Accelerating scale up of SMARTechs for water in Tanzania, using a market based approach

An assessment for SHIPO SMART Centre, Njombe

Carried out: September to December 2015
Client: SHIPO SMART Centre Tanzania
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Executive summary

In order to reach universal and equitable access to safe and affordable drinking water for all (SDG 6), simple, market based, affordable and repairable technologies, (SMARTechs) such as Rope pumps, may be a good alternative for rural water supply. Together with partners and via local entrepreneurs the SHIPO SMART Centre already realized close to 10,000 Rope pumps in Tanzania, of which half is via Self-supply (private wells).

This assessment looked at ways to accelerate scale up of SMARTechs in Tanzania from a marketing point of view. Local entrepreneurs, NGOs and Rope pump users were interviewed to get an idea about the supply chain and motivations of users.

The best marketing is a bottom-up approach. Good-working examples with a certain critical mass, and clearly showing the advantages for the user are the most efficient way to create demand and to realize a shift in the customers' decision making in favor of a SMARTech. Consumers do not want to take risks and incline to choose the same technology and supplier of their neighbor. The market for private wells may grow stronger when people better understand the economic benefits (direct and indirect income generation).

NGOs play an important role in the first stage of scaling up because both subsidy and social marketing are needed to establish a critical mass, to raise awareness at consumers and to convince the early adaptors of the new technology.

To accelerate scaling up of SMARTechs, it is needed to support existing workshops with all aspects of the supply chain and to enhance their technical and business skills. But that is not enough, new workshops need to be found and trained continuously, until a complete national distribution network has been reached. With this approach even 'the last mile' may be reached.

Acknowledgement

The study described in this report could only be carried out with the support of many people. Henk Holtslag aroused my interest on SMARTechs and supported me before, during and after the study with information and advice. The great hospitality of all employees of SHIPO SMART Centre and my housemates helped me to feel at home and to get some understanding of Tanzanian life, food and culture. Mr. Oygen Mwalongo and Morten van Donk facilitated my stay in Njombe, and I highly value the many discussions we had. Eelco van der Pal, Eugenia Kimaro and Neema Makwati were a rich source of information about the ins and outs of the SMART Centre and their support was essential to get access to entrepreneurs and Rope pump users. Laban Kaduma, Perecy Ugula and all other trainers and entrepreneurs I interviewed were very supportive in supplying me with answers on my questions. I am impressed by their entrepreneurship and learned a lot from them about how to run a business in Tanzania. I am very grateful to all Rope pump users for the interviews and their hospitality to invite me on their premises. I would also like to thank the people of IDYDC, MSABI, VETA and Winrock International for their openness and the time they spent with me to show their projects.

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1 Introduction

1.1 Objectives of the study

Main sources of drinking water in Tanzania are improved sources like piped water systems, gravity fed systems, protected wells with electric or hand pumps and unimproved sources like open wells, springs, rivers and lakes. Access to these sources is very unequally divided, not only between rural and urban households, but also between the different regions (see appendix 1). The majority of the population lives in rural areas, but more than half of the rural population does not have access to improved water sources (National Bureau of Statistics and Ministry of Finance 2013, WHO and Unicef 2015).

By the year 2030, Tanzania should achieve universal and equitable access to safe and affordable drinking water for all (Sustainable Development Goal 6). People without an improved water source often live in small communities where gravity systems or machine-drilled boreholes are not possible or too expensive. One way to reach the yet un-served and to improve rural and peri-urban water supply is to use the SMARTech approach as promoted by the SHIPO SMART Centre. Focus of this approach is to improve livelihoods of low-income groups by the use of innovative, low cost technologies that are produced and sold by the local private sector. SMART is the abbreviation for **S**imple **M**arket based **A**ffordable and **R**epairable **T**echnologies.

Examples of SMARTechs for water supply are manually drilled wells and Rope pumps. This hand pump can be used on wells up to a depth of approximately 35 meter. The per capita investment and maintenance costs of a Rope pump are much lower than those of a conventional piston pump such as an Afridev pump or India Mark II (P.A. Harvey and Drouin 2006, Acra 2012, iWASH 2013). In Nicaragua the Rope pump was successfully scaled up after its introduction 25 years ago and there are now over 70.000 installed (M.P. Lammerink, F. Brikké et al. 1995). SHIPO SMART Centre introduced the Rope pump 10 years ago in Tanzania. Currently some 10.000 pumps have been installed and are used for communal and private water supply. The governments in countries such as Zambia, Ethiopia and Uganda are now promoting the Rope pump to scale up Self-supply (Holtslag 2015, L. Mekonta 2015). A large advantage of a market-based approach is that people can make their own choices (because you can only sell a product when people want to buy it).

'Affordable and Repairable' means that these technologies are very suitable to be used for middle and lower income groups or families. Families or small groups mostly acquire a SMARTech for private use (Self-supply), fully or partly financed by the owners themselves (A. Olschewski 2015, H. Holtslag 2015, RWSN 2015)[1]. Purchase of a SMARTech may result in a substantial increase of the family income. Rope pumps, for example, are often used for multiple purposes, such as drinking, washing, cooking, gardening and irrigation.
Lower income groups can also get access to SMARTechs via communal supply. Drilled wells and hand pumps for larger communities are, in general, subsidized by NGOs or government. By using SMARTechs, investment costs for the NGO and maintenance cost for the community can be drastically reduced. This will result in an increased sustainability of the rural communal water supply.

The result of involving the local private sector in the distribution of these technologies is a 'profit based sustainability': local companies will continue selling SMARTechs after a donor project stops.

The SHIPO SMART Centre, hosted by the SHIPO organization in Njombe, is still the main training Centre for SMARTechs in Tanzania. The Centre is a member of the SMART Centre Group (in the

[1] In contrary, the initial investment cost for communal water supply systems are for 80 to 100% funded by NGOs or governments.

process of setting up). Other SMART Centres are based in Malawi and Mozambique and new Centres are planned in Zambia and Ethiopia.

Current objectives of SHIPO SMART Centre are to accelerate scaling up of SMARTechs for water supply in Tanzania and to introduce new suitable SMARTechs into the market.
To get ideas on how to accelerate scale up and how to sustainably grow the SHIPO SMART Centre, this study has been effected.

In the study it was tried to get an answer on the following questions:
- How can the SHIPO SMART Centre create a sustainable own business as a training centre in SMARTechs?
- How can accelerating scale up of SMARTechs in Tanzania be achieved?

For the first question the study looked at the business model of the SMART Centre, strong points and challenges and feedback from customers (chapter 2).
For an answer on the second question three topics have been studied:
- How do local entrepreneurs market and sell SMARTechs in middle and low-income markets (chapter 3)?
- How do NGOs and government in Tanzania stimulate the use of SMARTechs (chapter 4)?
- What are the needs and motivations of the users of SMARTechs (chapter 5)?

Information was obtained by open interviews with the SHIPO SMART Centre, local entrepreneurs and their customers (water users and NGOs), government (VETA), desk research and observations. A list of organizations and companies interviewed can be found in appendix 2.

1.2 Market approach in low income countries

For a market-based approach (promotion of products that have a commercial demand), it is necessary to have or create a value chain including material suppliers, companies producing and selling the SMARTech, and paying customers.

Figure 1.1 Standard supply chain

Selling products in subsistence markets asks for a different approach than in affluent markets (Hystra 2013, Viswanathan 2015).
Subsistence consumers and entrepreneurs face many uncertainties, such as seasonal income, unreliable electricity supplies or irregular public transport. People with low literacy levels tend to think more concrete (focusing on a single piece of information) and pictographic instead of grasping the whole context. Lack of resources combined with concrete thinking may result in short-term handling, because it is very difficult or even impossible to envision the future. Consumers may undervalue or ignore non-monetary resources such as time, costs and benefits beyond the immediate term or hidden benefits such as improvement of health.
Customers at the Base of the Pyramid (BoP) therefore make their decisions in a different way than more wealthy consumers. First of all, the purchase should improve their immediate life circumstances, and their decision is often a trade-off between similar important needs, between buying, making or leaving. Motivation of the poorest people to buy a product is often based on economics (what is my increase in income when buying the device) and people are willing to pay a

premium when the solution is free of risks. Because customer groups are often fragmented and heterogeneous, serving the BoP needs to be a high gross margin business.

Both Viswanathan and Hystra (Hystra 2013, Viswanathan 2015) mention that communicating the value proposition to potential customers is most effective from a bottom-up perspective (below the line marketing), thus a village level approach, word of mouth promotion and emphasis on buyer-seller relationships (local presence!) and social network are essential marketing tools to be successful.

The enabling environment in Tanzania is not very favorable for doing business. The country ranks low in the Doing Business Ranking of the World Bank, for 2016 ranking is 139 out of 189 economies (World Bank Group 2015). A good point is that the government now made starting a business easier by eliminating the requirement for inspections by health, town and land officers as a prerequisite for a business license (World Bank Group 2016). It still takes a long time and paperwork though to be registered as a business (personal communication Perecy Ugula and Laban Kaduma).

2 SHIPO SMART Centre: business model, strength and challenges

This chapter looks at the SHIPO SMART Centre itself, analyzing the current business model, the strong points and challenges. Suggestions will be made how to increase sustainability and growth of the Centre. First ideas about how to accelerate scale up of SMARTechs will be discussed.

2.1 Supply chain for SMARTechs in Tanzania

Figure 2.1 shows a scheme of the supply chain, from SHIPO SMART Center until end consumer. In this chapter and the following chapters, the various steps in the supply chain will be discussed.

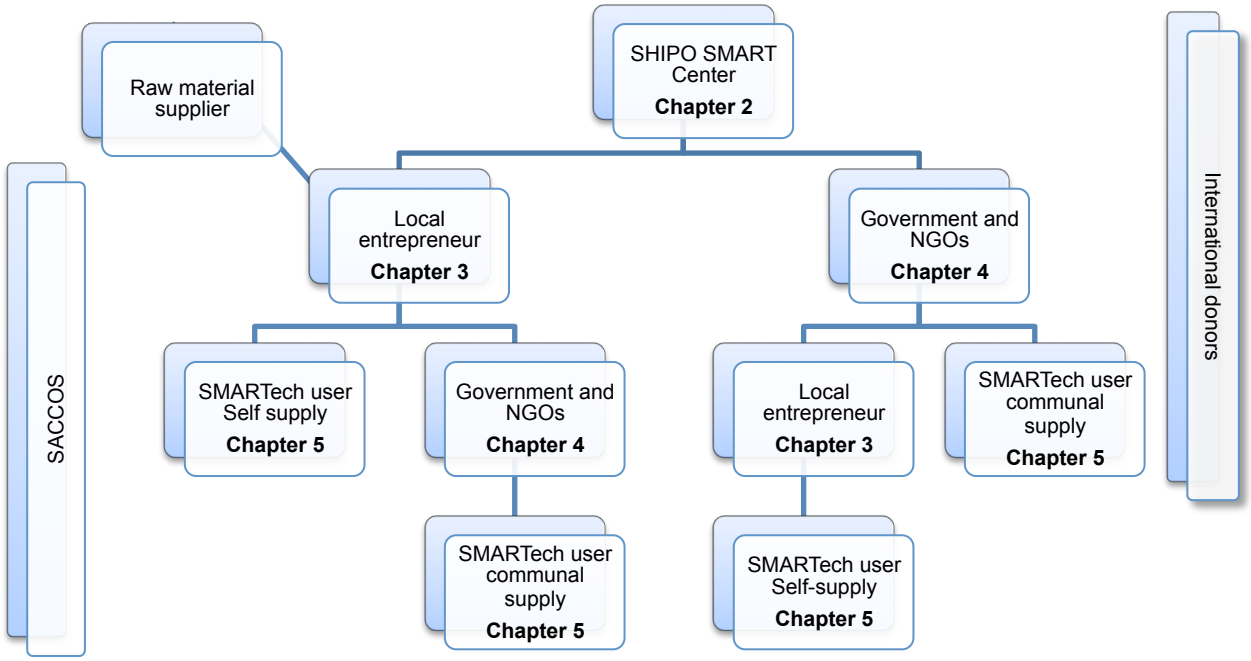

Figure 2.1 Supply chain of SMARTechs in Tanzania.

SHIPO started in 2004 to train selected diggers and welders on the production and installation of manually drilled wells and Rope pumps. In the period 2006 to 2010 they had a huge WASH project (TAZAMO) funded by DGIS via the support organization Connect International. It included the installation of around 1500 communal water points with manually drilled wells and Rope pumps in the villages around Njombe. After 3 years with these examples, families in peri urban areas in Njombe and other towns started to buy their own pump without subsidy (Self-supply) and installed them on their own shallow hand dug wells. After the TAZAMO program, the focus of SHIPO SMART Centre shifted from own implementation of water points (mainly communal supply) to training of entrepreneurs. These sell pumps to both NGOs and local government for communal water points and to families for Self-supply.

With support of the iWASH program[2], more than 30 trained local entrepreneurs have now included SMARTechs in their business. As a result, around 9,000 to 10,000 Rope pumps have been installed in Tanzania via the supply chain as drawn in figure 2.1. Exact numbers are difficult to

[2] iWASH was a program of USAID from 2010 to 2015, coordinated by FIU, to support sustainable, market-driven WASH services in Tanzania Global Water for Sustainability Program (2015). "Tanzania Integrated Water Sanitation and Hygiene Program (iWASH)." Retrieved December 8, 2015, from http://www.globalwaters.net/projects/current-projects/inrmw-new/.

obtain, because there is no system in place that registered the installed pumps after the TAZAMO project. The introduction of serial numbers on Rope pumps a few years ago is a first step in the good direction to get more insight into the number of pumps. The government website waterpointmapping.org (see also appendix 3) gives a lot of information about the location and functionality of water points, but it is not sure if Rope pumps are included.

From interviews and desk study, it was calculated that registered workshops have installed more than 7,000 Rope pumps and made more than 4000 Hand dug or hand drilled wells. This includes the communal wells installed during the TaZaMo project before 2010[3]. An estimated additional 1,000 to 2,000 pumps have been produced by copycats[4]. The activities of the TaZaMo project were continued during the iWASH program.
Before 2010 approximately 50% of the installed Rope pumps were installed for private use. From 2010, approximately 60-70% of the installed Rope pumps were installed for private use and this number still increases.

2.2 Business model of SHIPO SMART Centre

The 'business model', 'customer development' or simply said the way of working of the SHIPO SMART Centre can be visualized by a CANVAS business model, shown in table 2.1.

The original model was made by SHIPO SMART Centre together with the Dutch partner organization Aqua for All, but simplified for the purpose of this report and slightly modified according to new insights from the author (Coelman 2015).

Customers and relationships

The SHIPO SMART Centre currently has four customer segments, each with their own Value Proposition and customer relationship.
The entrepreneurs selected for the training (customer segment 1) have different educational backgrounds but all have experience with well digging or welding and metal skills.
Customers in customer segment 2 are NGOs who want to facilitate training for well diggers and welders on SMARTechs, but also vocational training institutes such as VETA, who now start to implement a Rope pump course for their students. A major step forward towards an official acceptation of the Rope pump technology and to further scale up the Rope pump.

Feedback from entrepreneurs was obtained how they perceive the training of the SMART Centre. Learning about new SMARTechs and how to get more customers was mentioned most frequently. Most interviewees mentioned that they could increase their business because of the training, but some of them argued they could not grow because of lack of capital. All were satisfied with the follow up from the SMART Centre after the training. Detailed answers can be found in appendix 4.
Feedback from NGOs and government institutions[5] who ask SHIPO SMART Centre to train 'their' entrepreneurs (customer segment 2) is in general positive and has resulted in repeated requests for trainings and participation to new donor programs (Waridi). With support from the iWASH program, VETA even started an own education module on Rope pumps.

[3] TaZaMo project: 10-20% contribution by community, which is still more than most conventional approaches.
[4] Metal workshops that made copies of the pump and started selling themselves without training (they did not receive a training because they were not aware of it or not registered as a company)
[5] Winrock International, MSABI, IDYDC, Dorcas, SAME World Vision, VETA

<table>
<tr>
<td rowspan="2">Partners

Development agencies

SMART Centre Group

Government and training institutes in Tanzania

Network organizations

Trainers

SACCOS</td>
<td>Key Activities

Identify, acquire and keep customers

Technical and business[6] trainings

Demonstration of about 15 SMARTechs[7] for water, sanitation and irrigation

Organize certification program

Develop financial support solutions

Introduce and build knowledge of new SMARTechs

Advocacy</td>
<td rowspan="2">Value Proposition

1. Increase income, reduce risk, get access to knowledge and networks and get recognition, by means of trainings, facilitation of financial support solutions and certification programs

2. Sustainable improvement of livelihoods by means of trainings in SMARTechs

3. Program of NGO is carried out in a reliable, risk free, trustful way, with high quality, by organizing bulk purchase of quality services and/or products

4. Safe and affordable (drinking) water for all by increasing options for Self-supply and reducing costs of communal supply</td>
<td>Customer Relationships

1. Technical and business support, monitoring, certification

2. After-sales support

3. After-sales support

4. Co-creation, feedback on results</td>
<td rowspan="2">Customer Segments

1. Local entrepreneurs, and indirect households and communities

2. NGOs or government who facilitate training for selected entrepreneurs

3. NGOs who want SHIPO to act as intermediate to supply SMARTechs for their projects

4. International donors who fund the program</td>
</tr>
<tr>
<td>Key Resources

Office, demonstration field, manuals, website, SMART info

Two coordinators, supporting staff</td>
<td>Channels

Personal contact, conferences, networks</td>
</tr>
<tr>
<td colspan="3">Cost structure

Salaries, trainings, training facilities, demos site and tools, monitoring, meetings with partners</td>
<td colspan="2">Revenue Streams

Main revenues come from customer segment 4, additional revenues from segment 2 and 3. Entrepeneurs from segment 1 only pay 30.000 TShs (14 USD) per training.</td>
</tr>
</table>

Table 2.1. Current business model of SHIPO SMART Centre

Key activities

In the period of 2004 to 2010, a number of technicians, drillers and welders were trained (TAZAMO program). Between 2010 to 2014, partly funded by iWASH, about 19 new workshops were trained in Njombe. The number of customized trainings in other parts of Tanzania increased over the years (SAME World Vision, Desk & Chair, TAPP project, etc.).
Certification of selected entrepreneurs is in progress and aims to guarantee a high quality standard of hand dug, hand drilled tube wells and Rope pumps, in order to improve functionality and credibility of this technology. Focus point of the Centre is also to introduce and adapt other new suitable SMARTechs for the Tanzanian market.
For accelerating scale up, suitable financial support solutions may need to be developed for entrepreneurs to make new investments and for potential Rope pump customers to spread the payment over time when they cannot afford to pay the full amount upfront. The current program with low interest loans via microcredit banks (SACCOS) has mixed results. At least 50 households and several entrepreneurs have benefitted from the program since 2013. But there are bottlenecks that prevent a fast scale-up, such as delays in repayment, unreliable banks, too low interest rate for the bank, members can only have one loan at a time, and the perception from the potential buyer that the product (well plus Rope pump for 600 USD) is too expensive. Marketing is also an

[6] The business training includes: concept of entrepreneurship, business idea generation, some marketing, business plan and management, and how to evaluate the business after 6-12 months.
[7] Safe hand dug and manual drilled wells, Rope pumps (standard, windmill, bicycle pump), EMAS pump, Treadle Pump, recharge system, rainwater harvesting, Tulip water filter, EcoSan toilet, drip irrigation, Solar pumps (planned). Also training in maintenance of Afridev pump (planned).

issue: a road show in 2012 / 2013 funded by SHIPO was very successful (Bullens 2012), but promotion by the SACCOS only does not give a desired result.
SHIPO is now considering other possible financial solutions such as village saving schemes.

2.3 Strong points and challenges of the SHIPO SMART Centre

Strong points of SHIPO SMART Centre and possible challenges for growth that were derived from the interviews are found in the following table.

Strengths	Challenges
• Strong proven market based concept to improve water situation in Tanzania • Good training facilities and demonstration field • Excellent technical trainings in house and on location, even outside Tanzania • Training of trainers resulting in the availability of local technical trainers. • Certification program in progress to guarantee quality • Program for financial support of entrepreneurs and SMARtech users • Trained workshops around Njombe can work independently and have been able to grow their business • Good follow up support to entrepreneurs of customer segment 1 after training • Knowledge Centre for new SMARTechs • Strong supply chain around Njombe (see chapter 3). • Experienced host organization • International donors and international WASH specialists strongly support the program and are good partners	• Dependent on a few international donors • Approaching new entrepreneurs and NGOs for trainings may be enhanced • More emphasis on business training and marketing support for entrepreneurs needed • More insight needed into the Tanzanian market for SMARTechs and how to develop this market • Currently, there is no follow up support / monitoring of trained entrepreneurs funded by other NGOs (customer segment 2) • Because entrepreneurs work independently, mapping of water points is challenging and there is less control possible on quality and functionality of the water points • Network with policy makers[8] may be improved • Small team, cooperation with other SHIPO projects may be reinforced. • Regular changes in management and trainers of the SMART Centre (may limit the build up of experience and knowledge). • No central location in Tanzania

Table 2.2 Strengths and challenges of SHIPO SMART Centre

[8] SHIPO is member of the water association TaWaSaNet and has regular meetings with local government, but the SMART Centre could be more involved. There are limited activities to advocate for SMARTechs and Self-supply at government level.

3 Local entrepreneurs: business model, sustainability and growth

3.1 Business model

For most entrepreneurs who were interviewed, sales of SMARTechs (mainly manually drilled or hand dug wells and Rope pumps) became a significant part of their business (50-100%) after they received one or more trainings from the SHIPO SMART Centre (see also appendices 4 and 7). Motivations to sell SMARTechs differ, and there are also large differences between the entrepreneurs in marketing and business skills.

Analysis of the interviews has resulted in the following business model for the entrepreneur, based on the SMARTech business.

<table>
<tr>
<td rowspan="2">Partners

Raw material suppliers

SHIPO SMART Centre

NGOs facilitating the training

Other workshops

SACCOS</td>
<td>Key Activities

Production and supply of a good quality rope pump (different models possible, with or without tank) with low maintenance costs

Installation of a reliable and good quality well, with or without a recharge system

Sales of water filters and drip irrigation sets

Education to users about maintenance

Giving reliable service during and after installation

Marketing of the products

Financial administration</td>
<td rowspan="2">Value Proposition

1. Reliable water source, which is nearby the house, always supplies enough water (sometimes for income generation), is easy to handle and gives independency from neighbors

2. Sustainable access to safe drinking water</td>
<td>Customer Relationships

1. Follow up after installation, supplying good quality, available for maintenance

2. Supplying good quality, trustworthy</td>
<td rowspan="2">Customer Segments

1. Families, small group of HH, etc. for Self-supply

2. NGOs or government who purchase the products for communal supply</td>
</tr>
<tr>
<td>Key Resources

Employees

Workshop (welders) and equipment

Microcredit to make investments</td>
<td>Channels

1. Via already installed wells and Rope pumps (neighbors), exhibitions

2. Personal contact, WASH networks, exhibitions</td>
</tr>
<tr>
<td colspan="3">Cost structure

Main costs are equipment and raw materials.</td>
<td colspan="2">Revenue Streams

Full payment, (partly) upfront or via microcredit banks. Value based pricing.</td>
</tr>
</table>

Table 3.1 Business model of the entrepreneur for improved wells and Rope pumps.

Material suppliers

The entrepreneur buys his raw materials at the local market or in Dar es Salaam (less expensive and for bulk supplies). Regionally, the supplier market seems to be best developed in Njombe and Mafinga. In Makambako, Iringa and Morogoro, not all materials are available.

Customers

There are two types of customers, each with an own Value Proposition. The first customer segment is the Self-supply customer (mostly one family or a small group of households, and sometimes a school and health clinic) who (partly) finances the wells himself, (partly) upfront or with financial support such as microcredit. They ask for a reliable water source, which is nearby the house, always supplies enough water (sometimes for income generation), is easy to handle and gives independency from neighbors. Chapter 5 elaborates more on the motivations of these customers.
The second customer segment is NGOs and government, who install the wells at communities, health clinics and schools. In general, these wells are partly or completely subsidized. This segment wants to ensure sustainable access to safe drinking water for as many people as possible. In general, entrepreneurs do not supply to communal supply users directly. Financial risks are too high and initiatives from the community to purchase a well and pump together are too low.

Revenues

Revenues are obtained via market mechanisms, payment is (partly) upfront. Entrepreneurs sometimes give a rebate when families cannot afford the full price or to promote the Rope pump in a new area. Less than 5% of the Self-supply customers purchase the Rope pump with microcredit (via SACCOS).

Channels

Most workshops not only have customers in their own region, but also far outside their region. This may have to do with the way they find their customers (the channels).
Table 3.2 gives an idea about the perceptions of entrepreneurs and Rope pump users how they find each other. Self-supply customers (customer segment 1) mainly choose the technology because of examples at neighbors, health clinics or other public places[9]. This was also found by Haanen and Kaduma (Rik Haanen and Kaduma 2011).

Marketing tool	How did the entrepreneur find his customers? (asked to 11 entre-preneurs, more answers possible) **Number of times answered**	How did the Rope pump user hear about Rope pump and supplier? (asked to 45 Self-supply users) **Number of times answered**
Rope pump seen at neighbor, tel number on pump	9	43
Direct contact with workshop	5	4
SHIPO open day 2015	3	0
Exhibitions (Saba Saba, Nane Nane)	3	0
Business cards	2	0
Brochures	2	0
Location of the workshop	2	0
Via SACCOS	0	2
Radio	1	0

Table 3.2. Sales channels of SMARTechs for Self-supply customers

Self-supply customers did not seem to shop around to find the cheapest supplier, but selected the one who installed the Rope pump at his neighbor or nearby public location. This finding corresponded with the perception of the entrepreneur about the motivation of a customer to choose for a specific entrepreneur, such as good quality or the only supplier in the area. The

[9] Uvinjo installed a Rope pump as demonstration model next to the office, this works very well. It also creates goodwill at its neighbors (for some free water) and extra income (water sales to others)

entrepreneur feels he can also actively influence the potential customer to choose for him (convincing power, better quality than the other workshops), and gives some value to exhibitions and workshop location. From the answers given, it can be concluded that a bottom-up approach with proven local examples is an efficient way to scale up the technology.

For all communal pump users interviewed, NGOs or government (customer segment 2) decided about the technology, not the user. Motivations for them to choose for the Rope pump were sustainability (easy maintenance, availability of spares, low cost), the market based approach and directions from donors (iWASH). They prefered to work with those entrepreneurs for which they had facilitated the training or who had a proven track record.

Key activities

Most of the interviewed entrepreneurs only produced and installed improved hand dug wells and Rope pumps. They did not implement the sales of other SMARTechs, although they were trained in them. Reasons mentioned were that the financial position of the entrepreneur was not good enough (to invest in drilling equipment and marketing, for example), entrepreneurs and customers had insufficient knowledge about the benefits of the product, the technology was too expensive for customers or there was no demand because there weren't any examples in their neighborhood.
For example, during the TaZaMo project, most of the new wells were manually drilled. But drilling a well is more expensive than hand digging and more equipment is needed. After the project, only few trainees, such as Uvinjo in Njombe, implemented the manual drilling technology. Uvinjo was also the only interviewed entrepreneur who successfully included rainwater harvesting and recharge systems in his business.

The above confirms that, when risks for both entrepreneur and customer are too high, a new technology or product cannot successfully be introduced in the market. That demand *can* be created has been proven by the success of the Rope pump, but also for example by the success of a low cost sprinkler for irrigation, developed by VETA Songea. They already sold to 3000 families in five regions (VETA 2014, Ugula 2015).

It is a challenge for some workshops to have a (good) financial administration and record keeping. Support in record keeping may not only be of benefit for the entrepreneur, but can also have a spin off to have a better insight in the number of SMARTechs sold and the rate of accelerating scaling up.

Most workshops trained their customers on maintenance and also offered maintenance services upon call[10]. Maintenance service costs included material and transport costs plus sometimes a small profit. It was also used as a customer relationship tool.

Key resources

For some entrepreneurs growth is difficult because they do not have enough capital to invest in material for new Rope pumps or in more advanced equipment. When SHIPO offered them to apply for a microcredit at SACCOS, they were all interested, but the amount offered in the end was probably not enough to give them a significant boost for their business[11]. According to the business trainer Perecy Ugula (Ugula 2015), an entrepreneur needs at least a loan of 3 million TShs to be able to start his business[12].

[10] Some workshops give a 3-6 months warranty after installation of the well / Rope pump.
[11] There was 4 million TShs available, but total requests summed up to 56 million TShs
[12] Turnover microbusiness: 0-5 million TShs, small business: 5-200 million TShs

3.2 Co-operation and competition

Kisangani Smith Group in Njombe used to be the largest provider of Rope pumps. However, business has decreased over the years and other workshops are copying and overtaking the business. Quite a number of entrepreneurs[13] who currently have their own company, used to work for Kisangani.
Figure 3.1 gives an indication of the links between the entrepreneurs. Some welders and diggers / drillers work together to supply a customer, some welders employ or subcontract diggers (not always trained with collapsing wells as a result), and some diggers / drillers purchase Rope pumps from trained welders.

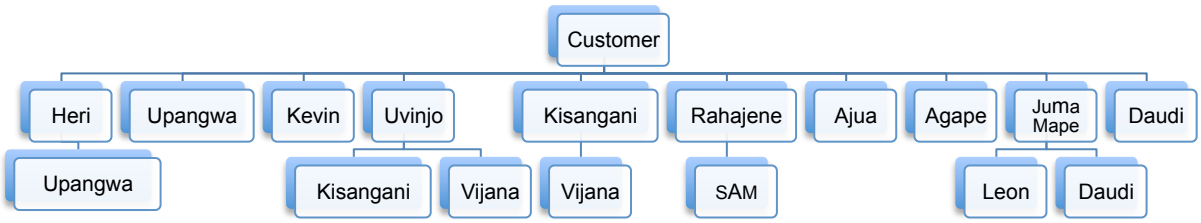

Figure 3.1. Competition and cooperation among the entrepreneurs.

Except for workshops in Makambako, most entrepreneurs do not face heavy competition. They have their own geographical area or have a good long-lasting relationship together[14]. Workshops in Morogoro worry about future competition from VETA students.
Some entrepreneurs complained (deserved or undeserved) that SHIPO favored Kisangani in case of orders.

3.3 Growth strategy

From the obtained sales data, rough estimation is that the workshops supported by SMART Centre and iWASH partners will sell at least 900 Rope pumps in 2016.
The business strategy of most entrepreneurs is to expand the customer base with existing products, some want to extend the product range with manually drilled wells. A few do not care if they sell SMARTechs or other products.
The entrepreneurs have a rough idea how to grow: by opening a branch office, changing the workshop location, increasing promotion, investment in more advanced equipment or arranging a loan to be able to purchase more material.

In practice, not all workshops have a growing SMARTech business, sales of some of them stagnate or even decrease. The discrepancy in ideas about growth and reality may be caused by a lack of financial means (it is very difficult for people who do not have earnings to raise enough money for a business), insufficient business and marketing skills, not enough insight into the market, no detailed strategic planning and, according to Ugula, attitude (people are responsible for their own business, not SHIPO or somebody else (Ugula 2015)).

With existing trained entrepreneurs only it seems difficult to accelerate scale up, unless they are supported with loans, business skills and marketing. Installation of demo SMARTechs at selected households may be an effective marketing tool[15], as a real-life example is the main decision tool for buyers (low risk, relationship).

[13] Upangwa Makambako, Upangwa Njombe, Mshikamano, Kevin, Mkalichuma and Vijana
[14] The entrepreneurs in Njombe have a good and long lasting relationship since they started working for the TaZaMo project in 2006
[15] A project with a demonstration plot near Makambako for communal use had good intentions but did not succeed: it is probably better to install a Rope pump for Self-supply and to use it to increase income.

4 Other organizations promoting SMARTechs

4.1 Organizations

Although many organizations in Tanzania are active in WASH (the network organization TaWaSaNet already has more than 40 members), only a handful of them promote SMARTechs for Self-supply. They are the (potential) customers of the SHIPO SMART Centre as mentioned in customer segment 2 of the SMART Centre business model (table 2.1), and most of them were partners in the iWASH consortium from 2010 to 2015[16]. Some data have been summarized in table 5.1. Not all organizations are included (such as SAME) because they were not interviewed or because insufficient information was available.

NGO	**Involved in SMARTechs since**	**Location**	**Approximate # trained entrepreneurs with active sales** (iWASH data)	**# SMART water points installed by these entrepreneurs**	**# SMART Communal water points realized by the NGO**
SHIPO	2004	Njombe	15	5000 - 7000	1500 - 2000
MSABI	2009	Ifakara	2	100 - 200	400
IDYDC	2012	Iringa	2	600 - 700	50
Winrock	2010	Morogoro	6	500 - 600	300
SEMA	2012	Singida	1	no data	3?
TDFT	2014	Tabora	2	50 - 100	50
Desk and Chair	2012?	Mwanza	1?	3?	150
VETA	2015	Morogoro	10 students	Not yet	n.a.

Table 4.1. Organizations involved in iWASH and SMARTechs: Starting year, approximate number of trained entrepreneurs with active sales (estimation), and number of communal Rope pumps realized by NGO but purchased from a trained entrepreneur.

MSABI, Winrock International, IDYDC and VETA were interviewed to understand their business model and how they realize the scaling up of SMARTechs.

4.2 Business models

Like SHIPO SMART Centre, the organizations MSABI, IDYDC and Winrock International aimed to scale up SMARTechs (mainly improved wells and Rope pumps) via a market-based approach. They facilitated that selected local entrepreneurs (welders and drillers) from different parts of Tanzania could be trained by the SMART Centre.
All three organizations started with the installation of subsidized communal wells and Rope pumps, like SHIPO did in the TaZaMo project. This created a critical mass, a supply chain, financial capital and experience for the newly trained entrepreneurs and led to examples in the market as a starting point for Self-supply.
This incubating period for low income markets is really necessary: even a commercial company such as Basic Water Needs, producing and selling water filters for low income households, needs funding for social marketing, to create awareness and to start up supply chains in Tanzania.

After this first period, the organizations stimulated independency of the entrepreneurs (shifting them to the Self-supply market), with mixed results. For example, in Ifakara, none of the entrepreneurs was very motivated to sell Rope pumps, according to MSABI due to a low demand from the market (which may have several reasons such as a lack of examples of Rope pumps on simple existing hand dug wells), whereas an entrepreneur in Iringa was highly successful.

[16] Winrock International coordinated the iWASH program in Tanzania from 2010 to 2015. They established horizontal networks with SHIPO SMART Centre, MSABI, IDYDC, SEMA, SAWA, Heifer International, TDFT Tabora, Desk & Chair Mwanza, and reinforced them to expand manual drilling and Rope pump technology.

Although all organizations aimed to scale up SMARTechs via the local supply chain, their way of working, and thus their business model, is quite different.

Winrock positions herself as a program-oriented organization and also works on advocacy and extensive fundraising. The organization achieved a breakthrough at the national vocational training institute VETA, who (after being trained by the SMART Centre), are currently implementing a curriculum for a training course on Rope pump production.

IDYDC is an NGO with programs in microfinance for sanitation, vulnerable children, vocational trainings and alcohol and drugs prevention. Although their WASH project was small and mainly funded by iWASH, they were able to make a significant contribution: one of the more successful entrepreneurs is based in Iringa, they implemented an own training course on manual drilling[17] and convinced several communities to purchase a well for communal use with microcredit and zero subsidy. IDYDC feels that installation of wells for communities is more important than for families, 'because these people need it most'. They recognize however, that wells at families or managed by families may be more sustainable 'because people care more'[18]. More than 90% of the communal water points were installed because of promotion by IDYDC. Monitoring of the water points two months after installation showed that about 70% of the pumps was working.
Another bottleneck for IDYDC was the hard ground layers and deep groundwater level around Iringa: villages north of Iringa are very dry but groundwater depth is more than 100 m.

Focus of MSABI is on realization of highly qualitative and sustainable water points (up to 28 m deep hand drilled tube well, and Rope pump) for both communities and families. Installation includes water quality measurements, extensive monitoring and optionally a maintenance insurance program (Pumps for Life). The education team takes care that commitment from communities is high. Drawback is that development of the supply chain for Self-supply is weak: MSABI needs to keep the projects in own hands (using the local workshops as mere suppliers) to guarantee the quality and because the costs per water point are too high for an unsubsidized approach.
MSABI is very good in marketing their approach to donors, especially the Pumps for Life program is a favorite. In this project, households and communities pay less than 3 USD month per water point for a maintenance insurance, for which they get around the clock service from a trained mechanic[19] (N. Holbro, H. Choyo et al. 2013). Currently, 180 out of the 400 installed Rope pumps are connected to this program. According to MSABI, the average time to repair the pump decreased strongly and functionality of the water points increased from 89 to 94%.

MSABI has an innovative approach towards other SMARTechs: an own sanitation team is piloting improved toilets and the EcoSan toilet, but demand creation is difficult and costs for households may be too high. They also support a women group in the production and marketing of low cost water filters (Tembo filters), which are ceramic pot filters. Due to their education team they are rather successful in marketing these filters.

[17] With good intentions but mixed results: IDYDC hired the trainees for installation of communal wells but they did not get orders from the local entrepreneurs.
[18] Not all communities paid back the loans, and these were in most cases the same communities who did not maintain the water points after installation. As a consequence, IDYDC had to pay the entrepreneurs from their own budget, because the NGO had made the contract.
[19] Mechanics work on commission base, and also promote water filters and Rope pumps at new potential customers.

4.3 Chances and challenges in accelerating the scale up of SMARTechs

The following table shows how the business model of the different organizations supports or limits acceleration scaling up of SMARTechs. The vocational training institute VETA is included because it is expected they will significantly contribute to the scaling up.

Organisation	Enhances scale up of SMARTechs	Limits scale up of SMARTechs
SHIPO SMART Centre	Good training facilities and excellent trainings in SMARTechs Many examples of Self-supply in the regions of Njombe and Iringa Independent entrepreneurs selling improved wells and Rope pumps Extensive knowledge about other SMARTechs and a strong knowledge backup from Dutch and other partners	Small group, thus limited human capacity to expand trainings and support more entrepreneurs with after-sales Not enough insight yet about how to market other SMARTechs No central location in Tanzania
MSABI	Large team dedicated to WASH Good model for sustainability of pump with the Pumps for Life insurance program Very good in marketing themselves at donors. Team is eager to carry out innovative pilots	Current model for wells and pumps is too expensive for the Self-supply market Weak development of the supply chain for Self-supply wells and pumps. Expat management needed to sustain funding
IDYDC	Understands the concept of Self-supply and training entrepreneurs. Introduced Self-supply for communal use.	Small WASH team, dependent on iWASH funding Only one trained entrepreneur has become successful in the market
Winrock	Experienced management with strategic insight, promoting Self-supply. Has opened the market for Self-supply around Morogoro. Supported VETA to start a course on Rope pump production.	More advocacy needed at government level.
VETA	Government institute for vocational training. Tanzanian teachers train Tanzanian students. Long term and sustainable funding by government. Serious approach, good quality training	Focused on training to produce Rope pumps, not (yet) on how to scale up this technology, and how to market it. No monitoring mechanism in place when Rope pump is installed.

Table 4.2. Scaling up SMARTechs: chances and limitations

5 Needs and motivations of the Rope pump user

This chapter describes the needs and motivation of water users (customer segment 1 of the entrepreneur, and indirectly customer segment 2) to choose for a Rope pump and includes functionality and maintenance costs.

5.1 Who are the Rope pumps users?

The Rope pump users can be divided into the following groups:

1. Users via Self-supply; fully self funded, with or without microcredit. In rural areas, many do not have access to a functioning water point near or at their premises. In peri urban areas, where there is a piped system, families have it as a pump for the garden or as a back up in case the piped system does not function.
2. Users via Communal water supply. Fully or partly subsidized by an NGO, others. These users are mainly based in rural areas and do not have access to another improved functioning water point.

During the assessment, 41 households having Rope pumps via Self-supply and 16 users of a communal Rope pump (fully or partly subsidized by NGOs or government) were interviewed[20]. In addition, 14 schools and health clinics were interviewed, of which an estimated 30% was Self-supply. Appendix 5 shows a map of the locations of the water points.
The families having an own fully funded Rope pump seemed to have a higher economic status than the communal water users: improved housing, more capital goods and often a job outside agriculture, such as teacher, shopkeeper or factory owner. There were for example many Self-supply Rope pumps around Mafinga, where people earn money from tree harvesting[21].

The number of households using one Rope pump varied between 1 and 35 households (5 to 175 people) in case of Self supply, and between 6 and 40 households (30 to 200 people) in case of communal supply. Thus, even when one family purchased a Rope pump, the many households used it!
Main differences between the Self-supply and communal supply water points were the decision makers / buyers (one owner in the case of Self-supply, a community together with an NGO in the case of communal supply), and the person responsible for operation and maintenance (the house owner versus a selected person from the community). In case of Self-supply, most owners provided the water for free to neighboring families, a minority sold the water for 50 to 200 TShs / 20 l bucket. Reasons to provide the water for free was that it was a favor for the neighbors, a habit in the village to share, or fear for the neighbors.

At schools, a Rope pump was used for 250 to 550 students and teachers. In all cases, the management of the school was responsible for the operation and maintenance of the Rope pump.

[20] A few communal Rope pumps from the TaZaMo project were visited. It is recommended to do a larger assessment on the functionality of these older pumps.
[21] Harvesting of pine trees and eucalyptus, which gives, as a rough estimate, an average income of 350,000 TShs / year according to a survey in Njombe region among 89 tree growers: average age of tree when selling: 11 years. Average price: 13,500 TShs / tree, average number of trees sold per year: 288 Tom Hilton via Asko Siintola (2015). Value Chain 2015_09_21. Iringa, Forestry Development Trust.

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5.2 Motivation to invest in a Rope pump

Self-supply users invested in an own well and Rope pump to have a reliable water source and abundant water nearby, and not to be dependent on other families, on waiting time because of limited amount of water available, on irregular functioning of a communal hand pump, or on (dirty) river water or other unprotected source far away. Before the installation of the Rope pump, people were mainly using a communal conventional hand pump such as an Afridev pump, a communal Rope pump (in a few cases), an open well with bucket, unreliable piped water or the nearby river.
'The Danida pump (Afridev pump, ed.) gives limited water, it is old and needs repair. It is a crisis' (family in Mtili, who chose for a private Rope pump).

The main reasons Self-supply customers mentioned to choose for a Rope pump and not for another technology were the easy handling, no access to electricity (for a submersible pump) and improvement of water quality. Main evidence for the perception of good water quality was that the water looked clean, people argued they did not get sick from the water and the logic of less contamination with a covered well.
The workshops selling Rope pumps additionally mentioned the affordability of the pump, the easy maintenance and low maintenance costs, and the durability of the pumps. Some workshops were trained to sell Tulip water filters but did not really promote them.

Main reason for NGOs to install a Rope pump for communal supply or schools was the lack of another nearby reliable and safe water source. In contrary to Self-supply, some communities could only use the Rope pump for domestic use because of limited amount of water from the well. In other communities though there was more water and people could also apply the water for other activities such as gardening and construction. There were no major O&M issues. Money was collected as a monthly fee or when maintenance was required.

5.3 Income generation

Because of the reliable water supply and easy access to abundant water, the water point could also be used easily for other activities than cooking, cleaning, drinking and washing, such as construction, gardening and commercial use. On basis of interviews and observations it was estimated that investing in an own Rope pump could bring a family an annual additional income between 90 and 1350 USD or even more[22]. Details can be found in Appendix 6.
According to a study of Haanen and Kaduma in 2011, the Rope pump resulted in additional income for 89% of the households studied (Rik Haanen and Kaduma 2011). The numbers also confirm other data from literature: an extensive study in Nicaragua showed that private Rope pumps improved the economic situation of families. On average their annual income increased with US$225 (J.H.Alberts and Zee 2002). A recent study on Rope pump users in Malawi showed an estimated increase in annual income of 180 USD (Rosendahl 2015).

5.4 Water quality

The majority of the people interviewed perceived the water as safe and did not see the need to purify the water. Entrepreneurs were trained to sell Tulip water filters but did not really promote them. Safety of water is sometimes mentioned as a critical point to decide for an Afridev pump instead of a Rope pump. However, there is not much evidence to make that distinction. MSABI measured the water quality of all 400 installed water points (wells and Rope pumps) they installed (wells drilled up to a depth of 28 m) near Ifakara and found zero contamination. Samples taken by

[22] This means the Rope pump can give a substantial additional income, as average annual household expenditure in rural Tanzania is around 2,5 million TShs (1125 USD) National Bureau of Statistics and Ministry of Finance (2014). HOUSEHOLD BUDGET SURVEY MAIN REPORT, 2011/12. Dar es Salaam.

SHIPO showed that some wells around Njombe have insufficient water quality, but this is very probably not caused by the type of pump but by the groundwater quality. One health clinic mentioned a decrease in waterborne diseases since they used the Rope pump. In literature, several studies can be found on water quality with Rope pumps. Several studies found that there was not much difference between the water quality of Rope pumps and other hand pumps like Afridev (P.A. Harvey and Drouin 2006, Beatrice Coloru, Salmon Mgaya et al. 2012). A study of MSABI showed that improved wells with Rope pumps had significantly less feacal contamination than open wells in the same area (Jacqueline Thomas, Novatus Mwangeta et al. 2013). The same results were found in an older study in Nicaragua (A.C.Gorter 1995).

5.5 Maintenance and functionality of the Rope pump

Table 5.1 gives an idea about the maintenance and functionality of Rope pumps in case of Self-supply and communal supply. Please be aware that data are limited and that answers showed large fluctuations. Therefore, the numbers are a first indication. Data may also be distorted because 40% of the Rope pumps were installed in 2015. Functionality of private pumps is higher and maintenance costs are lower than in the case of communal supply, but in both cases maintenance costs seemed to be still affordable for the majority of the users. Except for the dry wells, most users of the non-functional Rope pumps commented that they planned to repair them on short term. Maintenance costs also depended on the number of users: it can be expected that a rope needs to be replaced more often when the pump is used by 150 people than by 5 people. This study showed this trend but was not representative and random enough to draw any conclusions.

Type of water user	**Maintenance issues**	**Number of users**
Self supply Average installation year: 2013 (2008 – 2015)	None or minor problems repaired by user	23
	Rope exchange, guide block problems, other issues[23], average costs 6 USD water point / year	11
	Limited amount of water due to well	2
	Not in use because of dry well	2
	Not in use because of technical problems	2
	Functionality 92%	
Communal supply Average installation year: 2013 (2004 – 2015)	None or minor problems, repaired by user	7
	Rope exchange, guide block problems, other issues, average costs 11 USD / water point / year	4
	Limited amount of water	2
	Pumps for Life program. Costs 32 USD / water point / year	2
	Not in use because of rope break, guide block problems, delay in payment	4
	Functionality 80%	

Table 5.1. Maintenance and functionality of Wells and Rope pumps (excluding replacement costs)

On basis of the small study performed here, the maintenance insurance program of MSABI, Pumps for Life, seems to be more expensive for the user than ad-hoc repair. However, it is expected that this insurance program results in a longer life time of the pump, especially in the case of communal use (N. Holbro, H. Choyo et al. 2013). In addition, maintenance time was reduced: according to MSABI, without the Pumps for Life program, it took on average 13 days

[23] Cost of rope and guide block was respectively 20,000 and 10,000 TShs. These materials are locally available and need to be replaced on average once in one or two years (more in case of communal supply and schools). In some cases guide blocks should have been replaced sooner.

before people called their supplier, and another 90 days before the pump was repaired. With Pumps for Life, it took up to a few days only.
There are a number of studies in which Rope pumps were compared with conventional piston pumps. A study from Ghana showed that the average maintenance cost of a Rope pump was 40 USD per year, but this included depreciation and replacement costs (P.A. Harvey and Drouin 2006). The authors compared the Rope pump with a Nira AF85 hand pump, which had more than twice the maintenance costs of a Rope pump. A publication from iWASH also showed that maintenance costs of an Afridev or India Mark 2 hand pump were 3 to 5 times higher than those of a Rope pump (iWASH 2013). Another study around Njombe found that reliability was higher with the Rope pump and reparation costs were lower (12.5 USD / year) (Acra 2012).

6 Discussion and recommendations

Objective of this study was to get an answer on the following questions:
- How can the SHIPO SMART Center create a sustainable own business as training centre in SMARTechs?
- How can accelerating scale up of SMARTechs in Tanzania be achieved?

6.1 A sustainable business for SHIPO SMART Centre

Growing a sustainable business asks for a scalable and repeatable business model, with lots of loyal and new customers. Revenues should be at least to costs and have a repeatable pattern that lasts (Coelman 2014).
When we look at the business model in chapter 2, and at the strong points and challenges of the SHIPO SMART Centre, a couple of issues attract attention.

There is a satisfied and supportive customer base (donors, entrepreneurs, NGOs, VETA), due to a strong value proposition, a proven concept and good customer relationships. The number of customers is relatively small though, and the efforts to find new customers for trainings (entrepreneurs and NGOs) should be enhanced. There seems to be a (small) shift from training new workshops in Njombe (customer segment 1) to customized locations (customer segment 2). This may have to do with saturation of the market around Njombe and the finalization of the iWASH program.

Expansion of the staff of the SMART Centre with an M&E officer and a business-oriented team member, and closer cooperation with other departments may be useful to meet the challenges mentioned in chapter 2.

Revenues are direct and indirect strongly dependent on international donors (customer segments 2, 3 and 4). Informal discussions with people from NGOs and small companies gave different opinions if the latter can create a sustainable business in the long term, due to limited repeatability and scalability.
In case donors are seen as sustainable customers, growing the SMART Centre should be possible with the current business model or small adaptations. Focus will need to be on reaching more customers in all customer segments, creating tighter customer relationships and working on the supply chain for current and other SMARTechs (business training of entrepreneurs, showing the benefits and marketing of existing and new SMARTechs). Slight adaptations could make the model stronger, such as addition of a maintenance insurance program in the product portfolio and an additional emphasis on communal supply to attract more donors (MSABI model, see chapter 5). It is recommended to set a clear strategy and targets about the customer approach. The SMART approach could be advocated much stronger among donors and government. A conservative calculation showed that 10 years SMART Centre resulted in 10,000 low cost water points and 500,000 people reached, for a total estimated cost of 20 euro / capita, see appendix 7 (Holtslag 2015).

In case the SMART Centre wants to decrease its dependency on donors, a new / different business model needs to be developed. Options are for example a hybrid model in which local NGOs are still customers but at the same time the Centre asks a higher contribution from entrepreneurs in the form of profit sharing, or starts to sell SMARTechs herself (with entrepreneurs as suppliers). It is beyond the scope of this report to discuss this in more detail.

6.2 Acceleration scale up of SMARTechs in Tanzania

It has been shown in this study that scaling up affordable and repairable technologies (SMARTechs) for low-income markets is very well possible via a market-based approach.
Via entrepreneurs, the Rope pump has successfully been introduced in the Tanzanian market via communal and Self-supply and is praised by the users for easy handling, low maintenance costs and good quality. There is a sizeable group of customers from middle income and upper low-income groups in both urban and rural areas, who can afford to purchase the pump for own use. Self-supply may be accelerated when people better understand the economic benefits.

The best marketing is a bottom-up approach, as was also seen by Viswanathan and Hystra (Hystra 2013, Viswanathan 2015). Good-working examples with a certain critical mass, and clearly showing the advantages for the user are the most efficient way to create demand and to realize a shift in the customers' decision making in favor of a SMARTech. Low-income households in general do not like to take risks and incline to choose the same technology and supplier of their neighbor.
NGOs play an important role in the first stage of scaling up because both subsidy and social marketing are needed to establish a critical mass, to raise awareness at consumers and to convince the early adaptors of the new technology. This is a very difficult task for local entrepreneurs, as they have insufficient capital and knowledge to do this. After a critical mass has been reached, entrepreneurs can work independently to grow their business.

Giving entrepreneurs a good technical training and support afterwards (certification, monitoring, repeated trainings, etc.) is essential to ensure sustainability of the SMARTechs in the market. A broken pump or dry well is bad publicity and will prevent further scale up.
But NGOs also need to facilitate entrepreneurs in the development of their business: ensuring that there are enough raw material suppliers, training in all kinds of business aspects, facilitating loans for equipment and material, and providing tools for efficient marketing. Business support is of the same importance for accelerating scale-up as is technical support! This was clearly seen in the assessment: ignorance in record keeping, setting strategies or how to market Rope pumps more efficiently caused a stagnation of the business for some of the entrepreneurs. Some entrepreneurs returned to their old business because of more demand for those products. Last but not least, there is a maximum price that families can afford (or are willing) to pay. Not many families choose for the (more expensive) manually drilled well and the majority of the Self-supply customers cannot afford the full cost of a 'MSABI water point' (hand drilled well up to 28 meter and Rope pump).

To accelerate scaling up SMARTechs, it is not sufficient to support existing workshops only. New workshops need to be trained continuously, until a complete distribution network has been reached. Copycats should be found, convinced of the need to produce good quality and be trained to ensure quality of their products. It is estimated that there are between 5 and 20 workshops producing (sometimes bad) copies of Rope pump (Holtslag 2015).

The above is in principle valid for all SMARTechs the SHIPO SMART Centre wants to introduce into the Tanzanian market. Other SMARTechs such as drip irrigation sets, Water Recharge system, Tulip water filters and improved toilets are not yet successful due to limited marketing and /or a low demand from the market. People do not (yet) see the advantages of these products. For each new SMARTech, the SMART Centre needs to create a bottom-up marketing strategy to introduce the product in the market: define the customer segments, assess the advantage for the customer (Value Proposition), explain the advantages of the product to the entrepreneur and create a critical mass with good-working examples. This has worked very well for the Rope pump

With the new low cost technologies for communal and Self-supply a large part of the so-called 'last mile' may be reached. This means universal and equitable access to safe and affordable drinking water for all (Sustainable Development Goal 6).

Rope pumps (and other SMARTechs) are per definition suitable to apply in smaller and remote rural communities, as they are low cost, easy to maintain, and can be produced and sold by local entrepreneurs. There are (at least) three ways how lower income groups can be reached: (1) Although entrepreneurs do not directly reach the lowest income group, but rather middle class and upper low-income households), lower income families benefit from their richer neighbors by getting water for free or for a small fee. Acceleration of scale up via Self-supply may therefore directly result in communal use. (2) With financial support solutions, or with lower cost pump models, lower income households may also be able to afford a pump themselves.
(3) For communal supply at communities of 250 people or less, NGOs and government can be stimulated to install lower cost options than conventional machine-drilled boreholes and imported hand pumps, such as hand dug or hand drilled wells with Rope pumps (iWASH 2013).

Good quality wells and Rope pumps, followed by a good training of users on maintenance and ample availability of spare parts supports the long-term functionality of a water point, for both private and communal wells. The study has shown that maintenance costs for Rope pumps are small for both Self-supply and communal use, but functionality of the former seems to be higher. A maintenance insurance program such as Pumps for Life of MSABI would be very suitable to increase functionality, and is especially interesting for communal wells (higher maintenance costs, more users and less ownership). It will be a challenge though to find a sustainable profit-based mechanism for a similar insurance, and not to be dependent on donor funding.

6.3 Some recommendations for accelerating scale up of SMARTechs in Tanzania

1. Create a solid basis for further scale up: follow up on all trained entrepreneurs and copycats in Tanzania, to assess the current size of their business in SMARTechs and to support them with technical and business skills. Certify all good quality entrepreneurs in Tanzania, possibly together with VETA.
2. Develop marketing tools for entrepreneurs, so they can target their market more efficiently, and better explain the (economic or other) advantages of the product to the customer.
3. Explore the market for wells and Rope pumps in other parts of Tanzania and train new entrepreneurs, by approaching WASH NGOs in those areas (customer segment 2 in the business model of SHIPO SMART Centre). Start with social marketing and realization of a critical mass.
4. Increase sustainability of installed water points: check as many installed wells and Rope pumps as possible on functionality and find a good mapping tool for existing and new water points (there are already some data available, a.o. from Acra (2011), and waterpointmapping.org see appendix 3). Explore if a profit-based maintenance (insurance) program can be set up (with Pumps for Life as an example). A good mapping system and proof of functioning is also a good tool to attract larger donors active in WASH.
5. Advocacy. Involve government, TaWaSaNet and more policy-related NGOs to get more (official) support for SMARTechs in Tanzania.
6. The last mile. Give options to NGOs how to reach the lowest income households, which are often families in small communities or dispersed living families. One option is with fully or partly subsidized investment for communal wells (for communities smaller than 250 people). Another option is try to reach lower income rural families via Self-supply by exploring different financial support solutions and lower priced product options (but keeping quality). A third option is to find a way to convince higher income families, who invest in Self-supply, to sell or share their water with lower income households (but take care: this results in higher sustainability but may increase inequality and dependency).
7. Find the Value Proposition, raise awareness and establish a critical mass for other SMARTechs. When this is successful, the new products may be sold through the same channels as wells and Rope pumps.

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8 Appendices

Appendix 1. Main sources of drinking water in the different regions of Tanzania

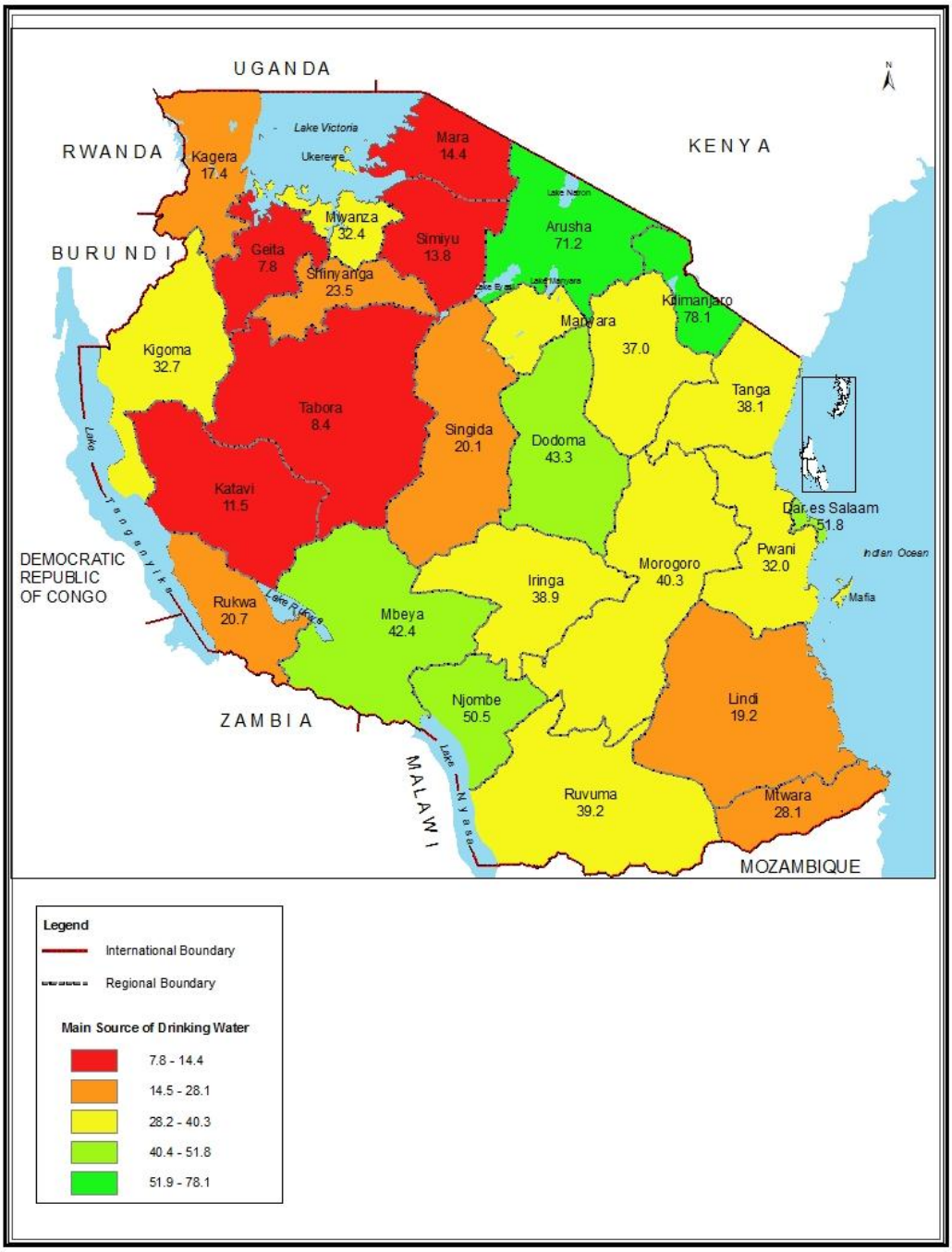
The main sources of drinking water are not only different between rural and urban dwellers, but also very unequally divided over the regions (National Bureau of Statistics and Ministry of Finance 2013).

Population, employment and sources of drinking water	total	rural	urban
Population 2014 (JMP 2015)	51 million (10-11 million HH)	69%	31%
Drinking water coverage (JMP 2015)			
- piped water onto premises	13%	6%	28%
- other protected sources	43%	40%	49%
- unprotected sources	30%	34%	20%
- surface water	14%	20%	3%
Employment (Census 2012)			
- in own or family farm	71%	86%	30%
- in own non-agriculture activity	17%	9%	38%

Table a1-1. Population, employment and sources of drinking water (National Bureau of Statistics and Ministry of Finance 2013, WHO and Unicef 2015)

Region	**Piped water (%)** **Into dwelling, into yard, public tap**	**Protected source (%)** **Tube well + borehole, protected dug well, protected spring**	**Unprotected source (%)** **Unprotected dug well, unprotected spring, surface water**
Dodoma	43	10	41
Arusha	71	7	19
Kilimanjaro	78	5	15
Tanga	38	10	48
Morogoro	40	23	34
Pwani	32	17	47
Dar es Salaam	52	26	5
Lindi	19	14	63
Mtwara	28	6	43
Ruvuma	39	21	39
Iringa	39	15	43
Mbeya	43	13	43
Singida	21	17	61
Tabora	9	17	72
Rukwa	21	21	57
Kigoma	33	27	38
Shinyanga	24	17	52
Kagera	17	21	59
Mwanza	33	24	42
Mara	14	15	67
Manyara	37	12	41
Njombe	50	10	39
Katavi	12	31	55
Simiyu	14	36	48
Geita	8	26	59

Table a1-2. Main source of water in Tanzania per region according to Census 2012.



Map a1. Percentage of Households that Used Piped Water as the Main Source of Drinking Water by Region, Tanzania Mainland, Census 2012.

Appendix 2. List of people and organizations interviewed

Organizations
SHIPO team
GoConsulting
MSABI team, Ifakara
IDYDC team, Iringa
Winrock International, Morogoro
VETA, Morogoro
Basic Water Needs

Local entrepreneurs:
Agape Group
Ajua Group
D-workshop
Heri Group
Kevin workshop
Kisangani Blacksmith and Renewable Technologies Company
Leon's workshop
Mkalichuma workshop
Rahajene Group
Upangwa Group Makambako
Uvinjo Group
Vijana Group

SACCOS
SACCOS Ugesa
SACCOS Faraja Mafinga
SACCOS Kilya (via Neema Makwati)

Rope pump users
71 interviews in Njombe, Iringa and Kuvuma region.
The selection was not random, interview possibilities depended on the availability of interpreters and workshops.
Interviews in Kishwahili were carried out with support of the SHIPO team and Uvinjo Group.

Appendix 3. Functional water points around Njombe

There is a government website, waterpointmapping.org, which gives an overview of functional and non functional water points (communal standpipes and hand pumps) in each ward in Tanzania, over a period of more than 40 years. The company Geodata has carried out the mapping, Water Aid and other donors have supported the project (Government of Tanzania 2015). It is a tool to get accurate information on water points for planning and budgeting (Water Aid Tanzania 2015). From the website however it is unclear how the information is collected, if the information is accurate and if Rope pumps are included. Table a3 shows the number of water points for the regions Iringa, Njombe and Ruvuma, according to this website. Njombe would have the highest coverage and highest percentage of functional water points of all regions in Tanzania. It would be interesting to contact Water Aid or the government for more information and possible cooperation.

Region	Total # water points	Communal standpipe	Hand pump	% Functional
All regions	86945	54740	22966	54%
Iringa	2292	1645	609	69%
Njombe	5425	5003	415	78%
Ruvuma	3810	2456	1226	55%

Table a3. Functional water points in Iringa, Njombe and Ruvuma according to Geodata.

Appendix 4. Feedback from entrepreneurs on the training of SHIPO SMART Centre

Question	Answers	Frequency of answers
What did you learn from the technical training?	• New SMARTechs, such as bicycle pump, EcoSan, EMAS pump, Treadle pump, Recharge, Making tanks	8
	• SHIPO method for drilling and digging	2
	• Standardization of the material	1
	• How to do precasting and make cover of well cap	1
Do you promote the 'new' SMARTechs?	• Not enough finances to by SHIPO drilling equipment	3
	• EcoSan, drip irrigation: difficult to introduce, because people need more education, and they have to take risks	2
	• I do not see a benefit of these other SMARtechs	1
	• There may be a market for EcoSan in Dar es Salaam	1
	• I cannot get materials for the EMAS pump	1
	• I believe in the bicycle pump (but no sales yet)	1
	• I promote and sell rainwater harvesting and recharge	1
What did you learn from the business training?	• How to get more customers	3
	• Independency, entrepreneurship	2
	• Importance of joining exhibitions, use of marketing tools such as social media and brochures	2
	• Better insight in profit and loss	1
Would you like to add other topics?	• Do not emphasize the rope pump only	2
	• Start a professional association	2
	• Add other technologies and local equipment used by the entrepreneurs	2
	• Repeat SHIPO open day next year, it resulted in new customers.	2
	• Extend the training for more practical experience	1
	• Learn how to make wells of more than 100 ft deep	1
What did the training bring for your business?	• Increase of the business	5
	• 'It changed my life', able to raise living standards for family	2
	• Not possible to apply the knowledge due to lack of capital	2
	• Expansion of network	1
What follow up did you get from SHIPO?	• Visits, phone calls, very satisfied.	7

Appendix 5. Map of the water points visited for interviews

Dark blue: self supply, full payment
Light blue: self supply with microcredit
Green: Schools, dispensaries, missions
Red: communal supply

Appendix 6. Increase of income with the Rope pump for Self-supply

This table is an estimation on basis of interviews and observations. Please note that estimation is very rough and does not include investment costs, necessary food for animals, fertilizers, etc.

Main use of rope pump	Benefit	Increase in income / year (TShs)	% HH using water for this purpose
Drinking, cooking, cleaning, washing, all nearby house / school	'Own` water, no need to buy water elsewhere	Up to 200,000 (100 l / day)	10%
	Mostly safer water than unprotected sources such as river	Less expenditure on medicine and hospital (not mentioned by any HH)	
	Saving time, more time for other activities and children (esp. girls) can spend more time in school	Indirect income	
Vegetable garden	Having own vegetables	350,000 (29,000 / month)*	40%
	Income generation from vegetables	100,000 – 300,000 (200 / bundle)**	20%
Avocado trees	Income generation from avocados	100.000 – 300,000 (2 – 6 trees)	5%
Sales of water	Income generation from water sales	1,000,000 – 2,000,000 (100 TShs / 20 l bucket)	10%
Production of local alcohol	Income generation: sales of local alcohol	1,000,000 - 2,000,000 (8000 / bucket)	5%
Animals (chicken, cows) for own use	Own milk, eggs and/or meat	50,000 – 150,000 Tshs (5000 for milk and eggs, 9000 for meat / month)*	80%
Animals for commercial use	Income generation, from milk, eggs and / or meat	500,000 – 3,000,000*** (200 / egg, 4,500 / small chicken, 10,000 / big chicken)	10%
Construction	Saving time	Indirect	
Agricultural processing	Income generation by milling for others	No Information	
TOTAL estimated additional income / HH / year		**200,000 – 3,000,000 (90 – 1350 USD)**	

* (National Bureau of Statistics and Ministry of Finance 2014); ** personal communication with Neema Makwati, SHIPO); *** Most people have a couple of chickens. One person had a chicken farm and earned 2 million / year from chicken sales only. Including eggs total income will be around 3 million.

Appendix 7. Costs for water supply per capita, in case a Rope pump is applied

First calculations (Holtslag 2015)

Description	Costs / people
Cost of software, 10 years SMART Centre Salaries for coordinators, technicians, trainers Trainings, infrastructure, workshops, demonstration site, follow-up	1,000,000 Euro / 10 years
Cost of hardware, infrastructure in 10 years 4000 communal water points with tube wells 20 - 45 m deep plus pump (1500 Euro / water point), 1000 Communal water points with hand dug wells plus pump (1000 Euro / water point)	7,000,000 Euro / 10 years
5000 communal water points, 80 people each	400,000 people
5000 Self-supply water points, 20 people each (Spin-off)	100,000 people
One time investment per capita	20 Euro / capita
Cost of water / m3 80 People x 10 ltr/cap/day x 365x 15 years = 4380 m3; 1500 Euro cost / water point	0.29 Euro / m3 (for 15 years operation)