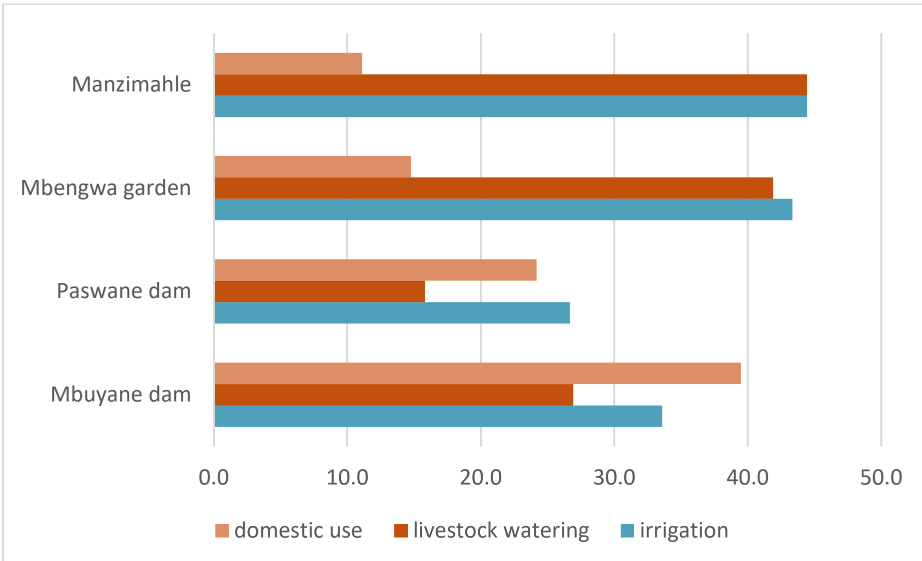

Figure 10. Priority of water use across project sites in Amalima

Adequacy of water varied from as low as around 20% to as high as 85% (Figure 11). In general the low level of water adequacy was driven by too few water sources. Water conflicts were reported in Mbengwa and Manzimahle by 20-25% of the respondents and these were all attributed to water shortage. Water conflicts were resolved through a committee hearing. Participation in the irrigation gardens was mainly based on volunteering followed by proximity to the water source and contribution to developing the water source.

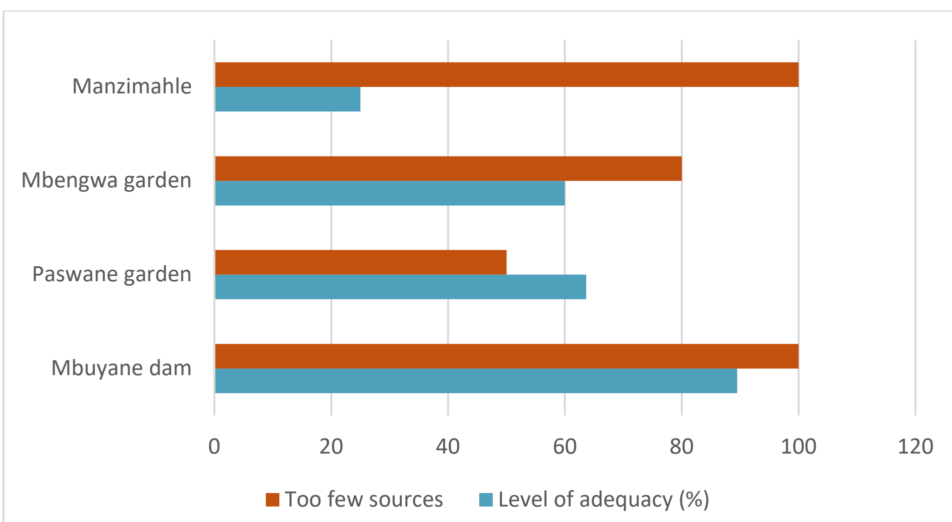

Figure 11. Bar chart of level of adequacy of water and related reasons across all sites in Amalima

Issues around quality of water were not well answered because of missing data (Table 6). However, the available data shows that smell and colour were important attributes to the community, and that the quality of water was more or less acceptable to both women and men. While the water was tested for quality at the commissioning of the water source, the proportion of respondents who responded affirmatively to testing at commissioning differed across the sites. Paswana was highest at 100% followed by Manzimahle at 50%. The proportion of respondents was lower than that conducted at the commissioning of the source. The quality of the water changed with seasons, which is indicated by changes in smell and colour.

Water conflicts were reported in the Mbengwa garden. A third of respondents (33%) reporting that conflicts were due to water shortage. The Irrigation Management Committee led the process of resolving conflicts, but while the Garden Committee typically took leadership in conflict resolution, it is reported that some conflicts were not solved because of the expenses associated with improving water availability.

Boreholes were the main complementary water sources, which were mainly used for domestic purposes (Table 7). The complementary water sources were regarded as very important to women and men although women rated them higher than men by 25%. Smell and colour were the most important water quality attributes, and the quality was said to change with seasons. The sources were tested for water quality.

Table 34. Water quality attributes and extent of water quality testing across Amalima sites

Name	Attributes of Water Quality					Extent of Water Quality Testing		Water Quality Changes with Season	How Water Quality Changes with Season		
	Smell and Colour	Smell Only	Colour Only	Acceptable to Women	Acceptable to Men	Ever Tested	Any Other Test		Smell and Colour	Colour	Smell
Mbuyane dam						35.3	27.8	11.8		50	50
Paswana dam						100	100	45.5			100
Mbengwa dam	83.3	16.7		100	66.7	44.4	30	10	100		
Manzimahle	100.0			100	100	50	33.3	25		100	

Table 35. Characteristics of complementary water sources in Amalima sites

Name	Water Sources		Water Uses		Very Important to		Attributes of Water Quality			Water Quality Tested	Change of Water Quality with Time
	Borehole	Weir	Domestic	Irrigation	Women	Men	Smell and colour	Smell	Colour		
Mbuyane dam	100	- - -	100	-	100	100	-	-		37.5	25
Paswane dam	-	- -	-	100	100		-	-	-	100	-
Mbengwa Garden	60	- - 40	100	-	88.9	66.7	83.3	16.3	-	10	20
Manzimahle	100	- -	100	-	100	50	100	-	-	50	33.3

5.3.2 Community Involvement

Community involvement in the planning of the water projects reported to be high with dedicated committees having been established to this end (Table 8). Both gender and age were the considerations in representation. Traditional leaders were more involved in site selection than community members across all sites (Figure 14). Community members participated in the construction of the facility mainly as general hands (Table 9). Financial contributions by community members was to purchase food for workers.

Table 36. Community involvement in planning of the water facility across Amalima sites

Name	Community Participation (Yes)	Mechanism for Participation		Method of Representation	
		Dedicated Committee	Existing Committee	Gender Only	Gender x Age
Mbuyane Dam	100.0	92.3	7.7	83.3	16.7
Paswana Dam	100.0	100.0	-	75.1	25.0
Mbengwa Dam	55.6	100.0	-	-	100.0
Manzimahle	100.0	100.0	-	-	100.0

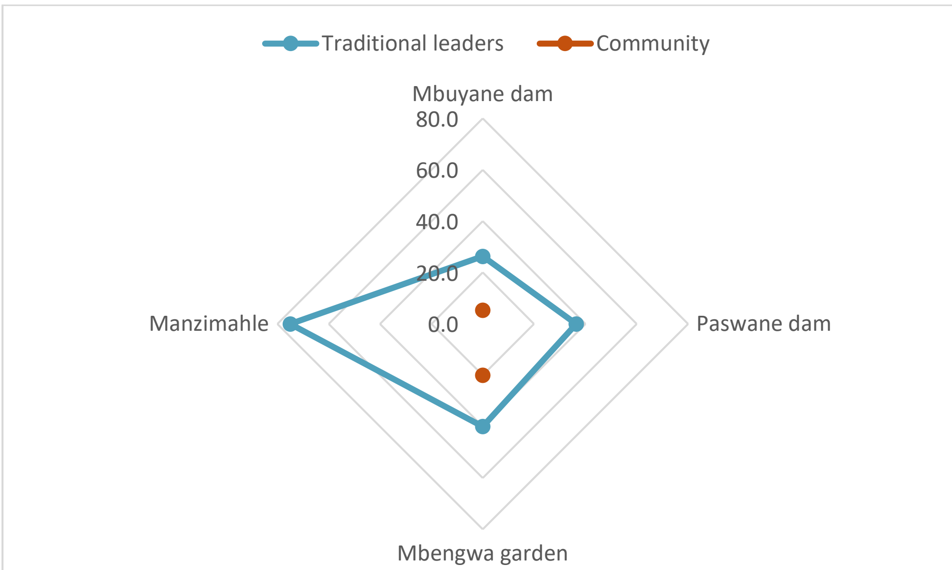

Figure 12. Radar chart of community involvement in site selection

Table 37. Community involvement in labour during construction of the water facility in Amalima sites

Name	Labour Contribution	How was Community Involved?	
		General Hands	Builders
Mbuyane dam	100	50	50
Paswane dam	100	100	-
Mbengwa Garden	100	100	-
Manzimahle	100	100	-

Across all the sites there existed rules for water allocation (Table 10). However, Mbuyane had the lowest proportion of respondents (15.8%) agreeing to their existence. This could be because there was no irrigation being undertaken. Water allocation rules were associated with irrigation because of the need to manage water and cultivation of crops. The rules originated mainly from Irrigation Management Committees and was mainly about water rationing. Proper water management of water sources was an issue in Paswana only. The rules were written across all the projects although few respondents said this was the case in Mbuyane perhaps due to the absence of irrigation. The Committee kept the record of rules in the local Ndebele vernacular. The Secretary took the record of the rules.

5.3.3 Operation and Maintenance

The community members involved in irrigated gardens were involved in operation and maintenance (O &M) of the schemes, and those who participated in O & M were identified by the community (Table 11). The assertion that O &M were carried out effectively because of absence of damage is at odds with the observation of O & M challenges. Training in O & M was offered to some community members. The question of who enforced the rules was poorly answered (Table 12). The rules were said to be broken less frequently and paying a fine was the most popular sanction. The community was said to be responsible for O & M. There was a high proportion of respondents with the majority paying USD1 per month, which was determined by the community (Table 13). The claim that the amount was adequate was not supported by the evidence on the ground.

While the majority of respondents were willing to pay for O & M and the claim that the community had enough capacity to undertake O & M, this was not supported by evidence on the ground and the fact that the average monthly household income for the majority of households was below USD50 (Table 14). As can be seen from Figure 13, the average household income is far below the Total Consumption Poverty Line (TCPL).

Table 38. Details of rules for water allocation in Amalima sites

Name of Project	Do Rules Exist? (Yes) (%)	Source of Rules (%)		What Are the Rules About? (%)		Is There a Written Record?		Who Records the Rules? (%)		Where Recorded? (%)	Language of Record (%)
		Irrigation Management Committee	Village Heads	Water Rationing	Proper Water Management of Water Sources	Yes	No	Committee	Other	Secretary Books	Ndebele
Mbuyane dam	15.8	100	-	100	-	14.3	85.7	100	-	100	100
Paswana dam	90	87.5	12.5	100	20	100		100	-	100	100
Mbengwa Garden	70	50	-	80	-	62.5	37.5	80	20	100	100
Manzimahle	100	100		100	-	100		100		100	100

Table 39. Selection criteria for people responsible for operation and maintenance and effectiveness of operation and maintenance in Amalima sites

Name	Method for selection	Is operation and maintenance being done effectively?	Why do you think operation and maintenance is effective?	Were people trained in Operation and maintenance		
	Community (%)	Yes (%)	No damages	Yes (%)	No (%)	Don't know (%)
Mbuyane dam	100	100	100	10.5	5.3	84.2
Paswana dam	100	100	50	50.0	10.0	40.0
Mbengwa Garden	100	100	100	30.0	30.0	40.0
Manzimahle	100	100	100	100.0	-	-

Table 40. Enforcement of operation and maintenance rules in the Amalima sites

Name	Who enforces rules? (%)			Does everyone know the rules?	Does Everyone have a Copy of the Rules?			Are Rules Broken?		How Often are Rules Broken?	What Happens if Rules are Broken?
	Community	Committee	Traditional Leaders	Yes	Yes	No	Don't Know	Yes	No	Less Frequent	Pay Fine
Mbuyane dam	100.0	-	-	100	-	57	43	-	100	-	-
Paswana dam	90.0	10	-	100	50	20	30	33	67	100	100
Mbengwa dam	-	-	100	100	30.0	20.0	50.	20	80	100	100
Manzimahle	-	-	100	100	-	100	-	100	-	100	100

Table 41. Description of contribution to operation and maintenance in Amalima sites

Name	Contribution to Operation and Maintenance	How Much is Charged Per Household? (USD)					Over What Time Period?		Who Determined the Amount?		Is the Amount Adequate?	Reason Why Amount is (In) Adequate?		
	Yes (%)	1	2	3	4	5	Monthly	Quarterly	Committee	Community	Yes	Amount Very Low	Many Contributors Available	Ability to Meet Other Obligations like Security
Mbuyane dam	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paswane dam	100	100	-	-	-	-	50	50	88.9	11.1	80	75	-	25
Mbengwa Garden	80	62.5	25.5	-	-	12.5	100	-	100	-	87.5	20	80	-
Manzimahle	100	-	100	-	-	-	100	-	100	-	100	-	100	-

Table 42. Willingness and capacity to contribute to operation and maintenance and replacing infrastructure in Amalima sites

Name of Project	Household Income Per Month (USD)						Are You Willing to Pay Full Operation and Maintenance Costs?	In a Case of a Breakdown are You Willing to Mobilise Funds?	Are You Willing to Replace Infrastructure?	Does the Community have Capacity to Replace Infrastructure?	Will the Project Continue to Work After Donor Withdraws	Does the Donor Provide Post Construction Support for Operation and Maintenance
	Up to 50	51-100	101-150	151-200	201-250	Over 250	Yes	Yes	Yes	Yes	Yes	No
Mbuyane dam	100.0	-	-	-	-	-	93.8	84.2	84.2	77.8	73.7	94.7
Paswane dam	90.0	-	-	-	-	10.0	100.0	100.0	100.0	81.8	72.7	90.0
Quested dam	40.0	30.0	30.0	-	-	-	80.0	100.0	90.0	70.0	90.0	40.0
Manzimahle	50.0	50.0	-	-	-	-	100.0	100.0	100.0	66.7	66.7	50.0

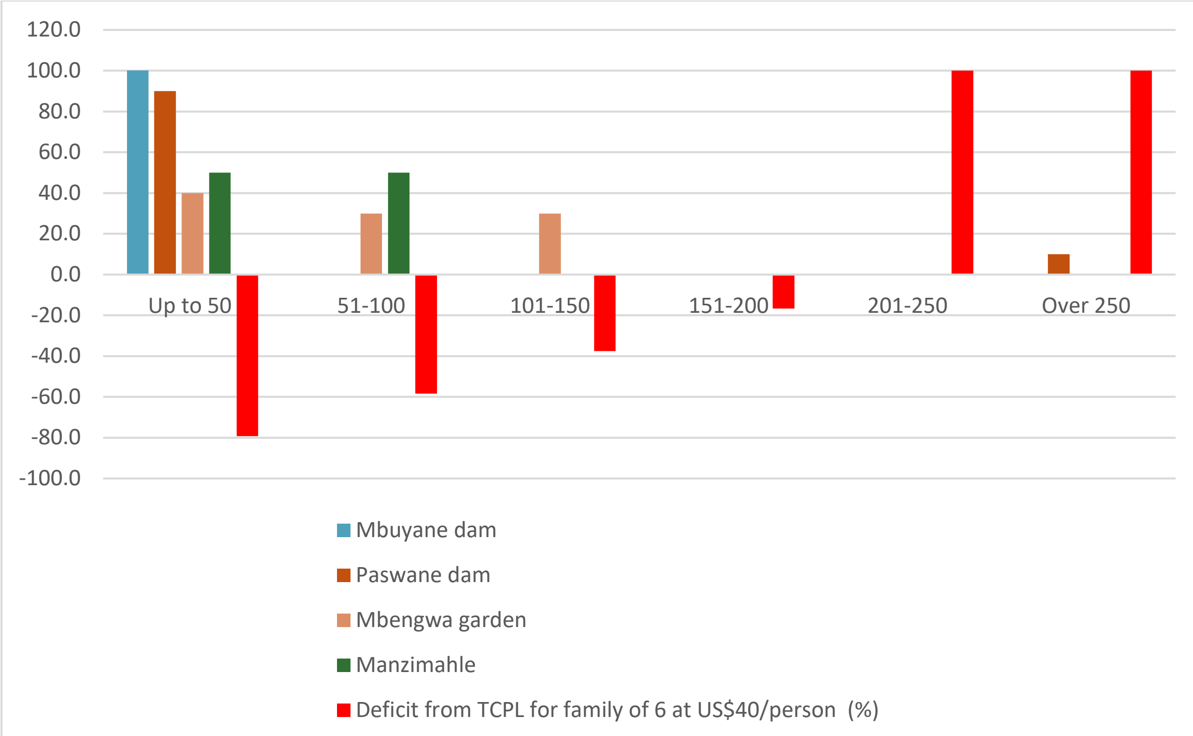

Figure 13. Average household income as a proportion of the Total Consumption Poverty Line

The proportion of respondents who were willing to pay two, three, and four times the current amount of money for operation and maintenance progressively decreased for all sites (Figure 14). The curve for Manzimahle was the steepest, indicating the members thought that they could not afford the required payments or that the payments could not fix the acute water shortage.

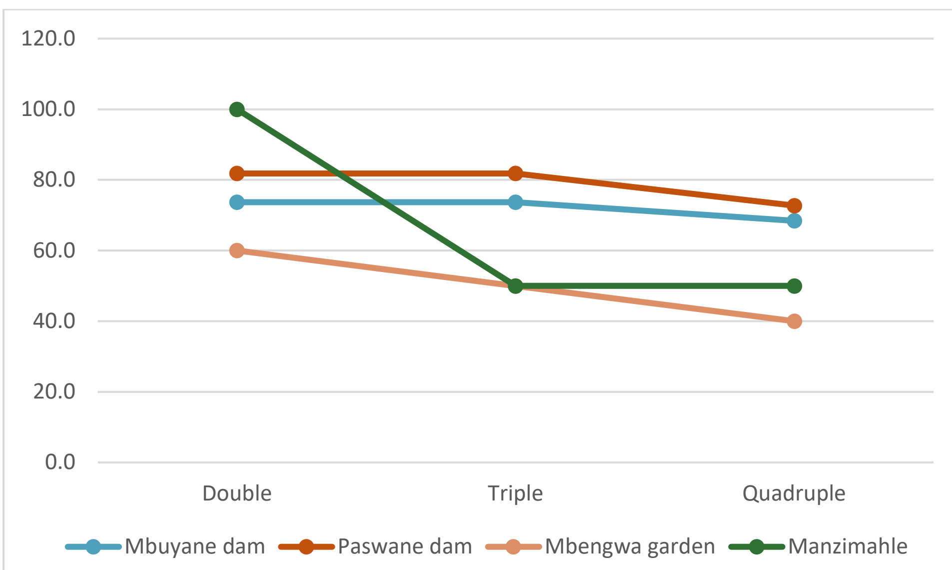

Figure 14. Willingness to pay for operation and maintenance as current amount of money contributed is increased by twice, three times, and four times

5.3.4 Partnerships

Figure 15 shows the perception that traditional leaders were the most effective partners.

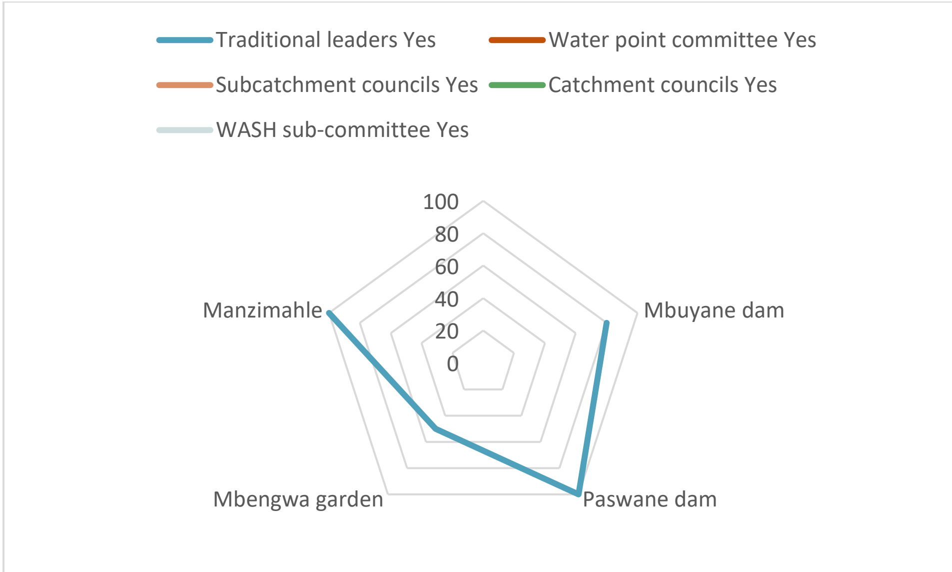

Figure 15. Radar chart of institutions communities claimed to work with in Amalima sites

6. CONCLUSIONS

Three "take aways" can be discerned from the visits to the Amalima sites, namely status of and prospects for MUS, self-supply projects, and irrigation technology.

6.1 Status of and Prospects for MUS

Across all the five sites, MUS was constrained by a number of factors related to design and operational challenges. An illustrative case is the design constraints at Mbuyane Dam, which is being used solely for livestock watering. There was no provision for water for irrigation or domestic purposes. Similarly, there was no provision for water for livestock watering or domestic purposes in Mbengwa, Mahambangombe, and Manzimahle, although these uses were very important to the communities. Pasvana seems to have been designed with the understanding that water for domestic and livestock purposes was already available in the community.

Operational challenges meant that even the water for single use purposes (irrigation) is not adequate across the four sites (excluding Mbuyane where there was no irrigation at all). The most affected sites were Mahambangombe and Manzimahle where at least half of the irrigated area was not being irrigated because of inadequate water availability. Even the area under irrigation was not receiving adequate irrigation. In the former, consistent breakdowns of the Bush pump was always preventing meaningful irrigation and at the time of the site visit, no irrigation was taking place and farmers were thinking of replacing the bush pump with a solar borehole. In the latter, the problem was the size of the pump. Farmers claimed to have been warned about this – that they would need to purchase a bigger pump. There were efforts to purchase a new pump at an estimated cost of R16,000 (about USD1,100). This is a challenge since farmers contributed 50 percent of the original investment costs (see below). While the entire irrigated area was under irrigation in Paswana, the future looked bleak because of a pump which was always breaking down and need to be replaced at a cost of R29,000 (approximately USD2,000) and two Jojo tanks which had started to leak. Farmers repaired them but this may not last for long.

Across all the sites, the prospect for effective corrective action was limited because of financial constraints. While farmers contributed to operation, maintenance, and repair costs, the USD1 per person per month amounts was too low to make any significant contribution towards the high costs required.

6.2 Self-Supply Projects

In two sites (Mahambangombe and Manzimahle) there was a strong element of self-supply apart from contributing to operation, maintenance, and repair costs. In Mahambangombe, the garden was established in 1989 by a group of 12 farmers using a pool, which failed to provide enough water and sometimes any water during the dry period. Apart from contributing labour during the installation of the bush pump-equipped borehole, farmers also contributed USD3,600 equivalent to reach 50 percent of investment costs. The money was raised from family members in the diaspora. Farmers are faced with a higher bill in the quest to replace the bush pump with a solar pump. In Manzimahle Garden, the community contributed R30,000 which was 50% of the costs. The farmers are facing a bill of R16, 000 to increase pump capacity.

Farmers also contributed significant amount to repairing infrastructure. In Paswana, farmers have repaired the problematic pump and the leaking tanks, and as a long-term solution are seeking to replace the pump at a cost of USD 2,000. In 2021/2022, farmers in Mbengwa used to a total of R10,000 (approximately USD700) to install taps as well as replace the solar panels that were stolen and for security for 6 months. It is worth noting that the irrigation was initiated by a group of community members who were being trained in WASH.

6.3 Irrigation technology

Farmers thought that fetching water by buckets from troughs to irrigate their plots was labour intensive and that the system should be replaced. In Mbengwa, farmers had already installed taps but this was not working because of technical inadequacies. It is ironic that farmers replaced drip irrigation that was installed in Manzimahle. These observations raise the question of community engagement in the selection of the irrigation technology.

References

Msibi, T., Kihupi, N., Tarimo, A. and Manyatsi, A. (2014) 'Technical Performance Evaluation of Centre Pivot Sprinkler Irrigation System at Ubombo Sugar Estate, Swaziland', vol. 3, pp. 23–38.

Appendix I. Schedule of consultations at the provincial, district and community level for Amalima sites

Date	Interviewees
I November	Matabeleland South province (Provincial Heads: Mzingwane Catchment Council; District Development Fund, Agricultural, Rural Development and Advisory Services), Gwanda Rural District Council
2 November	Matabeleland North province (Provincial Heads: District Development Fund; Agricultural, Rural Development and Advisory Services; Department of Irrigation; Department of Mechanisation)
3 November	Pasvani Irrigation, Gwanda district
4 November	Mbuyane Dam, Gwanda district
7 November	Mbengwa Dam, Bulilima District
8 November	Mahabangombe Garden, Bulilima district
10 November	Manzimhake Garden, Tsholotsho district

ANNEX E: FIELD REPORT FOR TAKUNDA PROJECTS

1. INTRODUCTION

This report presents a summary of the findings of field research activities that were carried out in the Takunda Intervention Area in Masvingo province in Chivi and Zaka districts (Figure 1) between 28 September and 14 October 2022. Appendix I shows the schedule of consultations that were made at the provincial, district, and community levels.

All members of the research team and all enumerators completed the UNICEF "Introduction to Ethics in Evidence Generation (Basic)" on-line course and certification prior to the commencement of fieldwork (Appendix II).

The report is organised as follows: Section 2 presents the approach and method that were used to collect data; Section 3 presents the partnerships at the provincial and district level; Section 4 describes the project characteristics; Section 5 presents findings of multiple water use across all sites in Chivi and Zaka districts; and Section 6 presents conclusions of the study.

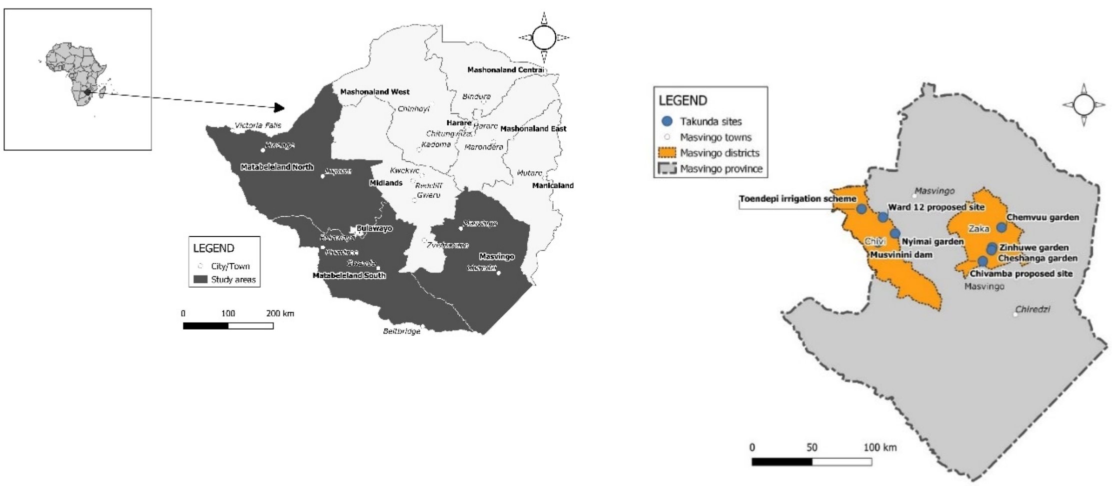

Figure 1. Location of projects visited in Chivi and Zaka Districts in Masvingo Province

2. APPROACH AND METHODS

The fieldwork was contextualised by a description of the legal and institutional framework governing provision of services in rural areas as captured in the Rural District Councils Act [116], Traditional Leaders Act, [117] and Constitution of Zimbabwe [118] [119]. This was followed by a description of the framework

[116] GOZ (1996) Rural District Councils Act; Chapter 29: 13: Harare: Zimbabwe.

[117] GoZ (2016) Traditional Leaders Act Chapter 29:17: Harare, Zimbabwe.

[118] GoZ (2013) Constitution of Zimbabwe: Harare, Zimbabwe.

[119] Chigwata, T.C. (2014) The law and policy for provincial and local government in Zimbabwe: The potential to realise development, build democracy, and sustain peace, PhD thesis, University of Western Cape, South Africa.

governing water services provisioning as captured in the Water Act [120], Zimbabwe National Water Authority Act, [121] and District Development Fund (DDF) Act [122].

Consultations at the provincial, district, and community levels were based on the agreed Key Informant Interviews (KIs), Focus Group Discussions (FGDs) and a household survey questionnaire (Appendix III). At the provincial level, KIIs were held with the ZINWA provincial office, Department of Irrigation, and District Development Fund. The aim was to understand the mandates and coordination mechanisms of the various organisations regarding provision of water in general and multiple water use (MUS) in particular. A similar approach was used for district stakeholders. At the community level, consultations were based on KIIs, FGDs and administration of a household survey.

In Chivi District, KIs were held with the Chivi Rural District Council, District Development Fund, Tokwe Sub-catchment, and CARE (the implementing organization for the Takunda projects). The aim of these interviews was to understand the mandate of the different organisations and their operational arrangements in relation to how water supply projects were planned and implemented. This was complemented by visits to community projects that were implemented by ENSURE and that will be implemented by Takunda (are in the planning phase). As can be seen in Appendix I, the team visited four sites in total: two ENSURE projects (Musvinini dam in Ward 15 and Nyimai Garden in Ward 16), one project implemented by the Government of Zimbabwe (Toindepi Irrigation Scheme in Ward 7), and the proposed Mhazo borehole in Ward 12, which Takunda is implementing. The fifth site (Svondo borehole in Ward 8) could not be visited because of communication challenges.

For the ENSURE and government projects, FGDs with community leaders were held instead of KIIs with individual community leaders due to time constraints and also because some leaders were not comfortable being interviewed individually. Invariably, these included the Ward Councillor, Headmen, Village Heads, Chairman of Asset Management Committee, Chairman of the Irrigation Scheme/Garden, Village Health Workers (VHWs), and representatives of relevant line ministries, principally the Agricultural Extension Worker and Environmental Health Technician. This was complemented by an FGD comprised of 10 or less individuals to map the water resources and discuss water challenges in the area. Up to 30 household survey questionnaires were administered individually to community members to gain deeper understanding of priority water challenges at household level. The research team also conducted transect walks across the water facility to observe water use practices in the company of community leaders. Finally, water samples were also taken from the water facility and complementary water source(s) to assess the quality of the water. The last two steps were not relevant for projects still under planning.

In Zaka District, stakeholder consultations involved KIIs with Zaka Rural District Council, District Development Fund, District Agricultural Extension Officer, District Environmental Health Officer, Mutirikwi Sub-catchment Manager, and CARE. The aim of these KIIs was the same as for Chivi District. The team visited a total of four sites: three implemented by ENSURE (Chemvumuvu dam in Ward 14, Zinhuwe Irrigation in Ward 24 and Cheshanga Nutrition Garden in Ward 25), and the proposed Chivamba borehole in Ward 28. The team did not visit Baharanga because of communication challenges.

[120] GoZ (1998) Water Act: Chapter 20: 24, Harare, Zimbabwe.

[121] GoZ (1998), Zimbabwe National Water Authority Act: Chapter 20: 25, Harare, Zimbabwe.

[122] GoZ (Government of Zimbabwe) (1982) District Development Fund. Chapter 29: 006. Harare: Zimbabwe.

3. PARTNERSHIPS FOR WATER SERVICE DELIVERY AT THE PROVINCIAL AND DISTRICT LEVELS

3.1 Provincial Level

The provision of water to the seven districts (Bikita, Chivi, Chiredzi, Gutu, Masvingo Rural Mwenezi, and Zaka) in Masvingo province is coordinated by the Provincial Water and Sanitation Sub-committee

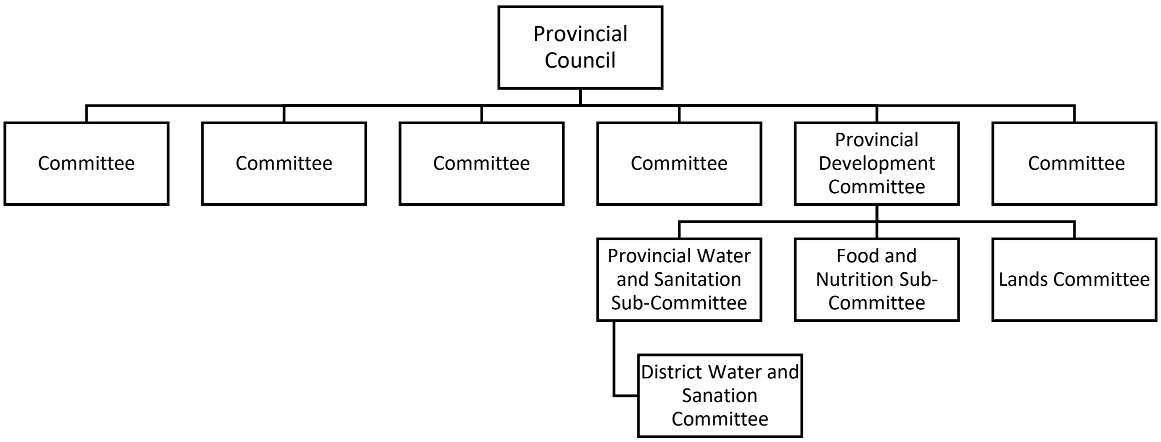

Figure 2. Location of the Provincial Water and Sanitation Sub-Committee within the provincial structures

(PWSSC), which falls under the Provincial Development Committee (PDC) (Figure 2). The PDC is made up of the Permanent Secretary for Provincial Affairs and Devolution (Chair); town clerks; secretaries and senior officials of local authorities; senior officials of the security services; and provincial heads of each Ministry and department in the province. The mandate of the PDC is to coordinate development planning and implementation as captured in the Provincial Development Plan. The PWSSC is made up of heads of government departments and state agencies and is driven by government departments and state agencies with a mandate for water development and management including ZINWA, DDF, and related services, such as food and nutrition and AGRITEX. The PSSWC is chaired by DDF while AGRITEX chairs the Food and Nutrition Sub-committee. The composition of the Food and Nutrition Sub-committee is the same as that of the PSSWC.

During the visit, representatives of ZINWA, Department of Irrigation and Department of Mechanisation, were interviewed.

3.1.1 ZINWA

Pursuant to the 1998 Water Act, ZINWA is responsible for water resource planning, development, and management. More recently (2021), ZINWA was also charged with water-catalyzed rural development and irrigation development. ZINWA oversees the Runde Catchment and has decentralized its services to two service centres: Chivi and Zaka. The boundaries for the catchment and the centres, however, do not coincide with political boundaries of the districts. The service centres develop irrigation schemes in cooperation with the Agricultural and Rural Development Authority, which provides managerial and business services. The service centres also provide potable water to rural centres on demand from local authorities and process permits for “agreement water,” while Catchment and Sub-catchment Councils allocate and permit use of water from public streams in line with their allocation plan and charging the gazetted rates.[123]

Service centers, under the leadership of a Manager, coordinate and undertake borehole drilling under the Presidential Borehole Programme. This Programme, which was initiated in 2021, aims to drill 35,000 boreholes across the country – one borehole in each of the country's 35,000 villages. Borehole drilling rigs are in the process of being sourced for this work and the drilling is coordinated by the office of the Minister of State for Provincial Affairs and Devolution. The boreholes are meant to provide water for all community needs, including domestic water, horticultural production, aquaculture, and water for non-range animals such as poultry and goats. To this end, demonstration sites or centres of excellence for multiple water use (MUS) are being set up in each rural province. In Masvingo, the demonstration site is the Sipambi Project. The project defines all the water uses as primary water and therefore do not require payment for use or of water levies.

The new mandate for irrigation development will be operationalized by the establishment of a Department of Irrigation within ZINWA. The aim is to ensure that all water in government dams is used for irrigation. It is understood that ZINWA is mandated to impound water, release, and convey to night storage facilities, as well as into primary and secondary canals/units. Tertiary canals/units are managed by farmers or their representatives.

Through this initiative, ZINWA is promoting MUS in practice, if not in name. There are, however, several challenges that remain:

- There are still issues to be resolved as to how ZINWA's new Irrigation Department will coordinate and share responsibilities with Department of Irrigation. The mandates are still unclear, as noted by one interviewee: "We are supposed to link with DOI…at the moment the linkage is not yet clear".
- ZINWA currently lacks technical capacity to carry out its new mandate. There are efforts to hire irrigation engineers to work under service centers.
- The working arrangements with other state agencies (worsened by the fact that there are many institutional changes) and non-state actors is work in progress.
- The dual role played by ZINWA, namely that of regulator of certain aspects of water development and management and an implementer of water development projects (such as borehole drilling and irrigation development) has now worsened.

3.1.2 Department of Irrigation

The Department of Irrigation has been in operation for two decades since its formation from AGRITEX in 2002. Its overall mandate is irrigation development in the country. Over the years, however, its mandate and structure have changed. While the Department used to have a presence at the district level, it now is restricted to provincial and national levels.

The Department of Irrigation recognizes the importance of a MUS approach, although it may not be named as such. Some examples of MUS include FAO-sponsored projects in Morova where troughs for

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[123] Water uses beyond "primary" uses require either a permit, when the water is removed from a public stream governed by the Catchment Council, or via an agreement with ZINWA where water is abstracted from ZINWA-operated infrastructure. Primary uses are defined under the Water Act as "*reasonable use(s) of water for basic domestic human needs in or about the area of residential premises," for the support of animal life, other than fish in fish farms or animals or poultry in feedlots; brickmaking for private use; or for dip tanks."* Therefore, any commercial use of water for irrigation or other productive livelihood requires a permit or an agreement.

cattle were provided (domestic +) and in Rupangwana where boreholes were drilled (so irrigation +). However, MUS is constrained by the narrow mandate of the Department. The Key Performance Areas (KPAs) of the department include the number of irrigable hectare developed/rehabilitated per year. As a result, provision of other water services such as water supply, sanitation, and fisheries are removed from the planned activities. The mantra is that "Irrigation is measured in terms of irrigated hectares and not water supply or fishponds……our target is 350,000 hectares of irrigated area."

The situation is worsened by the setting up of the Department of Irrigation within ZINWA, which has created uncertainty regarding the mandate of the Department of Irrigation and its continued existence. The provisions of Statutory Instrument 38 "Irrigable Area Controls which gives the state power to dictate what happens in irrigated area across all sectors in the country represents another challenge. [124]

3.1.3 Department of Mechanisation

The Department of Mechanisation (DoM) provides technical expertise for construction, design, and supervision for contour ridges and small dams, and catchment protection. It does this through one of its three divisions: Soil and Water Conservation. [125] DoM does not have a budget for small dams, but assists NGOs in the province. It operates from the province as it does not have district officers, which complicates the discharge of its mandate.

To ensure water availability, DoM conducts comprehensive feasibility studies, which include assessing risks to water supply. To address the lack of available runoff data in small sub-catchments, the DoM engages communities in identifying the perennial rivers in the area and community's perceptions of water security. These consultations are done in October, when water demand is at its peak and water availability at its lowest point.

The DoM is part of the Food and Nutrition Security Committee (FNSC), which is a committee of the Provincial Development Committee (PDC). The FNSC is made up of all departments that have a mandate related to food and nutrition security (including AGRITEX, ZINWA, DDF, and EMA) and is chaired by the Head of AGRITEX, the agricultural extension service. The DoM participates in the deliberations of the FNSC and submits reports to the PDC. The FNSC is the only committee the DoM sits on.

The DoM also works with NGOs in the province, such as Oxfam, Christian Care, and others, and actively make inputs in NGO-sponsored projects that support the design and construction of small dams, as well as other water projects.

The DoM actively promotes MUS because it not only benefits communities, but also increases the likelihood that the infrastructure will be maintained and protected, as all community members have a stake in the project. To this end, small dams are built to provide water for livestock and gardening. Water for livestock is through release of water from the dam and where water is pumped, drinking troughs are provided. Drinking water is also provided by drilling boreholes in the vicinity and confines of the infrastructure. This can be in the form of taps inside the garden to cater for the safe drinking water needs for irrigators and outside the garden to cater for the community. Water quality testing is conducted by the Ministry of Health to assess the suitability of the water for drinking.

Even in formal irrigation projects, nutrition gardens are also provided for to cater for community members who are not engaged in the formal project. Drinking water is also provided by drilling

[124] Zimbabwean Government Gazette (2021). Statutory Instrument 38 of 2021: Irrigable Areas (Control) Regulations [CAP 20: 10] Supplement to the Zimbabwean Government Gazette dated the 5th February, 2021, Government Printer, Harare.
[125]The Division of Soil and Water Conservation is now the in the Department of Mechanisation was responsible for coordination of the design and Department of Soil Conservation.

boreholes so that people do not consume raw water, which is not safe to drink. The practice is not to treat raw water but to drill a borehole. The Department is quite experienced in community water projects involving multiple water uses that utilize solar-powered boreholes. When consulted, the DoM representatives noted that the MUS approach is cost-effective in the long run.

3.2 District Level

Considerations surrounding water services at the district level include:

- Water and related committees under the Rural District Council (RDC);
- Processes NGOs must go through to get permission to implement water projects in the district; and
- Institutions that are active in water provision

3.2.1 Water and Related Committees

RDCs supply water through the RDC structures, particularly the Rural District Development Committee (RDDC), which has the mandate to integrate ward development plans, identify issues that need to be included in annual development and other long-term plans, prepare annual district development plans, and prepare and implement long-term and annual development plans. The RDDC is chaired by the District Development Coordinator, (DDC) a senior civil servant responsible for coordinating development activities in the district.

One of the functions of the RDDC is to coordinate water and sanitation through the District Ward Water and Sanitation Committee (DWWSC) and other committees, such as the Food and Nutrition Committee and the NGO forum (Figure 3; Table 1). The District Water and Sanitation Committee is the head of DDF at the district. The District Development Fund (DDF) is a parastatal that falls under the Office of the President and Cabinet (OPC). Its operations are governed by an act of parliament [126] and are found at the national, provincial and district level. DDF has a Water Division that is active at each of these levels.

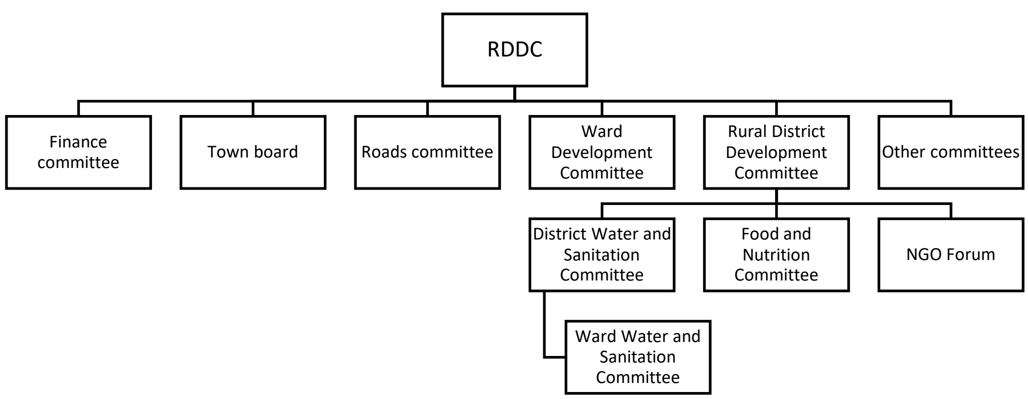

Figure 3. Committees of the Rural District Committee responsible for water and related services [127]

[126] GoZ (Government of Zimbabwe) (1982) District Development Fund. Chapter 29: 006. Harare: Zimbabwe.
[127] Adapted from Chigwata, T.C. (2014).

Table 43. Committees of the Rural District Development Committee

Committee	Composition	Functions
District Water and Sanitation Committee	DDF (Chair); Heads of Public Health, AGRITEX; Veterinary Department, Social Welfare, Environmental Management Agency; ZINWA; Ministry of Youth, Ministry of Women Affairs; Ministry of Environment; NGOs active in WASH	Coordinates and supervises water development activities in the district
Ward Water and Sanitation Committee	Water Councillor (Chair)	Identifies and monitors water development plans and projects at ward level
District Food and Nutrition Committee	AGRITEX (Chair); DDF; Heads of Public Health, Veterinary Department, Social Welfare, Environmental Management Agency; ZINWA; Ministry of Youth, Ministry of Women Affairs; Ministry of E	Coordinates and supervises agricultural and nutrition activities in the district
NGO forum	DDC (Chair), all NGOs in the district	A platform for NGOs to meet and discuss issues that relate to development activities in the district

All the NGO projects are presented to the (DWSSC) for approval. As far as possible, multiple use of water from boreholes and other water sources is encouraged. There is, however, no written protocol of how this should be done. Budget holders, be they a government department of state agency or an NGO, influence the degree to which MUS is adopted.

Water and sanitation services have improved since the launch of the Rural WASH Information Management System (RWIMS). RWIMS is a mobile-to-web-based monitoring system under the Rural WASH Sub-Sector, which was developed by Government of Zimbabwe with support from UNICEF. RWIMS captures and stores water, sanitation, and hygiene (WASH) information in real time and provides quick access to current data on rural WASH infrastructure. It enables communities to report changes in infrastructure functionality, which allows for quick responses from DDF and other local responders to problems that arise at community water points.

3.2.2 NGO Induction in the District

For NGOs to operate in the district, they must obtain a Memorandum of Understanding (MOU) with the RDC to ensure that their work on construction of small dams and borehole drilling supports the RDC mandate of providing water in the district. This support is critical as it supplements the limited resources available to the RDC (for example, it does not have a drilling rig).

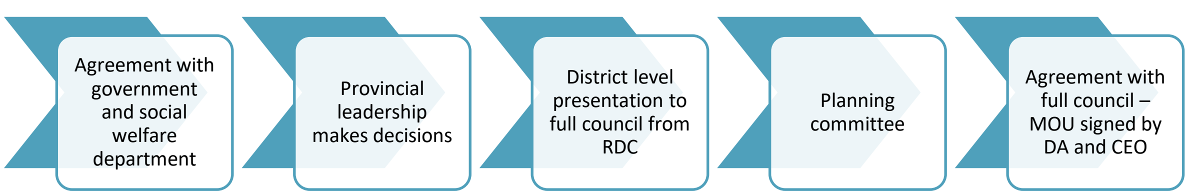

Figure 4. Process leading up to signing of the Memorandum of Understanding

Figure 4 shows the process of concluding an MOU. The process starts with an agreement with the Department of Social Welfare at the provincial level. Once cleared by the province, the NGOs submit a proposed scope of work to the RDC, where it is assessed for its relevance against the priorities of the district (as evidenced in the District Development Plan). Once approved, an MOU is signed by the NGO, the DDC, and the Chief Executive Officer of the RDC. The MOU allows the NGO to implement its activities and sit in the relevant RDC sub-committees.

3.2.3 Chivi district

As noted above, there are number of state and non-state institutions that are active in water provision. Below is a description of those that were available for interview.

3.2.3.1 District Development Fund

DDF's mandate is to site, drill, install, and rehabilitate boreholes, as well as train communities on how best to manage boreholes. [128] Among other things, communities are trained in problem identification. For example, if water is not coming out after 5 strokes of the pump, then something needs to be replaced. There is also training in financial management.

Borehole siting services are provided by the hydrologist based at the province. DDF also offers borehole siting services, borehole yields, pump tests, and training in operation and maintenance to NGOs. Due to lack of public funding, DDF is failing to discharge its mandate, and this is limiting the exploitation of prolific boreholes and potential for sand abstraction in silted rivers in the district. Water quality tests are done by the Ministry of Health.

There is a five-year strategic plan that includes construction of five new irrigation schemes and rehabilitation of 20 boreholes.

DDF used to installed bush pumps at a cost of USD 3,000 for all aspects. However, more recently, there is a shift towards solarised boreholes. DDF started installing solarised boreholes some 2 years ago working with such NGOs as World Vision. Solarised boreholes are not much more expensive than boreholes equipped with bush pumps, which require a lot of labour. According to DDF, the RIMS database provides a way of systematically locating boreholes for future investment.

DDF plays an important role in water supply in the district. It is a member of the Rural District Development Committee (RRDC), which is chaired by the District Development Coordinator (DDC). In Chivi district, the RDDC is made up of four (sub) committees, namely infrastructure, value addition, social services, food, and nutrition. Chairpersons of the committees and NGOs participate. DDF chairs the District Water Supply and Sanitation Sub-committee (DWSC), whose structure and composition has been presented above. DWSC meetings are held every quarter.

DDF subscribes to multiple water use projects because they empower communities for domestic water, livestock watering, and gardening. DDF on its own does not implement MUS projects because it does not have the financial means. It works with other partners to achieve this. There are MUS projects implemented by CARE that involve communities and schools and clinic. World Vision has similar projects, including weirs for multiple use and boreholes for potable water. Most boreholes are in piped water scheme (to households) e.g., Chivamba weir for animals with borehole for domestic water. If the sources are different, then each can be dedicated separately.

Challenges facing implementing of MUS projects include:

- Dry boreholes;
- Borehole collapse because of poor casing;

[128]The mandate for design and construction of small dam mandate was shifted to the province and is shared by the Department of Irrigation.

- Water point committees are not very effective due to donor dependence –communities fail to raise USD 16 needed for a leather washer;
- Attempts to charge vulnerable communities water levy for commercial water use;
- Empire building where some departments want visibility and do not collaborate fully;
- There are too many changes that are happening, which sometimes result in overlaps e.g. ZINWA ‘s new role in drilling boreholes is traditionally the mandate of DDF;
- Current water laws may need revision to suite post-colonial objectives in water management;
- Too many players without clear separation of responsibilities;
- There is also lack of understanding of operation and maintenance for projects - new departments may not be well coordinated and set up;
- Differences in project goals and targets occur with development partners e.g., target, impact period, water availability;
- People need to demand service services to be prioritized and invested in; and
- Treating water required for domestic consumption in irrigation projects.

3.2.3.2 Tokwe Sub-Catchment

The mandate of the sub-catchment is to supervise and monitor use, including charging levies for commercial water use as per SI47 of 2000. All commercial use of water is charged as indicated in Table 2 (located in 4.1 Overview of Water Projects below). Water use above 5ML/annum used for agriculture is charged in hectarage, calculated using maize, and assuming 15ML/ha/annum.

There is not enough human, material, and financial capacity to manage such a big sub-catchment, which covers 7,400 km^2, six districts, and 66 wards in parts of Midlands and Masvingo provinces. Despite its size, the sub-catchment only has seven employees and no vehicles. Lack of revenue has been exacerbated by failures to revise rates for applicable levies and account for intervening inflation and exchange rates. One of the consequences is that the sub-catchment lacks up-to-date water management tools such as remote sensing/GIS.

There is also a misunderstanding regarding the amount of money that is chargeable for boreholes in rural communities. Water that is above 5 ML is charged as commercial and not primary and this affects schools. Borehole projects that use the same amount of water fall in this bracket. To this end the sub-catchment has taken a principled stand for borehole projects being developed by Takunda. Takunda is claiming these are for community water needs and the donor does not want to pay.

The sub-catchment needs revenue to operate to invest in products where the sub-catchment helps communities. In 2019, it bought gate valves for an irrigation scheme and made available to Gondo 20 bags of cement and 30 bags to Tokwane Ngundu scheme. Ploughing back projects are performed based on recommendation of multidepartment constituted boards on which projects need intervention e.g., gate valve replacement for Gondo scheme.

3.2.3.3 CARE

CARE implements Takunda projects and is working in Chivi and Zaka districts. ENSURE (which was implemented between 2015 and 2020) operated in Bikita, Chivi, and Zaka districts. The decision on siting was based on a ZIMVAC report, which indicated that Bikita was less vulnerable than the Chivi and Zaka. The focus of ENSURE was on Health and Nutrition, Agriculture and Livelihoods and Environment and Resilience. CARE mobilises the community through the Councillor.

While CARE used to specialize in small dams, there is now a shift to solar powered borehole schemes, which make it possible for farmers to fetch water with minimal labour input. They are less expensive to run compared to a borehole equipped with a Bush pump.

Community visioning is an important for any project and focuses on vulnerability status, willingness, and capacity. Factors that are considered when selecting a community to participate in CARE projects include:

- Closeness to facility
- Vulnerability
- Ability to work
- Choice to work or not
- Beneficiaries allocate and provide labour for vulnerable members of the community who may not be physically able to participate e.g., the elderly, orphans of school-going age

Once the scope of the work is agreed, the community provides labour. CARE contributes material resources such as cement and pipes, transport, etc. This is done in collaboration with the RDC.

Several steps are taken to ensure sustainability of projects. First, the community is trained in all important aspects. CARE facilitates training in technical aspects of the facility and engages DDF and AGRITEX in these trainings. There is also training in financial management (undertaken by CARE), which includes the creation of saving clubs (*mukando). Mukando* are treated as part of community efforts instead of treating *mukando* as a different activity. Second, state agencies approve the facility. DDF is responsible for certifying that the facility was constructed in line with national standards. The Ministry of Health certifies completion of toilets. Third, CARE helps communities to set up an Asset Management Committee and Water Point Committee (for water supply) or Irrigation Management Committee. The Asset Management Committee oversees the dam or borehole while an Irrigation Management Committee would manage the irrigation scheme.

Fourth, CARE ensures that a signed document from the owner of the land used for irrigation is obtained stating that he or she will not claim the land. This is critical, as where it is not done, the consequences can be devastating. For example, one community uprooted the pipes and brought them to CARE rather than allow the landowner to hijack the community project. Fifth, the facility is handed to the community and to the RDC when the projects ends. CARE provides cost sheets of critical components so that the community can replace the components when necessary. CARE also hands over any remaining materials.

Some communities are better organised for sustaining these projects than others. In some cases, projects are seen as donor-driven and communities do not maintain ownership after handover. There are also cases where non-progressive leadership and social tensions over issues such as witchcraft can undermine project success. Political interference can also pose a serious challenge. It is important that RDC comes up with the MUS framework.

CARE works with the relevant local government entities throughout their projects. Apart from the technical aspects, CARE enters into an MOU with the RDC and DDC and the District Engineer approves the construction related aspects. On the other hand, CARE does not engage as much with ZINWA. DDF does surveys with CARE providing transport. It also works with Forestry Commission and Environmental Management Agency in gendered training and climate capacity training. The District Engineer approves the construction related aspects. Standard designs for troughs and facilities adopted from AGRITEX.

Coordination is supervised by the DDC (District Development Coordinator, formerly DA's office). The RDC signs and forwarded to councilors, works with Environmental Officer and Engineer. CARE offers capacity assessment trainings for council and EMA trainings. There is not much interaction with ZINWA. They work more directly with the catchment teams. Issues arise in borehole drilling exercise due to Chivi catchment office expecting CARE to pay levies of which CARE is not allowed to make such payments for community projects. There is an exemption for EIA services.

The working relations between actors engaged in these MUS interventions appear to be functional, with the exception of the issue of the Sub-catchment Council insisting that Takunda has to pay for borehole charges. CARE has emphasized that the donor is not going to pay for benefits to communities, but as a result, the boreholes falling under the Sub-catchment have not been drilled whereas in other sub-catchments where CARE is investing, drilling has commenced. This is a unique situation because even EIAs for dams are exempted for small dams (up to 8m). The sub-catchment requested an exemption from the higher authorities.

According to CARE, projects are integrated. There is provision for troughs for livestock watering, laundry points, and for drinking, including treatment for potable water. The standards are provided by the responsible government entities: troughs (AGRITEX and Department of Livestock); water supply (DDF); and toilets (Ministry of Health). Integrated projects which predated MUS started around 2007. Implementation has not been smooth because people were used to work in silos. CARE noted that USAID projects supported integration through Integration Frameworks and sequencing and layering of projects. MUS has not budget impacts in terms of project costs due to collaboration of activities. DDF does surveys with CARE providing transport.

However, CARE noted that only USAID projects stress MUS. Other NGOs do not, including Christian Care which focuses on WASH projects, Jairos Jiri, Nutrition Action Zimbabwe (pen fattening), and DAAP (Conservation Agriculture).

3.2.4 Zaka District

3.2.4.1 Mutirikwi Sub-catchment

The Mutirikwi catchment covers 7,941 km^2 in and includes parts of Gutu, Masvingo Rural, Zaka and Chiredzi, Chiredzi Urban and Masvingo Urban districts. As with all Sub-Catchments in Zimbabwe, the Water Act and its Statutory Instrument 47 of 2000 govern the constitution and mandate of the Mutirikwi Sub-Catchment in line with the policy of devolving water governance to enable stakeholders' participation in water use and management. ZINWA is the state agency responsible for water management in the country and oversees catchment and sub-catchment operations. Subcatchment duties include inspection and monitoring, catchment protection and collection of water levies as gazetted by government. All water users are charged sub-catchment rates.

Sub-Catchments are allowed to employ personnel as they see fit and Mutirikwi has three sections run by eight personnel: Water Management, Administration, and Finance.

"MUS is an approach that we want, especially integrating fisheries … it mimics the Presidential borehole initiative" ... In general, Mutirikwi Sub-catchment is oriented toward making both potable and irrigation water available to communities and, for this reason, labels water use for community gardens as "primary" under the Water Act, which is exempt from levies (Water Act, Sec. FILL IN). This helps communities to initiate projects and have more ownership.

The subcatchment faces several challenges, namely:

- The use of hydrological rather than administrative boundaries is a source of confusion for many stakeholders such as traditional leaders who find their area divided.
- Resources for monitoring water use are inadequate.
- The fact that Environmental Management Agency (EMA) deals with water quality issues does not help integrated water resource management.
- ZINWA is now acting as more of a competitor as it performs both operational and regulatory functions. There is need for independent regulator and operationally use of local structures including RDCs and community-based groups.

- There are operational challenges in working with NGO driven projects due to differences in priority areas and responsibility in the long term.

3.2.1.1 District Development Fund

DDF is responsible for coordination of WASH activities at the district level through its Water Division. It provides specialist services, such as borehole siting, which is done by the provincial hydrologist. Borehole drilling is also coordinated from provincial office, however the only rig at the provincial level is currently broken down. DDF used to supervise small dams, but this has been shifted to the provincial level and the Department of Mechanisation.

DDF has limited funding and is dependent on donors for drilling rigs in seven districts.[129] The demand for boreholes for schools, NGOs, clinics, and communities is enormous. ZINWA's programme of drilling 35, 000 boreholes seems to be duplication of responsibilities.

Capacity testing is conducted at new boreholes. DDF chairs the District Water and Sanitation Committee, which trains communities in operating and maintaining water infrastructure[130], on technical aspects, financing, and setting up of management committees, which are also responsible for security of the infrastructure. Village leaders are discouraged from being committee chairpersons to reduce conflict of interest. Management committees are also part of the Ward Water and Sanitation Sub-committee, which is chaired by the Ministry of Health.

Boreholes are in part identified using the Rural Water and Sanitation Hygiene Management System (RWSHMS). Extension workers at ward level make inputs into the system which is then reflected on the portal from which can be downloaded any data. The challenge is that often the extension workers do not have data bundles to upload information on the system.

DDF also works in partnership with NGOs to implement projects that provide communities with water for many purposes, including a piped water scheme for 14 rural institutions and surrounding households.

Solar schemes (which can cost up to US$50, 000 to install) are becoming more important for delivering MUS projects. DDF participated in hiring is involved in contractors. DDF has capacity to design but there may be issues with funders paying government affiliated engineers.

- Care involved DDF in technical assessment and rehabilitation
- ENSURE worked with DDF mainly for training the Water Point Committee

Dams constructed by CARE through ENSURE have been noted to have some economic benefit.

DDF encourages piped water schemes. NGOs are encouraged to utilize DDF services such as borehole yield testing. Livestock water points are generally accepted to be added to boreholes.

There is a national template for developing piped water schemes:

- Identify minimum number of beneficiaries
- Determine extent of influence
- Jointly identify contractor (DDF, NGOs and other state agencies).
- Mobilise communities from inception, providing of inputs into construction and

[129] DDF has no district engineers but works with those from ZINWA and RDC in the DWSC.
[130] Bush pumps are slowly being phased out in favour of solar type boreholes. This is because bush pumps can serve up to 250 households while solar boreholes can serve more people and are less laborious.

3.2.1.2 Agricultural and Rural Development Services (ARDS)

The Agricultural and Rural Development Services (ARDS) (previously Department of Agricultural, Technical and Extension Service, or AGRITEX) is the service extension department. ARDS provides training for farmers on issues including Conservation Agriculture (CA) and drought mitigation and is mandated to provide extension services in irrigation schemes. ARDS does not initiate water projects because it does not have a budget for infrastructure and so does not influence the location and design of water infrastructure.

The potential returns for horticultural enterprise can be as high as US$2000/ha (30%+). However, business training for farmers is important. Marketing and cropping schedule should be based on market dynamics and encourage market centered growth. Community boreholes service from 250-500 people.

3.2.1.3 District Environmental Health Officer

The Ministry of Health provides technical expertise for monitoring water quality in WASH facilities. It conducts faecal contamination tests in the field, provides chemical treatment, and identifies sources of contamination. The Ministry also provides training on water usage, handling, and storage. New water sources are tested for bacteria.

Ideally, water testing is a routine quarterly activity but resources limit implementation of this mandate. Organisations such as UNICEF help to provide the necessary equipment, but testing is generally conducted only when there is a complaint or outbreak. In the DWSC, MOH provides technical, water, toilet, and hygiene related expertise, and is responsible for issuing certificate of completion certificates for toilets according to MOH standards.

Ward Health Clubs are established in communities to train on water sources, usage, and storage. However, the Ward Environmental Health Technicians face constraints in resources that limit this service.

3.2.1.4 CARE

ENSURE included water supply projects and nutrition gardens that took an MUS approach. These projects were developed under the supervision of the CARE engineer who was responsible for Bikita, Chivi, and Zaka districts. Multiple use for developed facilities was adopted in later years (around 2007) mainly through USAID grants. Each project was a standalone. MUS needs to be deliberate because it may not be prioritized due to the extra cost that may be incurred such as ensuring drinking quality of irrigation sourced water.

The process under ENSURE involved working with communities to undertake a visioning process that identified priority water use needs and selected areas of intervention. A feasibility study was also conducted to determine which implementation partners should be leveraged. For water projects, CARE partners with DDF, which provides technical services. Additionally, water quality tests are normally conducted on new projects through the Ministry of Health.

At the close of the project, CARE hands responsibility over to the relevant government institution, which was AGRITEX in most cases (sometimes the Department of Mechanisation). Issues with this arrangement have included the fact that AGRITEX does not have an engineering tradition and that the Department of Mechanisation does not operate at district level.

The community also receives all remaining materials and Directory of Suppliers where the community could buy the required parts. It was confirmed that there was no Operational and Maintenance Plan left with the community.

CARE, like other NGOs in the district, participates actively in several water and water-related forums. The umbrella body for developmental partners (including state and non-state actors) is the Rural District Development Committee (RDDC), which is chaired by the District Development Committee (RDDC). Membership of RDDC includes:

- The RDDC representative
- Representative of the heads of government departments and agencies at district level (Department of Public, Department of Agriculture, Technical and Extension Services Forestry Commission, Environmental Management Agency, District Development Fund); and
- Heads of NGOs (in Zaka these include CARE, Christian Care, etc.)

The NGOS provide monthly and quarterly reports to the RDDC through the various sub-committees (i.e., the District Water and Sanitation Sub-Committee or Food and Nutrition Committee). These Committees meet monthly and include an NGO forum as a platform for NGOs to meet and discuss issues that relate to their operations. The forum is chaired by the District Development Coordinator and meets quarterly. CARE is also part of the Civil Protection Committee, which prepares for flood protection at the end of each rainy season.

There is also a donor syndrome in some communities resulting in failure of projects once donor participation has come to an end. Positive successful project culture adoption can enhance attitudes and sustainability of projects. Some communities are more proactive. Payment for services is limited and dependent on levels of commitment required.

4. PROJECT SITE CHARACTERISTICS

4.1 Overview of water projects

A total of four community water projects were visited in Chivi and Zaka districts (Table 2).

Table 44. Location and water supply characteristics of community water projects visited in Chivi and Zaka Districts

Scheme	Ward Location	GPS Coordinates	No. of FGDs	No. of Household Questionnaires	Water Source	Year Commissioned	Water Delivery System	Irrigation Technology
CHIVI DISTRICT								
Musvinini Irrigation	15	-20.45471, 30.53206	2	23	Musvinini Dam	2018	Water is delivered from the dam by gravity through a 100 mm steel pipe to rectangular water troughs in the irrigation scheme from which farmers irrigate using buckets	Piped Surface
Nyimai Garden	16	-20.38307, 30.67225	2	24	Nyimai Dam	1998	Water is delivered from the dam by gravity through a 90 mm plastic and steel pipe to rectangular water troughs in the irrigation scheme from which farmers irrigate using buckets	Piped Surface
Toindepi Irrigation Scheme	7	-20.18048, 30.39691	2	16	Solar borehole	2015	Water is pumped by solar pump to storage tanks and gravitated through a buried pipe to water taps in the irrigation scheme. In reality water is pumped into the taps due to missing return pipe from tanks and low pump capacity	Piped Surface
Mhazo proposed borehole	12	xxx	2	-	Under discussion	-	Under discussion	Under discussion
ZAKA DISTRICT								
Chemvuu Garden	14	-20.33311, 31.54751	2	8	Chemvuu Dam	2016	Water is gravitated to the garden through a buried steel pipe to water troughs in the garden from which farmers irrigate using buckets	Piped Surface
Zinhuwe Garden	24	-20.49724, 31.4712	2	22	Zinhuwe Dam	2018	Water is delivered via gravity from the dam through a buried steel pipe to water troughs in the garden from which farmers irrigate using buckets	Piped Surface
Cheshanga Nutrition Garden	25	-20.5215, 31.46469	2	16	Solar borehole	2018	Water is pumped by solar pump to two 10, 000 litre PVC tanks and gravitated through a buried PVC pipe to drippers. In practice water is channelled to a tap initially meant for drinking water in the irrigation scheme from which farmers irrigate using buckets.	In theory drip irrigation but in reality piped surface irrigation
Chivamba proposed borehole	28	xxx	2	-	Under discussion	-	Under discussion	Under discussion

4.2 Chivi district

4.2.1 Musvinini Dam

Research Activities

The first Focus Group Discussion (FGD) of traditional community leaders at this site included the Headman and Village Head, who were joined by the female Ward Councillor and the Irrigation Management Chairperson. The second FGD included the Chairman of Musvinini Dam Asset Management Committee, four (female) village health workers, an Agricultural Extension Worker and an Environmental Health Technician. The resource mapping group included 19 community members - 10 women and 9 men. A total of 23 household survey questionnaires were administered. Water samples were taken from the dam and a stream which the community uses as a complementary water source.

History of the dam

The dam was initiated as part of the Ward-level Disaster Risk Reduction Committee. The Committee's 60 members identified potential projects as mechanisms for resilience against drought. The area receives very little rainfall (reported at approximately 400 mm per year, but this figure has not been verified). The Musvinini Dam Project was one of those selected for funding and the people receiving drought relief provided labour for the weir construction. However, not all those receiving drought relief could benefit due to the limited availability the irrigable land.

Musvinini Dam was constructed in response to community consultations that identified the dam as an important disaster risk reduction strategy by addressing food security and nutrition needs and solve the livestock watering challenges in the area caused by poor water availability.

The communities (from Zimuto, Buchete, Madya, Mapaike, Marisa, and Mazango villages) provided stones, builders, and general labour for construction of the dam in return for 50 kg of sorghum given fortnightly. ENSURE provided transportation to ferry the stones, cement, and reinforcement steel, as well as the services of an engineer. Work on the dam was voluntary.

Due to its siting, the dam does not dry up (there was water in the dam during the visit). However, poor farming practices coupled with the steep slopes in the catchment have resulted in erosion and subsequent siltation of the dam. Flooding effects are accentuated because of the steep slopes.

Partners Engaged

- Zimuto, Buchete, Madya, Mapaike, Marisa, and Mazango villages
- Farmers and livestock owners
- Irrigation Management Committee
- Chivi High School and Chivi Growth Point (for markets and customers)

Water uses

The purpose of the dam was to improve nutritional status in the community through livestock watering, irrigation, and fish farming.

Livestock watering: The dam provides a source of water for livestock for 6 villages: Zimuto, Buchete, Madya, Mapaike, Marisa, and Mazango. Before the dam was constructed, villagers used to walk 7-10 km to water their livestock and a number of cattle died on the way. For example, the Chairman of the Irrigation Scheme lost three head of cattle in this manner. The dam waters about 240 head of cattle. Livestock owners are not required to pay anything for the water, including those who did not participate in dam construction. This is because water is a basic community need which no-one should be denied. This is also the case because there is no way to prevent the' free-riders'.

Irrigation: Water from the dam is also used for irrigating the 3-hectare irrigation scheme that was completed in 2017. Figure 5 shows the community's depiction of the dam and the layout of the irrigation scheme. As shown, there is a water treatment tank from which farmers get drinking water (and not domestic water).

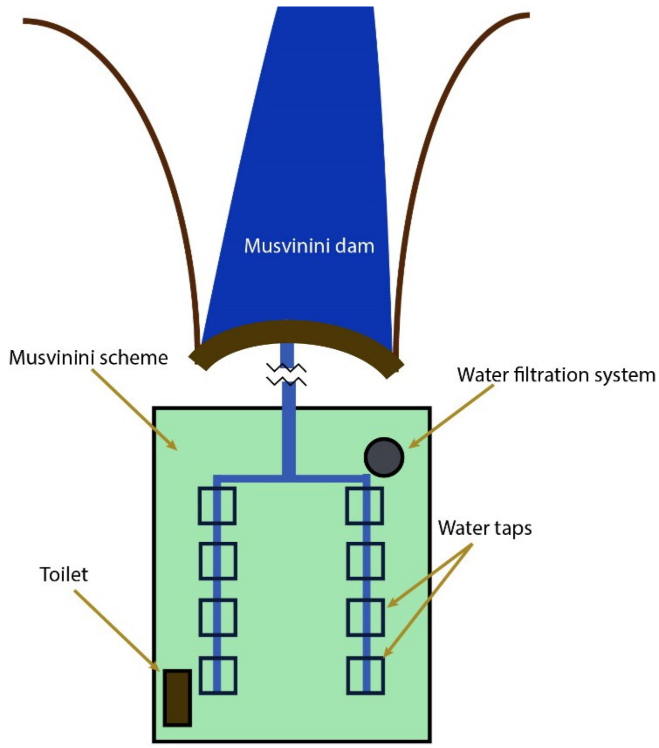

Figure 5. Modified community depiction of the Musvinini dam and irrigation garden

The irrigation scheme was designed to provide food security to the community. However, the size of the scheme was limited by the lack of available arable land in the vicinity of the dam (the terrain is very hilly). Consequently, the irrigators live a long distance from the scheme and have to traverse difficult terrain to access the scheme. This explains why irrigators are from Zimuto, Bvuchete, and Madya villages, which are relatively near the dam. Originally 92 farmers were involved in the scheme, but now there are 86 members (46 men and 40 women). The small plots were referred as '*magadheni*' (garden) which also may explain why women participated in large numbers. Traditionally, small gardens are worked by women whose gender roles entails farming of relish which is then used as part of the meal for the family.

Water is provided to the scheme by gravity through a 100 mm steel pipe and collected in 14 2 x 1 m rectangular tanks. Some farmers use water buckets to collect water from the tanks and bring it to their individual plots. Others have purchased hosepipes, which can be connected to the taps that were provided as part of the irrigation scheme. Farmers take turns to irrigate. The water was not quality tested since testing is reserved for drinking water**.**

Each farmer is allocated 11 plots, each measuring 4.5 square metres, so the total allocation per farmer is about 49.5 square metres. Land parcels are allocated randomly to ensure fairness to all irrigators.

Cropping began in 2015/16. Crops cultivated include beans, groundnuts, tomatoes, carrots, butternut, and maize. Crop choice is made through scheme members' consultation as well as discussions with potential buyers. Uniform cropping choice is applied to help better plan for irrigation.

Farmers can harvest 20 kg bags of beans, which are sold for USD 25-28, and three 20 kg bags of groundnuts sold at USD 12 each. There is a market available for the produce at Chivi High School and Chivi Growth Point. Household nutrition security has also improved because of the irrigation scheme. However, most of the respondents mentioned that they were not earning significant additional funds to plough back into the irrigation scheme given the small plot sizes.

The irrigation scheme is run by an Irrigation Management Committee (IMC) with seven members, two of whom are women (one is treasurer). By-laws govern the irrigation scheme. [131] Members said that the by-laws regulate the selection and replacement of the IMC, plot allocation, crop choice, marketing, plot allocation, and conflict resolution.

Farmers do not have separate fund for irrigation repairs and maintenance, but rather use money from collections made for security at the scheme. Collections are coordinated by the Irrigation Management Committee. The scheme is functional but faces challenges from poor organization and inadequate maintenance regime. Currently the outlet valve is leaking and one of the pipes burst. When asked, the farmers said they are planning to buy sealers. Respondents indicated that they felt ownership over the scheme but also that more efforts by development partners such as USAID were needed to assist them.

Fish farming: White and red bream were introduced into the dam to facilitate fish farming. At first, individuals who wanted to fish from the dam were charged USD 3 per day, but this was discontinued because of enforcement difficulties and the lack of willingness of people to pay without guarantee that one would catch enough fish. There is now rampant overfishing and very few fish left in the dam. Fish poaching is said to be a major challenge with people coming to fish at night using wooden canoes, especially from wards 12 and 14 and some said to be coming from as far as Mashava. The community did not see how the situation can be resolved because the dam is far from homesteads.

The Asset Management Chair acknowledged the challenge of fish poaching and also noted that the fence around the dam has been illegally removed. Although there are rules in place that impose fines for illegal fishing, so far no fines have been imposed.

Challenges

The project faces many challenges, including:

- The individual plots allocated to farmers in the irrigation scheme are small and most irrigators refer to them as 'garden' plots. Small plot sizes have meant that the production levels are limited and farmers cannot negotiate with bigger buyers who prefer to buy bigger quantities.
- The area selected for the scheme may have been suitable for gravity fed irrigation, but accessing the irrigated area is a major challenge for the farmers especially if they are transporting inputs and harvests. These have to be carried by head or hand is the path is not accessible to wheel barrows let alone ox-drawn carts.
- Marketing was noted as a major challenge despite collective efforts made to identify potential buyers before determining which crop(s) to cultivate.
- Security of the irrigated area is a major issue as it is in an isolated area and security has to be provided.

[131] Although requested, the project team was unable to obtain a copy of these by-laws.

- Human wildlife conflict is a major issue and the hired security guard has to protect the crops from wildlife.
- The fence protecting the dam area was stolen, enabling livestock to access all areas for water drinking water. The initial design limited livestock to the rocky sections to access water to avoid loosening soil which would then be washed into the dam.
- Siltation of the weir/dam was reported as a major issue that is reducing the dam's water retention capacity. Extending the embankment was said to be a possible solution though it was noted that the weir height at 7 metres was the maximum height allowed for weirs/dams constructed by non-state actors. Beyond that, the state has to be responsible for construction for such infrastructure.
- Poles used to fence the irrigated were being affected by termites and needed to be replaced.
- The outlet pipe was said to be too deep for the irrigators to maintain - it requires professional divers to carry out its maintenance.

4.2.2 Nyimai Garden

Research Activities

The Focus Group Discussion of community leaders included the Ward Councillor, three village heads, Headman Masunda, Chairman of the Nyimai Dam Asset Management Committee, Chairwoman of the Nyimai Garden, Security Officer, Agronomy Committee and Disability Coordinator and 6-8 members of different committees. Resource mapping was also undertaken by a Focus Group Discussion made up of seven women and three men. A total of 24 household survey questionnaires were administered. Water samples were taken from the water taps in the garden and from a tap from the second water treatment tank.

History of the Dam

The dam was constructed by DDF in 1993 after the community approached the District Administrator to address livestock watering challenges in the area. Communities used to water their livestock at the Tugwi River, which is some distance from the community. The dam was not completed due to a shortage of funding. In 1997, CARE assisted the community in completing the dam, providing materials (cement and transportation) and skills training while the community provided labour (gathering stones and building). The dam was completed in 1998.

Participation was voluntary for all the four villages (Gwenyaya, Ruvhaire, Pwanyayi, and Pfumo). Between 5 and 10% refused to participate in the construction of the dam. Some people joined later on as they saw progress. The dam wall was swept away by Cyclone Eline in 2000 and reconstructed by CARE in 2003. Figure 5 shows the community's depiction of the location of the dam and the garden.

The dam is one of the few water sources in the area. The 34 existing boreholes are not adequate for the 39 villages. The dam has seven committee members who are responsible for the safe operation of the dam.

Partners Engaged

- Gwenyaya, Ruvhaire, Pwanyayi, and Pfumo villages
- Additional villages in the District
- Farmers (including disabled farmers) and livestock owners
- CARE
- AGRITEX extension officer
- Environmental health technician

Water Uses

The dam is used for livestock watering, irrigation, domestic water, and fish farming.

Livestock watering: All people from the villages that were involved in constructing the dam and four other villages are able to water hundreds of livestock at the dam, provided they enter through the gate. No one is denied access and the fences have remained intact. This has also been helped by the community and local fishers, who have a vested interest in maintaining the dam.

Irrigation: there are 84 farmers in the irrigation scheme, each of whom is allocated 156 m^2. There are also beds for disabled persons. One disabled irrigator, who was also attended the meeting, is one of the top marketers.

Figure 6 shows the location of the dam and irrigation as depicted by the community. As shown, there is a water treatment plant made up of two tanks, each 4-5 metres in diameter and 3 m high. The first tank utilizes sand purification, while the second is treated daily by the Environmental Health Technician. The community did not know the type of tablets that are used for this treatment.

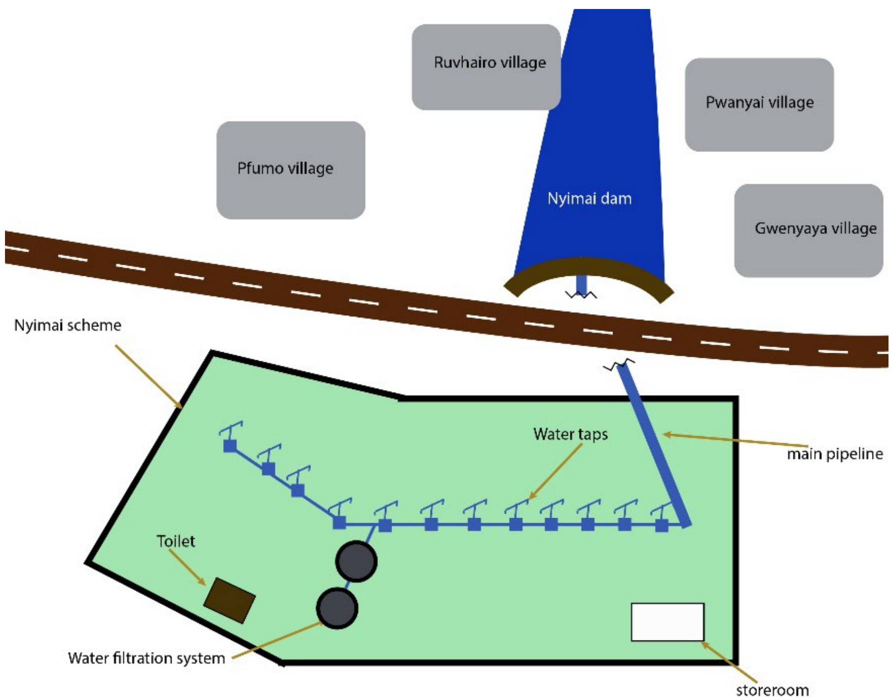

Figure 6. Modified community depiction of location of Nyimai Garden and irrigation garden

The beds were randomly distributed to ensure that irrigators face similar water conditions. Each farmer has one fruit tree at the eastern side of the irrigated garden to provide a healthy source of food and shade.

Water gravitates from the dam through a 2 km, 90mm diameter pipe, which is made of plastic and metal to convey water across the roads. In the field are taps and collecting well points. Some farmers bought hose pipes to irrigate, while others use plastic buckets to transport water to their crops. Irrigation is scheduled between 2 groups and the farmers grow covo, tomatoes, onions, butternuts, and beans. The cropping programme is followed across the whole garden and participating farmers receive advice from the AGRITEX Extension Officer.

Farmers use to sell to Beitbridge, but have since been outcompeted by local suppliers. To solve this issue, farmers are changing their planting dates and trying new crops.

Farmers do not pay for water and do not pay levies to the subcatchment council. Maintenance and repair is done on ad hoc basis and farmers contribute as the need arises. There are insufficient funds to have a dedicated fund, but the scheme rule is that you must pay to irrigate. There is a committee member who controls legal and compliance issues.

The lack of structure for operation and maintenance has given rise to challenges. The metal pipe frequently leaks because of old age and rusting and irrigators buy material to seal their leakages on an ad hoc basis. Some of the 9 taps currently in a state of disrepair. All the same the garden is one of the most successful long-term projects.

Fish farming: Fishing was added as a complementary activity. While there were initially rules governing fishing in the dam, these have been abandoned as they were unable to be enforced.

4.2.3 Toindepi Irrigation Scheme

Research Activities

The Focus Group Discussion of community leaders was made up of the Ward Councillor (who joined later on), the Chairman of the Toindepi Irrigation Scheme, five village heads who doubled as chairpersons of various agricultural production committees (such as Goat, Small Grains, Gardens, Overall Garden), the Agricultural Extension Officer (not responsible for the garden), and the Agricultural Extension supervisor new to the area. Sixteen household survey questionnaire were administered.

History of the Irrigation Garden

Toindepi Irrigation scheme was initiated as a youth project for Wards 7, 8, and 10 in 2015 and was financed by the International Labour Organisation (ILO). Early in the project, the solar panels, batteries, and fence used in the scheme were stolen despite the presence of a guard who provided protection in exchange for having irrigation plots. A criminal case was opened but the culprits were not apprehended. As a way forward, the community agreed to engage both youth and older people in the project with oversight from the village head. The government agreed to revive the project if the community contributed USD 350 (half of the required capital), but the community was only able raise around USD 100. The local member of Parliament then secured funding for replacing the panels but not the batteries. On 4 September 2021 the panels were replaced and the 1.4 horsepower pump was replaced by a 2 hp pump. At the same location is a 40 metre deep borehole fitted with a bush pump that was installed in 1992.

Partners Engaged

- Chimbo, Chickwe, and Mudyazhezha villages
- The 56 farmers in the irrigation scheme
- Livestock owners
- International Labour Organization
- Takunda

Water uses

It is estimated that, together, the bush and solar boreholes provide water for livestock and domestic uses for about 500 families in addition to irrigation activities. The boreholes serve the nearby villages (Figure 8), as well as additional villages in Wards 8, 9, and 10. Other boreholes in the area are reported to be less prolific. To balance the competing water uses, the community has been in place a schedule of using the water efficiently and equitably (Figure 7).

Figure 7. Schedule for using water in Toindepi boreholes

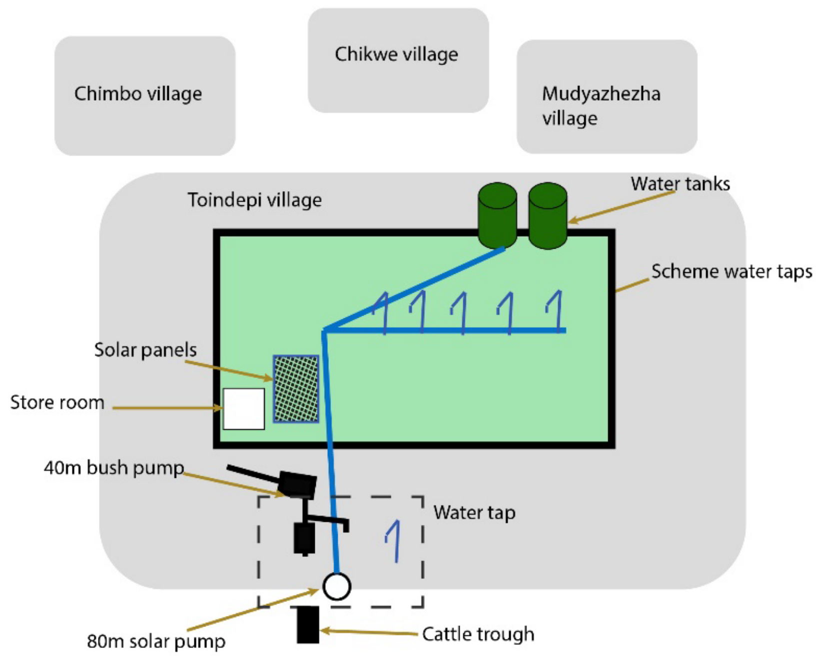

Figure 8. Modified community depiction and layout of the Toindepi irrigation garden

Domestic Use and Livestock Watering: Water from the boreholes is used for domestic water and for livestock watering for both the 5 core villages and other villages and people on farms in Ward 8 also use the water. For livestock there are troughs, but cattle now drink from buckets.

Irrigation: The solar pump delivers water directly to 12 taps along three lines, but only two of the taps are functioning. These are used alternately with one tap designated for domestic water and the other for livestock watering. Irrigation starts at 10 am. Before that people fetch domestic water and livestock watering.

There is a plan to store water in three Jojo tanks[132] and then gravitate the water to the taps for irrigation. Two tanks (10,000 and 5,000 litres) have been mounted and there is an additional 10,000 litre tank yet to be mounted. However, the tanks do not fill because all of the water is diverted for irrigation and domestic purposes. There is one pipe from the solar borehole to the tanks –there is therefore no outlet pipe to the garden.

[132] Local water storage tanks.

Pressure in the taps is low and was calculated using a quick bucket test to be around 0.27L/s. Due to the lack of sufficient water for all users and competing uses, only about 1.5 ha of the 5-ha garden is irrigated. It should be noted that the water availability challenges are not due to a lack of water and there is no record of the boreholes ever drying up.

The scheme is cultivated by 56 farmers. Each farmer has 3x25x1m areas on three blocks within the scheme. The 56 farmers are community members who voluntarily chose to work to restore the scheme with labor (such as erecting a brushwood fence). Additional community members are free to join the scheme but have to pay USD 5 to join and USD 10 as a contribution to the repairs undertaken so far. This amount will change over time as progress is made towards meeting the costs. In addition, each farmer pays USD 2 per month for two guards. Repair and maintenance is ad hoc.

Current irrigation relies on bucket system from a series of taps. Each farmer has 75 by two 1 metre rows/beds in three contiguous lots. Irrigation scheduling was initiated but not followed because of water challenges.

Future of irrigation in the scheme

Takunda undertook a community visioning exercise in April 2022, but the community is not aware of the outcome of this exercise and did not have records of the process. Takunda has noted that it has plans to come and assist the community, but that the irrigation scheme does not fit within Takunda's current scope of activities. Currently Takunda focuses on borehole drilling and rural water pipe system. Assistance may be sought through emergency funding.

4.2.4 Proposed Mhazo Borehole

Research Activities

The Focus Group Discussion of community leaders included the Ward Councillor, five village heads (all men) and four other male community members. Figure 9 shows the community's depiction of the proposed Mhazo borehole.

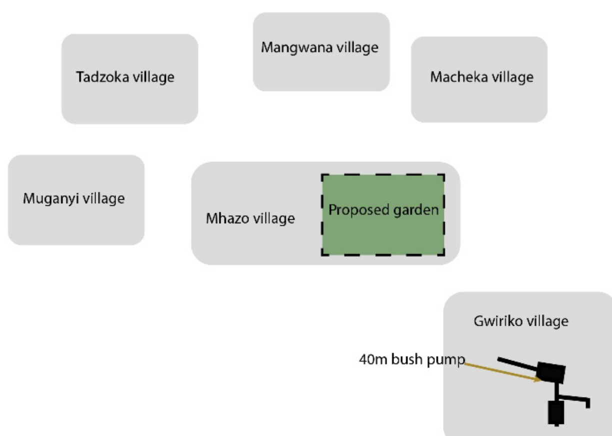

Figure 9. Modified community depiction of location and proposed Mhazo borehole

Partners Engaged

- Tadzoka, Macheka, Mhaso, Muganyi, Mangwana, and Gwiriko villages
- Tokwe Sub-catchment Council
- Rural District Council
- CARE

Community Visualisation Process

The community visioning exercise was undertaken between January and March 2022. CARE approached the VIDCO to consult the community regarding the water challenges it was facing. This initial meeting was followed by additional meetings at the village level in the villages that made up the VIDCO, namely Tadzoka, Macheka, Mhaso, Muganyi, Mangwana, and Gwiriko. Another VIDCO meeting in June 2022 was held to summarise and consolidate the consultations.

The consultations resulted in agreement to drill a community borehole to address a lack of sufficient water for domestic, livestock, and irrigation needs. The area currently only has one bush pump servicing over 250 households and this pump sometimes runs dry in the late dry season (October-November). Additionally, while the Tugwi River is located nearby, it is unsafe for water collection due to the presence of large numbers of crocodiles.

The plan was made to establish a community garden powered by a solar borehole in either Mhazo or Tadzoka village. The first choice was Mhazo because of its central location for all villages (some villages were as far as 20 km away). There was an understanding that a 'weir dam' would also be constructed nearby. The garden was planned to cover 1.5 hectares, with an understanding that the actual size and number of beneficiaries would be determined by the borehole yield.

The community consulted for this research expressed dismay due to unexplained delays in drilling. The CARE representative told the community that the drilling contractor has been paid and that progress had stalled because the Tokwe Sub-catchment Council is insisting on payment for registration and authority to drill.

Selection of beneficiaries: The targeted beneficiaries are members of the villages constituting the VIDCO although the leaders had different ideas regarding how specific beneficiaries would be selected. For some (Tadzoka), only capable people would be selected based on earlier experience where a similar activity was poorly subscribed. Another suggestion was that each village would be asked to submit names to be included in the garden, taking into account the number of households in each village (Tadzoka: 120; 28; 15; 37; 25 making a total of 225 households). Each village would be asked to submit a proportionate number of people, first on a voluntary basis and then by random selection as needed. Vulnerable people will be allocated pieces of land which will be worked by their caregivers as community leaders did not think it was possible them to undertake the work themselves.

Identification of land: The land where the garden would be established in Mhazo village belonged to the village head's late brother. The village head already talked to the widow and children who agreed to the arrangement, provided they would benefit from the garden.

No guarantees were in place to safeguard the possibility of the owners of the land changing their mind when the borehole was installed. The village head did not think that would happen because of the verbal agreement. The interviewer pointed out that CARE had witnessed a case where the owner of the land had chased away the community and privatised the borehole. For this reason, CARE insisted the owner of the land sign a declaration to indicate that they had voluntarily given the land and would not claim it back and that a copy of the declaration be lodged with the Rural District Council. The community agreed this would raise significant challenges but were unsure if the owners of the land in question would be comfortable with appending a signature to such a declaration. It was agreed that the land in question should be debated at VIDCO level in the presence of neutral facilitators and not village heads as they would raise suspicions. To avert such problems, uncontested land could also be sought, as in Tadzoka village where there was open land.

Proposed crops: At present, the size of plots and number of beneficiaries cannot be determined. However, since it was a community garden, people would be allocated beds/rows. No crops have been decided on. Marketing is likely to be challenge because of the location of the site, as there is only one mini-bus that makes one route**.** A market place will therefore need to be established to cater for buyers and sellers.

Operation and maintenance: The community wanted to be trained in operations and maintenance (O&M) once the garden was established. The users agreed to meet some of the O&M costs and were willing to pay for security of the infrastructure but there was lack of agreement on how much was affordable. It was agreed that people who refused to pay would not be allowed to irrigate, but abstraction for domestic water and water for livestock would not be subject to any sanction. The community plans to draft a constitution to address these complex issues.

Multiple water use: The discussion revolved around the garden and not any other use. When asked whether domestic water was an issue, the response was that the project was exclusively a garden and therefore reducing the size of garden to cater for domestic water supply was out the question and another borehole to supply domestic water should be sought. It was later agreed that that domestic water and water for livestock would be accommodated from the borehole as there are not sufficient additional boreholes in the area and the existing ones frequently broke down. Lutheran had sited boreholes but these were not developed. Cattle were driven 10 km for watering.

The community indicated that the government must invest in water supply. One solution would be for the RDC to buy a rig with devolution funds. This is, however, unlikely in the short term.

4.3 Zaka District

4.3.1 Chemvuvu Dam

Research Activities

The Focus Group Discussion of community leaders included the Headman, two village heads, the Chairman of Chemvuvu Dam Asset Management Committee, the Chairman of the Chemvuvu Irrigation Scheme, and two women who were members of other committees. The Focus Group Discussion of community members to undertake resource mapping was made up of 3 community members (women). Only 8 household survey questionnaires were administered as only a few irrigators were present (some had returned home) and community members indicated that they could not spare the 3 hours the team estimated would be needed to complete the exercise. The community was involved in labour-intensive irrigation, using wheelbarrows to fetch water directly from the dam because of low water levels. Water was no longer being discharged in the troughs from which they normally would fetch water to irrigate their gardens. Samples for water quality analysis were taken from the dam. No water could be obtained from the tank in which water was treated.

History of the Dam and Garden

The village heads initiated the process of building a dam to address the communities' water challenges and every household was asked to contribute USD 1. Before the exercise was completed, CARE engaged the community regarding disaster risk reduction in the community. The consultations resulted in a dam being identified as a suitable intervention. Fifteen villages were involved in the project.

CARE provided expertise and materials such as cement, shovels, hammers, trowels, wheelbarrows, and transportation for ferrying stones. The community contributed labour, including builders. Each participant was given 50 kg sorghum per month.

Construction started in 2016 and was commissioned on 25 May 2017. As can be seen from Figure 10, the dam is surrounded by ten villages. Museki School borehole serves the school and the community and is located 1.5 km from the garden.

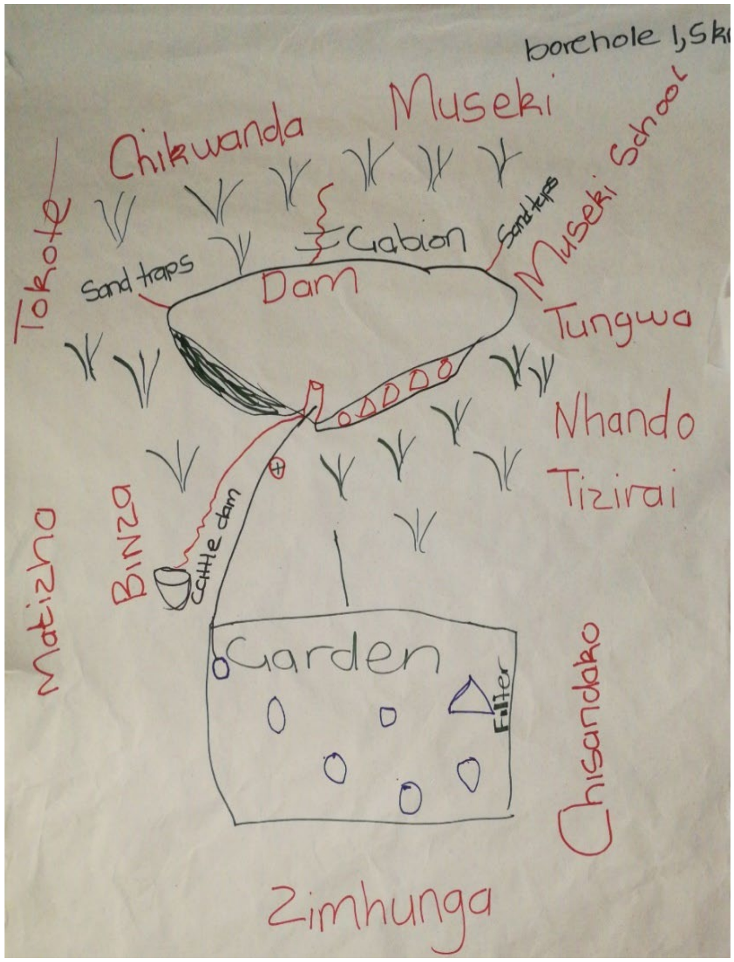

Figure 10. Community depiction of location of Chemvuvu dam and water use

The dam is fenced, and the fence is intact. The immediate catchment is well grassed and there is no evidence of siltation, as sand traps and gabions were built upstream. The water treatment tank in the corner of the garden labelled Filter is no longer working because of water shortages. There is also a toilet close to the entrance of the garden, which is not indicated on the diagram.

Partners engaged

- Chemvuvu Dam Asset Management Committee
- Chemvuvu Irrigation Scheme
- Farmers and livestock owners
- ENSURE

Water use

Water from the dam is used for livestock watering, irrigating the garden and for domestic purposes such as laundry and drinking since there are no nearby safe drinking water sources.

Livestock watering: It was estimated that over a thousand head of cattle are watered from the dam. Some cattle travel 6-7 km to the dam. Livestock drink from a special weir downstream of the dam wall.

Irrigation: The garden is about 1.2 ha in size and is irrigated by 56 individuals out of the 260 persons that participated in dam construction. It is located 1 km east of the dam. Eligibility to participate in irrigation depended on labour contribution to dam construction and vulnerability (including widows, orphans, and the elderly). Each farmer irrigates 30 beds measuring 3 x 1 m (equivalent to 0.02ha), which are randomly distributed across the garden to ensure that no farmer is advantaged or disadvantaged by the location of his/her beds. Most of the irrigators are from Ward 14, with three from Ward 13. People from Ward 15 declined to be part of the garden because of the long distance.

Water is gravitated from the dam 600 metres through a buried pipe to 6 ponds from which farmers irrigate using buckets. The ponds located downstream receive more water than those in the upper because of insufficient head. There are two irrigation groups: Group A, which irrigates Tuesdays and Fridays, and Group B, which irrigates Wednesdays and Saturdays.

Crops are grown according to a set schedule adhered to by all farmers in the scheme. The crops include leafy vegetables, carrots, onions, shallots, garlic, broccoli, beetroot, beans, okra, watermelons, and butternut. Marketing these crops is not reported to be a challenge.

The community values the garden because it caters for their household consumption and income needs. Sales from the garden can amount to USD 140 per year. The irrigators have used this income extended assistance to the broader community – they purchased books and pens for disadvantaged children at the nearby school.

The irrigators do not have a dedicated fund for operation and maintenance. They raise money when there is something urgent that is needed. Mukando (Savings Club), which was introduced by CARE, provides revenue.[133] Each irrigator contributes a defined amount of money per month, which is lent out to the community at 20% per month. They have raised enough money to purchase 5 kg of seed (worth USD 780) and the seed was delivered by a seed company. They also bought cattle (worth USD 350) for the field day.

Fish farming: The First Lady donated fish fingerlings to the dam.

Challenges

There is very little water in the dam, and it does not flow to the garden. This is because the catchment of the dam is small and arid and only fills when there is good rainfall. As a result, farmers fetch water from the dam for irrigation, which is labour-intensive.

The water treatment tank is empty because of the water shortage. However, even if filled up, the water was only for drinking in the garden and was not enough to take home. The community thinks the solution is to drill a borehole for the garden and drinking. They have approached the Minister of State, Deputy Minister, Member of Parliament, and Councilor to no avail. The First Lady was apprised of the situation when she brought fish to the dam.

4.3.2 Zinhuwe Dam

Research Activities

The Focus Group Discussion of community included four village heads, the Chairman of Zinhuwe Dam Asset Management Committee, the Chairman of the Zinhuwe Irrigation Scheme and other committee members (a total of five men and three women). The Focus Group Discussion of community members

[133] Mukando is one of several initiatives introduced by ENSURE. Others include chicken raising.

for resource mapping was made up of six community members. A total of 22 household survey questionnaires were administered.

History of the dam

This project was initiated by CARE, which gathered communities from villages within a 5 km radius at the Ward Centre for consultations regarding the water challenges facing the community. A total of 18 villages were represented and it was agreed that a dam would be constructed and that it would feed a community garden and irrigation scheme. CARE provided cement, transport for stones and sand, all construction tools (shovels, wheelbarrows, trowels, etc.), and trained a builder from each scheme in the ENSURE project on construction of the dam. The dam took 2 years to complete. The garden was built by 380 people (310 women and 70 men). Figure 11 shows the location of the dam and irrigation scheme.

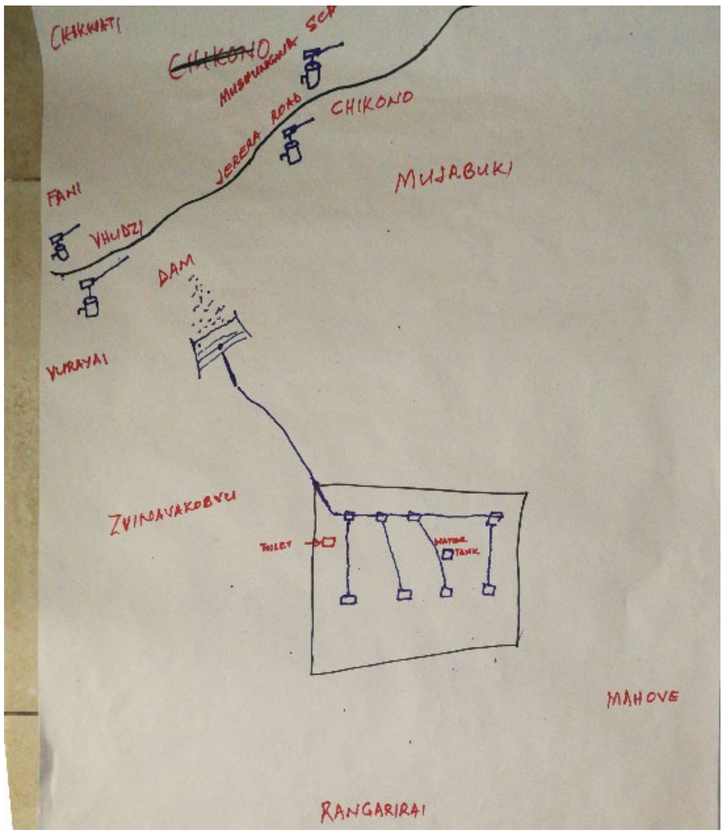

Figure 11. Community depiction of the location of the Zinhuwe dam and water use

Partners engaged

- Famers and livestock owners
- Takunda

Water use

The dam is used for gardening, drinking water, and livestock watering.

Livestock watering: Approximately 10 villages water their livestock from the dam. Additional villages used to access the dam for this purpose, but stopped coming because of the long distance. Cattle drink water directly from the dam, as part of the fence was stolen, and the community removed the remaining fence for safe keeping. The community had tried to protect the fence by taking shifts in guarding it, but this was abandoned due to the dangers posed by wildlife.

There are no rules regarding watering livestock because of the difficulties in enforcing them. This is also because the infrastructure for watering livestock was not put in place. Siltation is also an issue, and the ward environmental monitor has so far been unsuccessful in addressing this. The monitor does arrest people for cutting down trees, but communicated that he lacks resources (transport and a uniform).

Irrigation: People joined the scheme on a voluntary basis. Eight villages are involved in the garden, which is 1.5 hectare in size. There were initially 64 farmers at the scheme with three more added to make 67 at a fee of USD 100. Each farmer has 27 beds which measure 3 x 1 m. Every irrigator also has his/her own fruit tree.

An underground pipe transports water from the dam to the garden where water it is discharged into 6 ponds from which farmers irrigate using buckets. Now there is enough water in the garden. The dam usually dries in late dry season (October/November) and high competition for water ensues. The outlet valve at the dam was vandalized and therefore water is only controlled in the garden. Problems also arise from damaged valves in the garden. In the garden, the pressure from the dam is low and the garden is on a slope meaning one of the hydrants overpowers the rest when open.

There are two irrigation groups: the first on Monday and Thursday and the second on Tuesday and Friday. Farmers buy their own seeds and grow cabbage, covo, rape, onions, maize, shallots, and tomatoes. Government sometimes assists them with free seed through the Presidential Input Scheme. COVID 19 affected their marketing and sales to their traditional market at the local school. Marketing is also a problem because of too many gardens.

The garden faces no security challenges because all irrigators play their part. There are also stiff penalties with fines, such as: damaging irrigation infrastructure USD 5, stray dog USD 5, stray cattle USD 20, quarrelling in the garden USD 5.

There is no funding set aside for operation and maintenance. Farmers claim they lack capacity due to the challenges in the economy. Current contributions are USD 2 per annum or USD 1 per three months. Apart from money there are also challenges with procuring spare parts. Members have tried to replace valves but cannot find the right size.

Domestic water: Domestic water is also a challenge. The water treatment system that provided potable water for irrigators during irrigation is not functional. As a result, the irrigators resort to 4 boreholes equipped with bush pumps, which are 3-4 km from their villages. People can queue up to 3 hours. Men also participated in fetching water. They also drink water from the dam, which is causing high cases of diarrhea were reported.

Boreholes were mentioned during consultation, but nothing was done. There has been talk that Takunda is planning a solar borehole.

Challenges

To safeguard water in the future it is important to address the environmental degradation around the dam such as streambank cultivation. There is also a need to undertaking conservation works such as planting vetiver grass.

4.3.3 Cheshanga Nutrition Garden

The Focus Group Discussion of community leaders included the Headman, two village heads, the Vice Chairman of the Nutrition Garden, and a members of Committees, such as the Marketing Committee. There were two women present. A total of 21 household questionnaires were administered.

History of the garden

The garden was initiated as a result of CARE's consultations with the community regarding disaster risk reduction strategies in 2016. The first meeting about the dam was with village heads, which was followed by a meeting with community members. The community included people from villages within a 5 km radius, namely Tukununu, Munorwei, Chigaro, Runesu, and Mbengo.

CARE provided cement, ringforce and equipment (wheelbarrows, shovels, hammers, picks, trowels) and transportation of stones. The community provided labour, including builders for building the dam and were given 50 kg of sorghum per month. The dam was completed in 2017.

The dam was meant to provide water for irrigating a nutrition garden and for livestock watering. The water would be transported by garden to the community and farmers would access taps in the garden. However, there was a problem with seepage and the water loss prevented any irrigation. The plan to supply water from the dam was then abandoned because the dam was leaking. Attempts to repairs with concrete failed.

Drip irrigation installed

After it was clear that the dam was not a reliable source of water, CARE suggested to the community that solar powered borehole would be an alternative. The borehole was drilled in 2019 (the community is not aware of the process for siting of the borehole). Due to the low water levels, it was decided a drip system would be installed which would save water and labour. At first the drip lines were down the slope and later across the slope. There are 62 drips lines across the slope arranged a metre apart, but the drip system of poor quality.

The drip irrigation system has 210,000 litre tanks and a solar pump borehole (with no batteries) from which water flows by gravity to the drippers in the garden (Figure 12).

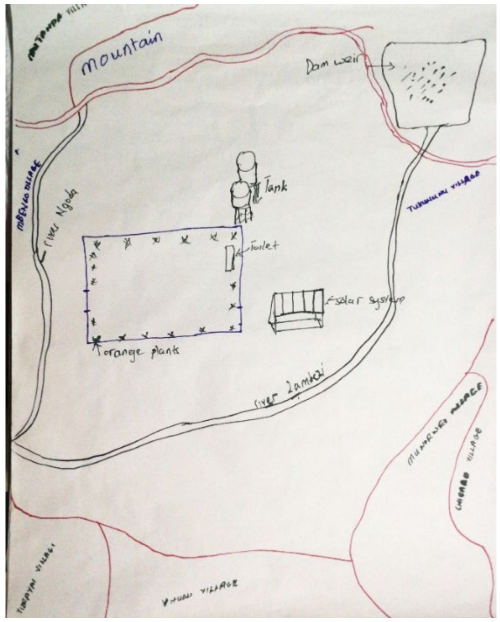

Figure 12. Community depiction of location of Cheshanga Nutrition Garden

Solar borehole water was designed to directly supply the drip system, but it takes 2-3 days to fill up the tanks and only 5 hours to drain the water from the tanks. The quantity of water is only adequate to irrigate one block at a time leaving three blocks without water due to lack of solar batteries and the small size of the pump. As a result, 20% of the garden is irrigated using buckets from the nearby streams which now do not have enough water. It is believed the pump has insufficient power and head (likely a 2 hp pump). Additionally, when there is cloud cover, the pump does not function.

The community does not know the capacity of the pump or the cost to pump water into the two 10,000 litre tanks. The community did not feel they had a say in the installation of the drip system.

Irrigation and water challenges

People who irrigate in the garden are from the villages who participated in the building the dam. Those from far away villages elected not to participate in the garden. At first, 50 farmers were elected to be in the garden, but the number dropped to 40 because of water challenges. Villages in the garden include Mutanda, Tukununu (scheme location), Munorwei, Chigaro, Vurayai, and Vhudzi.

Every irrigator has four rows that measure 45 x 40 cm (a total of 90 m^2). Farmers grow vegetables, maize, beans, and tomatoes. The vegetables and tomatoes appeared water stressed. Each farmer has a fruit tree. Irrigation is split into 2 groups who irrigate once per week on Monday and Friday. There was no indication of adequate training to cater for drip irrigation systems such as periodic replacement of drip pipes.

Domestic water

There is no water from the dam for drinking. The single tap intended for drinking water is now used to fill buckets to supplement inadequate drip irrigation supply. Drinking water is taken from shallow wells dug on the slope of the hillsides. The area appears to have a prolific underground water profile with observed October water level in the wells at less than 1m depth. Locals propose drilling of boreholes for potable water supply to supply the many people from surrounding areas with drinking water.

Land

The land on which the garden is located used to belong an old woman who passed away and the land reverted to the village head. It came to light that she had left her granddaughter who was also part of the garden (like any other irrigator) and had moved to her paternal village in 2020.

Operation and maintenance

There is no dedicated maintenance fund because of the high-water charges. Farmers do not have an operation and maintenance plan and do not know when to replace the different irrigation components. Farmers have hired a guard to protect the pump and the panels at USD 30 per month. Each farmer contributes towards the amount. Low production owing to inadequate water supply means they have difficulty fulfilling contributions.

4.3.4 Chivamba Proposed Borehole

The Focus Group Discussion of community leaders included six village heads (four of whom were women). No committees exist as yet. The Community visualization process proceeded as follows.

Community visualisation

Takunda/CARE gathered people of the VIIDCO on 27 October 2021 to deliberate the challenges in the area. On 24 November, the community was involved in developing a five-year community action plan, which was specific to Takunda activities. The deliberations were organized according to age and sex groups. There were female and male groups as follows: 15-35; 36-49; and 50 plus. Each group was asked to list and rank their preferred development activities. The results of this process are indicated in Table 3**.**

Table 45. Preferred activities according to respondents, age, and sex

Age group	Sex	Activity
15-35	F	Shop and retailing
	M	Practical skills
36-49	F	Poultry
	M	Fence making
50 plus	F	Irrigation garden
	M	Goats

A report back from these consultations was followed by a vote to determine which activity to prioritize and this process chose irrigation garden using a borehole. At a meeting of the village heads, it was decided that the borehole would be in either Chivamba or Matare village because these did not have enough water (Figure 13). The garden would be 1.3 hectares in size. The borehole would be used for domestic water and gardening.

Land issues

Owners of the land where the garden would be located would be given alternative pieces of land and be part of the garden. It was not anticipated that this would be a challenge because no-one would stand in the way of development. When it communicated that it was important to prevent possible conflicts by having a signed document as has been done elsewhere, the village heads welcomed the idea. The document would be signed by the owner of the land, village head, Committee representative, and Councilor. The village heads agreed that the RDC should be involved.

Irrigation

Other details, such as selection of irrigators, cropping programme, and operation and maintenance have not been discussed. They believe a borehole powered by a solar system would be easy to maintain.

Operation and maintenance

The village heads emphasized the need for a constitution to avoid problems such as those being experienced in the nearby piped water scheme where there was no control over who fetched the water and how much and difficulties in collecting fees.

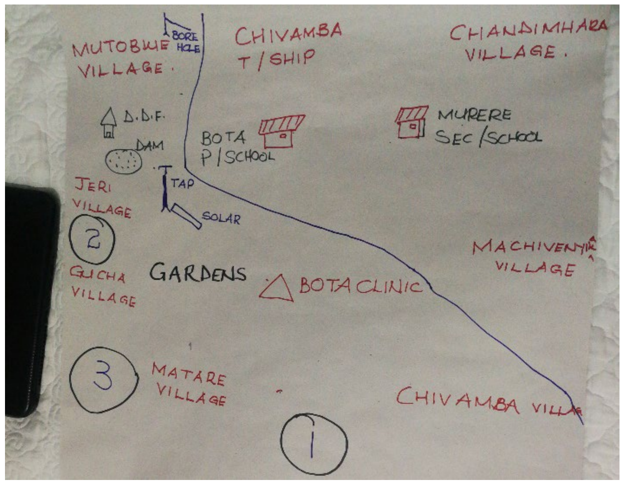

Figure 13. Community depiction of the proposed Chivamba borehole

5. MULTIPLE WATER USE AT THE COMMUNITY LEVEL

5.1 Respondent and Household Characteristics

The majority of respondents (90%) were female (Table 4). In some project sites such as Musvinini, Chemvuu, and Cheshanga, all the respondents were female. The number of male- and female-headed households varied across the sites. On average, male-headed household accounted for 60% of all households. There were, however, more female-headed households in Nyimai and Toindepi. The average household size was six.

Table 46. Characteristics of respondents and households across all project sites

Name	Household size	Sex of respondent (%)		Head of household (%)	
		Female	Male	Male	Female
Musvinini Irrigation	7	100	0	75	25
Nyimai Garden	5	87.5	12.5	46	54
Toindepi Irrigation Scheme	6	87.5	12.5	31	69
Chemvuu Garden	6	100	0	75	25
Zinhuwe Garden	7	67	31	67	33
Cheshanga Nutrition Garden	6	100	0	69	31
Average	6	90.3	9.7	60.5	39.5

5.2 Water Use in the Community

The water sources available in the communities included boreholes, weirs, dams, streams, and wells (Table 5). The importance of each water source differed from project to project, except for boreholes which were noted as first priority for all the projects. This suggests that domestic water, which is generally provided by boreholes, was a key priority for all respondents. All water sources in the community were shared with other villages. In addition to the communal water sources, there were also instances of self-supply water infrastructure at all sites except Cheshanga garden (Table 6). The fact that the highest number of self-supply water facilities was in Chemvuu suggests that it was the most insecure water source. All self-supply water projects were also shared with other villages but to a less extent that communal water sources.

Table 47. Importance and sharing of water sources in across all water projects at community level

Name	Water Source				Water Sources Shared With Other Villages
	1	2	3	4	
Musvinini Irrigation	Borehole	Weir	Dam	Well	87.5
Nyimai Garden	Borehole	Well	Dam	Stream	95.8
Toindepi Irrigation Scheme	Borehole	Well	Weir	Stream	87.5
Chemvuu Garden	Borehole	Weir	Dam	Stream/Well	87.5
Zinhuwe Garden	Borehole	Weir	Spring	Well/River	95.2
Cheshanga Nutrition Garden	Borehole	Spring	Well	Dam	100

Table 48. Presence and sharing of self-supply water facilities

Name	Presence (%)	Shared (%)
Musvinini Irrigation	41.7	20.8
Nyimai Garden	45.8	41.7
Toindepi Irrigation Scheme	56.3	50
Chemvuu Garden	75	62.5
Zinhuwe Garden	19	33.3
Cheshanga Nutrition Garden	0	0
Average	39.6	34.7

The main water uses in the communities included domestic, irrigation, and livestock watering in that order. This was consistent across all the projects. The proportion of respondents who thought that there was enough water to the community varied from 0 to 70% for reasons that included too few water sources, unreliability of infrastructure, seasonality, and operational challenges (Figure 14). As expected, the lowest proportions were in Cheshanga and Chemvuu, the two projects that faced the worst water insecurity. The severity of physical water scarcity meant that operational challenges were regarded as less important.

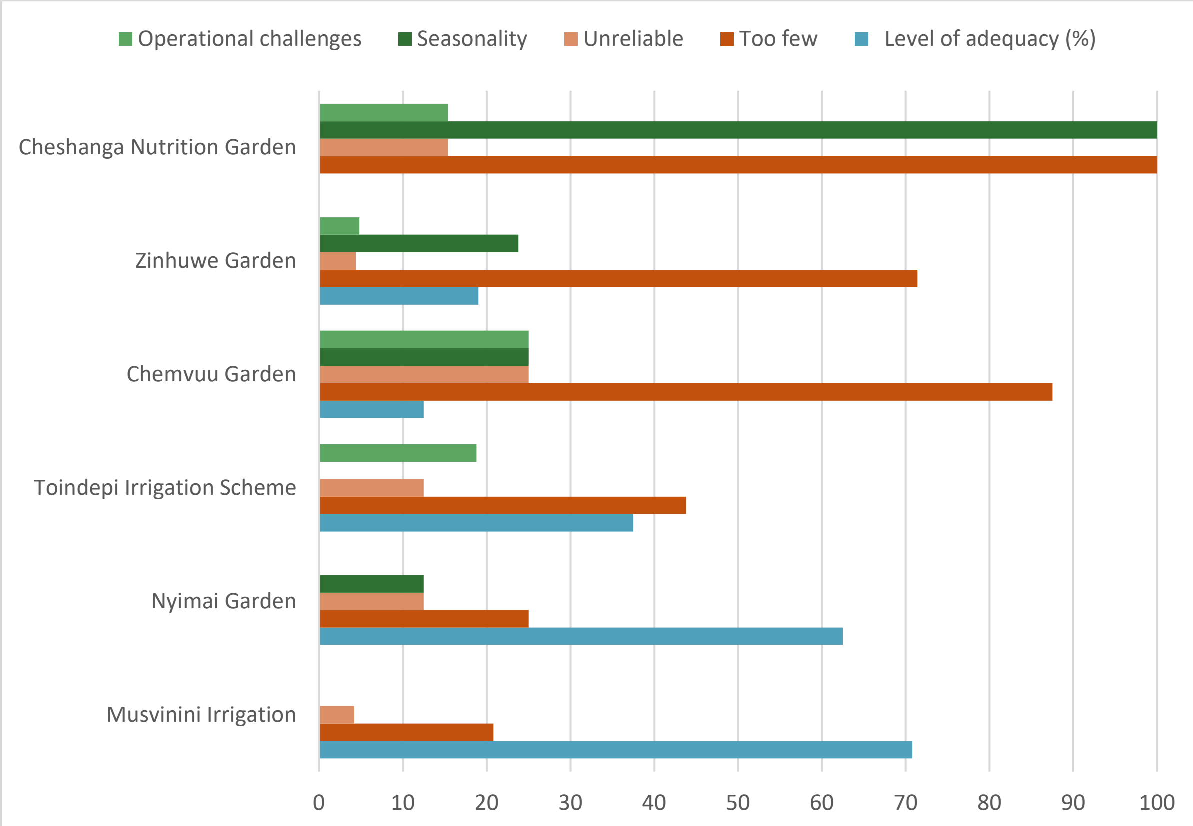

Figure 14. Bar chart showing the level of adequacy and reasons for water challenges at community level

Conflicts around water use were acknowledged by less than half of the respondents (Figure 15). Water shortages were the most frequently cited reason for water inadequacy followed by water management system and payment. The committees were most involved in conflict resolution (Table 7). Mutual agreement was the least popular.

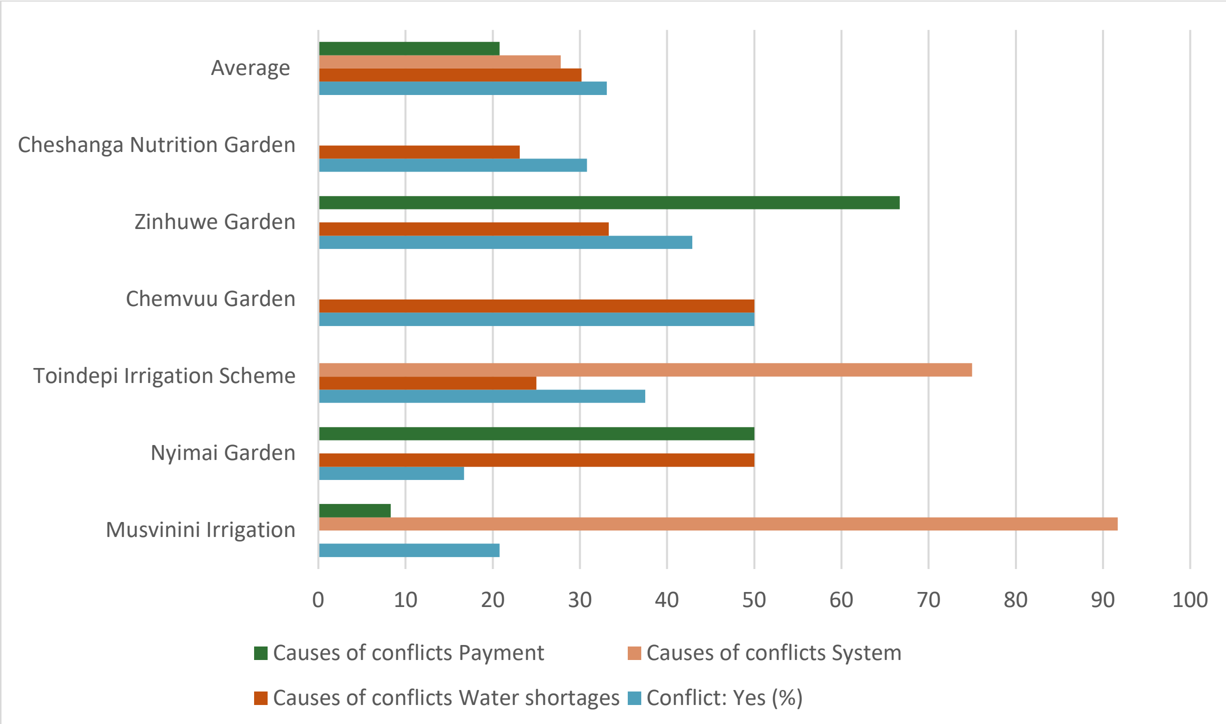

Figure 15. Incidence of and reasons for water conflict in the community

Table 49. Ways of resolving water conflicts across the sites

Name	Ways of resolving conflicts		
	Committee hearing	Community discussions	Mutual agreement
Musvinini Irrigation	100	-	-
Nyimai Garden	50	50	-
Toindepi Irrigation Scheme	20	80	-
Chemvuu Garden	50	25	25
Zinhuwe Garden	100	3	-
Cheshanga Nutrition Garden	60	40	-
Average	63.3	33	4.2

5.3 Water Management at Project Sites

5.3.1 Main water uses

Among respondents at project sites, irrigation was indicated as the most important water use, followed by domestic use and livestock watering (in that order) (Figure 16). This was in contrast to the community-level responses, which indicated the first priority was domestic water use. This suggests that the respondents who were plot holders prioritised irrigation.

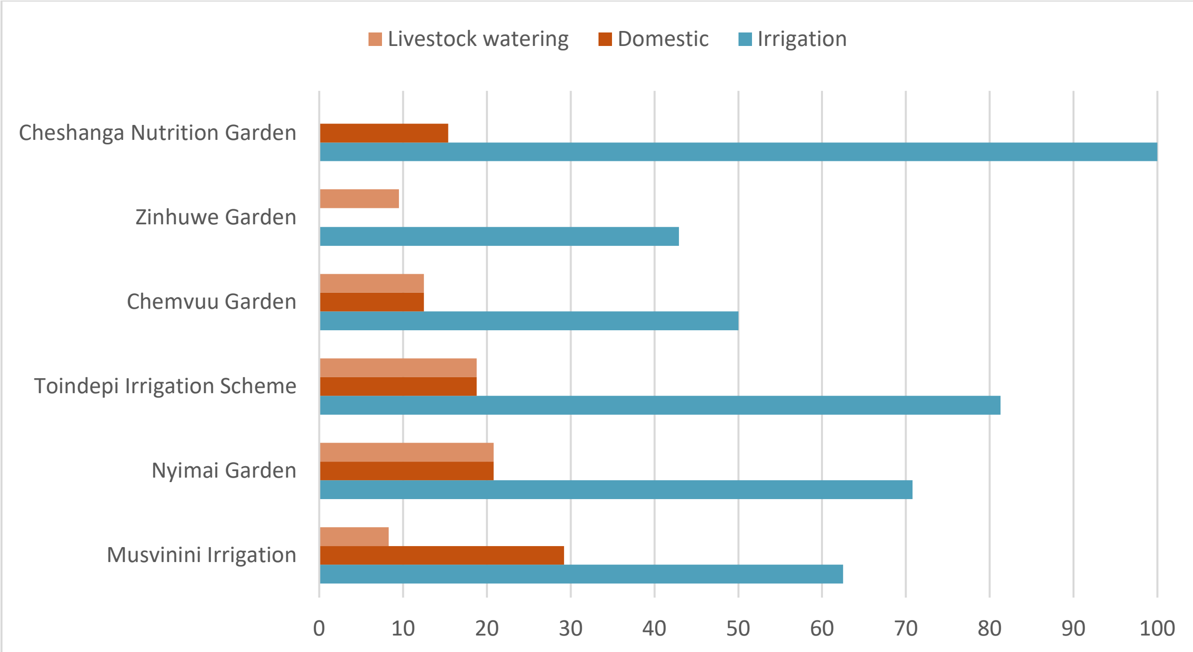

Figure 17. Priority of water use across all project sites

On average, 8 villages, 250 households and close to 2000 people benefitted from each water project (Table 8). This could be an underestimation, however, as respondents struggled to answer this question.

Table 50. Number of villages, households, and people benefitting from the water project across all sites

Name	Number		
	Villages	Households	People
Musvinini Irrigation	7	400	4920
Nyimai Garden	5	400	2400
Toindepi Irrigation Scheme	8	500	2500
Chemvuu Garden	7	56	68
Zinhuwe Garden	11	120	500
Cheshanga Nutrition Garden	8	50	-
Average	8	254.3	1731

Selection of beneficiaries in the irrigated gardens was based on five, non-exclusive criteria (Table 9). The relative importance of each criterion varied from site to site. The inclusion of disadvantaged community members indicates a community spirit.

Smell and colour, or the two combined, were identified as the most important water quality attributes pertaining to drinking water (Table 10). This, however, was identified by only about a third of the respondents. Acceptability of water quality to men and women was in the same range suggesting a high awareness of the poor quality of the water by all. Water quality testing was reported to have been done at least once, usually at the commissioning of the water source. The figures for any other test could be as low as below 50%. This corroborated responses from key informants, who confirmed that there was no routine water quality testing.

Water conflicts were reported to be present across all sites mainly due to physical water shortage (Table 11). This was reported in over 80% of responses for half of the sites (Cheshanga, Nyimai, and Zinhuwe). Attempts at resolving conflicts were mostly led by Irrigation Management Committees. The effectiveness of these processes, however, was low as indicated by proportion and level of satisfaction with the outcome, which averaged less than 15%. Traditional leaders were appealed to where conflicts were unresolved in all reported cases.

Table 51. Criteria for selecting beneficiaries in the irrigated gardens

Name	Criteria for Selecting Beneficiaries				
	Volunteers	Disadvantaged Community Members	Applications	Contribution to Constructing Water Source	Proximity to Source
Musvinini Irrigation	92.9	7.1	-	-	-
Nyimai Garden	41.7	-	20.8	25.0	12.5
Toindepi Irrigation Scheme	33.3	-	6.7	6.7	53.3
Chemvuu Garden	28.6	42.9	14.3	14.3	-
Zinhuwe Garden	60	33.3	-	6.7	-
Cheshanga Nutrition Garden	100	25	-	-	-
Average	55.1	18.1	7.0	8.8	11.0

Table 52. Water quality attributes and extent of water quality testing across all the sites

Name	Attributes of Water Quality					Extent of Water Quality Testing		Water Quality Changes With Season	How Water Quality Changes With Season		
	Smell and Colour	Smell Only	Colour Only	Acceptable to Women	Acceptable to Men	Ever Tested	Any Other Test		Smell and Colour	Colour	Smell
Musvinini Irrigation	37.5	29.2	25.0	12.5	8.3	40	13.6	45.8	66.7	33.3	-
Nyimai Garden	33.3	25.0	16.7	25.0	25.0	45	14.3	56.5	30.8	61.5	7.7
Toindepi Irrigation Scheme	18.3	6.3	68.8	93.8	93.8	83.3	42.9	53.8	-	100	-
Chemvuu Garden	62.5	12.5	12.5	14.3	-	50	42.9	87.5	66.7	33.3	-
Zinhuwe Garden	52.4	9.5	28.6	9.5	76.2	57.1	23.9	90.5	11.8	82.4	5.9
Cheshanga Nutrition Garden	7.7	7.7	23.1	60	-	100	0	7.7	25	50	25
Average	35.3	15.0	29.1	35.9	33.9	62.6	22.9	57.0	33.5	60.1	6.4

Table 53. Presence, attempts at and effectiveness of resolving water conflicts for the main water source

Name	Presence of Conflicts	Reasons			Attempts at resolving conflicts		Effectiveness of conflict resolution		
		Water Shortage	Social Problems	Both	Tried to Solve Conflicts	Who Led the Process	Conflict Resolved	Satisfied	Recourse to
Musvinini Irrigation	16.7	25	75	-	18.2	Irrigation Management Committee	12.5	8.3	Traditional leaders
Nyimai Garden	14.3	83.3	16.7		22.2	Irrigation Management Committee	12.5	20.8	Traditional leaders
Toindepi Irrigation Scheme	21.4	60	40	-	21.4	Irrigation Management Committee	18.3	12.5	Traditional leaders
Chemvuu Garden	42.9	50	25	25	25	Irrigation Management Committee	25	37.5	Traditional leaders
Zinhuwe Garden	23.8	83.3	16.7	-	37.5	Irrigation Management Committee	4.8	9.5	Traditional leaders
Cheshanga Nutrition Garden	7.7	100	-	-	100	Irrigation Management Committee	-	-	Traditional leaders
Average	18.0	66.9	28.9	4.2	37.4		12.2	14.8	

5.1.1 Complementary water sources

Across all sites, households depended on complementary water sources, which variously included boreholes, streams, springs, and wells that were used for domestic and irrigation purposes in that order (Table 12). The complementary water sources were more important to women because traditionally women are responsible for domestic water provision and gardening, which provides a source of nutrition to families. Water quality of complementary sources was similar in all respects to the primary water source. The same observations are true for water conflicts (Table 13).

Table 54. Characteristics of complementary water sources

Name	Water Sources				Water Uses		Very Important to		Very satisfied to		Attributes of Water Quality			Water Quality Tested	Change of Water Quality With Time
	Borehole	Stream/ River	Spring	Well	Domestic	Irrigation	Women	Men	Women	Men	Smell and Colour	Smell	Colour		
Musvinini Irrigation	63.2	36.8	29.2	8.3	25	50	79.2	76.9	76.2	83.3	28.6	19	19	33.3	37.5
Nyimai Garden	45.5	45.5	9.1	20.8	84.6	15.4	87.5	92.9	95.2	94.7	31.8	9.1	36.4	33.3	21.7
Toindepi Irrigation Scheme	53.8	15.4	27.3	18.8	100	-	93.8	100	86.7	86.7	25	12.5	62.5	26.7	68.8
Chemvuu Garden	33.3	-	33.3	33.3	100	-	62.5	-	-	-	25	50	-	50.0	75
Zinhuwe Garden	90.9	9.1	42,9	9.5	89.9	11.1	33.3	66.7	30	66.7	27.3	-	45.5	41.2	88.2
Cheshanga Nutrition Garden	-	36.4	27.3	-	25	75	100	-	33.3	-	23.1	7.7	23.1	23.1	30.8
Average	47.8	23.9	24.0	15.1	58.1	25.3	75.6	56.0	39.2	41.1	26.8	16.4	31.1	34.6	50.5

Table 55. Presence, attempts at and effectiveness of resolving water conflicts in complementary water sources

Name	Presence	Reasons for Water Conflicts in Water Sharing			Attempts at Resolving Conflicts		Effectiveness of attempts		
		Physical Water Shortage	Social Problems	Both	Tried to Solve Conflicts	Who led the Process	Conflict Resolved	Satisfied	Recourse
Musvinini Irrigation	17.4	8.3	4.2	-	8.3	Garden committee	12.5	8.3	Traditional leaders
Nyimai Garden	10.0	4.2	-		7.7	Garden committee	12.5	20.8	Traditional leaders
Toindepi Irrigation Scheme	6.3	6.3	-	-	-	Garden committee	18.3	12.5	Traditional leaders
Chemvuu Garden	40	50	-	25	42.9	Garden committee	25	37.5	Traditional leaders
Zinhuwe Garden	41.2	38.1	4.8	-	47.1	Garden committee	4.8	9.5	Traditional leaders
Cheshanga Nutrition Garden	7.7	15.4	-	-	11.1	Garden committee	-	-	Traditional leaders
Average	20.4	19.7	1.5	4.2	19.5		12.2	14.8	

5.3.2 Community involvement

Across all sites, community participation in the planning of the water project was confirmed and was generally high (Table 14). Community leaders were cited as having a higher level of participation than other community members. Participation of traditional leaders and community members was low. It is not clear why this was the case.

In most cases, dedicated committees were formed to spearhead planning of the project. The creation of these new structures may threaten the sustainability of water projects, as they are not always integrated into existing community water governance structures and project ownership may be lessened if the created committee dissolves at the end of the project. Both gender and age were important factors in the selection of committee representatives. The records of meetings held to discuss the planning of the establishment of the facility were generally unknown, so the number of and purposes of meetings were hard to track. Those consulted, however, reported discussions in relation to crop management and planning, water rationing, and creation of a constitution. The question regarding what changes were made after the initial discussions was poorly answered. Only in Chemvuu was there mention of changing crops and water saving technologies.

Table 56. Community involvement in planning of the water facility

Name	Community Participation (yes)	Who Participated?			Mechanism for Participation			Method of Representation			
		Traditional Leaders	Community Members	Both	Dedicated Committee	Existing Committee	Both	Not Stated	Gender Only	Age Only	Gender x Age
Musvinini Irrigation	83.3	45.0	25.0	30.0	68.8	12.5	12.5	-	26.7	13.3	60.0
Nyimai Garden	79.2	55.6	27.8	16.7	73.7	5.3	15.8	22.2	-	-	77.8
Toindepi Irrigation Scheme	56.3	77.8	-	22.2	77.8	22.2	-	11.1	-	-	88.9
Chemvuu Garden	62.5	80	20	-	25.0	50.0	25.0	50.0	-	-	50.0
Zinhuwe Garden	85.7	64.7	5.9	29.4	64.3	21.4	14.3	7.1	7.1	-	85.7
Cheshanga Nutrition Garden	100.0	100	63.6	9.1	100.0	22.2	55.6	25.0	100.0	8.3	41.7
Average	65.0	60.4	19.6	17.9	68.3	22.2	18.4	19.2	22.3	3.1	54.5

The community was also involved in site selection and the level of involvement of traditional leaders and community members in site selection was the same (Figure 17). The radar chart suggests that, although traditional leaders may be involved more in the planning process, the community is equally involved in one of the main important aspect of the planning process–site selection.

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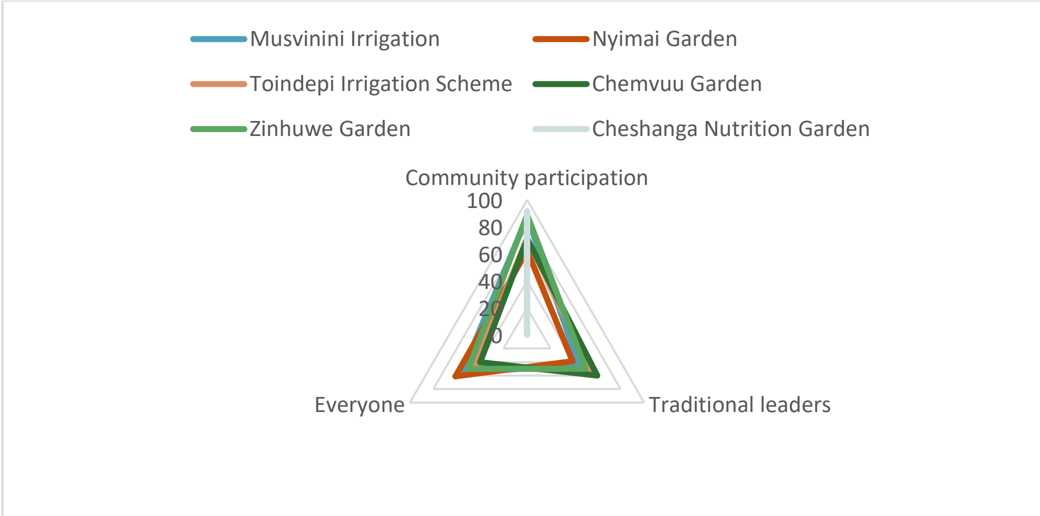

Figure 17. Radar chart showing community involvement in site selection

The community also contributed labour during construction of the projects, mainly as general hands (Table 15). In Musvisvini, some members of the community participated in semi-skilled work as builders. Financial contributions were in the form of providing food for workers and a joining fee (Table 16), but only 25% of respondents mentioned these contributions. Project costs were unknown to the community.

In all projects there were rules regarding water allocation, which mostly emanated from the "committee" (Table 17). Village heads played a minor role in this regard. The rules covered water rationing, proper management of water sources, and irrigation duties in that order of priority. Rules were mostly written down and kept by the Secretary on behalf of the committee. The record was mainly in the local Shona vernacular.

Table 57. Community involvement in labour during construction of the water facility

Name	Labour Contribution	How Was Community Involved?		
		General Hands	Builders	Both
Musvinini Irrigation	100.0	94.4	5.6	-
Nyimai Garden	100.0	100.0	-	-
Toindepi Irrigation Scheme	86.7	91.7	-	8.3
Chemvuu Garden	100.0	100	-	-
Zinhuwe Garden	100.0	93.3	-	6.7
Cheshanga Nutrition Garden	100.0	100	-	

Table 58. Financial contribution by community members

Name	Contribution (Yes)	Form of Contribution		
		Food for Workers	Joining Fee	Both
Musvinini Irrigation	17.6	8.3	5.6	-
Nyimai Garden	6.7	100.0	-	-
Toindepi Irrigation Scheme	12.5	6.3	6.3	8.3
Chemvuu Garden	20		12.5	-
Zinhuwe Garden	-	-	-	-
Cheshanga Nutrition Garden	22.2	-	--	

Table 59. Details of rules for water allocation

Name	Do Rules Exist?	Source of Rules		What are the Rules About?			Is There a Written Record?		Who Records the Rules?		Where Recorded?		Language of Record	
		Committee	Village Heads	Water Rationing	Proper Water Management of Water Sources	Irrigation Duties	Yes	No	Committee	Other	Secretary Books	District Office	Shona	English
Musvinini Irrigation	50.0	1000	-	81.8	-	18.2	45	55	100	-	91.7	8.3	90.9	9.1
Nyimai Garden	58.3	100	-	86.7	6.7	6.7	66.7	33.3	52.9	29.4	100	-	100	0
Toindepi Irrigation Scheme	86.7	81.3	-	92.3	-	7.7	50	50	90	10	88.9	11.9	100	0
Chemvuu Garden	62.5	37.5?	-	50	50	-	80	20	100	-	50	50	100	0
Zinhuwe Garden	85.7	93.3	6.7	80	6.7	13.3	85	15	100	-	100	-	100	0
Cheshanga Nutrition Garden	100	100	8.3	83.3	100	16.7	50	50	7.7	100	100	40	100	0

5.3.3 Operation and Maintenance

Across all sites, committee members were designated with responsibility for operation and maintenance and these members were elected mostly by the community (Table 18). The majority of the respondents thought that operation and maintenance were being done effectively because no damage and breakdown occurred and because training was provided to the communities. People were trained in how to open the water and siphoning provided by ENSURE and Takunda. A few respondents rated the training as very good.

Enforcement of rules was generally more positive than reality (Table 19). The vast majority of respondents were aware of the rules, but were either not aware that they were written down or did not know that everyone had a copy of the rules. The proportion of respondents who thought that the rules were broken or not broken across all sites were more or less the same. In general, the rules were moderately and less frequently broken. Paying a fine was the most cited sanction for breaking rules. The vast majority of respondents were of the view that community members participated in operation and maintenance and contributed ~USD 1 per month (Table 20) with the relevant committee determining the amount of money to be paid. The amount paid was believed to be adequate, although very low. The reasons for adequacy of the amount included: “many contributors were available,” “maintenance costs too high,” “no breakdowns,” “ability to meet other obligations like security,” and “failure to fix problems.” The variance in these responses demonstrate the lack of consensus regarding adequacy of the amount of money contributed for operation and maintenance. This lack of consensus was also apparent regarding answers to the following: Are you willing to pay full operation and maintenance costs? In a case of a breakdown are you willing to mobilise funds? Are you willing to replace infrastructure? Does the community have capacity to replace infrastructure? (Table 21). There was, however, consensus regarding the fact that the project would continue to function after withdrawal of the donor and that the donor does provide support after construction.

Table 60. Selection criteria for people responsible for operation and maintenance and effectiveness of operation and maintenance

Name	Method for Selection				Is Operation and Maintenance Being Done Effectively?		Why Do You Think Operation and Maintenance is Effective?			Were People Trained in Operation and Maintenance?		
	Community	Volunteers	Community x Volunteers	Qualification	Yes	No	No damages	No breakdowns	Trained personnel	Yes	No	Don't know
Musvinini Irrigation	92.9	-	7.1	-	84.2	15.8	33.3	66.7	-	34.8	43.5	21.7
Nyimai Garden	78.3	17.4		4.3	87.0	13.0	68.6	31.3	-	41.7	33.3	25
Toindepi Irrigation Scheme	100	-	-	-	73.3	26.7	33.3	22.2	44.4	43.8	37.5	18.8
Chemvuu Garden	85.7	-	14.3	-	85.7	14.3	50	50	-	66.7	33.3	
Zinhuwe Garden	85	15	-	-	78.9	21.1	33.3	33.3	33.3	61.9	38.1	-
Cheshanga Nutrition Garden	69.2	15.4	100	-	100	23.1	14.3	57.1	28.6	53.8	100	

Table 61. Enforcement of operation and maintenance rules

Name	Who Enforces Rules?			Does Everyone Know the Rules?		Does Everyone Have a Copy of the Rules?			Are Rules Broken?		How Often Are Rules Broken?			What Happens If Rules Are Broken?		
	Community	Committee	Traditional Leaders	Yes	No	Yes	No	Don't Know	Yes	No	Very Frequent	Moderately Frequent	Less Frequent	Hearing	Pay Fine	Both
Musvinini Irrigation	52.9	47.1	-	100	-	-	62.5	37.5	55.6	44.4	100	-	-	-	100	-
Nyimai Garden	60	26.7	13.3	89.5	10.5	4.3	65.2	30.4	50	50	11.1	22.2	66.7	21.4	78.6	
Toindepi Irrigation Scheme	30.8	30.8	38.5	100	-	6.3	-	66.7	38.5	61.5	40	100	60	44.4	44.4	11.1
Chemvuu Garden	50	33.3	16.7	100	-		85.7	14.3	66.7	33.3	-	-	100	-	100	-
Zinhuwe Garden	73.7	21.1	5.3	100	-	5.3	89.5	5.3	73.7	26.3	76.9	15.4	7.7	-		5.9
Cheshanga Nutrition Garden	15.4	100	23.1	100	-	100	15.4	-	100	58.3	-	100	80	100	8.3	-

Table 62. Contribution to operation and maintenance

Name	Contribution to Operation and Maintenance		How Much is Charged Per Household? (USD)					Over What Time Period?			Who Determined the Amount?			Is the Amount Adequate?		Reason Why Amount is (In) Adequate?					
	Yes	No	1	2	3	4	5	Monthly	Annually	Bi-annually	Committee	Community	Garden members	Yes	No	Amount very low	Many contributors available	No breakdowns	Maintenance costs too high	Ability to meet other obligations like security	Failure to fix problems
Musvinini Irrigation	33.3	66.7	55.6	33.3	11.1	-	-	100	-	-	100	-	-	84.6	15.4	100	-	-	-	-	
Nyimai Garden	78.3	21.7	89.5	10.5	-	-	-	78.6	7.1	-	100	-	-	82.6	13.0	72.7		18.2			9.1
Toindepi Irrigation Scheme	81.3	18.8	30.8	61.l5	-	7.4	-	75	8.3	8.3	100	-	-	41.2		83.3	-	-	-	16.7	-
Chemvuu Garden	100	-	-	-	-	-	75	100		-	57.1	28.6	14.3	71.4	28.6	80	20	-	-	-	
Zinhuwe Garden	90.5	9.5	94.4	5.6				93/3	6.7	-	100	-	-	72.2	27.8	50	-	50	-	-	
Cheshanga Nutrition Garden	100		100	23.1	7.7	-	23.5	100	–		100	-	-	100	61.5	20		10	10	20	30

Table 63. Willingness and capacity to contribute to operation and maintenance and replacing infrastructure

Name	Household Income Per Month (USD)						Are You Willing to Pay Full Operation and Maintenance Costs?		In a Case of a Breakdown, Are You Willing to Mobilise Funds?		Are You Willing to Replace Infrastructure?		Does the Community Have Capacity to Replace Infrastructure?		Will the Project Continue to Work After Donor Withdraws?		Does the Donor Provide Post Construction Support for Operation and Maintenance?	
	Up to 50	51-100	101-150	151-200	201-250	Over 250	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Musvinini Irrigation	62.5	16.7	8.3	4.2	4.2	4.2	54.5	45.5	66.7	33.3	66.7	33.3	41.7	54.2	37.5	62.5	20.8	79.2
Nyimai Garden	45.8	20.8	12.5	12.5	8.3	-	69.6	30.4	87.5	12.5	83.3	12.5	87.5	12.5	70.8	25.0	29.2	70.8
Toindepi Irrigation Scheme	68.8	25.0	6.3	-	-	-	37.5	62.5	100	-	100	-	93.8	6.3	75	35	31.3	68.8
Chemvuu Garden	85.7	14.3	-	-	-	-	85.7	14.3	100		62.5	37.5	50	50	75	25	25	75
Zinhuwe Garden	61.1	27.8	11.1	-	-	-	71.4	28.6	95.2	4.8	90.5	9..5			71.4	28.6	4.8	95.2
Cheshanga Nutrition Garden	46.2	23.1	23.1	-	-	7.7	100.0	30.8	100		100	-	100	38.5	100	23.1	100	-

Ability and willingness to pay for operation and maintenance depended on household income. The majority of the households had an income of up to USD 50, which was 80% of Total Consumption Poverty Line (TCPL) (Figure 18). Practically all households consulted in the project areas live below the TCPL.

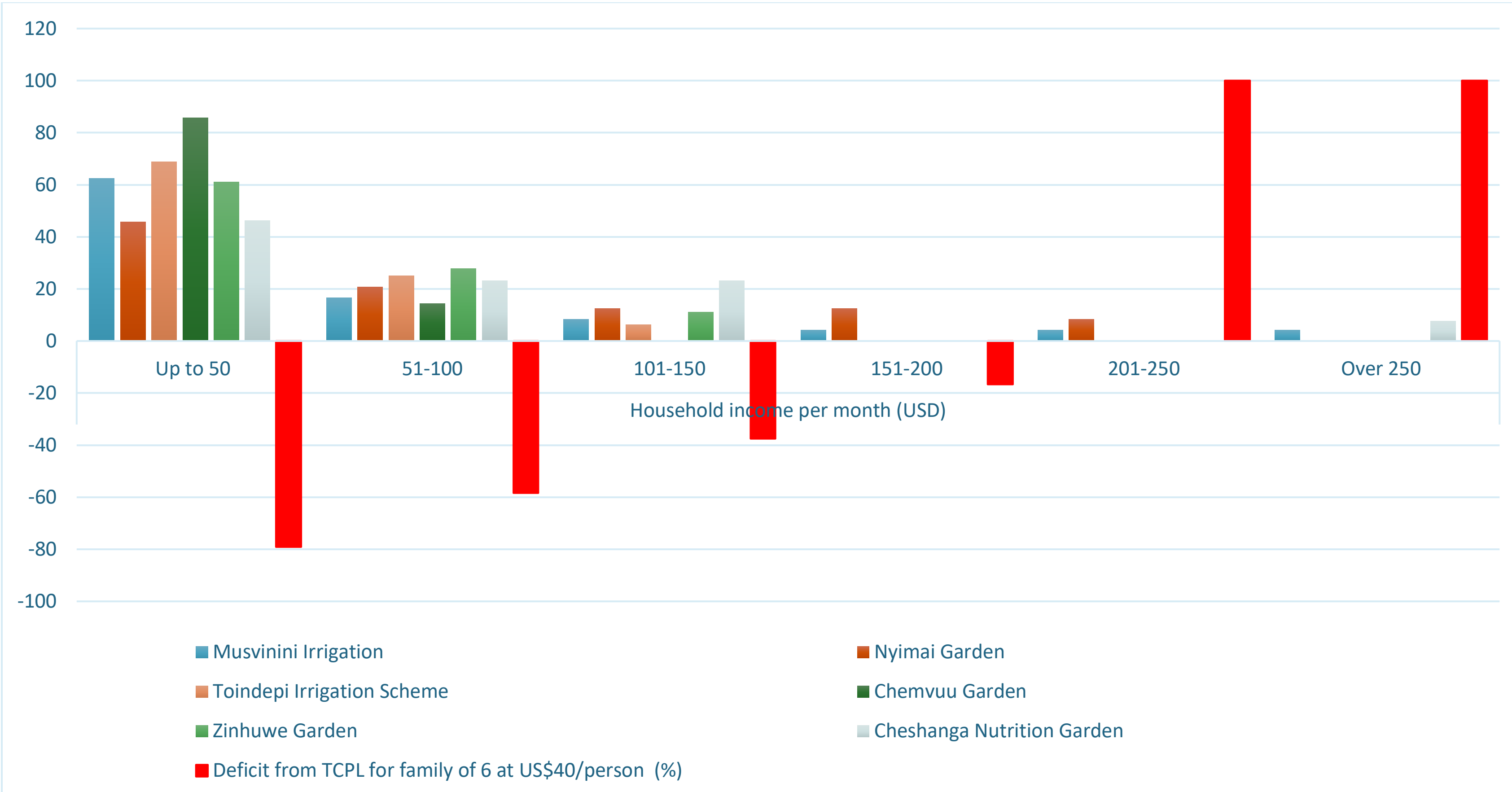

Figure 18. Average household income as a proportion of the Total Consumption Poverty Line illustrated with a % deficit from TCPL

This level of poverty means that the proportion of households willing to pay twice, three times, and four times the amount of money they currently contribute to operation and maintenance progressively decreases across all sites (Figure 19). The responses may have been affected by current amounts being paid which are in the order of USD $1 and $2 for most projects. The willingness to pay was also linked to the state of water security in the projects with households in water insecure project areas willing to pay more across all scenarios (Figure 20).

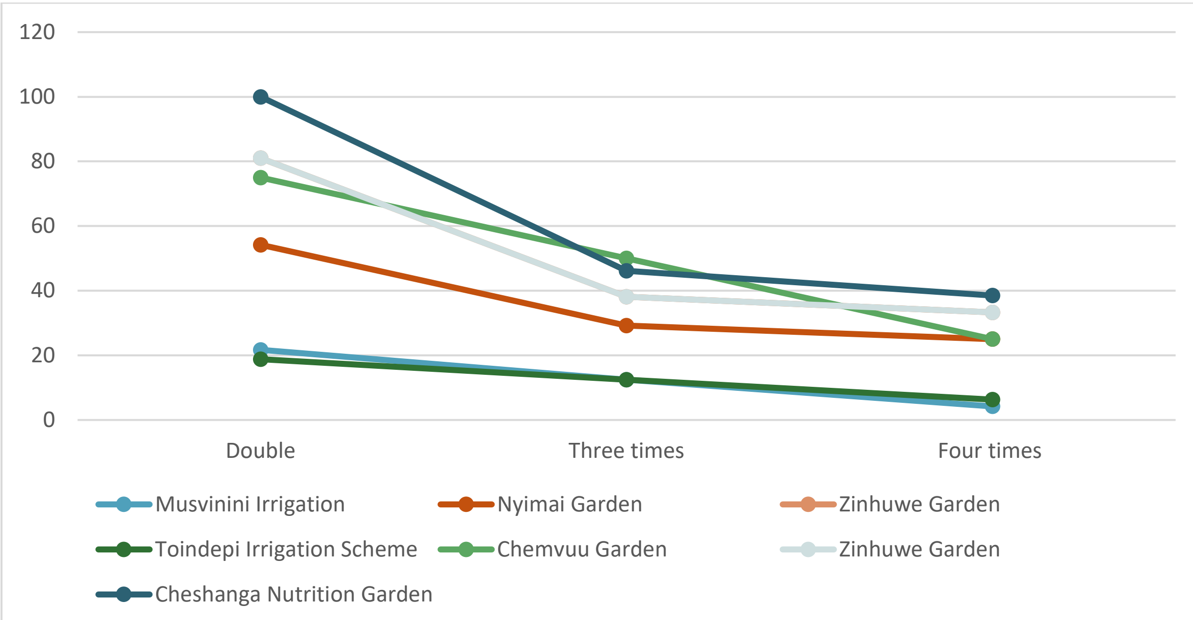

Figure 19. Willingness to pay for operation and maintenance as current amount of money contributed is increased by twice, three times, and four times

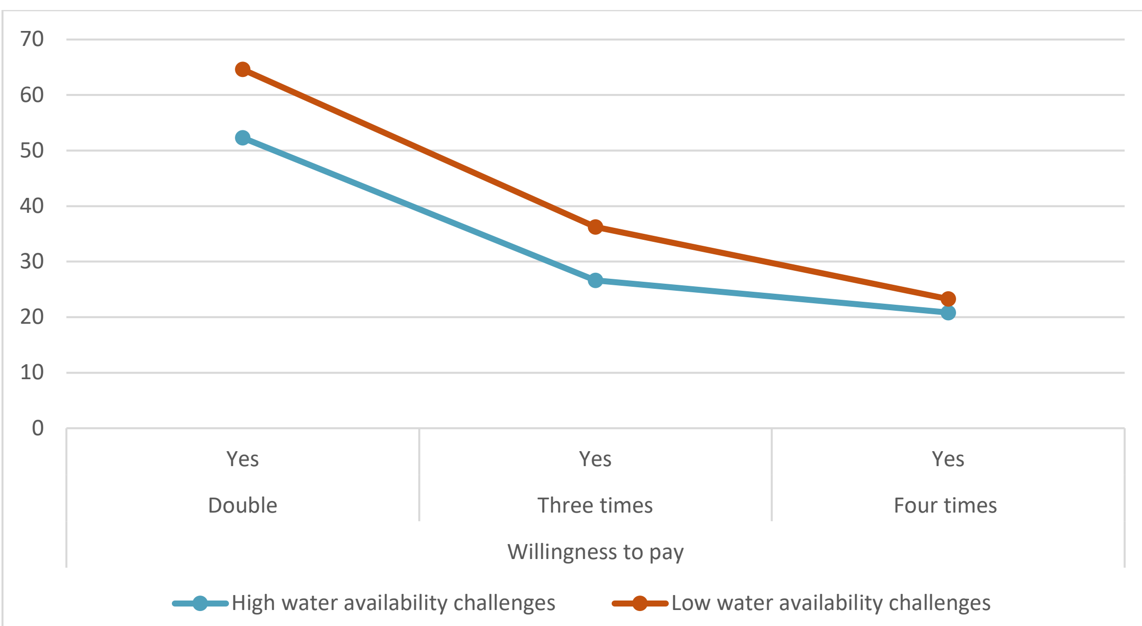

Figure 20. Graph showing willingness to pay for operation and maintenance by respondents in high and low availability projects.

5.3.4 Partnerships

Communities identified traditional leaders and water point committees as the main partner institutions for the projects. Sub-catchment councils, catchment councils, and WASH sub-committees were mentioned far less frequently, if at all (Figure 21). The lack of involvement of WASH sub-committees is surprising given that these were frequently mentioned as critical to water provision by Key Informants. The fact that sub-catchment and catchment councils were not on the awareness radar suggests that communities were generally unaware of institutions mandated with water resources management, which undermines their legitimacy to charge borehole registration and authority to drill fees.

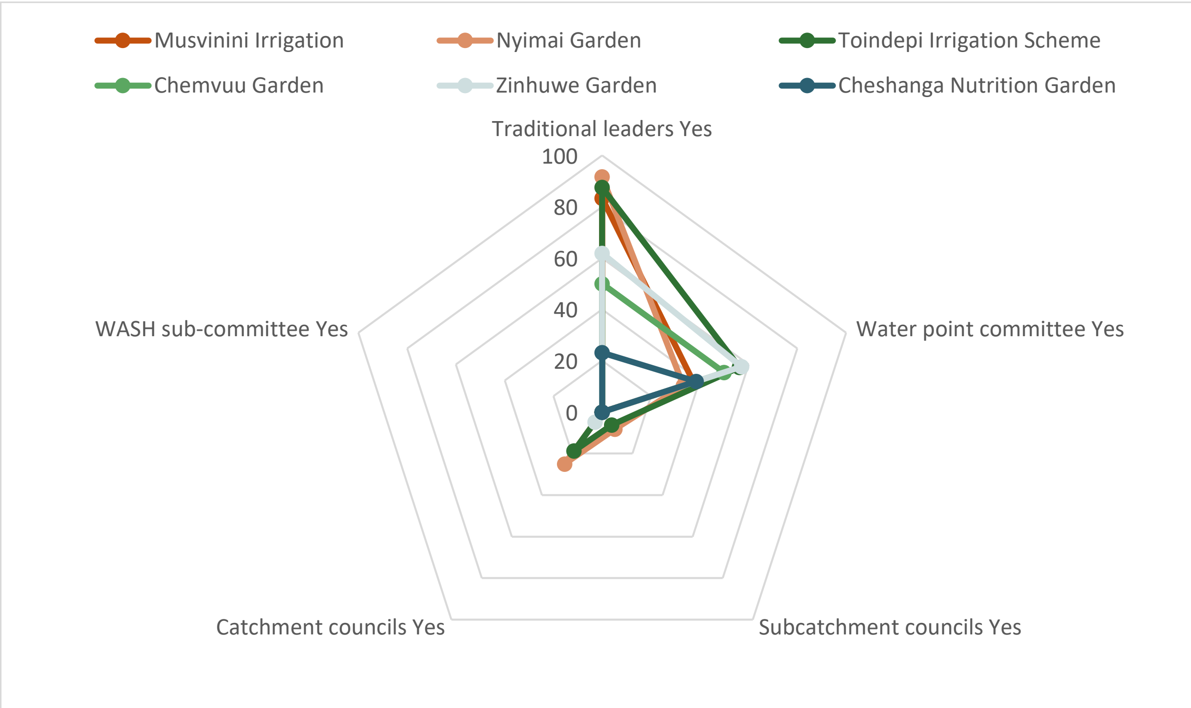

Figure 21. Radar chart showing the institutions communities claimed to work with

5.3.5 Other remarks

Table 22 shows other remarks made by respondents across all the sites.

Table 64. Other comments by respondents across all project sites

Name	Other Comments
Musvinini Irrigation	cleaning of the dam should be done construction of the wall boundary through donor assistance dam maintenance required through donor assistance expansion of the water source required increase the capacity of the water source increase the depth and capacity of the water source increase water capacity irrigation committee should tell people to conserve water rules are needed for the sustainability of the project the dam needs to be cleaned water supply to be improved
Nyimai Garden	construct tanks dam enlargement fencing the dam its helping farmers hence income

Name	Other Comments
	helping to reduce food shortage more pipes needed need for safe water to drink need for water pipes supplement water supply with borehole taps should be replaced in the garden water not getting to the JoJo tanks
Toindepi Irrigation Scheme	fencing of the water point need for another borehole need for proper security supplement water supply with borehole pipe maintenance is needed water is not enough
Chemvuu Garden	add more water because there is shortage of water for irrigation cleaning is required at the water source more water needed for farming and clean water for domestic use more water sources to be established poor provision of water supplement water supply with borehole water supply located very far from land to be irrigated
Zinhuwe Garden	add more boreholes and solar powered pumps donors are required to assist educate people establishment of borehole and safe water for drinking increase the capacity of the water source maintenance of the water source through donor support people should clean the water source putting boundaries solar powered water pumps are needed the dam must be expanded
Cheshanga Nutrition Garden	increase pump capacity more water supply more water supply from tanks need a bigger water pumping system need for a bigger pump need more water sources need more water sources for multiple uses

6. CONCLUSIONS

The field site visits in the Takunda Intervention Area in Chivi and Zaka district provide importance lessons for MUS implementation in Takunda and for Zimbabwe more broadly. These lessons are discussed in terms of the main findings from the sites, including the gaps that were identified and the way forward for future MUS implementation.

6.1 Main Findings

6.1.1 MUS Typology

Out of the six water projects that were visited in both districts, four sourced water from small dams and two from solar boreholes. Across all projects, water use included aspects of multiple water use (MUS) including livestock watering, domestic water, irrigation, and in a few cases, fish farming. The four small dams were initiated as water sources for livestock watering and can therefore be categorized as “Livestock plus” to which were added irrigation and fish farming in three small dams. The solar boreholes were primarily designed for irrigation and can be classified as “Irrigation plus” to which were added drinking water and livestock watering. The multiple water uses were, however, not satisfied for several reasons.

6.1.2 Project Design Issues

The projects were not designed to satisfy all the multiple uses. In Musvinini and Nyimai gardens and Toindepi Irrigation scheme in Chivi district and Chemvuu, Zinhuwe and Cheshanga gardens in Zaka district, there was only provision for potable water for irrigators to drink when conducting irrigation activities and not for their general household domestic water needs. There was also no provision for the domestic water needs of the community at large, despite the acute shortage of domestic water across these communities. There was also insufficient water for irrigation in Cheshanga Nutrition Garden and Toindepi Irrigation Scheme because of design issues – the small solar pumps were installed without batteries which resulted in insufficient levels of pumped water. Another design issues related to underestimating the amount of water generated by the catchment. This was the case in Chemvuu dam where there was virtually no water at the time of the visit. The design challenges could be raised in relation to the estimation of water requirements for various water uses. Table 23 shows the estimated water requirements for various water uses that can be used for that purpose.

Table 65. Average household water requirements per use per dam, per year in four small dams in Zimbabwe [134]

Water Use	Dewa	Denje	Avoca	Makoshe
Livestock	144.5	174.4	199.7	171.5
Irrigation	108.6	91.3	111.9	855.6
Domestic	46.0	50.4	38.1	42.4
Brickmaking	2.5	0.6	2.8	1.2

Design of components of MUS projects also varied from project to project. For example, troughs for livestock watering were not standardized. The other design-related challenge is that there were no Feasibility Study and Project Documents produced for each water project.

6.1.3 MUS concept

The provision of water for multiple water use was commonly understood and accepted by government departments, state agencies, NGOs active in the water sector, and the communities. Through the Presidential Borehole Programme, the government is drilling 35, 000 boreholes (one in each of the country’s villages) to provide water for domestic use and gardening, as well as for watering non-range livestock such as poultry. Piped water schemes also provide water for domestic and irrigation purposes. NGOs in the district, including CARE, provide for multiple water uses from one water infrastructure. Communities expect water infrastructure to meet their various water needs as much as possible. The local authority, RDCs, expect that all water projects implemented in their districts cater for the various community water needs.

This pragmatic approach to MUS was disadvantaged by under-designed MUS projects (see above) and not helped by a lack of clear strategy for implementing MUS in relation to the processes and technical designs. There is no policy or regulatory guidance at the national, provincial or district level that specifies or suggests how multiple water projects would best be implemented.

[134] Senzanje, A., Boelee, E. and Rusere, S. (2008)

It can therefore be said that MUS is being implemented by default and not by design.

6.1.4 Legal and policy framework

In general terms, it can be said that there are no legal and policy impediments regarding implementation of MUS. The adoption and implementation of IWRM principles, as captured in the Water Act and National Water Policy, provides an integrated water management framework, which in theory should help implementation of IWRM. However, the framework speaks to water resources management and not water supply. There is, however, a recognition that the IWRM approach needs to be re-examined to make it more suitable for addressing the water needs of vulnerable rural communities (Manzungu and Derman, 2016 [135]; Derman and Manzungu, 2016 [136]; Hove et al, 2016 [137]). In this regard the overt charging of primary water use, as suggested by Tokwe subcatchment, is jeopardizing the right to water as provided for in the Water Act and the Constitution.

The fact that the Water Act is being revised may presents an opportunity to streamline the legal and policy framework to enable implementation of MUS considering the devolution and decentralization policy, among others.

6.1.5 Institutional frameworks

At both provincial and district level, there are institutional mechanisms to facilitate implementation of MUS in the form of the Provincial Development Committees and District Development Committees, which bring together government departments, state agencies, provincial and local authorities, and NGOs with mandate for water and related service provision. This unique opportunity is, however, compromised by the lack of a guiding regulations/document (see above) and the fact that different institutions, when faced with challenges, tend to revert to their narrow mandate as asserted by the Department of Irrigation.

The re-organization of the state is also introducing uncertainties. The Government was in expanding the mandate of some institutions (ZINWA, which is now responsible irrigation development and drilling community boreholes) and forming of new organisations (Department of Soil Conservation. This is resulting in some overlaps of the activities undertaken by different institutions (Table 24).

Table 66. Overlaps of institutional overlaps for some water management aspects

Dimension	Departments with mandate
Small dams	Department of Mechanisation, District Development Fund
Smallholder irrigation in rural areas	Department of Irrigation, ZINWA
Catchment protection	Department of Mechanisation, Sub-catchment Councils
Rural irrigation	Department of Irrigation, ZINWA

Yet another challenge is that some departments with critical skills that can be deployed for the realization of MUS do not have a presence at the district level. These include the Division of Soil

[135] Manzungu, E, and Derman, B, (2016) Surges and ebbs: National politics and International influence in the formulation and implementation of IWRM in Zimbabwe, *Water Alternatives*, 9(3): 495-514.

[136]Derman, B. and Manzungu, E. (2016). The complex politics of water and power in Zimbabwe: IWRM in the catchment councils of Manyame, Mazowe and Sanyati (1993-2001), *Water Alternatives*, 9(3), 515-532.

[137]Hove,, T. Derman, B and Manzungu, E. (2016). Land, farming and IWRM: A case study of middle Manyame subcatchment, *Water Alternatives*, 9(3), 533-550.

Conservation of the Department of Mechanisation (which is now the Department of Soil Conservation) responsible for designing, construction and small dams, and the Department of Irrigation that is responsible for irrigation development.

Community level institutions face several challenges such as lack of capacity to enforce regulations especially at the asset management level, which is used for a variety of water uses, and cover operation and maintenance costs supported by an operational and maintenance plan.

6.2 Way Forward

To better implement MUS, it is important to:

- Ensure MUS projects are properly designed considering the various water uses and the related quantities at community level. This should be based on Feasibility Study and Project Documents supported by an Operation and Maintenance plan.
- MUS should be implemented by design and not default. RDCs should be supported to produce an Implementation Manual or Guidelines for MUS projects which will guide implementation of all projects. This should be a consultative process.
- There is a need to for clear policy position regarding payment of registration and authority to drill for community water projects. A clear policy position is also needed for land tenure arrangements of land on which community gardens will be located.
- There is need to think how best the various institutions can best be coordinated to achieve MUS. This may include lobbying Government to lobby to streamline the institutional framework. Local institutions need to be capacitated in relation to the technical details of the project, project costs and operations and maintenance plans.
- The degree to which communities can maintain the infrastructure should be spelt and not assume that communities can cover all maintenance costs.

Appendix I. Schedule of Consultations at the provincial, district, and community level

Date	Interviewees
28 September	Provincial Head, Masvingo province; Provincial Head, Department of Irrigation, Masvingo province and 1 other; Mutirikiwi Subcatchment Manager, Chivi and Zaka Centre Managers, ZINWA;
29 September	
3 October	Musvinini dam, Chivi district
4 October	Nyimai Garden, Chivi district
5 October	CARE, Chivi District
6 October	Toindepi Borehole, Chivi district
7 October	Mhazo Proposed Borehole, Chivi District
11 October	Chemvuu dam, Zaka district
12 October	Zinhuwe dam, Zaka district
13 October	Cheshanga Nutrition Garden, Zaka district
14 October	CARE, Zaka district Chivamba proposed borehole, Zaka district
24 October (by phone)	Provincial Head, Department of Mechanisation
26 October	Provincial head, DDF, Masvingo province

Appendix II: Research Tools

1. INTRODUCTION

The development of research tools was primarily based on the Research Questions that were identified in the Research Proposal, which were subsequently presented and discussed during the kick-off meetings. This included an additional question on the continued functionality and sustainability of established MUS.

The Research Tools were designed to find information regarding:

- integration of local government in MUS planning;
- institutional mechanisms for successful MUS implementation;
- adequacy of existing governance framework;
- options for successful financing of MUS projects;
- prospects of sustainability of water planning, implementing and sustaining of MUS projects;
- factors and mechanisms that more equitable allocation of water service provision in MUS projects; and
- continued functionality and sustainability of established MUS projects from a users' point of view.

From these were derived questions for the different stakeholders that were identified on the paper on the Sampling Frame that was also discussed during the kick-off meetings. The stakeholders included:

- Government Departments and Agencies operating at the national level
- Government Departments and Agencies operating at the **p**rovincial, district and ward level Operations
- Catchment and Sub-catchment Councils
- Development Partners and Multilateral Agencies
- Community leaders
- Community members

The questions were fined tuned for the different stakeholder categories and the particular Research Tools that included Key Informants, Focus Group Discussions, Household Survey, and Participant Observations. The questions were formulated in such a way that the data collected could be triangulated as described below.

7.5 2. KEY INFORMANTS

2.1 National Level Operations: Government Departments and Agencies

Engineer Taurayi Maurikira**:** Chief Executive Officer - Zimbabwe National Water Authority (ZINWA)

Head: District Development Fund (DDF)

Engineer B. Chitsungo: Department of Irrigation

Mr S. Tapererwa: Director –Extension Services -Agricultural Advisory Services

GUIDING QUESTIONS

Priority Issues

- Please explain how different water uses are prioritized for rural areas and how decisions are made regarding allocation among those uses.
- Please describe the mandate of your organisation in rural water supply and/or water/irrigation development.
- Please describe the approach that your organisation uses in fulfilling its mandate.
- Is the approach linked to a specific policy/strategy or legal requirement?
- In your opinion, do you provide comprehensive (encompasses all important aspects) and integrated service (coordinated across all important aspects) service?
- What are the major challenges you face in providing these services?
- Are there services you don't provide that you feel you should? What prevents you from providing those services?

Partnerships

- Which public departments and agencies do you cooperate with in the discharge of your mandate?
    - Do other departments/agencies engage with you?
    - If so, what are the mechanisms for cooperation and do they differ across institutions?
    - If not, what are the obstacles/challenges to effective cooperation? What is being done to manage the situation? What might be done to incentivize better cooperation?
- Which development partners and NGOs do you work with?
    - Do development partners and engage with you? I
    - If so, what are the mechanisms for cooperation and do they differ across institutions? If not, what are the obstacles/challenges to effective cooperation?
    - If not, what are the obstacles/challenges to effective cooperation? What is being done to manage the situation? What might be done to incentivize better cooperation?

Experience with MUS

- Are you familiar with Multiple-Use Water Services (MUS)?
- Does your organization prioritize MUS systems within their government policies and funding strategy? If so, please describe.
- Do you have any experience(s) implementing MUS? Please describe.
    - If yes, what are the benefits of MUS in your experience? Do these benefits differ across different uses and/or users?
    - From your experience(s), what needs to happen to ensure these benefits are realized in future interventions?
    - What are the likely constraints and opportunities facing MUS implementation and sustainability in Zimbabwe?

2.2 Provincial, District and Ward Level Operations: Government Departments and Agencies

Provincial Irrigation Engineers: Matabeleland South, Matabeleland North and Masvingo provinces

District Irrigation Engineers: Bulilima, Gwanda, Tsholotscho, Nkayi, Chivi and Zaka districts

ZINWA Catchment Managers: Mzingwane, Gwayi and Runde Catchments

Chief Executive Officers and Engineers: Bulilima, Gwanda, Tsholotscho, Nkayi, Chivi and Zaka Rural District Councils

District and Ward Extension Officers: Bulilima, Gwanda, Tsholotscho, Nkayi, Chivi and **Zaka districts**

Provincial, district and local health representatives: Environmental Public Health Department:

GUIDING QUESTIONS

Priority Issues

- Please explain how different water uses are prioritized for rural areas and how decisions are made regarding allocation among those uses.
- Please describe the mandate of your organisation in rural water supply and/or water/irrigation development.
- Please describe the approach that your organisation uses in fulfilling its mandate.
    - Is the approach linked to a specific policy/strategy or legal requirement?
    - In your opinion, do you provide comprehensive (encompasses all important aspects) and integrated service (coordinated across all important aspects) service?
    - What are the major challenges you face in providing and/or sustaining these services?

Partnerships

Which public departments and agencies do you cooperate with in the discharge of your mandate?

- What does your current cooperation entail – what are respective roles? Would you like more cooperation, and if so, how should it be accomplished?
    - Do other departments/agencies engage with you?
    - If so, what are the mechanisms for cooperation and do they differ across institutions?
    - If not, what are the obstacles/challenges to effective cooperation? What is being done to manage the situation? What might be done to incentivize better cooperation?

Which development partners and NGOs do you work with?

- Do development partners and/or NGO engage with you?
- If so, what are the mechanisms for cooperation and do they differ across institutions?
- If not, what are the obstacles/challenges to effective cooperation? What is being done to manage the situation? What might be done to incentivize better cooperation?

As far as registration and reporting requirements for development partners and NGOs are concerned, including on financing support, budgets, and expenditures:

- Do you require them to sign any document(s), and, if so, what do those cover?
- What type and frequency of reports do you require?
- In addition to reports do they make verbal reports and if so at what forum(s)?
- How does your office use or act on the information provided in the reports?

Experiences with MUS

- Are you familiar with Multiple-Use Water Services (MUS)?
- Does your organization prioritize MUS systems within their government policies and funding strategy? If so, please describe.
- Do you have any experience(s) implementing MUS? Please describe.

- If yes, what are the benefits of MUS in your experience? Do these benefits differ across different uses and/or users?
- From your experience(s), what needs to happen to ensure these benefits are realized in future interventions?
- What are the likely constraints and opportunities facing MUS implementation in Zimbabwe?

2.3 Catchment and Sub-Catchment Councils

Catchment Council Chairpersons (Mzingwane, Gwayi and Runde): Sub-Catchment Council Chairpersons: Upper Gwayi (Bulilima and Tsholosho)

GUIDING QUESTIONS

Priority Issues and Mandate

- Please explain how different water uses are prioritized for rural areas (in general and in your Catchment and Sub-Catchment areas in particular) and how decisions are made regarding allocation among those uses.
    - What provisions are made for altering priorities/allocation during times of scarcity? How have these been implemented? Please describe any conflicts that may have arisen and how communities have been engaged in these processes.
- Please describe your mandate as far as water planning and management is concerned (Please provide copies of all catchment and operational plans/drafts of plans)
- How do you engage with communities and their members during water resource planning and management?
- Do you think you are fulfilling your institutional mandate?
    - If not, why and what can be done to better meet your mandate?

Partnerships

With regards to your operations:

- Which government departments and agencies work with you and how?
- Which development partners and NGOs do you work with and how?
- Do you work with water users? If so, which ones and how?
- What processes, including written ones, do you follow when interacting with stakeholders?
- How is primary water defined in your (sub) catchment and what is the lower limit primary water?
- What types of water conflicts arise in your area of jurisdiction? How do you resolve such conflicts?
- Have you ever attended to conflicts that exclusively involve primary water use and between primary uses and permitted uses?

Multiple Use Water Services (MUS)

- Are you familiar with Multiple-Use Water Services (MUS)?
- Does your organization prioritize MUS systems within their plans? If so, please describe.
- Do you have any experience(s) implementing MUS? Please describe.
    - If yes, what are the benefits of MUS in your experience? Do these benefits differ across different uses and/or users?

  - From your experience(s), what needs to happen to ensure these benefits are realized in future interventions?
  - What are the likely constraints and opportunities facing MUS implementation in Zimbabwe?

Finances

With regards to financial issues in your (sub)-catchment:

- What is the cost/fee of agricultural water use for:
  - A1, A2, old resettlement, and communal farmers?
  - surface and groundwater?
  - livestock, irrigation, other uses?
- At what threshold and amount do you charge primary water uses?
- What is the method and costs of billing for different water uses and sources?
- What revenue do you raise per month/quarter/year (please provide documentation)
  - How is the revenue shared between Catchment Council, Sub-catchment Council, and ZINWA?
  - Is the money raised enough to meet Catchment Council, Sub-catchment Council operations?
- Do you undertake monitoring of water quantity and water quality and if so how is it organised and how effective is it?
- What other constraints do operations of your Catchment and Sub-catchment Council face?

2.4 Development Partners and Multilateral Agencies

EU

USAID

UNICEF

Others

GUIDING QUESTIONS

1. Priority areas

- What are the key, water-related developmental priorities your organisation focuses on?
- What are the priority issues you focus on related to water supply and development in Zimbabwe?
- How do your priority areas fit with Government of Zimbabwe policies/priorities?
- To what extent does MUS fit with your priority areas or funding strategy? Please describe.
- Do you have any experience(s) implementing MUS? Please describe.
  - If yes, what are the benefits of MUS in your experience? Do these benefits differ across different uses and/or users?
  - From your experience(s), what needs to happen to ensure these benefits are realized in future interventions?
  - What are the likely constraints and opportunities facing MUS implementation in Zimbabwe?

2. Partnerships

- Which government departments and agencies do you work with and in what way?
- Do you work with other donors and development partners? Which ones?
- What formal or informal/practical arrangements define your working relationships?

3. Progress so far

- Have you financed/implemented MUS projects in Zimbabwe? Please describe the projects, including their approximate cost.
- Do you think MUS is:
    - Relevant
    - Efficient
    - Effective
    - Sustainable
- Do you have examples of good practices in MUS projects?
- Are there any challenges of MUS that single-use approaches avoid? Are there other challenges that are relevant to further development of MUS in Zimbabwe?

4. In future

- Are you likely to fund/implement more MUS projects?
- Is MUS now your preferred way of implementing rural water supply and development?

2.5 Community leaders

Traditional leaders; Ward Councillor; Water Point Committee; Irrigation Management Committee; WASH Committee

GUIDING QUESTIONS

Overview of Water Issues in the Community

1. What are the main uses of water, in order of priority, in your area?
2. What are the main sources of water for the community?
3. Of the water sources you have mentioned, which sources were developed
    - In conjunction with a government agency/agencies? Which one(s)?
    - In conjunction with an NGO(s), and which NGO(s)?
    - Are natural sources (rivers, lakes, etc.)?
    - Developed by individuals/community?
4. Which water sources rank high in order of importance in the area in terms of reliability?
5. How many villages/households/people benefit from the various water sources and how are priorities for allocation determined?
6. To what extent are the water uses met? Does this differ across different stakeholders (e.g., women and men)?
    - What explains the level of satisfaction (e.g., too few and unreliable sources, seasonality, operational challenges)?
    - What are the main reasons for breakdowns in infrastructure? How easy is it to obtain spare parts or get the source repaired?
7. Do you consider the water from the various water sources for different water use(s) of acceptable quality? What parameters are considered to be key for the different water uses and water users?

8. Do water conflicts arise in the area? If so, please describe the type of conflicts, those involved, the causes, and how they are resolved. What is your role in resolving water conflict?
    - Are conflicts more common across specific users/uses? Which ones?
    - Are conflict resolution mechanisms accessible to all users/community members? If not, what are the challenges?

Role of Community

1. How is involvement of community members in a water project decided?

- How were the community members involved in the project? Was it through a specific committee for the project (and what selection process was followed) or through an existing committee/structure? For either committee/structure, how was it representative in terms of participating villages, gender, and age?

2. How is the role of the community in water supply and water/irrigation development in the following areas?

- Project identification
- Planning/technical design/lay-out
- Labour contribution
- Capital investment
- Operation and maintenance
- Joint monitoring and evaluation

Partnerships

- Which government departments and agencies did/does the community work with and in what way?
- Did/does the community work with the Rural District Council and in what way?
- Did/does the community sign any paperwork/documents with the Rural District Council and, if so, who actually signed the paperwork? Does the community have a copy and who keeps it? Is it in the local language?
- Which NGO(s) did the community work on the project with and in what way? Did the community sign any paperwork/document with the NGO and, if so, who actually signed the paper work? If so does the community have a copy and who keeps it? Is it in the local language?
- Did/does the community work with private service providers and in what way? Did the community sign any paperwork/document with the private sector service provider and, if so, who actually signed the paperwork? If so does the community have a copy and who keeps it? Is it in the local language?

MUS experience

1. Has the community been involved in water projects that provide water for more than one water use?

- Who introduced the idea?
- Was the community receptive to the idea?
- Has this been proved to be good idea and why?
- What were the constraints and opportunities facing such projects? Specifically, what were the constraints and opportunities related to planning for, building, operation and maintenance, and management of these MUS structures?

2. Have stakeholders been involved in water projects that provide a single use of water?

- Were communities involved in planning and implementation of these projects?
    - Was the community receptive to the idea?
    - Has this been proved to be good idea and why?
    - What were the constraints and opportunities facing such projects?
- What additional stakeholders were involved in planning and implementation of these projects and what were their roles? What were the opportunities, constraints, and challenges related to their engagement?

QUESTIONS SPECIFIC TO DIFFERENT COMMUNITY LEADERS

Type of leader	Questions
Traditional leaders; Ward Councillor	Who owns the water resources, if anyone? What do you see as boundaries of the water resources that belong more to your community than to communities elsewhere? If other communities want to come and tap into the resources in this village, can they do that? Do they have to ask permission, and, if so, from whom and why this person? Are there any conflicts within your community about the sharing of the naturally available water resources? If so, describe them? Has there been some solution, and if so, describe the solution? How do you see your role in such conflicts, and why?
Representatives of Water Point Committees; WASH Committees; and Irrigation Management Committees (Note composition by gender, age)	How were you appointed or selected to become member of the committee? What do you see as your roles? What are your three main challenges in implementing your roles?

3. FOCUS GROUP DISCUSSIONS

3.1 Predecessor Projects -Community Members

Female FGD : 10-15 members of all available age groups **Male FGD**: 10-15 members of all available all age groups Resource Mapping; 3-4 members from each FGD (see Instructions in Section E)

GUIDING QUESTIONS

Across all the sections issues pertaining to women and men should be interrogated.

SECTION A: WATER ISSUES IN THE COMMUNITY

1. What are the main uses of water in order of importance in your area?
2. What are the main sources of water for the community in order of reliability?
3. To what extent are the water uses satisfied?
4. What explains the level of satisfaction (e.g., too few and unreliable sources, seasonality, operational challenges)?
5. Do water conflicts arise in the area? If so, describe the type of conflicts, the causes, how they are resolved, and by whom.

SECTION B: CHARACTERISTICS OF WATER INFRASTRUCTURE BEING VISITED

1. Site name and location (province, district, ward, village)
2. When was the project planned and commissioned?
3. Name of Implementing Agency
4. Source of water and method of water abstraction/conveyance.
5. Number of beneficiaries
    - How many villages/households/people benefit from the infrastructure?
    - How were the beneficiaries determined?
    - Under what conditions do the beneficiaries use the water?
6. Planning the infrastructure
    - Which water uses, in order of priority, was the infrastructure designed for?
    - Were the needs/ preferences of women and men considered? If so how?
    - How different was the design of the infrastructure from earlier water infrastructure implemented in the area e.g. in terms of catering for different water uses and type of infrastructure?
        - Are the differences positive/negative and in what way?
    - What are the constraints and opportunities facing past and current approaches?
7. Current water uses from the infrastructure
    - What are main water uses in order of priority? How does this vary between men and women and why?
    - Is there enough water for the different uses of water? If not how is this managed and who is in charge/coordinates the response? How does this affect men and women?
    - Do you consider the water of acceptable quality for the different water uses and water users? What parameters are considered key for the different water uses and water users?
    - Are there problems regarding sharing water among the different users?
        - Please describe and characterise the problem(s) e.g. problems could be related to physical shortage of water (e. g. due to seasonality) or social problems (e.g. differences between community members, women and men)
        - Has the community tried to solve the problem(s) – if so, how, and who was leading? What arguments were used by the different parties? What were the outcomes?
8. Alternative/complementary water sources
    - Are there are alternative/complementary water sources? If so why are they necessary?
    - How many villages/households/people benefit from the infrastructure and how is this determined?
    - What are main uses of water uses from the alternative/complementary sources?
        - Under what conditions do the households/people use the alternative/complementary water sources?

    - How reliable are the alternative/complementary water sources? If unreliable how is this managed and led/coordinated by who? How does this affect men and women?
- Do you consider the water from the alternative/complementary water sources for different water use of acceptable quality? What parameters are considered to be key for the different water uses and water users?
- Are there problems regarding sharing water among the different water users?
    - Please describe the problem(s). Are the problems related to physical shortage of water (e. g. due to seasonality) or social problems (e.g. differences between community members, women and men)
    - Has the community tried to solve the problem(s) – if so, how, and who was leading? What arguments were used by the different parties?

SECTION C: COMMUNITY INVOLVEMENT IN WATER PROJECT BEING VISITED

9. Community engagement process
    - How was the community members involved in the project? Was it through a specific committee for the project (and what selection process was followed) or through an existing committee/structure? For either committee/structure, how was it representative in terms of participating villages, gender, age, wealth, and specific use for women and men?
10. Issues
    - What issues were discussed, what method was used to identify them, and what was agreed regarding community involvement in the following:
        - Project identification
        - Planning and technical design (including technology choice and siting/lay-out and uses of the water
        - Contribution to capital for the infrastructure
        - Labour contribution (paid, voluntary)
        - Operation and maintenance
        - Monitoring and evaluation
        - Conflict resolution
11. Were the outputs of the discussion of the issues written down? If so, by whom and who keeps the record?
12. What changes were made during implementation and why?

SECTION D: PARTNERSHIPS FOR THE INFRASTRUCTURE

13. Which government departments and agencies did/does the community work with and in what way?
14. Did/does the community work with the Rural District Council and in what way?
15. Were there any challenges/constraints to working with the Rural District Council? If so, please describe them and whether/how they were resolved.
16. Was the Rural District Council responsive to the communities' concerns and needs? If so, how did they engage? If not, what issues were unresolved?
17. Did/does the community sign any paper work with the Rural District Council and if so who actually signed the paper work? If so does the community have a copy and who keeps it?
18. Which NGO(s) did the community work on the project with and in what way? Did the community sign any paper work with the NGO and if so who actually signed the paper work? If so does the community have a copy and who keeps it?

19. Did/does the community work with private service providers and in what way? Did the community sign any paper work with the private sector service provider and if so who actually signed the paper work? If so does the community have a copy and who keeps it?
20. Did/does the community develop rules/bye- laws for operating and maintaining the infrastructure?
    - If so did the community receive assistance in formulating them?
    - Were the rules/bye-laws written down, and signed and by who and under whose custody are they kept?
    - Is it possible to have a copy of the rules/bye-laws?
    - Are the rules generally complied with? If not, which rules have been difficult to enforce? How has enforcement taken place and by whom? What, if any, are the challenges faced in enforcing the rules? How could the rules be changed (and in what ways) to improve compliance and enforcement?

SECTION E: INSTRUCTIONS FOR RESOURCE MAPPING

The objective of resource mapping is for the Focus Group Discussions, represented by 3-4 people they choose, map the sources and uses of water from the water infrastructure point and alternative/complementary water sources. The resource mapping will be presented to the rest of the Focus Group Discussions for discussion and confirmation.

On the map, members will be asked to indicate the following:

- Location of the water infrastructure
    - Location of villages that depend on the infrastructure
    - Location of major water uses such irrigation gardens, dip tank
    - Location of major land uses such as fields, grazing areas
- Approximate distance between the infrastructure and the villages and major water uses
- Location of alternative/complementary water sources
    - Location from water infrastructure being visited
    - Location of villages that use water from the water point and alternative water sources
    - Location of major water uses from alternative/complementary water sources
- Approximate distance between alternative/complementary water and water infrastructure, villages that use the water infrastructure and alternative/complementary water sources and main water and land uses.

3.2 Planned Projects – Community Members

Female FGD : 10-15 members of all available age groups

Male FGD: 10-15 members of all available all age groups

Resource Mapping; 3-4 members from each FGD (see Instructions in Section E)

GUIDING QUESTIONS

Across all the sections issues pertaining to women and men should be interrogated.

SECTION A: WATER ISSUES IN THE COMMUNITY

1. What are the main uses of water in order of importance in your area?
2. What are the main sources of water for the community in order of reliability?

3. To what extent are the water uses satisfied?
    - What explains the level of satisfaction (e.g. too few and unreliable sources, seasonality, and operational challenges)?
4. Do water conflicts arise in the area? If so describe the type of conflicts, the causes and how they are resolved.

SECTION B: CHARACTERISTICS OF WATER INFRASTRUCTURE BEING VISITED

5. Site name and location (province, district, ward, village) and
6. Name of Implementing Agency

7. i List number and purpose of meeting leading up to establishment of WF

Meeting (State date if remembered)	Purpose of meeting

ii. During discussions, what issues were raised, how they were discussed and what was agreed, and were there any differences regarding gender, age, wealth status? **Refer to the table below.**

Issue	Method	What was agreed
Site selection What was the role of the implementing agency, Rural District Councils, government departments, community leaders, community members, Who participated in site selection, Were there any disagreements and how resolved?		
Number of beneficiaries How many villages/households/people benefit from the infrastructure? How were the beneficiaries determined? Under what conditions/rules do the beneficiaries use the water?		
Water source, method of water abstraction/conveyance		
Planned water use		

Issue	Method	What was agreed
Which water uses, in order of priority, was the infrastructure planned for? Were the needs/ preferences of women and men considered? If so how were those needs/preferences reflected in the design? How different was the design of the infrastructure from earlier water infrastructure implemented in the area e.g. in terms of catering for different water uses and type of infrastructure? What constraints and opportunities facing past and current approaches were identified? Was water quality considered for different water uses?		
Alternative/complementary water sources Were alternative/complementary water sources considered? If so what roles would they play and what rules would apply.\? Was water quality considered for different water uses?		
Financial contribution to the infrastructure		
Labour contribution (paid, voluntary)		
Operation and maintenance		
Monitoring and evaluation		
Conflict resolution		

SECTION C: PARTNERSHIPS FOR THE INFRASTRUCTURE

7. Which government departments and agencies did/does the community work with and in what way?
8. Did/does the community work with the Rural District Council and in what way?
9. Were there any challenges/constraints to working with the Rural District Council? If so, please describe them and whether/how they were resolved.
10. Was the Rural District Council responsive to the communities' concerns and needs? If so, how did they engage? If not, what issues were unresolved?
11. Did/does the community sign any paper work with the Rural District Council and if so who actually signed the paper work? If so does the community have a copy and who keeps it?

12. Which NGO(s) did the community work on the project with and in what way? Did the community sign any paper work with the NGO and if so who actually signed the paper work? If so does the community have a copy and who keeps it?
13. Did/does the community work with private service providers and in what way? Did the community sign any paper work with the private sector service provider and if so who actually signed the paper work? If so does the community have a copy and who keeps it?
14. Did/does the community develop rules/bye- laws for operating and maintaining the infrastructure?
    - If so did the community receive assistance in formulating them?
    - Were the rules/by-laws written down and signed? By whom and under whose custody are they kept?
    - Is it possible to have a copy of the rules/by-laws?
    - Do the rules still and how has been their implementation? Do you think they need to be changed and in what way?
    - Are the rules generally complied with? If not, which rules have been difficult to enforce? How has enforcement taken place and by whom? What, if any, are the challenges faced in enforcing the rules? How could the rules be changed (and in what ways) to improve compliance and enforcement?

SECTION D: INSTRUCTIONS FOR RESOURCE MAPPING

The objective of resource mapping is for the Focus Group Discussions, represented by 3-4 people they choose, map the sources and uses of water from the water infrastructure point and alternative/complementary water sources. The resource mapping will be presented to the rest of the Focus Group Discussions for discussion and confirmation.

On the map, members will be asked to indicate the following:

- Location of the water infrastructure
    - Location of villages that depend on the infrastructure
    - Location of major water uses such irrigation gardens, dip tank
    - Location of major surface water sources, land uses such as fields, grazing areas
- Approximate distance between the infrastructure and the villages and major water uses
- Location of alternative/complementary water sources
    - Location from water infrastructure being visited
    - Location of villages that use water from the water point and alternative water sources
    - Location of major water uses from alternative/complementary water sources

Approximate distance between alternative/complementary water and water infrastructure, villages that use the water infrastructure and alternative/complementary water sources and main water and land uses.

4. HOUSEHOLD SURVEY QUESTIONNAIRE

Purpose of Survey and Ethical pronouncements

- This survey is meant to get the views of community members who are beneficiaries of water infrastructure facilities that were/are facilitated by Ensure and Takunda in Masvingo and Manicaland provinces, and Amalima and Amalima Loko in Matabeleland North and South provinces regarding planning, operation and maintenance of the water facilities.
- The aim is to draw lessons for improving the way water points are managed.

- Please feel free to answer the survey as freely as you can. You are free to participate in the survey and are allowed to stop for any reason.
- The information that you will provide will be treated as private and confidential.
- No reference by individual name will be made. Information provided will be aggregated such no individual respondent will be identified.

Name/Identity of Enumerator ☐

Questionnaire number ☐

Date and time (start) of interview ☐

PART A: RESPONDENT AND HOUSEHOLD CHARACTERISTICS

1. Name of respondent (Optional) ☐

2. Gender of respondent i. Male ☐ ii. Female ☐

3. Age group of respondent (in years)

20-30	☐	31-40	☐	41-60	☐
61-70	☐	71-80	☐	Over 80	☐

4. Gender of household head i. Male ☐ ii. Female ☐

5. Age group of household head (in years)

20-30	☐	31-40	☐	41-60	☐
61-70	☐	71-80	☐	Over 80	☐

6. Size of household ☐

PART B: GENERAL WATER SOURCES AND USES IN THE COMMUNITY

7. What are the main sources of water in order of ☐

importance/reliability in your village?	
8. Are the water sources (rivers and/or infrastructure) cited in (5) shared with other villages?	
9. Is there any infrastructure (e.g., boreholes, pumps, shallow dams) that are owned/managed by individual households in your village?	
10. Is the infrastructure owned/managed by individual households shared with other households?	
11. What are the main uses of water in order of importance in your village?	
12. Does the community have adequate water for all uses, and does this come from the sources cited in (7) or in (9)?	
13. If not, what are the reasons, e.g. too few sources, unreliable sources, seasonality, operational challenges with infrastructure	
14. Does your household have adequate water for all uses, and does this come from the sources cited in (7) or in (9)?	
15. If not what are the reasons, e.g. too few sources, unreliable sources,	

seasonality, operational challenges with infrastructure?	
(i) Are there any conflicts associated with using water from the sources cited in (7)?	
(ii) If yes, what are types and causes of the water conflicts? The causes and how they are resolved?	
(iii) How are the conflicts resolved?	
(iv) Are there any incidents where conflicts were not resolved, and what conflicts were these?	
16. (i) Are there any conflicts associated with using water from the sources cited in (9)?	
(ii) If yes, what are types and causes of the water conflicts? The causes and how they are resolved?	
(iii) How are the conflicts resolved?	
(iv) Are there any incidents where conflicts were not resolved, and what conflicts were these?	

PART C: WATER FACILITY (WF) CHARACTERISTICS AND WATER USE

17. Name of Water Facility (WF)		Year commissioned	

18. Location of WF

(a) Village

(b) Ward

(c) District

i. Gwanda		ii. Bulilima	
iii. Chivi		iv. Tsholotsho	
v. Zaka			

(d) Province

i. Mat South		ii. Mat North	
iii. Masvingo			

19. Source of water

i. Borehole		ii. Weir	
iii. Deep well		iv. Other (Specify)	

20. Method of abstraction

i. Handpump		ii. Solar pump	
iii. Gravity		iv. Grid electric pump	
v. Diesel/petrol			

21. Number of villages served by WF

22. Number of households served by WF

23. Number of people served by WF

24. How were the beneficiaries determined?

25. Under what conditions/rules do people use water?	

26. What do you think about water use as captured in Table 1?

Table 1. Importance of different uses of water and availability from water facility

Water Use (in order of priority)	Importance (1 =very important; 2=important; 3=just about important; 4= not important		Satisfaction with availability of water supply (1=very satisfied; 2=satisfied; 3=just about satisfied 4= not satisfied)		Explanation/Remarks
	Women	Men	Women	Men	
1					
2					
3					
4					
5					

27. What do you think about the quality of water as captured in Table 2?

Table 2. Describe the quality of water for different water uses from the water facility

Water use	Parameter(s) e.g. smell, colour (State more than one if necessary)	Acceptability (1=Acceptable; 2=Marginally acceptable 3= Not acceptable)	
		Women	Men
Drinking			
Other domestic uses (Food preparation, Cooking, Cleaning, Hand washing, Child Care, Bathing, Laundry)			
Irrigating vegetables			
Irrigating field crops			
Irrigation crops and trees at homestead			
Livestock watering			

Water use	Parameter(s) e.g. smell, colour (State more than one if necessary)	Acceptability (1=Acceptable; 2=Marginally acceptable 3= Not acceptable)	
		Women	Men
Brickmaking			
Other (specify)			

28. Was the water quality assessed when the infrastructure was established?

29. Has there been other water quality assessment ever since the establishment? i. Yes ☐ ii. No ☐

30. (1) Does the water quality change with seasons? i. Yes ☐ ii. No ☐

(ii) If yes, how does it change with seasons? i. Yes ☐ ii. No ☐

31. Are there problems/conflicts regarding sharing water among the different uses/users?	
32. Please describe and characterise the problem(s) e.g. problems could be related to physical shortage of water (e. g. due to seasonality) or social problems (e.g. differences between community members, women and men)	

33. Has the community tried to solve the problem(s)/conflicts – if so, how, and who was leading?

34. What arguments were used by the different parties to solve the conflicts? What were the outcomes?

35. Are aggrieved parties satisfied by how conflicts are resolved (Justify your answer?)

36. If not satisfied what is the recourse that can be taken?

37. Are there alternative/complementary water sources? If so why are they necessary?

38. Under what conditions/rules do people use water?

39. Regarding alternative/complementary water sources, what do you think about the aspects captured in Table 3?

Table 3. Perceptions of importance of different uses of water and availability from alternative/complementary water sources

Water Use (in order of priority)	Importance (1 =very important; 2=important; 3=just about important; 4= not important		Satisfaction with availability with water supply (1=very satisfied; 2=satisfied; 3=just about satisfied 4= not satisfied)		Explanation/Remarks
	Women	Men	Women	Men	
1					
2					
3					
4					
5					

40. Comment on the quality of alternative/complementary water sources as indicated in Table 4.

Table 4. Describe the quality of water for different water uses from alternative/complementary water sources

Water use	Parameter(s) (State more than one if necessary)	Acceptability (1=Acceptable; 2=Marginally acceptable; 3= Not acceptable)	
		Women	Men
Drinking			
Other domestic uses (Food preparation, Cooking, Cleaning, Hand washing, Child Care, Bathing, Laundry)			
Irrigating crops fields			
Irrigation crops and trees at homestead			
Livestock watering			
Brickmaking			
Other (specify)			

41. Was the water quality ever assessed? If so when and for what?

42. Does the water quality change with time? i. Yes ☐ ii. No ☐ iii. Don't know ☐

43. Are there problems/conflicts regarding sharing water among the different uses/users from alternative/complementary water sources?

44. Please describe and characterise the problem(s) e.g. problems could be related to physical shortage of water (e. g. due to seasonality) or social problems (e.g. differences between community members, women and men)

45. Has the community tried to solve the problem(s) – if so, how, and who was leading? What arguments were used by the different parties? What were the outcomes?

PART C: PARTICIPATION IN PLANNING AND ESTABLISHMENT OF WF

46. i. Was the community members involved in the planning of the water project?

ii. If yes, was the involvement through a specific committee for the project (and what selection process was followed) or through an existing committee/structure?	

iii. For either committee/structure in (ii), how was it representative in terms of participating villages, gender, age, wealth, and specific use for women and men?	

47. i List number and purpose of meeting leading up to establishment of WF

Meeting (State date if remembered)	Purpose of meeting

ii. During discussions, what issues were raised, how they were discussed and what was agreed, and were there any differences regarding gender, age, wealth status? **Refer to Table 5.**

Issue	Method	What was agreed
Project identification		
Site selection		

Issue	Method	What was agreed
Planning and technical design (including technology choice and siting/lay-out and uses of the water		
Financial contribution to the infrastructure		
Labour contribution (paid, voluntary)		
Operation and maintenance		
Monitoring and evaluation		
Conflict resolution		

iii. Were the outputs of the discussion of the issues written down? If so by who and who keeps the record?	

iv. What changes were made during implementation based on these discussions and why?	

48. Community involvement in site selection

49. Role of your household in site selection

50. Community labour contribution during construction/establishment

51. Household Labour contribution by community during construction/establishment

52. Community financial contribution during construction/establishment

53. Household financial contribution during construction/establishment

54. Do you know the total cost of project? If so how much was it in USD?

PART D: OPERATIONAL MODALITIES

55. Are there rules for allocating water (specify)?

55. Are the rules written (specify)?

56. Are there any limitations on quantity of water use (specify)

57. In the event of water shortage how does water allocation change?

58. Who enforces the rules around water use?

59. How did the rules come into being?

60. Does everyone know the rules?

61. If they are written, does everyone have a copy of the rules	i. Yes	☐	ii. No	☐

iii. Don't know ☐

62. Are the rules broken (Specify)

63. What happens when someone breaks the rules?

PART E: OPERATION AND MAINTENANCE

64. Who is responsible for operation and maintenance of the water facility?

65. How were the people responsible for operation and maintenance selected?

66. Do you think that operation and maintenance is being done effectively and why do you say so?

67. Were people trained in operating the infrastructure i. Yes ☐ ii. No ☐

iii. Don't know ☐

68. How many people were trained and over what period (sessions); what was topics were covered in the training; who facilitated and did the training; how well was the training?

Period (Session)	Number of people trained	Topics covered	Facilitator of training	Training rating (Scale: 1 worst; 5 Best)

69. Do people contribute (in cash or kind) to operating & maintaining infrastructure? i. Yes ☐ ii. No ☐

70. How much is charged per household/village and over what time?

Period of time	Charges per Household

71. What happens if some does not pay all or part of the amount and delays payment?

72. How was the amount arrived at?

73. Do you think the money that is contributed is adequate, explain your answer?

PART F: SUSTAINABILITY PROSPECTS

74. Provide an estimate household per month (USD)	Up to50	☐	51-100	☐	101-150	☐
	151-200	☐	201-250	☐	Over 250	☐

75. Are you willing to pay full cost of operation and maintenance? i. Yes ☐ ii. No ☐

76. If not the full cost, why not?

77. If there is breakdown are you willing to mobilise funds for repair? i. Yes ☐ ii. No ☐

78. Are you willing to mobilise funds to replace the infrastructure if needed? i. Yes ☐ ii. No ☐

79. Do you think the community has capacity to replace the infrastructure? i. Yes ☐ ii. No ☐

80. Do you think the WP will continue to operate when donors end their involvement? i. Yes ☐ ii. No ☐

81. Did/does the donor provide post-construction support for operation and maintenance? i. Yes ☐ ii. No ☐

82. i. How much money (in USD) are you willing to pay per month to meet operation and maintenance of water infrastructure?

ii. If the money you are willing to pay was doubled, would you be prepared to pay?

iii. If the money you are willing to pay was trebled, would you be prepared to pay?

iv. If the money you are willing to pay was quadrupled, would you be prepared to pay?

83. Names of institutions relevant to the water sector and Water Point (e.g. traditional leaders, Water Point Committee, Sub-catchment Council, Catchment Councils, WASH Sub-committee, and their contribution to sustainability of project.

84. Any other comments you want to make about water supply.

Thank you

Time of interview (end)

Annex 1: Research Project Information Sheet

Title of Study: Successful partnerships for Multiple-Use Water Services (MUS)

In the Takunda and Amalima Loko intervention areas of Zimbabwe: RFA: SC-PRO-WASH-RFA-2021-03

Principal Investigator (PI): Jessica Troell, Environmental Law Institute

Funder: United State Agency for International Development (USAID)

Introduction

You are being invited to take part in this research study because your community was part of one or more Multiple-Use Water Services (MUS) projects that were implemented by ENSURE and Amalima and are currently being implemented by the Takunda and Amalima Loko Regional Food Security Activities (RFSAs). This study is being conducted by a research team made up of Ms. Jessica Troell (Environmental

Law Institute), Dr. Barbara van Koppen and Dr. Everisto Mapedza (International Water Management Institute) and Professor Emmanuel Manzungu in his personal capacity. Professor Manzungu is the Field Research Coordinator and is the representative of the Research Team.

You are being asked to participate in a (please circle one): Key information interview/Focus group discussion/Questionnaire.

Purpose

The purpose of this research is to:

- Understand the institutional and organizational factors that are important in designing, implementing, and sustaining MUS in Zimbabwe;
- Identify promising interventions for MUS – based on the experiences of the Takunda and Amalima Loko RFSAs and their predecessors—in order to provide actionable recommendations for interventions designed to increase the reliability, resilience, and overall success of MUS in the implementation areas, as well as in other USAID Bureau for Humanitarian Assistance (BHA)-funded projects in other countries.

To this end, your voluntary cooperation is being sought to provide answers to a number of questions about your experience with the previous/current MUS projects. The nature of the questions is indicated below. In addition to the interviews, we will also be collecting water samples from your community's main water sources. The water samples will be tested for pH, EC, and turbidity and the results will be analyzed at ZIMLABS, an accredited laboratory testing provider with ISO/IEC 17025:2005 certification, which is based in Harare.

Study Procedures

If you take part in the study, you will be asked to answer or discuss questions like these:

- How can local government be better integrated into MUS planning and operation in RFSA projects and what are the gaps and challenges with local government integration?
- What institutional mechanisms or principles can be shown to be successful in facilitating more effective organizational cooperation and sustainable MUS implementation?
- How well do the existing governance frameworks (laws, policies, and institutional mandates and capacities) facilitate and support different MUS interventions and what are the key gaps?
- What principles can be derived from the ways in which various financial arrangements have been implemented to support MUS, and what steps are needed to bring them to scale? In particular, how have or could the following financial mechanisms been used and what challenges have they faced?
- How is the sustainability of water (particularly groundwater) resources addressed in planning for, implementing, and sustaining MUS?
- What factors and mechanisms ensure that MUS interventions drive more equitable allocation of water service provision and can effectively target historically vulnerable and persistently marginalized populations, including gender and youth equality
- What management systems ensure continued functionality and sustainability of established MUS, from a users' point of view?

You will NOT be asked any questions that could lead to your identification (other than your age, gender, and location) or the identification of your family (other than the age and gender of your head of household, if different from yourself). You will NOT be asked to answer any questions regarding your political affiliation or associations. No one will come to your house or homestead or personal space. If any questions like these are asked, please STOP the interview and ask to speak to a field supervisor to share your concern(s). These people will be identified for you prior to beginning the study. Further complaints or concerns may also be raised to Jessica Troell, the Principal Investigator, as well as anonymously with a third party, as indicated in the section below on "Questions and complaints."

The interview process should take approximately 40-45 minutes. You should feel free to ask questions to the research team at any time during this process.

Benefits

The research team will analyze the data from this study and provide lessons regarding planning and implementation of water projects that can be used for the benefit of communities in Zimbabwe.

Risks and Risk Mitigation

You are being asked to participate in this study in a public location and not at your home or homestead to avoid identification of any private information and to reduce the risk that your children will be present during the process. This is to protect your identity and maintain confidentiality, as well as to reduce any risks to you and your family. The enumerators for this study have been trained and have passed an Ethics certification course in advance of this process. However, if at any time you feel uncomfortable or at risk, you should stop the enumerator and ask to speak with one of the project supervisors present to share your concern(s). These people will be identified for you prior to beginning the study. Further complaints or concerns may also be raised to Jessica Troell, the Principal Investigator, as well as anonymously with a third party, as indicated in the section below on "Questions and complaints."

We will protect the information we collect from you during this study and your identity will remain anonymous. To protect your confidentiality and avoid any potential risk for an accidental breach of confidentiality, we will not share any information that will identify you. We will only include identification of your facility in our report with your consent. However, it is possible that some data may not be kept fully anonymous, despite our best efforts, in which case we will take appropriate measures to mitigate the release. Additionally, some of the questions asked may make you uncomfortable and/or you may not want to answer them. In these cases, you are free to decline to answer without any judgment or negative repercussions. Finally, despite best efforts, the study may not have the desired impact of improving planning and implementation of MUS for communities.

Costs

There will be no costs to you for participation in this research study.

Compensation

You will not be paid for taking part in this study.

Confidentiality

All information collected about you during this study will be stored with a code name (or number). This code will be used only by the research team to link your name to the provided information, but nobody else. No report, internally or externally, will show your name, unless you explicitly provide consent to do so.

Data sharing

The data collected for this project will be shared by email within the research team, but **not** outside of the research team. The research results, based on the analysis of the data, will be part of a report or reports and published articles, and will be shared more widely with all stakeholders and interested parties by email and as downloads from the ELI, IWMI and PRO-WASH websites. These publications will include summaries of the data (but not the actual data itself) and references to the data without any indication of any personal information.

Voluntary Participation/Withdrawal

Taking part in this study is voluntary. You are free to not answer any questions or to withdraw at any time without any negative repercussions. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study, at which point your data will be deleted.

Questions and complaints

If you have any questions about this study now or in the future, you may contact the Principal Investigator, Ms. Jessica Troell, via email at troell@eli.org, or by phone at +263 (0)774 923 472.

You may also register any complaints or concerns through a third-party process at https://secure.ethicspoint.com/domain/media/en/gui/42925/index.html. You can also report anonymously by phone at +1-844-287-1892.

Participation and Non-discrimination

Your participation is voluntary, and you may refuse to participate without penalty or discrimination at any time by any institution involved in this study. Your participation in any aspect of the Takunda/Amalima Loko project does not imply your willingness to participate in this interview/focus group discussion/questionnaire. If you choose not to participate in this interview/focus group discussion/questionnaire, there will be no negative repercussions from our research team or from the Takunda/Amalima Loko project staff. The team will not reveal your decision to outside parties to ensure that you will not be victimized and that no one will harass you or try to induce you to participate against your will.

You will be provided with a copy of this Information Sheet, which you may keep. To indicate your willingness to voluntarily participate in the study, the research team, through Professor Emmanuel Manzungu as the Field Research Coordinator, will ask for your verbal consent. As a record of your consent, Professor Manzungu, will sign the form in the presence of another witness.

CONSENT

PARTICIPATION IN RESEARCH IS VOLUNTARY.

You have been given a copy of this project information sheet and consent form to keep.

Signatories to the verbal consent:

Name of the representative of the Research Team: Professor Emmanuel Manzungu

____

Signature

Date: _______________________________________ _____________

Name of witness: ____

Signature: ____

Date: ____

Annex 2: Oral/Verbal Consent Talking Points

All bullets below should be used to explain the project and guide the consent discussion.

1. **Who you are:** Identify yourself and clarify your association with the project and partnering institutions ……… (mention in particular national partner institutions which the participants might know).
2. **Research study:** Explain that you are asking the subject to participate in a research study.
3. Who is in charge: Please mention that Professor Emmanuel Manzungu, the Field Research Coordinator, is in charge.
4. **Purpose and/or procedures:** Provide a brief description of the study purpose, and activities or types of questions that will be asked in a jargon-free language.
5. **Benefits and possible risks for the participant:** like through exposure in the community, or associated with publishing sensitive answers on informal practices, etc.
6. **Why subjects were selected:** Describe how the participant was selected or why he/she is being asked to participate.
7. **Time commitment:** Clarify how long the participation/interview will take.
8. **Voluntary participating:** State that the subject can stop participating at **any** time and, if applicable, and can also **skip** survey questions without penalty or discrimination.
9. **Confidentiality:** Confirm that confidentiality of the research data will be maintained and the subject's personal information will [not] be shared with anyone outside the research team [or even kept completely anonymous].
10. **Consent:** Explain that we will only continue the interview if the possible participant is interested and provides her/his **verbal** consent to participate. For this please note the participant's name, date, and (dis)agreement in a separate list. No signature of the participant is needed, but your name and ideally the name of a witness (e.g. extension officer).
11. **Contact Info:** Provide contact information for you and your superior investigator whom to contact with questions or complaints. Also explain that the participant can call a **local institution** with questions or concerns or his/her rights as a research participant.