

Drop By Drop: Conservation, Irrigation, and Innovation

*Market Analysis and Options for Water-Productive Irrigation
Financing in Tanzania*

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About the 2030 Water Resources Group

The 2030 WRG is a global public-private-civil society partnership. It was formed at the World Economic Forum in 2008 by a group of governments, multinational companies, multilateral agencies, and international nongovernmental organizations. In 2013, the government of Tanzania invited the 2030 WRG to support the establishment of a 2030 WRG-Tanzania partnership. The partnership prioritizes agricultural water management, particularly the sustainable expansion of water-smart irrigation, which provided the motivation for this report.

About the Financial Sector Deepening Trust

The mission of the Financial Sector Deepening Trust (FSDT) is to improve the livelihoods of poor households by reducing vulnerability to shocks and increasing access to financial services for communities and businesses. This in turn will increase incomes and employment. Expanding access to agricultural finance is the FSDT's core focus in Tanzania.

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The Case for Water-Productive Irrigation in Tanzania

Economic development, led by agriculture, has put global water resources under enormous strain. The world's fresh-water use is growing at more than double the rate of population growth.¹ Conserving these finite resources, while meeting the demands of growing economies, requires focused efforts to use water more efficiently.

Tanzania has 2,300 m³ of water per capita, but lacks the capacity to store and use it effectively. More than 80 percent of the rain that falls in the country is not used for any productive or social purpose.²

Irrigation can quadruple agricultural yields.³ However, of the 29.4 million hectares available for sustainable irrigation,⁴ about 381,000 hectares are irrigated, largely using traditional methods.⁵ Only 76,000 hectares are irrigated using more productive methods.⁶

Maximizing crop per drop

The agricultural sector can reduce water losses, increase water productivity, and reallocate water through improved irrigation technology and infrastructure. This might mean lining canals to prevent water seepage, or introducing efficient irrigation methods (such as sprinkler or drip systems) that use less water.

Farmers can improve water productivity by calculating the amount of water a crop needs using real-time climate data to prevent overwatering and wastage. Improved irrigation also enables more sophisticated "fertigation": allowing farmers to feed fertilizers more directly and efficiently to crops, generating further savings.

Capturing and recycling runoff irrigation water can also increase water productivity. In some cases, water reallocation can be used to transfer water used on water-intensive crops (such as flood-irrigated rice) to more water-efficient crops (such as sprinkler-irrigated maize).

Production estimate of selected irrigated crops in Tanzania (2013)

Crop	Land under cultivation (hectares)	National output (1,000 metric tons)
Sugar	50,000	3,000
Rice	900,000	1,880
Coffee	No data	50,000
Tea	No data	25,000
Maize	4,000,000	4,700

Irrigated agriculture yields dramatic improvements, enabling up to three production cycles a year for most vegetables, as well as a second growing cycle for some of the country's vast unirrigated rice production. Without irrigation, for example, Tanzania's tomato yields are generally below 40 metric tons per hectare. With irrigation, yields can increase to 220 metric tons. In addition, irrigation allows farmers to sell produce when prices are higher, increasing gross margins on tomato sales by about 18 percent.

More water-productive irrigation could transform Tanzanian agriculture, substantially increasing the crops produced for local and export markets, and allowing farmers to extend the growing season. This is critical given the need to feed one of the fastest growing populations in the World, and will become increasingly important as East Africa gets hotter in the years to come, with more rain expected during the wet season and less rain in the dry season.⁷

Increasing the productivity of water use in agriculture in Tanzania therefore represents a significant market opportunity. It also represents a natural priority for public policy, for civil society concerned

¹World Water Organization, 2010. http://www.theworldwater.org/water_facts.php

²2030 WRG. *2015 Annual Report*. 2015.

³URT. *The National Irrigation Policy (Draft)*. Ministry of Water and Irrigation, 2009.

⁴URT. *The National Irrigation Policy (Draft)*. Ministry of Water and Irrigation, 2009.

⁵In addition, there is also a sizable area that is both unplanned and informal and hence not included in official statistics.

⁶2030 WRG. *Tanzania: Hydro-economic overview – An initial analysis*. Final Report. 2014.

⁷Hulme et al., 2001; IPCC, 2001; Osbahr et al., 2011.

about the social and environmental consequences of water shortages, and for businesses needing to maintain a social license to operate in the face of increasing water competition.

Great Ruaha and Pangani catchment areas

The Ruaha and Pangani are both agriculturally productive but increasingly water-stressed catchments. They formed the basis of this analysis of Tanzania's irrigation needs.

Great Ruaha

The 84,000 km² Great Ruaha River catchment is located in the country's southwest. Of the catchment's mean annual runoff of 3,330 mm³, an estimated 58 percent in some way supports hydropower, national parks, and irrigation abstraction for commercial sugar production. Only 13 percent is used for domestic purposes.

The river's flow varies considerably by season. A rain-fed crop can comfortably be grown during the wet season, but irrigation is needed to extend the growing season and produce a second crop cycle.

Water management is critical to the economy of the Great Ruaha. The catchment is at the heart of the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), where much of Tanzania's future agribusiness growth is anticipated. The Ruaha river contributes 50 percent of the nation's hydropower, while the Ruaha National Park is central to the second most lucrative tourism circuit in the country.

Rapid growth in population, combined with a corresponding increase in unlicensed abstraction of water by small-scale farmers, has been a major cause of the recent decline in water flows in the Ruaha. Water resources user groups play an important role in policing water use and ensuring that environmental standards are maintained, but need more support from local government authorities or leaders.

Pangani

The Pangani River basin covers the regions of Arusha, Kilimanjaro, Manyara, and Tanga over an area of about 43,650 km², mostly in Tanzania. It is home to 5 million people, a major source of commercial and subsistence agricultural production, 17 percent of the nation's electricity production, and a host of world renowned biodiversity hotspots critical for the country's tourism industry.

These diverse interests have at times led to conflict between water users, conflict over the right to manage resources, and conflict between users in different locations. The growing demand for water resources has damaging results. The basin's forests are being depleted and high demand for resources has led to the basin being classified as "water-stressed" (1,200 cubic meters per capita, compared to 2,300 cubic meters per capita for Tanzania as a whole).

Agricultural production is suffering due to water shortages throughout the basin. To address water scarcity, underground water can be tapped and investments made in water harvesting for domestic use. However, investments have been limited to sporadic and ad-hoc investments across the public sector, private sector and civil society.

Driving Forces Influencing the Irrigation Sector

Farmers in Tanzania have access to a range of irrigation technologies from local, regional, and international suppliers. Basic water storage and irrigation equipment, such as tanks and small-scale drip kits, are readily available and offer potentially attractive returns, but farmers often lack the finances, knowledge, and markets to justify adopting new water-productive technologies and approaches.

Sample of water-related programs, projects, and initiatives

A selection of programs to improve farmers' water management and protect the environment include the following:

- *The Water Sector Development Program* – an amalgamation of the Water Resources Management Program, the National Rural Water Supply and Sanitation Program, and the Urban Water Supply and Sewerage Program. The program aims to address shortfalls in urban and rural water supply infrastructure, improve water resource management, and strengthen sector institutions.
- *Government Agriculture Programs* including the Agriculture Sector Development Program and the Big Results Now initiative, which are improving water availability for crops in the Pangani and Rufiji basins. The government also aims to increase sugar production by 150,000 million metric tons.⁸ The target is to set up 25 commercial farming deals for rice and sugarcane, and pilot professionally managed collective rice irrigation and marketing programs in 78 sites.
- *The Southern Agriculture Growth Corridor of Tanzania*, which is working to connect and coordinate sustainable agribusiness development in the south of the country.
- *Major donor programs* including notably by the World Bank, DFID, USAID and JICA. For example, REGROW, a pipeline World Bank project with a \$100 million budget, will support the government's sustainable environmental and wildlife management efforts in the Ruaha region. The project is also expected to help smallholder farmers with water efficiency and sustainable irrigation.
- *The Financial Sector Deepening Trust*, which is working with the 2030 WRG on an irrigation financing facility.

⁸URT. *National Key Result Areas Agriculture – Tanzania Development Vision 2025 Big Results Now Roadmap*. 2013. Accessed February 4, 2016. <http://www.pdb.go.tz/documents/Roadmaps/01.%20Tanzania%20BRN%20Roadmap%20-%20NKRA%20Agriculture.pdf>.

Saving and storing water: Ponds, dams, and tanks

Tanzanian farmers and households have developed a range of water-storage systems:

- *Ndiva* are small communal ponds that store water overnight. They are common in mountainous districts such as Same and Lushoto.
- *Malamboare* man-made ponds that are dug in relatively flat areas and strategically located to harvest as much runoff as possible. They are common in semi-arid parts of the country like Kilimanjaro, Dodoma, Singida, Tabora, Mwanza, and Shinyanga. Minimizing evaporation losses is the main challenge.
- Sand dams are dug in the bottom of seasonal rivers to store water. This is common in Dodoma, Mwanza, Shinyanga, and Tabora.
- Tanks store rainwater harvested from tiled or iron roofs. The method was developed for collecting household water but is increasingly being used for irrigation and livestock. Because they are family-owned, maintenance is usually good. Tanks vary in size from 1 m³ to 100 m³. Stored water can be channeled or carried to the field. Tanks, unlike ponds and sand dams, can be commercialized.

Irrigation equipment suppliers and technologies

Tanzania has several companies supplying irrigation equipment, including pumps, pipes, sprinklers, center pivots, linear move systems, and precision drip and micro-sprinkler systems. These companies sell equipment that is easy to import and install on small farms, rather than large gravity-fed flood or furrow irrigation systems. The systems typically range between \$4,000 and \$6,000 per hectare.

The market for irrigation technologies is diverse and growing, although the efficiency of each system varies. The features of different irrigation technologies are shown in the table below.

[Comparison of irrigation technologies](#)

	Gravity	Pressurized				Precision	
	Flood/furrow	Moveable sprinkler	Fixed sprinkler	Center pivot/linear move	Water cannon	Surface drip	Micro-sprinkler
Requires extensive land forming	Yes	No	No	No	No	No	No
Capital cost – in-field equipment	Low	Medium	Medium	High	Medium	High	High
Operating costs	Low	Medium	Medium	High	High	Low	Low
Maintenance requirements	Low	Medium	Medium	High	Medium	High	High
Complexity of use requiring specialist support	Low	Medium	Medium	Medium	Medium	High	High
Mechanical harvest capability	Yes	Yes	Yes	Yes	Yes	No	No
Potential to over-irrigate	High	Medium	Medium	Medium	Medium	Low	Low
Ease of 24-hour operation	Low	Medium	High	High	High	High	High
Water-use efficiency	55%	75%	75%	85%	65%	95%	90%

The table reflects international norms for well-managed irrigation programs. Actual efficiencies on small farms may vary depending upon crop water requirements and tools to measure the water used.

A program of investment and partnerships between government and the private sector can help drive the irrigation technologies market, giving farmers access to the financing, technologies, and skills they need to improve their water and production efficiency.

Irrigation Investment Opportunities

Crops

Tanzania has a relatively young irrigation market, which presents a range of investment opportunities.

Rice

Tanzania has one of the fastest-growing urban populations in East Africa. This means there is growing demand for rice, the second-most important food and commercial crop in Tanzania after maize. The country offers ideal conditions for rice cultivation, with tropical temperatures, rich and fertile soil, plenty of sunshine and rain, and large river systems. Tanzania is currently the number one rice producer in East and Southern Africa.⁹

Rice yields, however, are low – below 2 metric tons per hectare. Small-scale farmers produce about 90 percent of Tanzania’s rice on farms that average 1.3 hectares. Because rice is grown using flooding, it is the most water intensive of all crops. About 74 percent of Tanzania’s rice is grown using rain-fed irrigation.¹⁰ The remainder is irrigated using small, traditional irrigation systems in villages.

Several sites have been earmarked for large irrigated rice programs, and the government and donors appear ready to fund outgrower irrigation systems, training, and input supplies.

Rice producers can improve water productivity significantly using systems of rice intensification. This concept combines several practices, including changes in nursery management, time of transplanting, and management of water, nutrients, and weeds. A nucleus outgrower rice program is already achieving yields of 8 metric tons per hectare using the new system.

Sugar

Tanzania is a net importer of sugar. Four large estates produce about 300,000 metric tons of raw sugar annually, leaving a shortfall of about 220,000 metric tons that has to be imported to meet local demand.¹¹

Wide-scale irrigation and drainage can substantially boost output. Average yields of rain-fed sugarcane range from 40 metric tons to 80 metric tons per hectare compared to yields of between 80 metric tons and 110 metric tons per hectare of irrigated sugarcane. Improved cane varieties and field practices can also play a role in expanding production.

Current cultivation covers 50,000 hectares of which around 50 percent is irrigated (almost all on the large estates).¹² Across the country, there are good opportunities to improve outgrowers’ yields by helping them with irrigation, given the “tight” nature of the value chain in the sugar sector (strong links between smallholders and a sole offtaker). Entrepreneurs and smallholder farmers need financial assistance for sugarcane farming, including the installation or expansion of irrigation systems and equipment.¹³

Coffee

Coffee is one of Tanzania’s main agricultural exports, accounting for about 5 percent of total export value. The country’s high-quality coffee can command high prices, and there is potential for large sales volume increases if production expands.¹⁴ Yet average annual production has stagnated over the past 30 years, while yields have continuously decreased and outputs have not reached their quality potential, contributing to low farm-gate prices. Smallholder farmers produce about 90 percent of the country’s coffee, and most do not use irrigation.

⁹FAOSTAT

¹⁰FAO, 2015. http://www.fao.org/fileadmin/user_upload/ivc/PDF/SFVC/Tanzania_rice.pdf

¹¹Rabobank. *Industry Note #386*. 2013. Accessed February 12, 2016. <http://www.nmbtz.com/uploads/fc7bd8e651d8997c5b0ee219b640b1ae-Rabobank-IN386-Tanzania-Sugar-Plaat-June2013.pdf>.

¹²As above.

¹³PASS. *Draft Investment Potential for Sugarcane*. 2013. Accessed February 12, 2016. <http://www.pass.ac.tz/Sugar.pdf>.

¹⁴TFC. *Tanzania Coffee Industry, Development Strategy(2011/2021)*. 2012. Accessed February 12, 2016. http://www.coffeeboard.or.tz/News_publications/startegy_english.pdf.

Vegetables

The horticultural sector has grown significantly over the past decade, averaging 11 percent annual growth. In 2013, horticulture contributed 31 percent to national agriculture exports.¹⁵ Medium-sized and large farms produce high-value vegetables, such as French beans and baby corn, which are generally exported to European markets. These vegetables are grown under intensive care, mostly using irrigation systems. Smallholder farmers tend to produce vegetables for the local and regional markets, including onions, tomatoes, and green peppers.

Prices for onions, tomatoes, and eggplants are higher during the dry season, offering significant advantages for irrigated farms. Although several farmers are investing in greenhouses and drip irrigation, maintaining the greenhouses and acquiring the necessary technical skills remain a challenge. In addition, timing production to coincide with the season when vegetables are scarce in the market can be difficult. As a result, not many farmers have been able to reap the benefits of growing vegetables in greenhouses, although recent growth has been rapid.

Green maize

Maize is principally a rain-fed crop, with only a small amount grown under irrigation for domestic and local consumption. Several farmers are growing maize for sale during seasons when the product is scarce. Maize grown using irrigation is mainly sold in cobs.

The following table sets out the irrigation technology options for each crop.

Crop, market, farmer type, proposed technology, and water-saving potential

Crop	Market	Farmer type	Technology	Water-use efficiency
Rice	Local/national markets	Plantations, outgrowers, and smallholder farmers	Center pivot and furrow	Center pivots are water efficient (85%); furrows are less water efficient (55%)
Sugarcane	Local/national markets	Nucleus estates and outgrowers	Center pivot, overhead sprinklers, drip, and furrow	Overhead sprinklers are water efficient (up to 90%)
Coffee	Export market	Nucleus estates	Drip irrigation	Drip irrigation is very water efficient (up to 95%)
Maize	Local/national and regional markets	Smallholder farmers and nucleus estates	Furrow and center pivot	See above
Beans	Local/national markets	Smallholder farmers	Furrow	See above
Vegetables	Local/national, regional, and export markets	Predominantly smallholder farmers, medium-scale farmers, and nucleus estates	Furrow and drip irrigation, sometimes drip irrigation in greenhouses	See above

Market segments

The market for irrigation finance is segmented into subsistence farmers, semi-commercial and commercial smallholder farmers, emerging medium-sized farmers, and large farms and estate companies. Based on the small geographic sample covered in this research, the estimated demand for irrigation financing in the next three to five years is \$45 million. Based on the size of the sample, a conservative estimate of the national financing opportunity would be upwards of \$150 million. The breakdown of the sample across market segments is discussed below.

¹⁵TAHA, 2016.

Estimated demand for irrigation financing based on study sample

Source of demand	Amount (\$ million)
Irrigation programs	23.5
Large plantations	2
Emerging farmers	2
Other private and public initiatives	5
BRN investments (government initiative)	12
Total	44.5

Irrigation programs

For many irrigation programs, the most immediate opportunities lie in improving water-saving systems already in place.

In the Great Ruaha catchment, for example, limitations on licenses for new abstractions are already in place. At Igomelo in the Rufiji basin, the water is gravity-fed from a canal with an all-year abstraction permit. This is a flood irrigation program, with no opportunity to irrigate land above the level of the main river. However, the land adjacent to the main canal could be irrigated using a portable pump with sprinklers or drip systems. This could involve converting some of the existing flood-irrigated fields to sprinkler or drip systems to free up water for the expansion. In addition, the main canal is mostly unlined. Typically, earth canals can lose 5 percent or more of their water through seepage and percolation. Lining the canal would save water and might allow further expansion of irrigated lands without abstracting more water.

Concrete lining for canals is expensive, but its durability and lifespan make it a good long-term investment. About \$23.5 million is needed to line the canals of the programs sampled. This sample size constitutes about a third of the formal programs in the country, which means that total demand for financing for lining canals could be an estimated \$70.5 million.

Large plantations

Based on the small sample surveyed, irrigation financing demand from large-scale plantations was estimated at \$2.5 million. Many plantations have alternative sources of funding, but would be interested if the terms for the finance were favorable. A brief overview of the needs of some of the large plantations in Tanzania is provided below.

In the sugarcane sector, a large company has partnered with the government and increased its production threefold. The company has built canals and generates its own electricity, which it uses to run pumps used for water abstraction and irrigation. It has also improved its water efficiency by lining canals and using several irrigation systems, including drip, sprinkler, and surface irrigation. About 246 hectares of the company's land is not irrigated due to poor soil quality, but it intends to improve soil acidity and invest in sprinkler irrigation. It also has a pilot drip irrigation project under way on 88 hectares of land.

An agricultural and horticultural producer that specializes in French beans, baby corn, and vegetables uses drip irrigation on its 230 hectares of land. It aims to bring an additional 250 hectares under production. The company has invested in a facility that can store 800,000 m³ of water. It also intends to invest in a center pivot irrigation system.

Tanzania's largest grower and exporter of avocados has received funding from various sources to make the production, processing, and exporting of avocados profitable. The company's entire nucleus farm is

under irrigation; 125 hectares under micro-sprinklers and 12 hectares with drip irrigation. The business is considering a second farm, which will also need irrigation equipment.

Emerging medium-scale vegetable producers

Drip irrigation is water and energy efficient, saving up to 65 percent more water than traditional surface irrigation.¹⁶ Emerging farmers are starting to use small-scale drip irrigation to produce vegetables, especially in Arusha and Mwanza. Some farmers are using drip irrigation in greenhouses, while others are using this method to irrigate open plots of land. The number of hectares used to produce vegetables in greenhouses increased by 5,700 percent between 2010 and 2015.

There are more than 700 greenhouses in Tanzania, of which 76 percent are privately owned. The smallest greenhouse costs about \$3,000. The estimated financing demand for emerging medium-scale vegetable producers is more than \$2.1 million per year. This could be even higher if demand for renovating old greenhouses and installing boreholes is taken into account.

Other private and public initiatives

A Tanzanian company that manufactures ketchups, jams, and chutneys has recently commissioned a new tomato paste processing plant in Iringa. About 1,500 farmers supply the factory with tomatoes during the normal harvest season from February to March. The company aims to buy from about 3,000 farmers, particularly from irrigated farms so that tomato supply is year-round. The company has been working with an irrigation supplier on a trial with 10 farmers. The supplier provides extension services and has offered to establish irrigation demonstration plots. This relationship between farmer, irrigation and extension supplier, and buyer offers an opportunity for irrigation financing.

Another firm aims to provide smallholder farmers with quality vegetable seeds and support. It works with partners to introduce vegetable farmers to new technology and improved seed varieties. Demonstration plots provide a good entry point for irrigation suppliers interested in the smallholder market.

A nongovernmental organization working with communities in lower Moshi initiated three irrigation programs. It drilled boreholes and installed electricity for pumping water for domestic use, and the irrigated production of maize and vegetables on 48 hectares of land. The organization divided the land into 200 plots for crop production. This project is now run by the community. The organization is also considering a large flood-control project, which would help increase water supply for irrigation. A total of \$3 million is needed for this initiative.

A for-profit organization is helping smallholder farmers in about 20 villages, most of which are still using flood irrigation. The organization and its partners aim to help between 150,000 and 300,000 smallholder farmers grow high-value crops for the local and export market. The irrigation technology is still to be defined, but it is likely that it will be imported because local suppliers are considered expensive.

Big Results Now (government initiative)

Under the BRN initiative, 25 sites have been set up for irrigated production of sugarcane and paddy crops. The total estimated investment in irrigation equipment on these farms is \$8.2 million – \$4.8 million on nucleus farms and \$3.4 million on smallholder farms. The government is looking for private investors who are committed to developing these commercial farms.

The BRN initiative also plans to develop a smallholder-based, professionally managed collective rice irrigation and marketing initiative. The demand for this initiative is an estimated \$3.3 million.

¹⁶IFC. *Inclusive Business Case Study: JAIN Irrigation Systems Limited*. 2014. Accessed February 4, 2016. <http://www.ifc.org/wps/wcm/connect/f6fdcd8047e252ca9d05fd299ede9589/Jain+Temporary.pdf?MOD=AJPERES>.

Total investment demand for the BRN's various initiatives amounts to an estimated \$11.5 million.

Financing Options

Despite a clear need, no specific financial product is designed to support irrigation. There are few financing options available for most Tanzanian farmers, 85 percent of whom are smallholders. Their access to irrigation is mainly confined to government and donor projects, many of which are not functioning properly. A few of these farmers have started using hand pumps, and some are using a combination of gravity and drip irrigation.

Commercial and medium-sized farmers are the main market for precision irrigation systems, but there are limited financing options for this group. Commercial lenders have not designed special products for irrigation equipment, so this type of financing falls under the banks' mainstream loans, which are predominantly based on collateral. Some commercial lenders are venturing into non-traditional cash crops to increase their agribusiness portfolio.

Possible financiers and their products

A selection of commercial and developmental banks has been analyzed to provide an overview of possible irrigation financiers and their products. A review of non-bank financial institutions is also provided.

CRDB Bank

CRDB Bank does not offer a specific irrigation financing product, but it does support the entire value chain of major cash crops through its agribusiness department, including scheme, individual, business, and corporate loans. Current total exposure is about \$291 billion, of which less than 2 percent is for irrigation-related projects (mainly large sugarcane and tea farms). Irrigation financing is usually allocated as a portion of the borrower's overall financing budget. The bank is open to financing irrigation investments as long as the borrower and the project meet lending requirements. CRDB also provides financing to cooperatives—it appears that it has financed most of the group-based irrigation programs in Tanzania.

National Microfinance Bank

National Microfinance Bank does not offer a specific irrigation financing product. Nearly 80 percent of the agribusiness department's total portfolio is made up of loans to smallholder farmers, with the balance for emerging and commercial farmers. By the end of 2015, the bank's total agribusiness exposure was \$30 million, but it is rolling out a new agribusiness strategy that aims to increase its exposure to \$127 million. The strategy focuses on financing the entire value chain and increasing from three crops (coffee, cashews, and tobacco) to 12. The bank is also interested in irrigation facilities for rice, sugarcane, and horticulture, provided the project is sustainable, scalable, and involves the right partners.

Tanzania Agricultural Development Bank

The Tanzania Agricultural Development Bank is a new public bank that aims to improve productivity, post-harvest handling, and market access. It officially started operating in January 2016, with a focus on Iringa, Morogoro, Tanga, Njombe, Pwani, and Dar es Salaam as pilot regions.

The bank supports the entire agricultural sector by providing loans for agricultural inputs and infrastructure development, including irrigation, to subsistence farmers, commercial farmers, and agriprocessors. The interest rate ranges from 7 percent to 12 percent per year, to be repaid between one and 15 years depending on the type of finance required. The bank could have a substantial impact on the agricultural sector, especially for medium-sized and large farms and companies. Its interest rates are attractive, particularly for large capital investments in overhead irrigation or large areas of drip irrigation.

Equity for Tanzania

Equity for Tanzania offers financing of up to \$71,000 for equipment through leases. Other than the leased equipment, no additional collateral is required. To date, it has financed eight small businesses in the irrigated horticulture sector. It has also recently introduced a smallholder outgrower finance program, which targets farmers growing produce for larger agribusinesses. This initiative offers small, flexible, and affordable equipment leases to small-scale farmers to increase their yield and income. A typical program might involve 50 farmers growing for a single agriprocessor, with each farmer needing \$3,000 of equipment. Equity for Tanzania can finance this as a bundle, which is repaid using an off-take arrangement with the agriprocessor/buyer.

Private Agricultural Sector Support

Private Agricultural Sector Support provides loan portfolio guarantees to the agricultural sector. By December 2015, it had a total guarantee fund equivalent to \$42 million, of which \$19 million was committed to various banks.

Africa Enterprise Challenge Fund

The Africa Enterprise Challenge Fund (Tanzania Window) only funds agribusiness ideas implemented in the country. The fund seeks innovative agribusiness ideas from farming, plantation, and ranching companies; outgrower programs; producers; manufacturers and distributors of agricultural inputs; agriprocessors; traders; merchants; and other private service providers, including market information, extension, and other agricultural services.

Irrigation financing models

Value chain financing is an innovative model. It involves financial flows between parts of the value chain, such as buyers or input suppliers, as well as funding from financial institutions, or combinations of both. Several value chain finance models could finance irrigation in Tanzania:

Tight value chain

In tight, integrated value chains, such as sugar and cotton, farmers have only one buyer for certain types of crops. This makes side selling costly and difficult. Successful commercial intermediaries with integrated supply chain management recognize the value in working with smallholders to increase productivity and secure stable supplies. Providing finance to farmers helps to increase production, yields, and quality for the benefit of the buyers and the farmers. Finance mechanisms may be obtained through the buyer or from the bank to the farmer directly, with the security of an agreement between the bank, the buyer, and the farmer.

Outgrower model

Outgrower models can help farmers access input finance due to the additional security the buyer provides to the lender. These initiatives bring together four elements: a central farm and facilities surrounded by growers who produce on their own land under contract; inputs and technical assistance from the nucleus farmer; guarantees to purchase the growers' crops subject to predefined standards; and growers typically receiving an agreed percentage of the final sale of their products. Although this still leaves growers exposed to price and weather risk, it allows them to allocate a portion of their land to growing a cash or export crop they otherwise would not grow due to limited market access.

Leasing

Leasing relies on the lessee's ability to generate cash flow to service the lease payment, rather than on the balance sheet or credit history. This is why leasing is advantageous for new companies, or small and medium-sized businesses that do not have a long credit history or a significant asset base for collateral.

Leasing entities with a focus on the agricultural sector are often linked to agricultural equipment manufacturers or distributors. Rural leasing can be profitable, but may require government and donor support at first. In addition, rural leasing companies may not always be viable, because leasing is a specialized financial activity that often requires large urban operations.

Wholesale model

This model is based on a bank lending indirectly to smallholders through an aggregator organization, such as a farmer-based organization or cooperative. The entire group is the borrower and members guarantee each other. This model reduces the costs of creditworthiness assessments and loan administration. Security can be enhanced using cash collateral requirements at organizational level, instead of traditional collateral or claiming the harvest proceeds of individual farmers.

Credit guarantee arrangement

Credit guarantee arrangements to finance irrigation can work well because they bring all parties together.

Using this approach, potential borrowers submit loan requests for irrigation equipment financing to the financial institution. After approval, the financier, borrower, and other strategic partners work together to select a reputable equipment supplier. The financier notifies the supplier and provides assurance that it will pay for the equipment on delivery and complete installation.

The partners providing the credit guarantee arrangement for the approved loan are also identified in advance and asked to sign a memorandum of understanding stipulating their obligations. The partners provide a cash cover guarantee, usually ranging between 50 percent and 70 percent of the loan. The exposure depends on the risks and agreement terms with the financial institution.

Strategic partners interested in improving and developing irrigation financing facilities in Tanzania could help select the right suppliers, organize training for the farmers (borrowers), and work to ensure the arrangement is beneficial to all parties. Organizations like the Southern Agriculture Growth Corridor of Tanzania or the Financial Sector Deepening Trust could be these facilitators.

Voucher system

Some programs, such as the former Tanzania Agricultural Productive Program, have piloted voucher systems for farmers' kits, including irrigation equipment. The program issued vouchers to smallholder farmers for 50 percent of the costs and the remainder had to be paid in cash to the equipment supplier. The vouchers do not only cover the investment costs, but also the agronomic support and maintenance of

Financing options by market segment

Different market segments are suited to a combination of financing options:

- *Subsistence farmers in irrigation programs:* Grants through savings and credit cooperatives or any other farmer organization; wholesale lending through cooperatives or other group guarantee arrangements; and vouchers provided and managed by donor agencies/projects.
- *Semi-commercial smallholder farmers producing commercial commodities:* Personal loans or group guarantees through savings and credit cooperatives, or commercial loans with guarantees.
- *Commercial smallholder farmers growing high-value crops:* Lease financing and matching grants from organizations like the Africa Enterprise Challenge Fund.
- *Medium-scale farmers:* Guaranteed loans, matching grants, and commercial loans.
- *Outgrowing programs:* Lease products and concessional loans.
- *Farmers in tight value chains:* Inclusive value chain financing products and/or credit guarantees from commercial banks.
- *Large firms and farms:* Bonds, concession loans, and guarantees.

the systems. Vouchers have an inherent corruption risk (like any finance on concessional terms), but, if strictly managed and closely monitored, it can provide great leverage for the farmer and supplier.

Conclusion

Agriculture accounts for 85 percent of Tanzania's exports, more than 50 percent of employment, and up to 90 percent of water use, and yet is by far the most underserved sector by financial institutions and capital markets. Water-productive irrigation systems will help Tanzania improve its food and water security; reduce the import of and foreign currency spent on staples; and increase revenue by exporting vegetables and sugar.

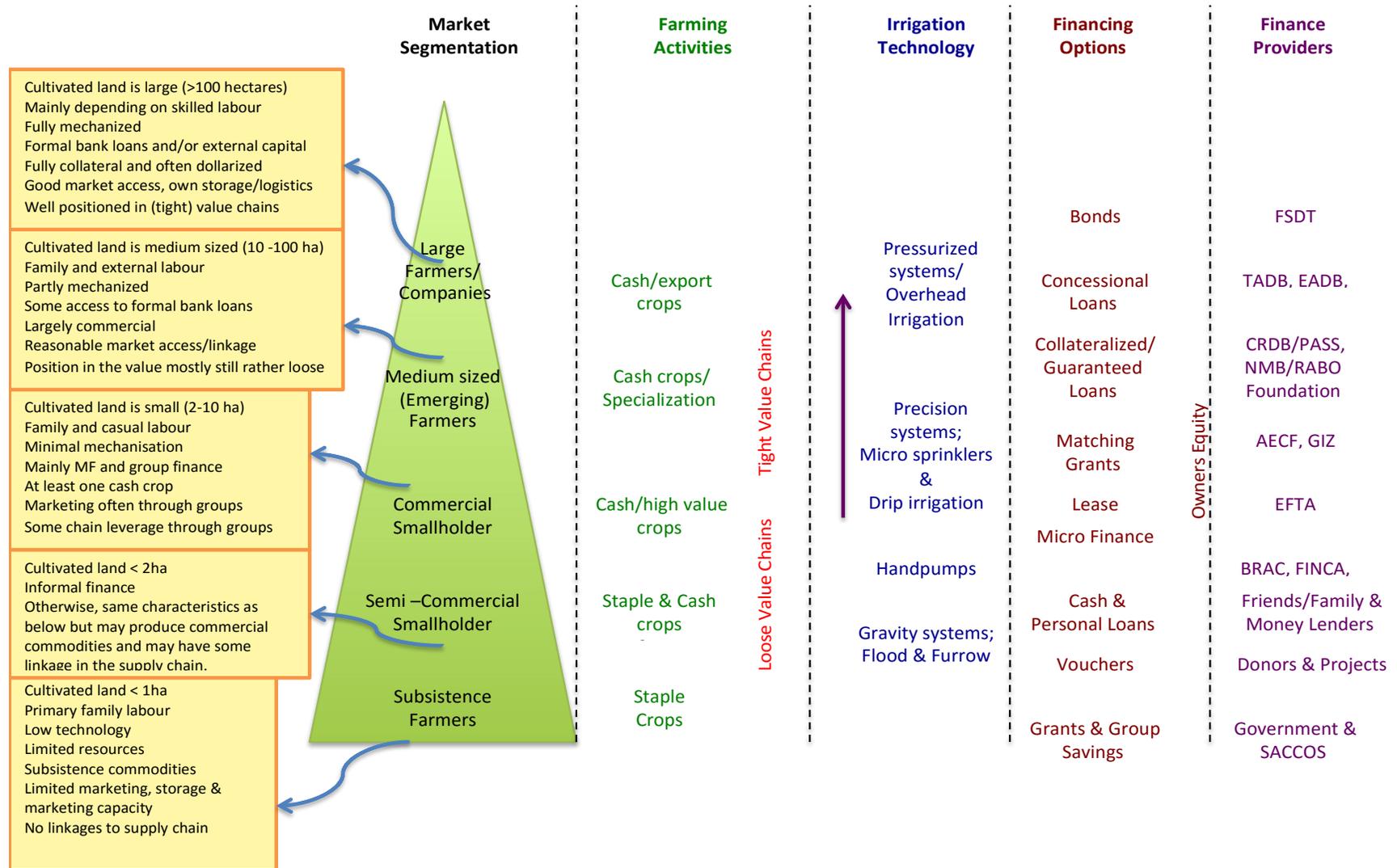
The market for irrigation technologies and equipment (especially for medium and small-scale irrigation) is diverse and growing, with both new entrants and experienced regional suppliers providing a range of products. Small and medium-sized farms are increasingly investing in greenhouses and drip irrigation, but maintaining this equipment and developing linkages to markets is a challenge. Any new irrigation project in Tanzania should be coordinated with irrigation suppliers to ensure that farmers have the training, support, and maintenance service they need to get the full benefits of their new equipment.

Based on the small geographic sample covered in this research, demand for irrigation financing in the next three to five years is an estimated \$45 million. Based on this sample figure, a conservative estimate of the national demand for finance is upwards of \$150 million. This presents a significant market opportunity.

The demand comes from diverse sources, and each group needs a financing facility tailored to its needs, with some areas requiring greater concessional investment than others. Options vary from financing through value chains to leasing, wholesale models, credit guarantee arrangements, and financing through block farming.

Improving agricultural water productivity requires the involvement of actors across the value chain, including financial institutions, banks, development organizations, equipment suppliers, private firms, farmers, and the government. A multi-stakeholder approach is therefore critical to take advantage of this substantial opportunity whilst ensuring the long-term sustainability of water use.

Figure: Market segment, technologies and finance



Appendices

Appendix 1

Supply of irrigation equipment

There are several companies with local representation in Tanzania supplying irrigation equipment to farmers. Some of these are international companies with offices in Tanzania. Companies visited during the course of this study were:

- **Balton Tanzania**, a UK subsidiary that sells irrigation technologies, seeds, agriculture chemicals, and fertilizers. Balton also supplies a “FarmerKit”, which provides for a full package of services for farmers, including agronomy support, greenhouse supply, irrigation, seeds, and so on. It tailors the technology and services to each customer’s needs. A full package may cost \$6,000 per hectare.
- **Irrico International**, a Kenyan company that specializes in poly-tunnel greenhouses, reservoir linings, and steel water tanks. Irrico International’s drip irrigation kit (quarter acre), which consists of water tanks, filters, connections, pipes, and drip tape, costs \$4,000 per hectare.
- **Wade Rain East Africa**, a US company that manufactures and supplies all types of irrigation products to the agricultural sector. Wade’s drip kit (one acre), which consists of filters, pipes, fittings, and drip tape, costs about \$4,500 per hectare.
- **JAIN Irrigation**, a multinational organization based in India, manufactures drip and sprinkler irrigation systems and components, integrated irrigation automation systems, PVC and PE piping systems, plastic sheets, and greenhouses.
- **Kickstart International**, a not-for-profit organization based in Dar es Salaam that promotes and sells foot-powered treadle pump and hand pumps for very small irrigation programs. About 850 pumps were sold in Tanzania in 2015. The treadle pump costs \$140.

A number of other irrigation solutions, powered by solar energy are also being sold. These initiatives are new and not yet extensive in the country.

Appendix 2

Gross margins of selected crops

Summary of crop gross margins: Great Ruaha

Description	Igomelo					Ruaha Mbuyuni	
	Onions sold from field	Onion stored	Tomatoes sold from field	Stored tomatoes	Maize	Onions season 1	Onions season 2
	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha
Land preparation	531	531	463	463	463	644	644
Agriculture inputs	1,792	1,792	934	934	354	752	1,159
Management	448	448	629	629	73	763	397
Harvest and post-harvest costs	271	1,023	269	269	0	328	769
Total cost	3,042	3,794	2,295	2,295	891	2,487	2,969
Yield (metric tons/ha)	36	50	35	55	3	20	30
Sale price (\$/metric ton)	153	224	150	230	653	198	475
Income	5,426	11,304	5,250	12,650	1,763	3,957	14,243
Gross profit	2,384	7,511	2,955	10,355	873	1,470	11,275
Simplified gross margins	44%	66%	56%	82%	49%	37%	79%

Summary of crop gross margins: Pangani

Description	Lemkuna	Mawala	LOMIA		Kiryia	Ngage	Kikavu		Longoi
	Paddy	Rice	Paddy	Rice	Rice	Onions	Beans	Eggplants	Onions
	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha	\$/ha
Land preparation cost	343	890	624	617	357	655	179	226	298
Agricultural inputs	727	544	324	324	253	819	524	676	1,216
Management	309	646	386	393	700	1060	119	1162	667
Harvest and post-harvest costs	599	557	143	474	493	196	119	571	173
Total costs	1,978	2,637	1,477	1,808	1,803	2,730	941	2,635	2,354
Yield (metric tons/ha)	8.4	6.6	4.8	4.8	5.3	19.5	1.7	60	15
Selling price (\$/metric ton)	387	541	595	1012	667	440	741	143	667
Income	3,250	3,571	2,856	4,858	3,535	8,580	1,260	8,580	10,005
Gross profit	1,272	934	1,379	3,050	1,732	5,850	319	5,945	7,651
Simplified gross margins	39%	26%	48%	63%	49%	68%	25%	69%	76%