


Mapping and analysis of the business ecosystem for smallholder irrigation in Rwanda

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Water for Food
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at the University of Nebraska



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Captions

Front Cover: Grace Mukarusagara looks at a fuel pump used for irrigation in Nyagatare District, Rwempasha Sector. (See page 31 for irrigation pump in use.) Credit: Raïssa Urujeni

Pages 2-3: A farm in Rwanda uses solar panels combined with sprinkler and drip irrigation to grow cash crops like these banana plants. Credit: Frances Hayes

Page 5: A canal and sluice gate are used to direct the flow of irrigation water pumped to a corn field in Nyagatare District, Karangazi Sector. Credit: Raïssa Urujeni

Page 7: This co-op of smallholder farmers uses small-scale irrigation technology to irrigate corn and other crops during the dry season. Credit: Frances Hayes

Page 31: A smallholder farmer irrigates his tomato crop using flexible hose piping attached to a fuel pump in Nyagatare District, Rwempasha Sector. (See front cover for fuel pump used.) Credit: Raïssa Urujeni

Page 34: A smallholder farmer carries French beans harvested from a field irrigated with a small pump in in Bugesera District, Gashora Sector. (See back cover for bean field.) Credit: Raïssa Urujeni

Page 36-7: DWFI staff join smallholder farmers for interviews in Bugesera District, Ruhuha Sector. Pictured here are Ferdinand Turatsinze (second from left), Grace Mukarusagara (fourth from left), and Natacha Akaliza (second from right). Credit: Raïssa Urujeni

Page 38-9: A smallholder farmers' co-op carries a system of tubes and sprinklers to a field, allowing them to plant and harvest an extra season and increase their income. Credit: Frances Hayes

Back Cover: Grace Mukarusagara (center) and Ferdinand Turatsinze (right) look out at a lake used for irrigating a field of French beans, visible on the right, in Bugesera District, Gashora Sector. Credit: Raïssa Urujeni

Executive Summary

This report analyzes the business ecosystem for providing irrigation goods and services to smallholder farmers in Rwanda. The focus is on farmer-led irrigation, namely the distribution and use of small irrigation pumps and associated equipment used by individual farmers or shared between a few farmers. Key findings are:

- 1. All irrigation pumps are currently imported into Rwanda.** Different irrigation technologies are sourced from different countries. Dubai is a key transshipment point and wholesale market for pumps.
- 2. Multiple kinds of marketing channels for irrigation pumps operate within Rwanda.** Price and quality differentiation are observed in the market for irrigation pumps and these influence marketing strategies. Climate variations across the country also affect the kinds of equipment marketed and sold to smallholder farmers.
- 3. The government-run Small-Scale Irrigation Technology program subsidizes purchases of some irrigation equipment and influences the entire market.** The rules around program access have fundamentally altered and segmented the retail marketing process for small-scale irrigation equipment.
- 4. Government agronomists at the sector and district level are key influencers in irrigation pump marketing channels.** The role of agronomists in technology choice and adoption has been underappreciated.
- 5. Non-governmental organizations play an important role in the growth of smallholder irrigation in Rwanda.** The organizations that have been the most effective in supporting the expansion of irrigation are those that provide aggregation of technical, financial, and management functions to groups of farmers.

Our report and findings are based on dozens of in-person interviews, as well as on associated research, that we conducted. We suggest some potential steps to improve the business environment for small-scale irrigation equipment in Rwanda, with a focus on practical, actionable changes:

- 1. The Small-Scale Irrigation Technology (SSIT) program has been critical to making irrigation technology available and affordable to smallholder farmers.** Small improvements in its operation can thus have a large impact. We suggest:
 - a. Implementing electronic and online recordkeeping within the SSIT program.** This would allow forms to be completed and stored digitally and shared between government agencies. In turn, this would make the program more efficient and allow farmers to access appropriate technology more quickly than currently possible, particularly if key forms were prepopulated using available geospatial data.

- b.** Allowing farmers to pay for equipment in installments. This would expand the irrigation retail market as, despite the government subsidy, some farmers still struggle to afford irrigation equipment. Such a scheme might be facilitated by the government and involve banks, development funds, and non-governmental organizations.
- 2.** There is an opportunity for new businesses that serve as wholesalers and retailers of spare irrigation parts. The lack of easily-accessible irrigation equipment parts is a pain point for farmers. A related recommendation is for the government to require retailers who participate in the subsidy program to carry spare parts or to have a small repair shop.
- 3.** Finally, there are many farming cooperatives, entrepreneurs, and support organizations seeking connections to support smallholder irrigation. We recommend that:
 - a.** The Rwanda Cooperative Agency expand its database to include a Needs Assessment for cooperatives published online.
 - b.** A non-governmental organization establish an irrigation-focused start-up incubator to train aspiring entrepreneurs and to facilitate access to seed money, outside investors, and potential customers.

This report is divided into three sections: an ecosystem map that explains relationships between important actors involved in smallholder irrigation in Rwanda, key findings to understand the smallholder irrigation ecosystem, and recommendations and potential next steps.



Introduction

In Sub-Saharan Africa, only a small proportion of irrigable land is currently irrigated. Effective expansion of irrigation could increase smallholder incomes and climate resilience without compromising underlying natural resources. Over the last decades, the focus of irrigation expansion in Sub-Saharan Africa has been on the construction of large donor- and government-funded canal and reservoir systems. There is now recognition of significant smallholder irrigation provision through decentralized, small-scale, and entrepreneurial pathways, often described collectively as “farmer-led irrigation.” As a result, there is growing interest in understanding and expanding the full set of pathways by which smallholder farmers access irrigation goods and services.

The business ecosystem around smallholder irrigation is complex and involves a broad variety of disparate entities. Developing an understanding of the ecosystem requires analysis not only of government policy and donor priorities, but also of international supply chains; relationships between equipment manufacturers, wholesalers, and retailers; and key influencers and decision makers, from farmers’ fields to the offices of relevant government ministries.

This report presents a mapping and analysis of the business ecosystem for smallholder irrigation in Rwanda in 2021. We describe important elements of the current ecosystem, and we provide analysis around some underappreciated leverage points. In addition, our intent is to highlight the different methods necessary to develop new and useful insights. This report relies on information from a series of structured interviews with key ecosystem participants, closely related to the customer discovery process from entrepreneurship but adapted to local context and culture.

During the research phase of the project, our team in Rwanda conducted dozens of interviews with business owners, government officials, non-governmental organization staff, and smallholder farmers. Together with analysis of policy documents, scientific and academic reports on agriculture, company marketing materials, and other materials, the interviews form the basis of this report. By “getting out of the building” and talking to as many ecosystem participants as possible to understand their motivations, operations, and day-to-day challenges, we were able to gain a holistic and nuanced understanding of smallholder irrigation as it occurs in Rwanda in 2021.

Our report is divided into three sections: an ecosystem map that explains relationships between important actors involved in smallholder irrigation, key findings needed to understand the ecosystem, and recommendations and potential next steps.



Background

Rwanda's vision of long-term economic development includes a large expansion of irrigated area within the country. A key component of development plans is to increase smallholder access to irrigation as a mechanism to improve food security, nutrition, and incomes. An interim planning goal aims to more than double the irrigated area in Rwanda, from 48,508 hectares in 2017 to 102,284 hectares in 2024.¹

There are currently three pathways for smallholder farmers in Rwanda to access irrigation services:

1. Government and donor-funded irrigation, where the farmer is part of a group getting access to irrigation through large, managed irrigation schemes.
2. The Small-Scale Irrigation Technology (SSIT) program, where a farmer or small group of farmers purchase and own individual irrigation equipment in a transaction that is managed and subsidized by the government.
3. Other pathways, including where a farmer purchases an unsubsidized new or used pump or rents a pump from a retailer or neighbor.

In this report, we focus on the second and third pathways, namely individual, small-scale irrigation equipment that reaches the farmer through a variety of marketing channels. Whereas large government and donor-funded irrigation projects are relatively well-studied across Sub-Saharan Africa, there has been little analysis of the distribution of small irrigation equipment, particularly diesel and petrol pumps, directly to smallholder farmers. As such equipment is widespread and often reaches farmers at scale

without high levels of subsidization, it is worthwhile to understand the overall ecosystem and what lessons might be learned from it. Although there is currently a high level of interest in individual solar irrigation equipment for smallholders, the vast majority of individually-owned and operated irrigation equipment in Sub-Saharan Africa is diesel and petrol powered.

According to the Ministry of Agriculture and Animal Resources (MINAGRI) Annual Report for fiscal year 2019-2020, the total irrigated land in Rwanda was 63,742 hectares.² Of this area, 72 percent was served by large irrigation schemes (58 percent in marshlands, 14 percent on hillsides) and 28 percent was served by small-scale irrigation technologies. Small-scale irrigation represented over a quarter of all irrigation in Rwanda in 2020, and we expect the adoption rate of small pumps in the country will continue to grow and accelerate.

¹Republic of Rwanda. 2017. Rwanda 7 Years Government Programme: National Strategy for Transformation (NST1). <nirda.gov.rw>. Accessed 8/17/2021.

²Ministry of Agriculture and Animal Resources, Republic of Rwanda. 2020. Annual Report 2019-2020. <minagri.gov.rw>. Accessed 8/23/2021.

Equipment Retailers in Rwanda: A glimpse at the shelves

If you visit irrigation retail shops in Kigali, you will find a variety of equipment and accessories. The most common equipment is petrol and diesel pumps of different sizes and capacities. Usually these are accompanied by suction and hose pipes in various lengths, which are sold separately. Suction pipes are mostly short (a few meters), and hose pipes are often much longer, say 100 meters, depending on the area to be irrigated. Such equipment is the most common because it is affordable to farmers and user friendly.



Other equipment that may be found in an irrigation retail shop includes manual pumps, including hand or treadle pumps, together with dam sheets. Although not as many retailers sell this type of equipment, they are commonly used in Nyagatare district for rainwater harvesting and pumping water for cattle.

Other materials that may be found include rain guns, sprinkler heads, and drippers, although the demand for them is not high because they are expensive compared to the equipment mentioned above. Sprinklers are used on larger farms with land area between 1 and 10 hectares. Drip systems are mainly used to irrigate high value crops like French beans, fruit trees, and other horticultural crops.

Rwanda Smallholder Irrigation Ecosystem Map

The business ecosystem supporting smallholder irrigation includes a large and diverse group of interacting entities. Some of these, such as equipment retailers, work directly with smallholder farmers. Others, like some multilateral organizations, work indirectly with smallholders through their program and project support.

DWFI's "Rwanda smallholder irrigation ecosystem map" captures irrigation businesses serving smallholder farmers as well as the broader irrigation ecosystem in the country. It includes a range of partners, funders, industries, university programs, and advocates that intersect with and support local businesses (Figure 1). At the center of the map is the smallholder farmer who irrigates, the target customer for our study. The surrounding entities are categorized into different functional groups based on how they primarily provide value to the customer. Those entities shown in blue, and immediately surrounding the center of the map, have direct contact with farmers. Organizations shown in green, and further out from the center of the map, have influence in the irrigation ecosystem but are not primarily working directly with farmers.

The main goal of the ecosystem map is to show all the key players surrounding farmers, and their role in the business ecosystem that is involved with supporting irrigated agriculture. This map can be used by entrepreneurs interested in starting an irrigation business to identify potential customers, suppliers, partners, investors, donors, and other resources. The map can also be used by organizations who want to support entrepreneurship and access to irrigation to learn who is involved, where current efforts are focused, and where there are gaps or opportunities for services and investment.

We have defined the functional groups involved in smallholder irrigated agriculture and entrepreneurship below.

Government SSIT Extension & Advocacy efforts are led by agronomists at the district and sector level and by Small-Scale Irrigation Technology (SSIT) engineers.³ Sector agronomists mobilize farmers to irrigate through extension activities, such as in-person meetings and radio shows. The sector agronomist provides information and helps farmers make decisions around irrigation, including the decision to irrigate, what system to use, what equipment to buy, what crops to plant, and how often to irrigate. Sector agronomists support farmers with filing and completing SSIT applications. Although it is not part of their official job description, sector agronomists will often advocate for farmers' financial interests if the farmer is challenged to pay his or her portion of the irrigation equipment. For example, such advocacy can take the form of agronomists helping to connect farmers to donors and microfinance institutions. SSIT engineers provide further technical assistance and support to agronomists, retailers, and farmers.

Equipment Retailers supply irrigation equipment to farmers, install irrigation systems, train farmers on maintenance and operation of the equipment, and perform repairs. SSIT retailers work with the government to provide subsidized equipment to farmers, so that more smallholder farmers can afford irrigation technology.

³In Rwanda, districts are composed of multiple sectors. There are 30 districts in Rwanda and 416 sectors.

In 2020, SSIT retailers in Rwanda included ETC Agro Tractors & Implements, Pro Water Rwanda Ltd., INTERTECH, Innovatechs Ltd., Enterprise de Construction Mixte (ECM), Water Energy Center, Holland Greentech Ltd., Ignite Power Rwanda Ltd., Open Construction & Related Services Ltd., Nikki Production Ltd., General Consultancy & Trading Company (GCTC) Ltd., Overseas Logistics General Services Ltd., and SOCOSE Ltd. Not all irrigation equipment retailers fall within the SSIT program. As explained below, program entry and participation are costly. An example of a non-SSIT equipment retailer is V&D General Trading Ltd.

Agronomic Decision Support organizations work closely with farmers to provide extension services and link farmers to markets. These functions are different to those of government agronomists, who each oversee an entire sector or district. Agronomic decision support organizations supplement the activities of the sector agronomist.

Examples include HoReCo Rwanda, the Youth Engagement in Agriculture Network (YEAN), and the Rwanda Youth Agribusiness Forum (RYAF). An important function of these organizations is to create communities of farmers that opt into their services, often through social media connections. The entities listed here are groups of young professionals that work through contracts from the government or non-governmental organizations to assist farmers in cooperatives in specific areas of the country, based on local needs.

Another type of agronomic decision support is sensor technology companies, which provide tools that help farmers to know how much to irrigate. Some companies may advise farmers when to irrigate as well. There are currently few sensor technology companies serving smallholder farmers because many farmers cannot afford sensors and do not understand the purpose and importance of sensors in agriculture. Most sensors used by smallholder farmers in Rwanda are donated. An example of a sensor technology company

serving smallholder farmers is the Seed Technology Engineering and Science (STES) Group Ltd.

Upstream and Downstream Supply Chain Partners sell input supplies paired with services and education. Agro-dealers provide seed, fertilizer, chemicals, and other inputs to farmers. Different dealerships may also offer paired advisory and extension services, such as marketing assistance or training on nutrition and post-harvest handling.

Examples include One Acre Fund, Palladium, Inades-Formation, and the Rwanda Rural Rehabilitation Initiative (RWARRI).

Aggregators help farmers get financial and technical help by bringing together various disconnected resources to support farmers and having the expertise to interface between these resources where the farmer cannot. They sometimes implement irrigation projects and are involved in monitoring and evaluation of these projects. Some aggregators will provide small grants directly to farmers.

Examples include Hinga Weze, the European Cooperative for Rural Development (EUCORD), the Clinton Development Initiative (CDI), and the Alliance for a Green Revolution in Africa (AGRA). Some aggregators assist with implementing government policies. For example, AGRA works with the government on seed production, the use of inputs, and post-harvest practices.

Finance organizations address the need of smallholder farmers for investments and loans. Non-profit organizations may give money to offset the cost of purchasing equipment. Microfinance organizations assist farmers with access to credit, which enables them to afford irrigation technologies.

Figure 1: Rwanda Smallholder Irrigation Ecosystem Map



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RWANDA SMALLHOLDER IRRIGATION ECOSYSTEM MAP

3 Primary Pathways for Smallholder Farmers (SHFs) to Irrigate:

- 1. Government & donor-funded irrigation:** a farmer is part of a group getting access to irrigation through large, managed irrigation schemes, such as the Kagitumba, Matimba, & Hinga Weze projects.
- 2. Small-Scale Irrigation Technology (SSIT) program:** a farmer purchases and owns a manual, diesel, petrol, or solar pump subsidized by the government.
- 3. Other pathways:** a farmer purchases an unsubsidized new or used pump or rents a pump from a retailer or neighbor.

RESEARCH & HIGHER EDUCATION

University of Rwanda-CAVM
 Integrated Polytechnic Regional College (IPRC)
 Rwanda Institute for Conservation Agriculture (RICA)
 Daugherty Water for Food Global Institute (DWFI)
 International Water Management Institute (IWMI)

EQUIPMENT MANUFACTURERS WITH WHOLESALE & RETAIL NETWORKS

Large-scale Irrigation:
 Valmont Industries, Jain Irrigation, Lindsay Corporation, Netafim, Rivulis Irrigation Ltd.
Small-scale Irrigation:
 Davis & Shirliff, KOSHIN Ltd., Honda, Vlasis Industrial Co. Ltd., LORENTZ, KickStart International, Sonatubes Ltd.

RWANDA DEVELOPMENT BANKS & FUNDS

Development Bank of Rwanda
 Rwanda Green Fund – FONERWA
 Business Development Fund (BDF)

MULTILATERAL ORGANIZATIONS & FOREIGN GOVERNMENT AID ORGANIZATIONS

International Fund for Agricultural Development (IFAD)
 U.S. Agency for International Development (USAID)
 Korea International Cooperation Agency (KOICA)
 Japan International Cooperation Agency (JICA)
 Food and Agriculture Organization of the UN (FAO)
 International Finance Corporation (IFC)
 World Food Program (WFP)
 The World Bank

Aggregators

- Hinga Weze
- European Cooperative for Rural Development (EUCORD)
- Clinton Development Initiative (CDI)
- Alliance for a Green Revolution in Africa (AGRA)

Agronomic Decision Support

- HoReCo Rwanda
- Youth Engagement in Agriculture Network (YEAN)
- Rwanda Youth Agribusiness Forum (RYAF)
- Seed Technology Engineering and Science (STES) Group Ltd.

Equipment Retailers

- ETC Agro Tractors & Implements
- Pro Water Rwanda Ltd.
- INTERTECH
- Innovatechs Ltd.
- Enterprise de Construction Mixte (ECM)
- Water Energy Center
- Holland Greentech Ltd.
- Ignite Power Rwanda Ltd.
- Open Construction & Related Services Ltd.
- Nikki Production Ltd.
- General Consultancy & Trading Company (GCTC) Ltd.
- Overseas Logistics General Services Ltd.
- SOCOSE Ltd.
- V&D General Trading Ltd.

Government Extension & Advocacy

- Sector Agronomist
- District Agronomist
- Small-scale Irrigation Technology Engineer

Banking & Finance

- World Vision
- SNV Rwanda
- Oxfam – Duterimbere
- Bank of Kigali
- KCB Bank Rwanda Ltd. (KCB Group)
- Equity Bank Rwanda Ltd. (Equity Group)
- Umurenge SACCO
- COPEDU PLC
- Urwego Bank

Upstream & Downstream Supply Chain Partners

- One Acre Fund
- Palladium
- Inades-Formation
- Rwanda Rural Rehabilitation Initiative (RWARRI)



GOVERNMENT ORGANIZATIONS

Ministry of Local Government (MINALOC)
 Rwanda Agriculture and Animal Resources Development Board (RAB)
 Ministry of Agriculture and Animal Resources (MINAGRI)
 National Agricultural Export Development Board (NAEB)
 Rwanda Environment Management Authority (REMA)
 Rwanda Water Resources Board (RWRB)

OPERATION & MAINTENANCE ON GOVERNMENT PROJECTS

Rural and Civil Engineer Consultants Ltd. (RCEC)
 CIMA International Inc.

Rwanda Smallholder Irrigation Ecosystem Map

Examples of non-governmental organizations that provide subsidized inputs include World Vision, SNV Rwanda, and Oxfam – Duterimbere. Examples of banks that make loans to smallholder farmers include Bank of Kigali, KCB Bank Rwanda Ltd. (KCB Group), Equity Bank Rwanda Ltd. (Equity Group), Umurenge SACCO, COPEDU PLC, and Urwego Bank.

Equipment Manufacturers with Wholesale & Retail Networks design, produce, and market equipment, including pumps, pipes, accessories, and spare parts, that are used in irrigation schemes serving smallholder farmers, or owned by individual smallholder farmers. Equipment manufacturers influence the function, quality, and cost of irrigation equipment available in Rwanda. The companies that own the brands do not necessarily own the manufacturing facilities that make the equipment. This category includes manufacturers that manage their own distribution networks and may work directly with equipment retailers or government agencies on the ecosystem map.

Examples of large-scale irrigation manufacturers used by smallholders include Valmont Industries, Jain Irrigation, Lindsay Corporation, Netafim, and Rivulis Irrigation Ltd. Examples of small-scale irrigation manufacturers are Davis & Shirliff, KOSHIN Ltd., Honda, Vlasis Industrial Co. Ltd., LORENTZ, KickStart International, and Sonatubes Ltd. Dayliff, Honda, Koshin, and Vlasis are the most common pump brands in Rwanda based on our observations and experience.

Research & Higher Education institutions create and spread knowledge to people helping smallholder farmers. They study irrigation and agriculture to develop best management practices. These

institutions also train future leaders in agriculture. They offer extension services to smallholder farmers, though this is not their primary function.

Examples include the University of Rwanda-CAVM, Integrated Polytechnic Regional College (IPRC), the Rwanda Institute for Conservation Agriculture (RICA), the Daugherty Water for Food Global Institute at the University of Nebraska (DWFI), and the International Water Management Institute (IWMI).

Multilateral Organizations & Foreign Government Aid Organizations fund and implement different irrigation projects, ranging from large investments in infrastructure to small pumps for farmers. These organizations are often mission-driven and can focus on objectives such as climate change resilience or childhood nutrition. Multilateral organizations leverage their funding to bring together partners and shared financing for projects. In addition to financing, multilateral organizations provide their own technical and extension support.

The Sustainable Agricultural Intensification for Improved Livelihoods, Food Security and Nutrition Project (SAIP), supervised by the Food and Agriculture Organization of the United Nations and the World Bank in collaboration with the government's National Early Childhood Development Program, is an example of the collaborative work multilateral organizations do in Rwanda. Other examples of multilateral organizations and aid organizations include International Fund for Agricultural Development (IFAD), U.S. Agency for International Development (USAID), Korea International Cooperation Agency (KOICA), Japan International Cooperation Agency (JICA), International Finance Corporation (IFC), and the World Food Program (WFP).

Development Banks & Funds receive money from sources such as donors and multilateral organizations for specific purposes including access to irrigation, nutrition education, and post-harvest handling training. Development banks hold these funds and distribute money to other banks and organizations, such as cooperatives and businesses, that meet the criteria for receiving funds. Individual farmers and start-up founders can also apply for grant funds or loans.

Examples include the Development Bank of Rwanda, Rwanda Green Fund – FONERWA, and the Rwanda Business Development Fund (BDF).

Rwanda Government Organizations create, implement, and enforce policies related to irrigation and agriculture. The government sets goals for irrigated land and irrigation equipment sales and tracks progress towards these goals. Government organizations regulate, research, and recommend best practices for many activities, including food processing, post-harvest handling, export of agricultural commodities, land management, seed production, and access to water resources. The government also directs investments in agriculture and irrigation, including managing the SSIT subsidy program and implementing large-scale irrigation projects. Government agencies work closely with other partners, including the private sector, non-governmental organizations, and multilateral organizations to implement projects and create policy.

Examples include the Ministry of Local Government (MINALOC), Rwanda Agriculture and Animal Resources Development Board (RAB), Ministry of Agriculture and Animal Resources (MINAGRI), Rwanda Water Resources Board (RWRB), National Agricultural Export Development Board (NAEB), and Rwanda Environment Management Authority (REMA).

The Rwanda Water Resources Board (RWRB) ensures the availability of sufficient water resources for sustainable development and is directed to monitor water use in the country and to enforce

permitting requirements. Permitting gives water use rights to farmers, cooperatives, and water users associations for agricultural irrigation, livestock, and home consumption. RWRB coordinates with other organizations, such as the Rwanda Agriculture and Animal Resources Development Board (RAB), to help farmers apply for water use permits. While the permitting process exists, the government currently does not monitor water use at a field level or enforce irrigation water use restrictions for smallholder farmers. Smallholder farmers also do not pay for the irrigation water that they use.

Operation & Maintenance on Government Projects is done by civil engineering consultancy and construction businesses. These companies help to ensure that government-funded projects are well maintained and function as designed. They are selected through government tender. Examples include Rural and Civil Engineer Consultants Ltd. (RCEC) and CIMA International Inc.

The smallholder irrigation ecosystem map is a high-level overview of the actors influencing irrigation and entrepreneurship in Rwanda. We provide a more in-depth analysis of the market for irrigation pumps in the following section.

Cost Range of Most Common Irrigation Systems

Multiple kinds of irrigation systems are subsidized through the SSIT program, with a corresponding range of costs. The three common systems in Rwanda are described below, from the least to the most expensive. The primary factors that determine which irrigation system a farmer purchases are 1) need for irrigation, 2) size of the farm, and 3) cost of the system.

Manual Pumps plus Suction and Hose Pipe: These pumps are the least expensive on the list of SSIT equipment. For example, a treadle pump with foot valve discharge of 4000 liters/hour at total dynamic head (TDH) of 13 meters, with a 3-meter lens suction pipe (32 mm diameter) and suction lift of 5-7 meters, plus a delivery pipe of at least 15 meters costs 90,000 RWF (90 USD). Treadle pumps are commonly used by farmers with small land holdings and those collecting or pumping water for cattle. A farmer may also decide to buy a treadle pump because it's the type that they can afford to purchase. In addition to the lower purchase cost, there are no other operating costs such as buying fuel or diesel.



Petrol or Diesel Pumps plus Suction and Hose Pipe: These pumps are in the middle of the cost range and are the most common system. Many farmers prefer petrol pumps due to their moderate cost and ease of use. According to the SSIT price list, the price range for a petrol pump is between 87,500 and 300,000 RWF (87.50 to 300 USD). These pumps are often purchased with suction and hose pipes, which adds about an additional 83,500 to 150,000 RWF (83.50 to 150 USD). Even though there are operating costs associated with petrol or diesel pumps, farmers prefer these pumps because they are affordable, commonly available on the market, and less labor-intensive than treadle pumps. We estimate that 70 percent of the equipment purchased through SSIT is petrol/diesel pumps.

Cost Range of Most Common Irrigation Systems



Solar Pumps with Sprinklers or Drip

Although drip and sprinkler systems are part of the subsidy program, they are expensive. Drip and sprinklers are used by farmers with larger land sizes, from 1-10 ha. The cost of operation and maintenance is high compared to other systems. Smallholder farmers often can't afford these kinds of systems, which are usually accompanied by solar or electrical pumps. Small-scale farmers acquire such systems via donor partners such as Hinga Weze, or via government-funded projects.



Key Findings from Discovery Interviews

Overall, the market for small irrigation pumps has numerous growth opportunities for entrepreneurs and private-sector solutions, as well as for entrepreneurial nongovernmental organizations and government agencies. Smallholder farmers make choices about what products they want to purchase based on their needs and available resources. Entrepreneurs, in turn, respond to those needs by creating start-ups and businesses. The following five key insights are aimed at people and groups who want to promote and support irrigation entrepreneurship – including the Government of Rwanda, multilateral organizations, donors, development banks, and start-up founders. In order to do so effectively, it's important to understand the existing supply chain, distribution channels, customer types, challenges, and opportunities.

Insight 1. All pumps are imported, and they come from multiple countries. Different technologies are primarily sourced from different countries. Dubai is an important intermediary wholesale market.

Common irrigation pump brands in Rwanda are Koshin, Honda, Dayliff, and Vlais for diesel or petrol pumps; Lorentz for solar pumps; and KickStart for manual pumps. Koshin and Honda pumps are Japanese made, while Dayliff, Vlais, and KickStart pumps are made in China. Lorentz solar pumps come from Germany. Some companies and brands, such as Koshin, Davis & Shirliff, and KickStart, outsource their manufacturing. Lorentz is a known exception; they own their own manufacturing facilities (Table 1).

Most irrigation equipment will pass through wholesale distribution in Dubai before arriving at retail shops in Rwanda (Figure 2). Dubai is home to many wholesale equipment businesses, whose business models are based on intermediation. A wholesaler in Dubai imports equipment shipped in bulk directly from the manufacturer. The wholesalers maintain an inventory of various pump brands and specifications, as well as accessories and parts. Wholesalers do not sell directly to the end user, in this case the smallholder farmer. Rather, they sell to equipment wholesalers and retailers in Rwanda.

Manufacturing in Rwanda:

No irrigation pumps are manufactured in Rwanda. Local manufacturing is limited to pipes, metal fabrication, and small parts, including polyvinyl chloride (PVC) and high-density polyethylene (HDPE) pipes, water tanks, and sprinkler rain guns.

Table 1. Common Small Pump Brands in Rwanda

Pump Brand	Pump Type	Headquarters	Manufacturing Location
Koshin	Diesel/petrol	Japan	Japan
Honda	Diesel/petrol	Japan	Japan
Dayliff*	Diesel/petrol	Kenya	China
Vlais	Diesel/petrol	China	China
Lorentz	Solar	Germany	Germany
KickStart	Manual/Treadle	U.S.	China

*Owned by Davis & Shirtliff

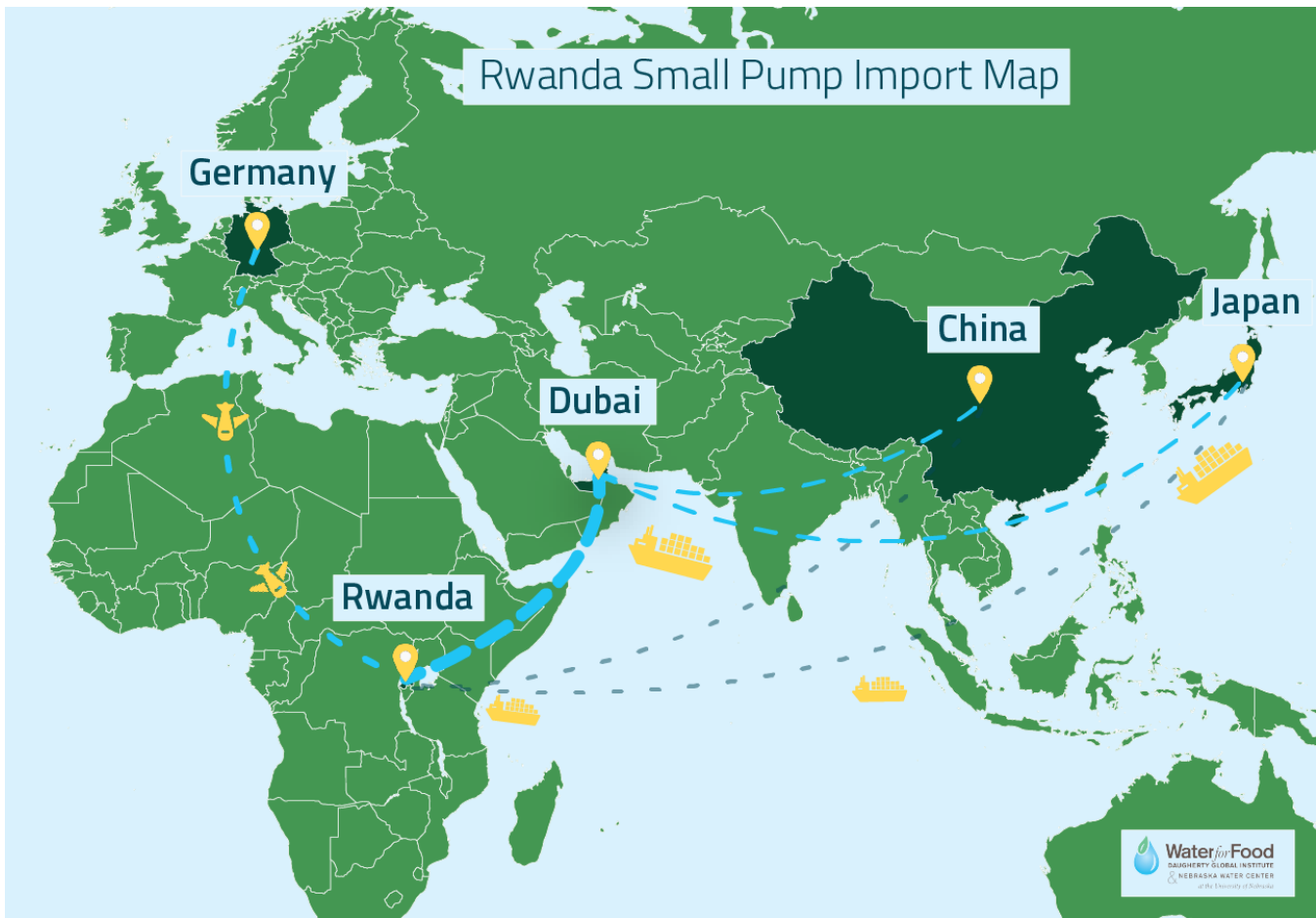


Figure 2. Rwanda Small Pump Import Map

Key Findings from Discovery Interviews

Factors that make Dubai an attractive market for distributors of irrigation equipment purchasing from Rwanda include easy and cheap travel connections, the availability of different types of equipment in one place, a range of equipment quality, minimal regulations, and short shipping times. According to equipment distributors in Rwanda, it takes 2 to 3 weeks to transport irrigation equipment from Dubai to Rwanda, whereas it takes 2 to 3 months to get irrigation equipment shipped from China or other countries. Especially for small quick deals, Rwandan retailers order from Dubai. When retailers are targeting a large market or anticipating a high demand over an extended period, they may place orders to be shipped from China because they can buy in bulk at discounted prices and can ship one full container or more.

Within Rwandan irrigation equipment distribution networks, some equipment is kept in stock in retail stores, while other equipment is ordered on demand. Equipment that is always in stock includes diesel and petrol pumps and hose pipes, because smallholder farmers use these items widely and demand is high in the dry season of June to September. Additionally, hose pipes are often replaced, which creates high demand. Equipment that is not usually kept in stock includes dam sheets and solar powered pumps. In fact, many distributors are not interested in selling dam sheets, as they must be ordered in large quantities and demand may be low. The retailers we spoke with had mutually agreed that only one of them would sell dam sheets for this reason. For solar, the level of demand is still low, and the equipment cost is high, so it does not make sense for retailers to keep a large inventory. Solar pumps are ordered by request and transported by cargo plane due to the small quantities ordered and the relatively high prices, making the shipping time quick.

Based on our interviews with irrigation entrepreneurs, we estimate that currently the number of irrigation pumps sold in Rwanda each year is in the low thousands (likely less than 2,000). Despite these modest numbers, the market for irrigation pumps among smallholder farmers is sufficiently developed that there is both brand awareness and preference. The market also exhibits price and quality differentiation as well as opportunity for growth.

From our interviews, we identified the primary ways that brand awareness spreads in smallholder farming communities and factors that are most important to farmers when expressing brand preference. The sound of an irrigation pump running can catch the attention of farmers nearby, who often work close together by swamps and surface water. Farmers learn about brands by word of mouth, from seeing or hearing about a neighbor who successfully used a pump, and from government agronomists who recommend brands. Smallholder farmers have very little exposure to direct marketing for irrigation brands. The factors that are most important to farmers when evaluating different brands are quality and cost. Farmers want pumps that will be reliable, durable, easy to use, and not too expensive.

Insight 2. The distribution channel for irrigation pumps flows from the manufacturer to a wholesaler or retailer, then to the smallholder farmer. Varying demand for irrigation across the country has led to regionalization of marketing channels.

In Rwanda, most irrigation retailers are independent business owners, and they sell various brands in their stores. They are not franchises and do not have an exclusivity agreement with any specific manufacturer. For those retailers who depend on the SSIT program for equipment sales, the program requires various

equipment brands and specifications (See Insight 3 for more on SSIT). Entrepreneurs in Rwanda have created relationships with manufacturers and wholesalers who can deliver the products that meet those requirements. Based on our interviews, we identified four ways that entrepreneurs selling irrigation pumps in Rwanda can currently get the equipment into their shops (Figure 3).

i. Wholesale market in Dubai

Most of the pumps used in Rwanda are manufactured from multiple countries but sourced through Dubai. Equipment shipped from Dubai is primarily diesel and fuel pumps, rain guns, hose pipes, and other pump accessories. Based on our research, we estimate that around two-thirds of the irrigation equipment in Rwanda is shipped from Dubai.

Retailers usually place orders from wholesalers with whom they have an established relationship by

phone call, direct message, or email. We spoke with one Rwandan pump retailer who uses WhatsApp to order pumps from his supplier in Dubai; the supplier’s contact information is viewed as a well-guarded secret. These transactions are generally paid by wire transfer. Ordering and taking payment through a website is less common. Retailers in Rwanda also work with third-party logistics companies to provide ground transportation for shipments once they reach the port of arrival.

ii. Regional sales offices of irrigation pump brands

Irrigation entrepreneurs may also order branded equipment from regional sales offices. An equipment dealer may choose this option because their customers want a specific pump brand, and the company already exists in Rwanda. For example, Davis & Shirliff (D&S) has a sales shop in Kigali and

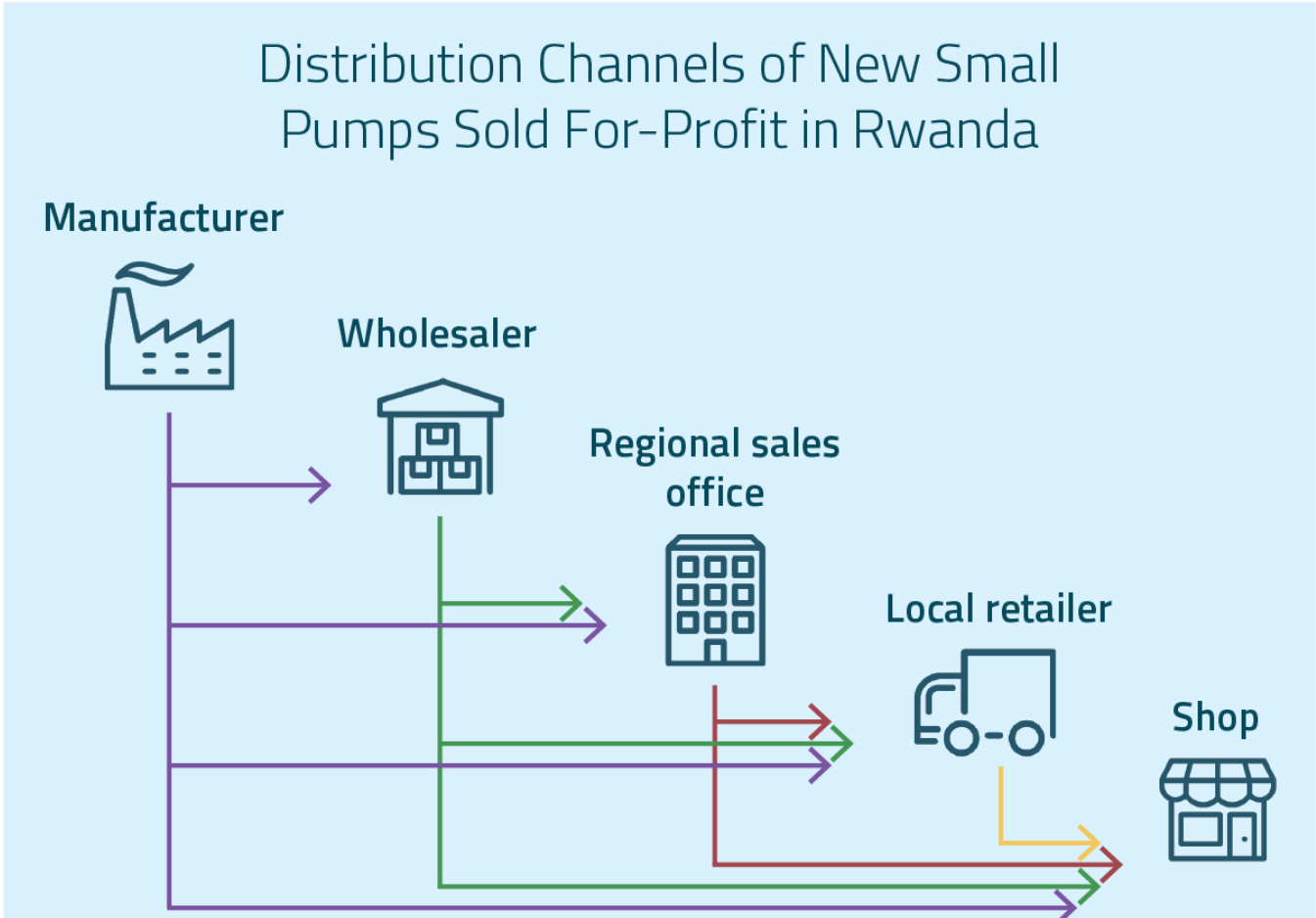


Figure 3. Distribution Channels of New Small Pumps Sold For-Profit in Rwanda

Key Findings from Discovery Interviews

retains strong control over their supply chain of Dayliff equipment. In our interview, D&S explained that they do not ship their equipment directly to the entrepreneur, but rather to their sales office who then sells on to local dealers. Retailers in Rwanda cannot order Dayliff pumps from D&S in Kenya or China without approval from the Kigali office.

Multiple entrepreneurs we spoke to, including SOCOSE, ECM, and INTERTECH, purchase Dayliff pumps from D&S in Kigali. Unsurprisingly, some retailers also reported that it is more expensive to buy pumps in Kigali than to order similar pumps from China or Dubai

iii. Local equipment retail markets

An equipment dealer may choose to order irrigation equipment from other local retailers. This option is useful when a dealer needs only a few pumps (e.g., less than 5) and is not expecting restocking soon. A dealer is likely to use this option depending on the relationship they have with other retailers.

The local equipment retail market can include shops whose primary inventory is irrigation equipment, as well as general hardware shops that sell or rent accessories, generators, and various pumps. In our interviews, one irrigation entrepreneur who is not an SSIT distributor, V&D, mentioned that – in addition to selling pumps to farmers – they also sell pumps and accessories to other retailers. This does not mean, however, that V&D is a wholesaler; they maintain a smaller inventory than a wholesaler.

iv. Direct from manufacturer or factory

In cases where equipment quality is an issue of concern, a distributor may choose to order equipment directly from a manufacturer with a good reputation rather than from a third party. Also, retailers may

order from the manufacturer or factory if there are no regional sales offices, or if they have a large order for many irrigation pumps and can receive a lower price by ordering and shipping in bulk.

For example, Lorentz solar irrigation equipment is recommended by RAB under the SSIT program, but Lorentz doesn't have a regional sales office in Rwanda. Retailers thus order Lorentz solar pumps directly from the manufacturer in Germany. These orders are usually for a small number of pumps, which are transported via freight plane. Some retailers we spoke to also order diesel/petrol pumps directly from factories like Vlais in China.

The relationship between the dealer and the manufacturing company or factory can also influence the ordering decision. In the case of Lorentz, they offer after-sale service which is a bonus on top of buying their equipment. Lorentz has a program that supports their clients where they send their technicians in Rwanda to train the retailers' technicians on operation and maintenance.

⁴Ministry of Agriculture and Animal Resources, Republic of Rwanda. 2020. Annual Report 2019-2020. <minagri.gov.rw>. Accessed 8/23/2021.

⁵Food and Agriculture Organization of the United Nations. 2021. AQUASTAT. <fao.org/aquastat>. Accessed 8/26/2021.

⁶MINIRENA-RNRA, Republic of Rwanda. 2015. Rwanda National Water Resources Master Plan. <rwb.rw/fileadmin>. Accessed 8/26/2021. Note: See Section 1.9 for recommendations on groundwater development for each of the nine major catchments in Rwanda.

The demand for irrigation varies across the country, based on topography, water resources, climate, and types of farming or other activities (Figure 4). The estimated total area equipped for irrigation in Rwanda is around 63,742 hectares, as of 2020.⁴

Reasons for regional differences in the demand for irrigation include:

- **Topography.** There is little irrigated agriculture in western Rwanda, where we find steep slopes that increase the risk of flash floods and erosion, as well as increase pumping costs to irrigate land.
- **Water resources.** The eastern part of Rwanda has abundant rivers and lakes that can be harnessed for irrigation purposes. We find a greater number of irrigation schemes in the northeastern and southeastern parts of Rwanda compared to other areas. So far, the vast majority of irrigation in Rwanda is from surface water. As of 2017, 99 percent of the irrigated area in Rwanda was served by surface water and only 1 percent from groundwater.⁵ However, there is opportunity to expand groundwater irrigation in the country.⁶
- **Climate.** Irrigation demand depends on both temperature and precipitation. Eastern Rwanda is both drier and hotter than western portions of the country. These areas have more irrigation in place, including both small-pump irrigation and other larger government and non-government irrigation schemes.
- **Farming Activity.** The demand for different types of irrigation equipment varies depending on the dominant agricultural activity. For example, in the northeastern district of Nyagatare, farmers are more likely to use dam sheets to harvest rainwater along with treadle pumps to fill drinking water tanks for cattle or to irrigate livestock fodder. Also in this area, there are relatively large farms (4-10 hectares), and farmers are starting to benefit from solar irrigation. In comparison,

in the southeastern district of Kirehe, diesel and petrol pumps are preferred, as they are easily accessible, easy to use, and reliable to irrigate cash crops like tomatoes, onions, cabbage, eggplant, green peppers, and French beans.

Insight 3. A government subsidy program has altered and segmented the retail sales process for small-scale irrigation equipment.

Overall, the small irrigation pump market has been segmented into two parts: equipment sourced by the government's Small-Scale Irrigation Technology (SSIT) program and non-SSIT equipment. Subsidized equipment is sold only through approved SSIT retailers. These retailers have responded to a government tender, met certain requirements for selection, and signed a contract with the Rwanda Agriculture and Animal Resources Development Board (RAB). The SSIT contract lists equipment that can be sold through the SSIT program as well as the price. A variety of equipment is covered by the program, including petrol, diesel, solar, and manual pumps, dam sheets, hoses, and piping. Most of the specifications listed in the contract do not include mention of a particular equipment brand; equipment retailers can choose the brand or model that they supply that meets the program requirements. For accepted equipment, the government pays the retailer the farmer's subsidy of 50 percent or 75 percent of the list price. The program is tiered and provides higher subsidy levels to economically disadvantaged farmers.

Participating in the SSIT program comes with certain barriers and risks for retailers. To be approved to sell equipment through SSIT, entrepreneurs must have at least five years of experience in selling and installing irrigation equipment. This is a barrier to start-ups that lack the experience that established companies have.

Key Findings from Discovery Interviews

Approved SSIT retailers must also provide a performance guaranty of 5,000,000 RWF (5,000 USD), which they can recover only if they stop participating in the SSIT program. The deposit serves as a guarantee that the retailer will correctly install and repair equipment sold to smallholder farmers. The deposit represents a barrier to entry as it is equivalent to providing the government a zero-percent interest rate loan; access to 5 million RWF in cash is not feasible for most start-ups.

The contract between the SSIT retailer and the government stipulates that the retailer delivers and repairs equipment (within a 1-year warranty period) to the farmer. This can be costly – especially if the retailer often delivers equipment far away from where they operate – since transportation, installation, and repair fees are not covered within the cost of the subsidized equipment paid for by RAB. In an interview with SOCOSE, they told us that transportation of irrigation equipment to customers is a challenge for them in some areas because it is not included in the SSIT cost structure. Partly due to the transportation issue, some of the distributors have branches in multiple districts, to allow operations closer to their customers.

When a farmer applies and gets approved for the SSIT subsidy, it is the responsibility of the retailer, not the farmer, to collect the government portion of the subsidy. During our interviews, retailers reported that a challenge with selling equipment through the SSIT program is that irrigation equipment may leave shops without full payment, because payments from RAB can be delayed. Additionally, SSIT retailers cannot deliver equipment to farmers if they do not have an active contract with RAB. Long procedures for signing these government contracts can cause delays and uncertainty

in getting equipment to farmers.

Such risks can be offset by substantial returns for being in the program. Retailers registered to sell SSIT equipment have a wide range of customers. Since most farmers are smallholders, some of them cannot afford to buy irrigation equipment except with the government subsidy. This increases the demand for irrigation equipment.

Government agronomists and RAB raise awareness of irrigation and SSIT opportunities throughout the country. This increases demand for irrigation equipment and brings in new customers. It also lowers retailers' customer acquisition costs, since SSIT retailers don't have to go out looking for customers; customers come to them on the recommendation of government agronomists.

Retailers who sell equipment under the SSIT program also get exposure to larger markets. In past projects where NGOs supported smallholder farmers, it has been SSIT program-participating retailers that supplied the irrigation equipment. This includes cases when NGOs paid an additional subsidy for small pumps to farmers, as well as for large government and NGO funded projects, such as Hinga Weze. In fact, the most profitable contracts for entrepreneurs are in supplying large irrigation schemes, and SSIT retailers have an advantage in this area.

Within the private sector, well-established businesses (retailers) with good cash flow benefit the most from SSIT. These businesses do not struggle to pay the 5 million RWF warranty or have to worry about delays in the government paying for the subsidized portion of equipment costs. In some cases, irrigation equipment is only a small portion of equipment retailers' business, and this makes it easier to deal with the entry costs of program participation (e.g., Holland Greentech).

The SSIT program also presents several barriers to farmers. Even though farmers can get the equipment at 50 percent or 75 percent off the original price, they must pay the remaining 25 to 50 percent of the cost upfront to receive the equipment. This can be challenging since the farmers targeted for the SSIT subsidy are smallholders, who aim to use irrigation in part to raise their income. Farmers must take the risk to invest first, sometimes putting their home or property up as collateral for a loan, before seeing any benefits.

Among farmers, those in cooperatives have benefited the most from the SSIT program since members of a cooperative can share the upfront cost of the subsidized equipment compared to an individual smallholder farmer, who will pay the amount alone. When smallholder farmers are grouped in cooperatives, they also benefit from NGO financial support, as most NGOs tend to finance farmers in cooperatives rather than individual farmers (See Insight 5 for more information).

From interviews that the team conducted, retailers mentioned that there are farmers who buy irrigation equipment without government subsidy, meaning outside of the SSIT program entirely. Some of the reasons that a farmer might buy irrigation equipment without using the government subsidy include:

- **Awareness.** There are cases where farmers are not aware of the subsidy program. This may vary by district in part due to the effectiveness of the outreach campaigns by the sector and district agronomists.
- **Time.** The farmer might need the equipment quickly, for example to keep their crops alive during the dry season, which may influence them to buy the equipment without the subsidy. For farmers to buy equipment using the subsidy they must apply and follow procedures, which take about 2 weeks if the equipment is available in the store or about a month if out of stock.
- **Availability.** Equipment could be out of stock locally and it might take extra time, travel, or

Used Pump and Rental Market

Used pumps may be rented between farmers or rented and sold at equipment shops. Farmers we spoke with in Ruhuha and Nyamata sectors told us that the rental price is negotiable between farmers. Farmers have different preferences such as renting only the pump, the pump plus petrol/diesel, or irrigating the fields of their neighboring farmers and getting paid for both the work and the irrigation equipment used. In Bugesera district and sector, one farmer's rental fee is 1,000 RWF (1 USD) per 1 liter of petrol used. The pump owner is not responsible for providing petrol, and this makes the cost of renting the pump 2,000 RWF (2 USD) as 1 liter of petrol costs 1,000 RWF.

At a hardware store (Quincaillerie) located in Nyamata Sector, Bugesera District, the owner said she rents irrigation pumps at 20,000 RWF (20 USD) per day, but the price is negotiable. The challenge with rental services is mainly associated with terms and conditions. For example, it is often difficult to know who will be responsible for repair costs in the case of any damages.

Key Findings from Discovery Interviews

effort to get the equipment. As a result, the farmer might choose to buy the pump from another nearby retailer that does not sell subsidized equipment.

- **Eligibility.** The government subsidy has different criteria when it comes to who qualifies, including farmers' socio-economic class and the total land they rent or own. Farmers sometimes don't qualify for the SSIT subsidy and hence buy the equipment at full cost.
- **Government Oversight.** Some farmers don't want the government to control or conduct follow-up checks on their agricultural activities after being part of the subsidy.
- **Price Competition.** Non-SSIT retailers may be selling some items at a lower price than 50% of the subsidy. One retailer we interviewed, V&D General Trading Ltd., says they can offer less than the SSIT price on some equipment. This suggests that there may be some price inflation occurring as a result of the SSIT program itself.
- **Rental Market.** Farmers might also find renting cheaper and easier than buying their own pump. A farmer might rent the pump from a neighbor and pay a certain fee for the pump and to buy fuel, but this depends on the pump owner and the renters. Informal pump rental markets are widespread, though quite variable in terms of structure, across Rwanda.
- **Donations.** Some farmers might not use the SSIT subsidy because they received pumps from donors. Rwandan farmers have received support from various non-governmental

organizations, such as the Clinton Foundation, Feed the Future – Hinga Weze, and World Vision. For example, farmers in Bugesera and Ngoma have received solar pumps from donors.

Insight 4. Government agronomists at the sector and district level have a highly influential role in the subsidized pump market.

Agronomists play a critical role in the SSIT program. They oversee processing of SSIT applications and determine if all program requirements have been met. Agronomists work closely with smallholder farmers and retailers and influence farmers' decisions of what equipment to buy, what brand to buy, and what store to buy from. Smallholder farmers often easily agree with what agronomists recommend because of the common belief of farmers that the agronomist has more knowledge and experience than they do.

At the time of an SSIT application, the smallholder and agronomist discuss the farmer's needs and what irrigation system is suitable. Agronomists recommend specifications of irrigation equipment to purchase and may also recommend a specific brand. Agronomists amplify the word-of-mouth message for brand awareness. They talk to many different farmers about which pumps work the best and are the most reliable over time, and they accumulate and pass on that information.

Once the equipment list is determined, agronomists give the farmer a list of approved retailers in their district. The agronomist can help farmers to reach out

Farmers who received SSIT Equipment per District

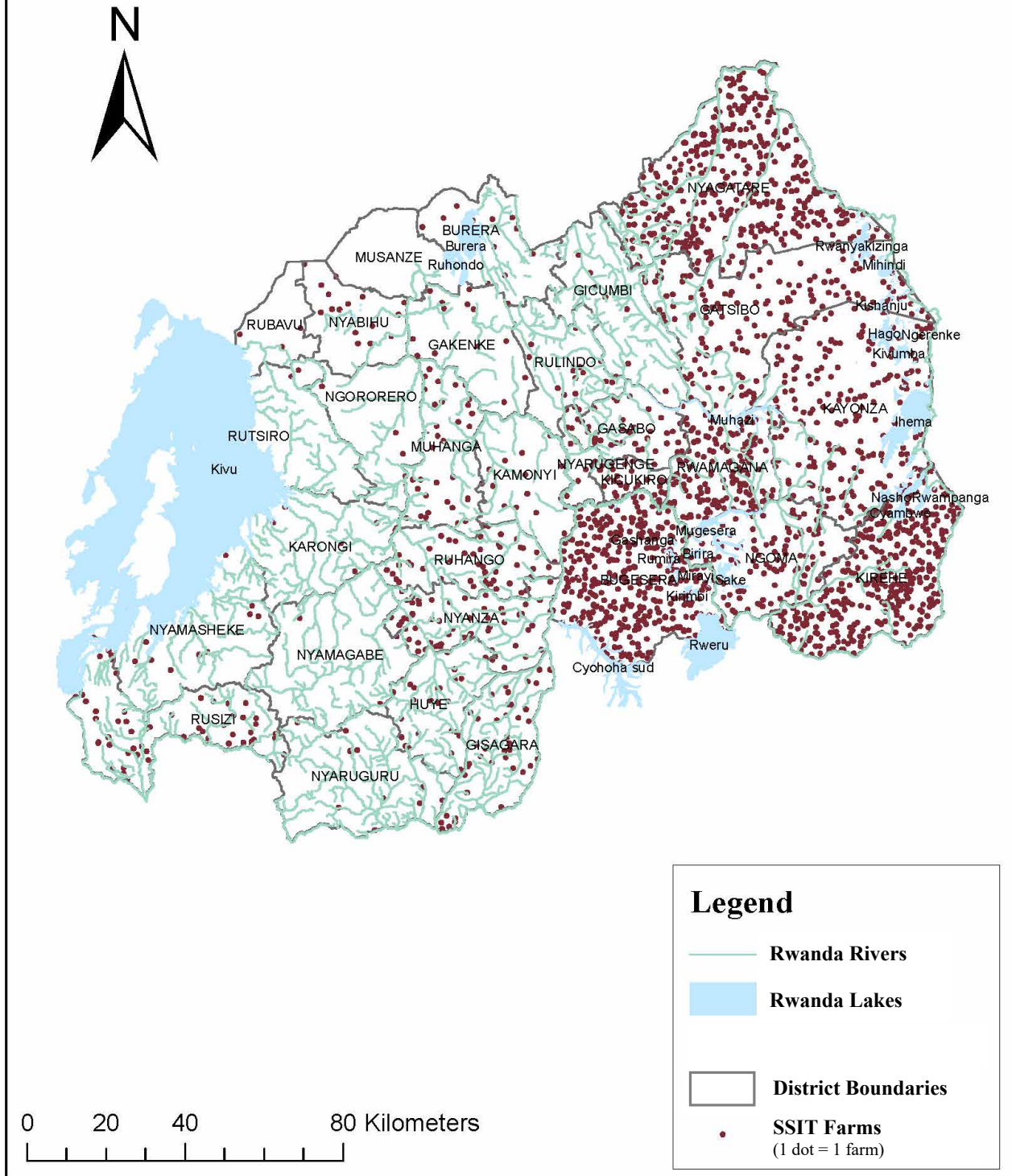


Figure 4. Locations of SSIT Recipients in Rwanda, 2014 - 2017
 (Source: RAB)

Key Findings from Discovery Interviews

Who has a say?

When it comes to deciding what irrigation system, technical specifications, or equipment brand a smallholder farmer will purchase, multiple people can give advice and make decisions at different times. The agronomist usually advises the farmer at the time of the SSIT application. Retailers and SSIT engineers can also influence and impact decisions, usually when it comes time to design, purchase, and install an irrigation system.

to the retailer to see if the equipment is available. An agronomist may refer a farmer to a particular retailer depending on several factors, including the relationship the retailer has with the district, what brand of equipment a retailer has in stock, how quickly and easily the shop can deliver, and the effectiveness of the shop's after-sale service. This referral reduces the customer acquisition cost for SSIT retailers and correspondingly raises the importance of the relationship the retailers have with individual agronomists.

Agronomists also influence the adoption of irrigation technology since they are meant to mobilize farmers to irrigate and engage in outreach and education events. Agronomists promote the SSIT program by informing farmers about requirements to join the program and about how the program has benefited other farmers. Agronomists increase awareness of the role of irrigation to smallholder farmers in many ways. For example, they host farming competitions and extension events. In Kirehe district, agronomists give a reward of a pump or dam sheet to the most improved farmer in the whole district, to motivate the rest of the farmers to join the program and work hard.

Agronomists also have “field days” in the district where they visit farmers and do demonstrations of how irrigation equipment, especially petrol and diesel pumps, is used. Across the country, there are week-long annual agricultural exhibitions in each district for agricultural entrepreneurs to showcase their goods and services. These exhibitions are open to the public and attract many guests, including businesspeople and professionals in irrigation and agriculture, seeking to learn and network. In these exhibitions, retailers demonstrate how to use equipment and technology like trucks, pivots, treadle pumps, rainwater harvesting systems, and so on. In addition, every district has a public radio show, and the agronomists use it to spread awareness of the SSIT program and other subsidies available in the district.

So, who influences the type and price of irrigation equipment for sale? In the case of SSIT sales, RAB has the most influence on the type of equipment for sale and the price. RAB administers the SSIT program and employs irrigation engineers at the

district level. Through RAB, the government releases a tender where local and international companies can bid to sell and supply SSIT equipment. In this case, RAB provides a list of approved equipment and their specifications that can be subsidized, and this is the only irrigation equipment that can be sold through SSIT. RAB also recommends some brands for irrigation equipment, like Lorentz for solar irrigation. RAB sets the price on this equipment after analyzing the market. If the price is increased by the manufacturer, RAB cannot set the price lower than that of the manufacturer. If a type of equipment is not listed by RAB it cannot be sold through the subsidy program, and the equipment listed cannot be sold above the price determined by RAB.

In the case of non-SSIT sales, retailers have the most influence on the price of equipment. Retailers are independent business owners and can set the price on the unsubsidized irrigation equipment they sell. For example, if a retailer gets a motor pump from Dubai or China at a certain cost and this pump is not registered under SSIT program, the retailer can set the price at which to sell this pump. However, RAB still has a significant influence on the type of equipment for sale in the country because of the dominance of the SSIT program. Retailers are not likely to import equipment that is not going to be sold or that is unpopular, and most of the awareness and preference for irrigation equipment comes through word-of-mouth between farmers and outreach by government agronomists, who promote the SSIT program and the type of equipment available through SSIT.

Insight 5. Social enterprises and non-governmental organizations, whose business models include knowledge aggregation and financial intermediation, also have an enhanced role in the small pump market and adoption of irrigation technology by smallholder farmers.

Technical aggregators function as a glue that helps smallholder farmers, financial institutions, donors, government agencies, and other key players work together in the agricultural ecosystem in Rwanda. NGOs often play the role of intermediary, connecting farmers with resources. Smallholder farmers do not have just one challenge: they have financial limitations, a lack of technical skills, challenges with transportation and marketing, and more. Assisting a farmer with just one service will not fix all of their problems. Many NGOs in Rwanda take a holistic approach and fill in multiple gaps in government initiatives and efforts.

NGOs play a crucial role in supporting irrigation for smallholder farmers. Even though smallholder farmers can purchase irrigation equipment with 50 to 75 percent subsidies, some farmers can't afford the remaining amount. According to interviews we had, including with staff at CARITAS Rwanda, African Evangelistic Enterprise (AEE) Rwanda, and Hinga Weze, NGOs support such farmers by providing some percentage of what the farmer is supposed to pay for the equipment, which makes the equipment more affordable/less expensive. For example, if a farmer is supposed to pay 50 percent of the equipment price, an NGO can support this farmer by paying either the remaining 50 percent or some smaller amount. In this case, the farmer applies for the subsidy, and once granted, the NGO

Key Findings from Discovery Interviews

contributes to the farmer's portion of the payment. Some NGOs (especially charity NGOs) also buy and install irrigation equipment for farmers without any monetary contribution from the farmer or applying for the subsidy.

NGOs also provide grants to the Government of Rwanda to support smallholder farmers. These grants are collected and distributed through the Rwanda Business Development Fund (BDF) or the Ministry of Agriculture and Animal Resources (MINAGRI). Beneficiaries apply for these grants and are approved for funding if they meet the conditions specified by the donor. For example, if the Clinton Foundation gives money to the Government of Rwanda and specifies that the money must go to smallholder farmer irrigation, only people with projects that include irrigation and smallholder farmers are eligible to apply for the grants through BDF.

Some NGOs also provide financial intermediation services and help farmers to get loans from banks to buy small-scale irrigation equipment. From the interviews we undertook, we learned that it is difficult for banks to work with smallholder farmers, especially when loans are involved. However, trust is increased when there is support from a known third party that provides the bank assurances of good financial and business management. Some NGOs act as that third party by helping farmers to apply for loans. An example of such an organization is the European Cooperative for Rural Development (EUCORD). EUCORD helps smallholder farmers in cooperatives with bookkeeping, applying for loans from microfinance banks, and intermediating between farmers and banks. According to COPEDU PLC, a microfinance institution headquartered in

Kicukiro district, working with farmers who are part of EUCORD programs has increased their trust in lending to smallholder farmers.

Some NGOs train farmers on using irrigation equipment, on different farming practices, and provide nutrition education (e.g. Women for Women). Different NGOs sometimes partner to help smallholder farmers. For example, EUCORD trains farmers on how to use small-scale irrigation equipment and intermediates between smallholder farmers and microfinance institutions, while ICCO Cooperation (now called Cordaid) partners with EUCORD in training farmers about bookkeeping and market access.

NGOs also influence how farmers in Rwanda organize and get access to information. NGOs prefer to work with smallholder farmers in cooperatives for several reasons:

- **Efficiency.** Working with cooperatives is more efficient. It reduces customer acquisition cost and enables NGOs to reach groups of farmers quickly and easily, which is important since NGOs have limited resources.
- **Impact.** By reaching more farmers, NGOs increase the impact of their work.
- **Risk Mitigation.** By working with farmers in groups, NGOs reduce the risks to their projects and investments. Farmers can help each other with knowledge, operations, maintenance, harvesting, payback of loans, and more.

The Government of Rwanda encourages smallholder farmers to join cooperatives so that they can benefit

from these NGO programs. NGOs often coordinate with the government, including sector agronomists, MINAGRI, or BDF. The government orients NGOs to specific districts where the need is high and fits the mission of the organization. This creates business and financial incentives for farmers to form cooperatives and may limit the assistance that smallholder farmers may receive if they are not part of co-ops.



Challenges, Opportunities & Next Steps

There is a significant opportunity to increase the irrigated area in Rwanda. Only slightly more than 10 percent of the land area with potential for irrigation is currently irrigated (63,742 hectares out of approximately 600,000 hectares).⁷ Additionally, the Government of Rwanda is prioritizing investments in small-scale irrigation technology, with an SSIT annual budget of over 150 million RWF in 2020⁸ and favorable taxation policies.⁹

By understanding the challenges and opportunities around irrigation entrepreneurship, many actors – including the Government of Rwanda, multilateral organizations, donors, development banks, and start-up founders – can develop new business models, build effective private-public partnerships, and launch or scale profitable irrigation enterprises. Based on our research, we identify several challenges and opportunities to expand private sector-led irrigation for smallholder farmers in Rwanda.

SSIT Program

Even though the Government of Rwanda provides subsidies for irrigation equipment to farmers, some farmers still struggle to afford the remainder of the equipment cost. One solution to this challenge might be to allow farmers to pay the non-subsidized portion of equipment costs in installments. This would allow more smallholder farmers to access irrigation equipment.

Additionally, RAB could formally help farmers apply for additional funds and facilitate such transactions. For example, because district agronomists oversee SSIT activities, banks currently approach the district and sector agronomists when they have some local lending incentives, and request that district staff link the lenders with farmers. In these meetings with banks, microfinance institutions, and NGO funders, agronomists often unofficially vouch for smallholder farmers and advocate for their financial interests. This advocacy fills a gap in the ecosystem and could be incorporated as an official part of an agronomist's – or another district employee's – job description. Additionally, formally involving for-profit banks, non-profit development funds, and NGOs that make loans or grants to farmers, facilitated by the government, would supplement the government's SSIT budget and increase the reach of the program.

⁷ Ministry of Agriculture and Animal Resources, Republic of Rwanda. 2020. Annual Report 2019-2020. <minagri.gov.rw>. Accessed 8/23/2021.

Rwanda Water Resources Board, Republic of Rwanda. 2021. Rwanda Water Portal. <waterportal.rwb.rw>. Accessed 8/26/2021.

⁸ Ministry of Agriculture and Animal Resources, Republic of Rwanda. 2020. Annual Report 2019-2020. <minagri.gov.rw>. Accessed 8/23/2021. Note: See Annex 4 for SSIT budget.

⁹ Irrigation retailers can benefit from favorable tax policies. All agricultural equipment and inputs are Value Added Tax (VAT) exempt.

An additional barrier to more businesses participating in the SSIT program is the high deposit retailers must pay to participate in the program (a guaranty of 5 million RWF, equivalent to 5,000 USD). One pathway for increasing retailer participation in the SSIT program is for NGOs or development banks to support entrepreneurs by paying the SSIT deposits for smaller, or disadvantaged, retailers.

A further constraint in the SSIT program, discussed in Insight 3, is the often-long process for retailers to get payments from the district government. At least three agencies are involved in budgeting and executing financial transactions, involving multiple paper forms: the Ministry of Finance, RAB, and district governments. One possible solution to this would be to implement electronic recordkeeping that would allow forms and records to be completed, shared, and stored digitally, thus speeding up the paperwork and monitoring of financial transactions.

An opportunity within the SSIT program is to strengthen the role of agronomists and SSIT engineers in advising farmers on their irrigation schemes based on each farmer's unique needs. Most smallholder farmers, in addition to learning about irrigation from their neighbors, rely on agronomists and NGOs for advice on which irrigation technology to use. One of the NGOs we interviewed told us that they do field visits to determine which irrigation technology is suitable. Utilizing GIS databases with surface water and topographic data could reduce field work and help agronomists, SSIT engineers, and NGOs to better advise farmers on the best irrigation technology suitable in a specific region. The SSIT purchasing and reimbursement process could be sped up even further if key forms were prepopulated using available geospatial data, allowing some preauthorization to occur.

Finally, we believe the SSIT program could also have its own socio-economic criteria for subsidies and not rely on the government socio-economic categories (ubudehe). A subset of farmers who currently qualify for SSIT and generally benefit the most from the

program are those that belong in socio-economic category 3 and own land between 5-10 hectares. Though still considered a smallholder farm, this size represents a relatively large farm in Rwanda. For farmers owning between 5-10 hectares, their SSIT program subsidy could be a bit lower compared to those with smaller landholdings. This would allow the government's SSIT budget to preferentially serve the poorest farmers.

Aggregators

As discussed in Insight 5, aggregators serve an important function in the irrigation ecosystem. We believe that closer coordination with the Government of Rwanda could support aggregators to reach more cooperative groups. From the interviews we undertook, some cooperatives work with as many as four different aggregators, while other cooperatives work with none. While this perhaps reflects on the ability of cooperative leadership to manage relationships with NGOs, there is likely some inefficiency resulting from duplication of services by the NGOs.

District officials do informally advise development groups, aid agencies, NGOs, and others on which cooperatives meet their criteria for selection, such as good governance. This advisory process could be formalized and expanded. Aggregators could work with district officials in charge of cooperatives who understand the ecosystem to know which cooperatives are working well but need help that aligns with the expertise that that organization offers. Additionally, the Rwanda Cooperative Agency (RCA) is a public institution in charge of regulating, promoting, and providing support to cooperatives. One of RCA's responsibilities, together with each district, is to maintain a database of cooperatives, with basic information such as location and point of contact. RCA's database could be expanded to include a Needs Assessment for cooperatives that is accessible online.

Challenges, Opportunities & Next Steps

Repairs and Spare Parts

One challenge to scaling up small pump irrigation in Rwanda is a general lack of spare parts to repair pumps. Retailers who sell pumps through the SSIT program are required to provide a one-year warranty to farmers. After that, if a pump breaks, it is unclear what happens. There are several possibilities, including that a pump may be repaired at a general mechanic shop, repurposed, or simply discarded.

One possible solution is that existing repair shops, such as those that service other machinery, could be encouraged to expand into repairing irrigation pumps. This may happen organically as the number of irrigation pumps in use increases. There is also an opportunity for business owners who want to serve as local wholesalers of spare parts. It might be profitable for a business specializing in spare parts to pay the shipping and stocking costs to import parts in bulk and to sell them in smaller quantities to a retail network. The need for local wholesalers is contingent on demand. As more pumps are sold in the country, this business model will likely be more viable.

Additionally, RAB can encourage or require retailers who participate in the SSIT program to carry spare parts or to have a small repair shop. However, this should be done in a way that allows the retailer to make a profit on repairs. Another possibility to increase the supply of spare parts is for some retailers to become dealerships for pump brands. These dealers could be trained and supported by the manufacturer to perform repairs.

Youth Entrepreneurship

There are opportunities to raise awareness of agricultural entrepreneurship among young professionals in Rwanda and to mobilize young people to start businesses. One way to get younger people involved is to make agriculture more attractive by promoting the business and financial opportunities of the field. Aggregators who are interested in investing in youth could provide entrepreneurial workshops or courses on start-up methods that help young people know what to expect and feel prepared to start businesses around irrigation. Potential entry points in the ecosystem which we believe young entrepreneurs can access include pump rentals and irrigation as a service, acting as a local wholesaler of spare parts, or operating a franchise for an irrigation equipment manufacturer. Another role for aggregators to support entrepreneurship would be through establishing an irrigation focused start-up incubator that facilitates access to seed money, outside investors, and potential customers.



Future Research

Our research around this study highlighted several areas for future research that would improve understanding of the irrigation ecosystem in Rwanda:

- What are successful irrigation business models in place in the country, and what lessons can be learned from those case studies?
- What is the size and significance of the rental pump market, and of the market for used pumps?
- What happens to irrigation pumps reaching the end of their design life, and can operating lifetime be cost-effectively extended?
- How can opportunities for financing be extended to smallholder farmers that are not in cooperatives?
- Are there differences in adoption, financing, and ownership of irrigation technology based on gender in Rwanda?









