

USE AND BENEFITS OF SOLAR WATER PUMPS

**Kenya, Tanzania & Uganda
Consumer Research**

JUNE 2019

EFFICIENCY FOR ACCESS COALITION



60__decibels



Photo credit: Simusolar

Executive Summary

This report outlines research findings from the solar water pump sector in East Africa. Using the [Lean Data methodology](#) developed by the 60 Decibels team whilst at Acumen. A team of researchers across Uganda, Kenya and Tanzania spoke to 375 SunCulture, Futurepump, SolarNow and Simusolar solar water pump customers regarding their experiences with their pumps so far. The customer interviews explored user characteristics, background, farming practices, former irrigation and pumping methods, satisfaction with current solar water pumps, quality of life changes, and changes in productivity. The report also benchmarks consumer experience with solar water pumps against other technologies (e.g. solar home systems and cookstoves) deployed in the off-grid energy sector.

Most solar water pump users in this sample have higher incomes relative to the average off-grid consumer. One explanation for the income gap relates to the state of the market in East Africa. The solar water pump market in Uganda, Kenya, and Tanzania is nascent. Existing consumers are likely innovators and early adopters who have a relatively high risk appetite and more disposable income. As markets scale, prices should decrease, making the technology accessible to a larger portion of the market.

The results of this study are encouraging, despite limitations in sample size and interview timeframe. Irrigation related expenses in this sample decreased by 91% on average with the use of solar water pumps; however, this excludes the repayment costs for pumps that were financed. Customers also reported positive impacts on their agricultural yields and productivity since purchase, and the majority experienced improvements to their quality of life overall.

Customers also identified areas for improvement. Half of the customers interviewed identified specific challenges they had experienced with their product. The most common challenge was equipment malfunction. However, as results are self-reported, reported malfunctions could be due to other factors such as mismatched expectations, lack of customer training, or misuse. The volume of reported customer challenges is not surprising due to the early stage of solar water pump technology at the time of the interviews. Customer satisfaction is expected to improve as awareness of solar water pumps increases and companies iterate on their product design and improve after sales support.

There are substantial economic and livelihood benefits that accrue to smallholder farmers through the use of solar water pumps. To realize these benefits and encourage sustainable market growth, we recommend the following:

- 1) **Market intelligence** to quantify the opportunity and direct sales;
- 2) **Consumer insights** to ensure continued matching of user expectation and technology design, financing, and user experience;
- 3) **Technology research** to establish quality benchmarks and ensure that technologies in development meet farmer's needs and deliver intended benefits; and
- 4) **A framework for impact measurement** that includes longitudinal studies to accurately quantify and report on impacts of solar water pump usage for smallholder farmers.

Report roadmap

How this report is structured

In the report **introduction**, you'll find a summary of our results and important background information that outlines our methodology.

The remainder of the report is designed to **mirror a customers' journey** and interactions with their new solar pump; starting with the customer profile, their experience, impact, and finally retention and some reflections on the future of the sector. The appendix includes more information on Lean Data and our work.

Look to page 4 for a detailed table of contents.



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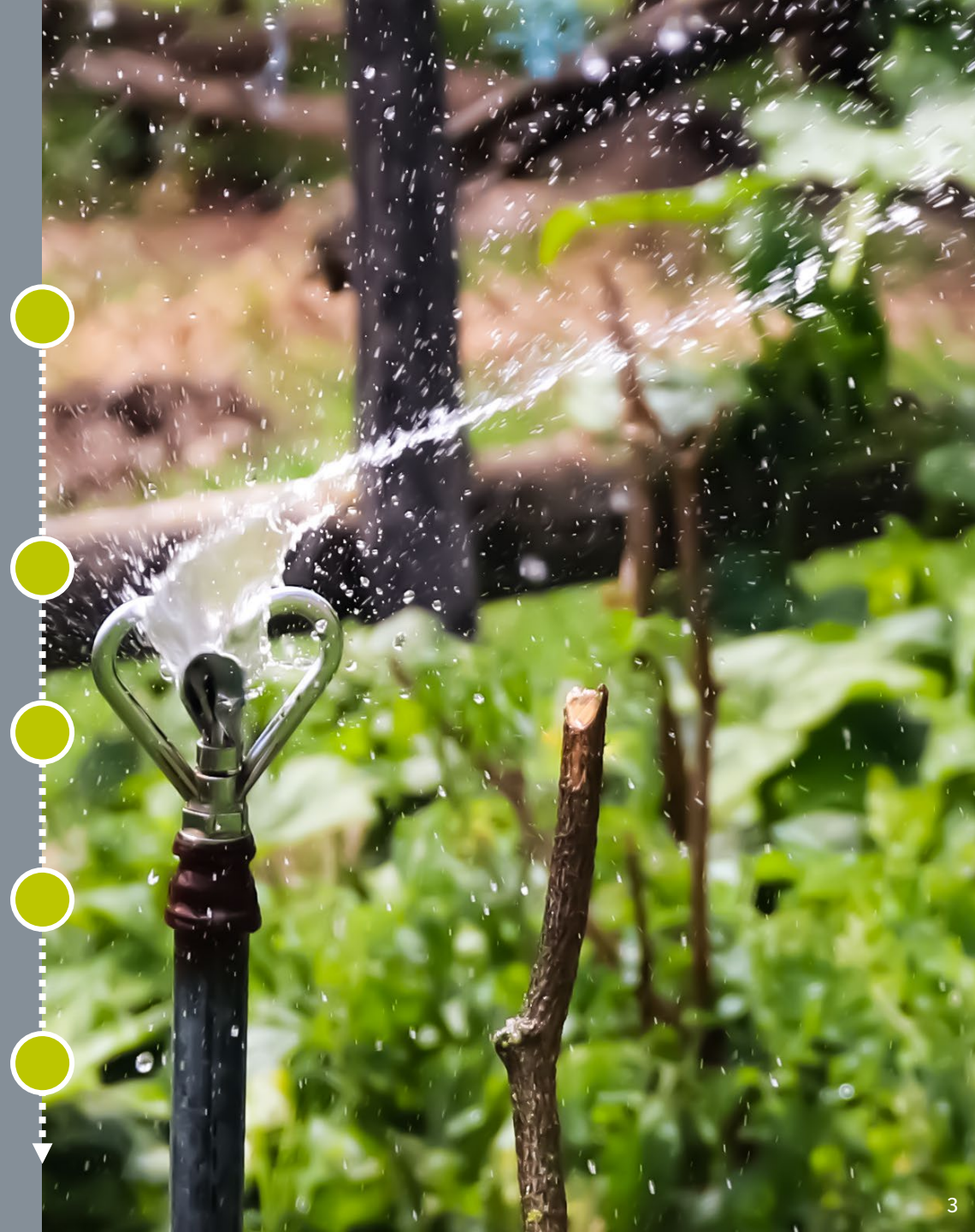


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Introduction

This report was designed to inform the approaches and priorities of off-grid appliance programme actors, donors, and investors and kick-start further research on the overall impact of off-grid appliances.

As part of an effort to scale markets for super-efficient appliances, the Efficiency for Access Coalition reached out to the 60 Decibels team and asked them to explore the observed benefits and potential challenges solar water pump customers experience. A particular focus was placed on smallholder farmers in East Africa.

Over the past three years, the 60 Decibels team have conducted four Lean Data projects with solar water pump customers of Simusolar, Futurepump, SunCulture, and SolarNow. We have aggregated all the data collected on these customers to pull out general trends while maintaining strict data protection and confidentiality. As solar water pumps represent a nascent market, our sample size was limited by customer numbers (sales) at the time of projects.

This material has been funded by UK aid from the UK government. However, the views expressed do not necessarily reflect the UK government's official policies.

What is the Efficiency for Access Coalition?



Efficiency for Access is a global coalition promoting energy efficiency as a potent catalyst in clean energy access efforts. Since its founding in 2015, Efficiency for Access has grown from a year-long call to action and collaborative effort under Global LEAP and Sustainable Energy for All, to a coalition of 13 donor organizations.

Coalition programmes aim to scale up markets and reduce prices for super-efficient, off- and weak-grid appropriate products, support technological innovation, and improve sector coordination. Current Efficiency for Access Coalition members have programmes and initiatives spanning three different continents, 44 countries, and 19 key technologies.

The Efficiency for Access Coalition is coordinated by CLASP and Energy Savings Trust.

Special thanks to:



Methodological overview

Introduction to 60 Decibels and Lean Data

60__decibels

60 Decibels is an impact measurement company that helps organizations around the world better understand their customers, suppliers, and beneficiaries. Its proprietary approach, Lean DataSM, brings customer-centricity, speed and responsiveness to impact measurement.

Since 2014, the 60 Decibels team has completed more than 300 projects, gathering feedback and social outcomes data from more than 78,000 respondents across 33 countries.

What are Lean Data energy projects all about?

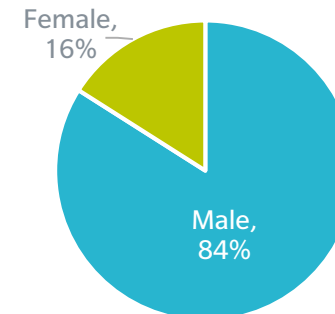
Lean Data projects in energy are conducted via baseline and follow-up interviews (Deep Dive), one-off interviews (Core Insights), or bespoke interviews on a standardised set of customer profile, impact, and business indicators. This report includes a mixture of deep dive and core insights project data, but only compares data for customers at similar stages of product ownership. The customers sampled were selected randomly from each company's full customer base. Smaller sample sizes were often due to limited sales.

Customer interview details

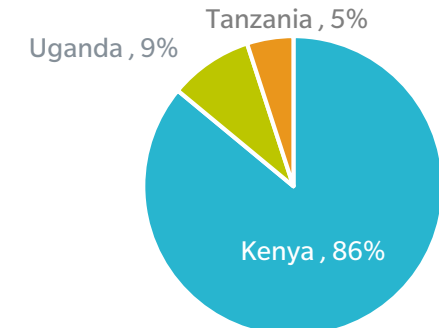
- **Companies:** SunCulture, SolarNow, Simusolar and Futurepump customers
- **Timeline:** 2016 to 2018
- **Number of total respondents:** 375
- **Ownership duration:** On average, Core Insights customers had purchased their product 5 months before the interview. Deep Dive interviews were conducted with new customers (had their pump for 4 weeks or less), with a follow up interview 3-4 months later.

Respondent breakdown

Gender



Country



What is a solar water pump?

An overview of solar water pumps and their uses

Forty percent of the global population relies on agriculture as its main source of income, yet access to water remains an ongoing struggle for many. Cost reductions for solar water pumps has the potential to make modern irrigation accessible and cost-effective for nearly **500 million small-scale farmers worldwide**.

Pumping water from the ground through solar pumping systems offers a **clean and simple alternative to electric and diesel-driven pump sets**. Solar pumping systems are often used for agricultural operations in remote areas or where the use of an alternative energy source is desired. Solar pumps use naturally aligns with solar radiation, as water demand typically increases during the summer when solar radiation is at a maximum. If properly designed, **solar pumping systems can result in significant long-term cost savings and increased agricultural productivity to farmers**.

The cost of solar water pumps has decreased significantly in the last two decades mainly because of a fall in PV panel prices. As prices have dropped, more small-sized solar water pumping systems have entered the market and are becoming more accessible to small scale farmers. In 2013, 80 percent of farms (or 33 million) in Africa were less than 2 hectares¹. **Small pump systems can typically range in cost from about \$400-\$3,000**. A 20-year life cycle cost comparison between a fuel and solar powered pumping system for a 1 acre farm found that the breakeven point between the two systems occurs during the fifth year of operation.² Additionally, Winrock International was able to provide data to financial institutions during their Kenya Smallholder Solar Irrigation project that shows payback periods of 1.5 years or less.³



Results

Key Takeaways

- The average solar water pump (SWP) customer has a **higher income, higher level of education, and is less risk-averse than customers of other off-grid products**. This may be because the SWP market is **relatively nascent** in comparison to markets for other off-grid products. This profile supports our theories of adoption and uptake.
- Unsurprisingly, **half of customers reported facing challenges** with their product, due to the early stage of the market at the time of the interviews. The top cited challenge among SWP customers was equipment malfunction. These challenges could be due to early stages of product development, mismatched customer expectations, and customer misuse.
- Overall, customers are relatively satisfied with their solar water pump. Satisfied customers talked about **time savings, decreased intensive physical labour, and cost efficiencies** in comparison to their previous irrigation method.
- Most SWP customers also reported increases to their productivity, most often mentioning **increased yields and a lack of seasonality** in their produce as the drivers behind the change.
- The majority of customers also said that their new product was **good value for money**, that they **couldn't easily find an alternative** to their new SWP and that their **quality of life had improved** because of their new pump.

25%
poverty reach
(living below \$3.10
per day)¹

55%
of customers moved
up the energy ladder
(for irrigation)

91%
reduction in
expenditure on
water acquisition
post-SWP purchase²

64%
of customers had
owned a solar
product before

81%
of customers felt their
quality of life had
improved since SWP
purchase

82%
of customers
perceived their SWP as
good value for money

64%
of customers
had questions or
suggestions for
improvement

55%
of customers
with challenges
reported technical
issues

¹Kenya only

²not inc. pump repayments

Indicator glossary

Definitions of the Lean Data impact metrics used in this report



Poverty reach and inclusivity

This indicator uses the Poverty Probability Index[®] to identify likelihood of customers living below the poverty line. We use the World Bank international poverty line of relative poverty at \$3.10 per person per day.



Quality of life change

This indicator looks at depth of impact and is measured by the % of customers saying their quality of life has 'very much improved' because of access to the product/service (other options: 'slightly improved', 'no change', 'got slightly worse', 'got much worse').



Value for money rating

This indicator gives a sense of how customers feel about the cost of access compared to the value they get: usage, effectiveness, efficiency. It is measured by the % of customers saying they rate the value for money of their product/service as 'very good' or 'good' (other options: 'very poor', 'poor', 'fair').



Net Promoter Score[®]

The Net Promoter Score[®] is used the world over as a proxy for gauging customer satisfaction, stickiness and loyalty. This indicator is important for understanding customer experience and gathering feedback. It is measured through asking customers to rate their likelihood to recommend the product/service to a friend on a scale of 0 to 10, where 0 is least likely and 10 is most likely.



Ease of Use (No customer challenges)

We measure this through looking at the % of customers who have *not* experienced challenges using the product/service i.e. an inverse indicator for % of customers experiencing challenges using their product/service. Challenges could include technical faults, mismatched expectations, or customer misuse so would be addressed in different ways.



First Access (Product/service novelty)

This indicator provides us with information on how companies are providing families with new experiences and opportunities. Measured by % of customers saying they did not own or have access to the relevant product/technology before purchasing the product/service.



No Access to Alternatives

This indicator looks at awareness of and access to choice in the market and gives us an idea of how critical the company is for providing access. This is measured through % of customers saying they could not easily find an alternative to the product/service.

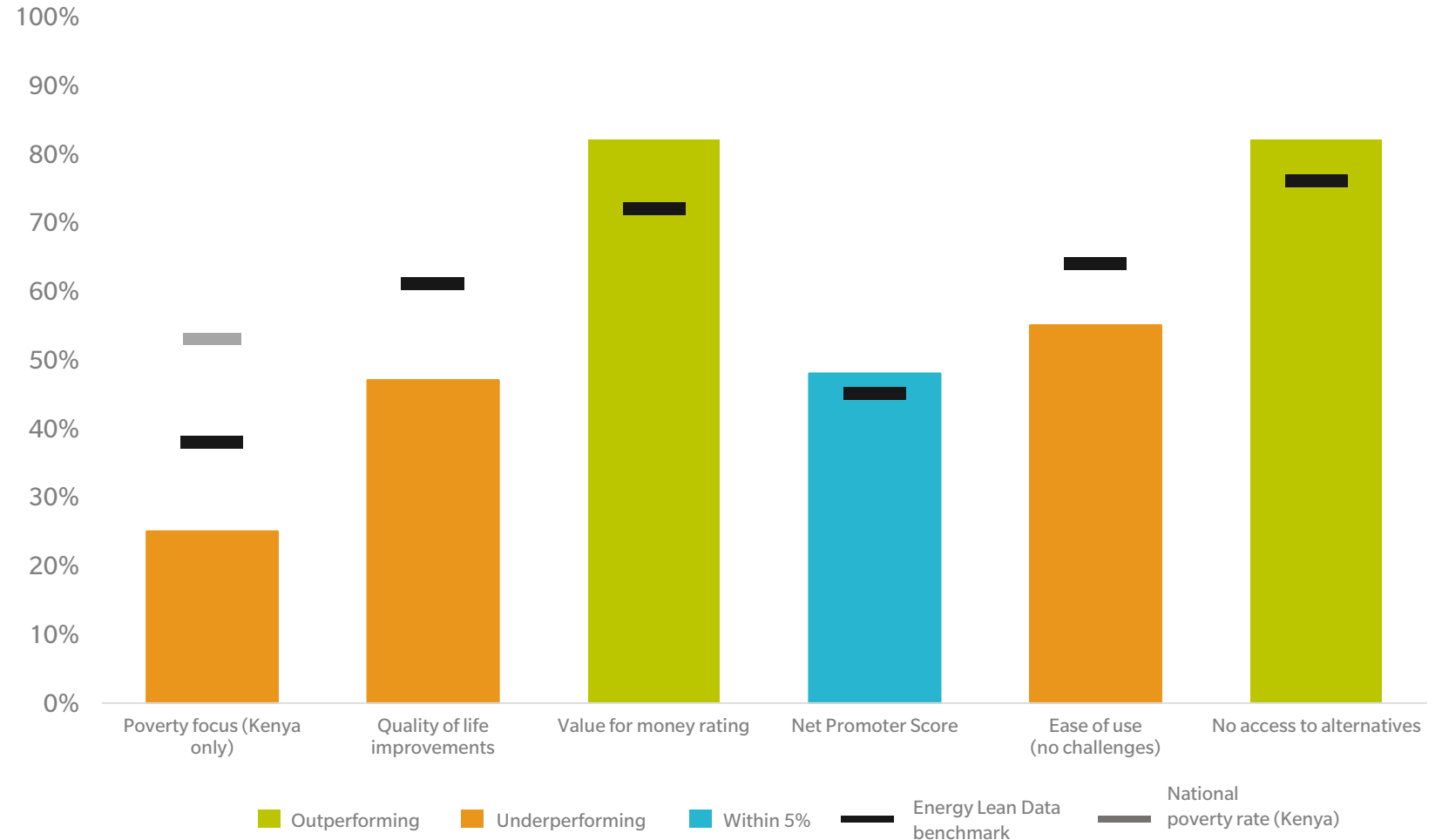
Benchmarking impact

Comparing SWP companies to other off-grid sector companies

Based on the feedback collected from Simusolar, Futurepump, SunCulture and SolarNow solar water pump customers, **solar water pump companies are outperforming in 3 out of 6 of the core benchmark impact indicators relative to off-grid sector peers based on aggregate data.**

The solar water pump sector is nascent in comparison to other off-grid sector peers. This could explain why their performance is lagging in comparison to more developed and wider-reaching products such as solar home systems.

The benchmark is created from the average performance of 39 energy companies' Lean Data projects across 13 countries. Further information on benchmarking can be found on page 9. Higher indicator percentages reflect a more positive impact score.





Customer profile

- Who is the typical solar water pump customer?
- What is the income profile of solar pump customers?
- What are the main sources of income for a pump user's family?
- Benchmarking poverty reach
- What are customers' water sources and incumbent irrigation methods?
- What are customers' farming practices?
- What are some of the non-agricultural uses of a SWP?
- Case study: SunCulture



Experience



Impact



Next steps

"We no longer use lots of energy to get water. I have increased my income through selling vegetables. This income helps my children to get some pocket money for school and also serves our basic home needs like food. I do not need to depend on my salary anymore. This water pump has helped me make some savings."

Zena Nyamagwira, Simusolar customer

Who is the typical solar water pump customer?

To better understand customers' needs, we tried to find out more about their lives

The average solar water pump customer is **male, in his 40s, and lives with five other people**. There was a broad distribution of age in our data from 24 to 64, which suggests that solar water pumps appeal to a wide demographic. The majority of customers were in their 40s and 50s.

86% of customers have been educated to an upper secondary school level or higher. Note: though the sample size for this question was small, these results are consistent with trends we have found across all our off-grid appliance projects. In general, solar pump users tend to be older, have higher incomes and are more educated than solar home system, lantern or TV customers.

Education levels may affect financial literacy and understanding of any agreements customers must sign. However, there does not seem to be any correlation between education level and challenge rates in this study.



All female customers reported their income was regular throughout the year, compared to 79% of male customers. This may suggest that female customers are more likely to purchase when they have confidence in reliable income – this may be important when considering financing and repayments

Selected demographics of solar water pump customers interviewed



47 years
average age



16%
female respondents



6 people
average household size



42%
high school educated



82%
have regular incomes



78%
use their pump for irrigation



13%
owned more than one solar pump

Case Study: what is the income profile of SWP customers?

Income profiling provides insight into product affordability

We used our data from Kenya to create a case study on income profile of SWP customers. We selected Kenya due to our a large sample of customer data and the number of companies working in the country.

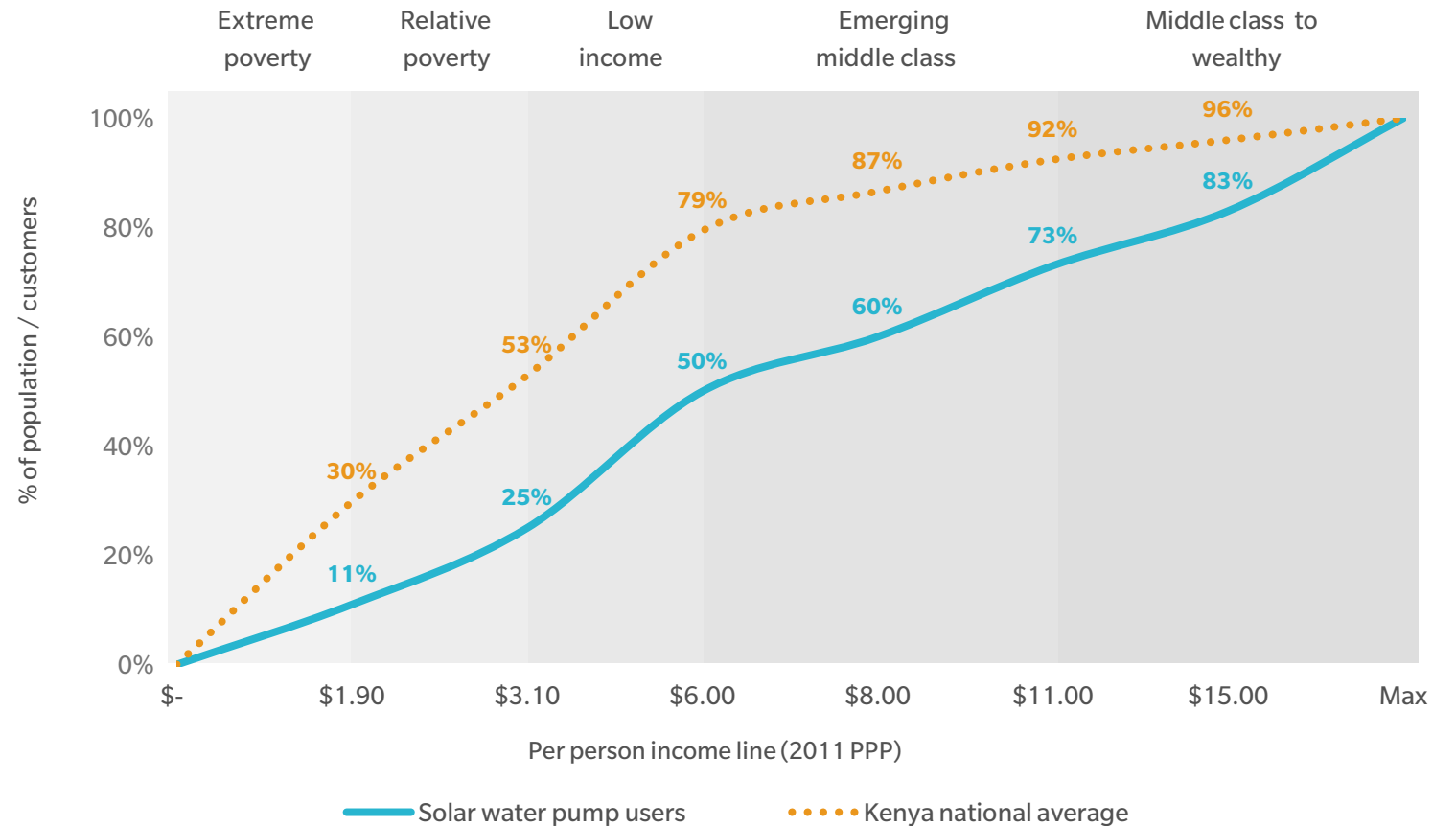
Using the Poverty Probability Index[®], we can plot the income distribution of Kenyan solar water pump customers alongside the national poverty rate in Kenya. This helps us to understand how inclusive the solar water pump industry is, and which income segments the product is reaching.

Overall, **25% of solar water pump customers in Kenya live below the \$3.10 per day poverty line**, relative to **53% nationally in Kenya**. This suggests that solar water pumps are serving a somewhat wealthier subset of the population.



Female customers were slightly higher income than male customers with 20% living below the \$3.10 poverty line compared to 25% of men.

Proportion of SWP customers living below World Bank international poverty and income lines, relative to Kenyan national average



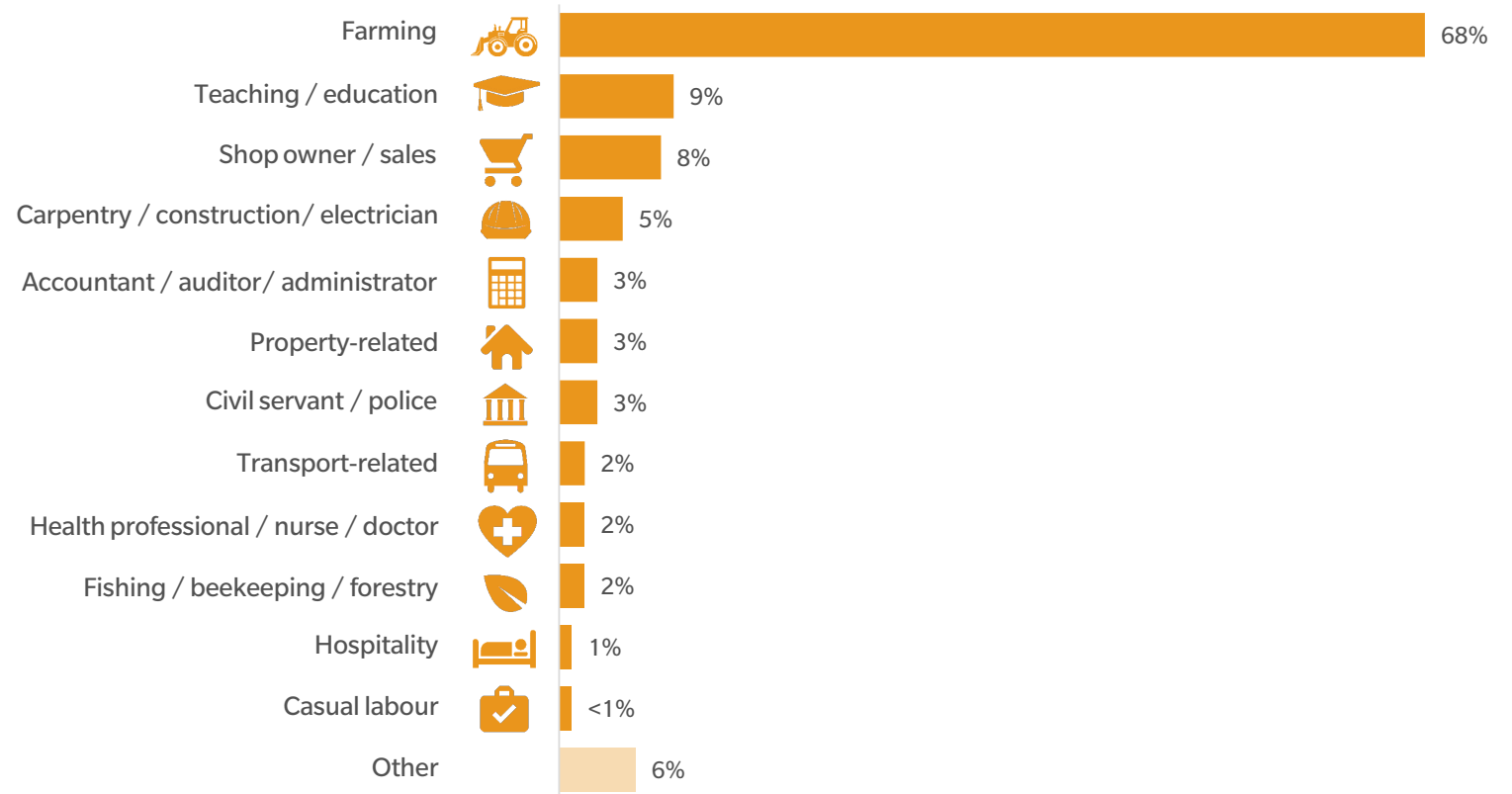
What are the main sources of income for a SWP user's family?

To better understand water pump customers' income profiles, we asked a question about their primary income sources

Unsurprisingly, the majority of customers relied on some type of farming for their income, but one-third did not rely on farming at all. On average, respondents talked about 1.5 sources of income, suggesting that many customers are not exclusively focused on agriculture. This is echoed by our **recent survey of 400 farmers in Tanzania** that showed that 50% of head farmers engage in off-farm activities for generation of extra income.

We also asked questions around access to credit and prior loans to get an understanding of pump affordability. We found that **70% of pump customers got a loan to purchase their new solar water pump** and for **63% of customers, it was their first time buying a product on credit**. This may demonstrate the critical role financing plays in access. For the Tanzanian market, we conclude **in a recent study** that effort to increase SWP adoption will not gain traction without credit

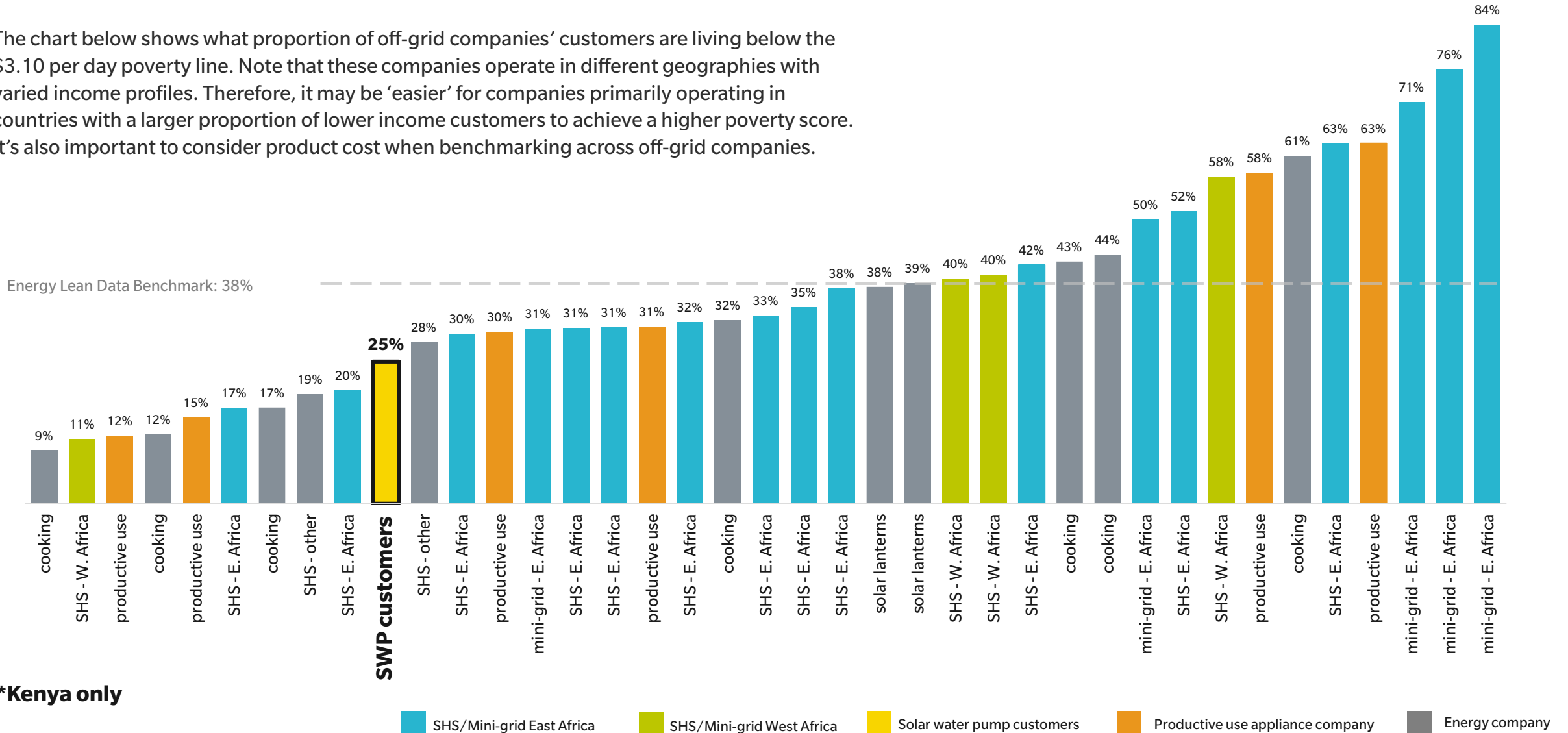
Primary income sources for a SWP user's family in the last 12 months:



Benchmarking poverty reach

Seeing how inclusive solar water pumps are in comparison to other off-grid energy products

The chart below shows what proportion of off-grid companies' customers are living below the \$3.10 per day poverty line. Note that these companies operate in different geographies with varied income profiles. Therefore, it may be 'easier' for companies primarily operating in countries with a larger proportion of lower income customers to achieve a higher poverty score. It's also important to consider product cost when benchmarking across off-grid companies.



What are customers' water sources and incumbent irrigation methods?

Understanding water sources and former irrigation methods helps us understand whether customers are replacing technology or product stacking

Most customers rely on boreholes as their primary water source. **On average, customers spent 8.8 hours per week collecting water.** Users estimated that they pumped or collected approximately 6,800 litres of water per week prior to SWP access, responses ranged from 3 to 80,000 litres.

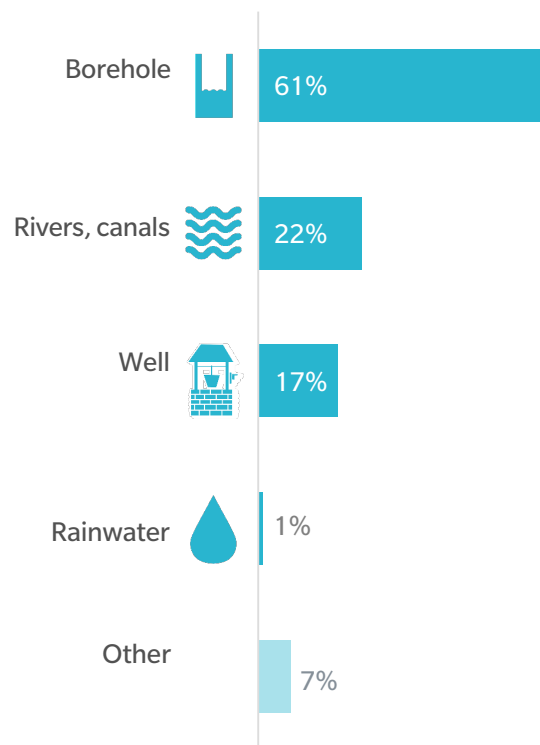
While those previously using generators for irrigation may shift to more SWP use and reduce regular spending on fuel as well as **reducing carbon emissions**, those using manual irrigation mentioned **saving money from hiring casual labour**, so there may be negative livelihood implications of SWP use in the community; something to consider more broadly.

Solar water pump access represents a **step up the energy access ladder for 55% of customers.** This means moving to more modern provision of energy. In this case, moving from manual labour to solar technology.

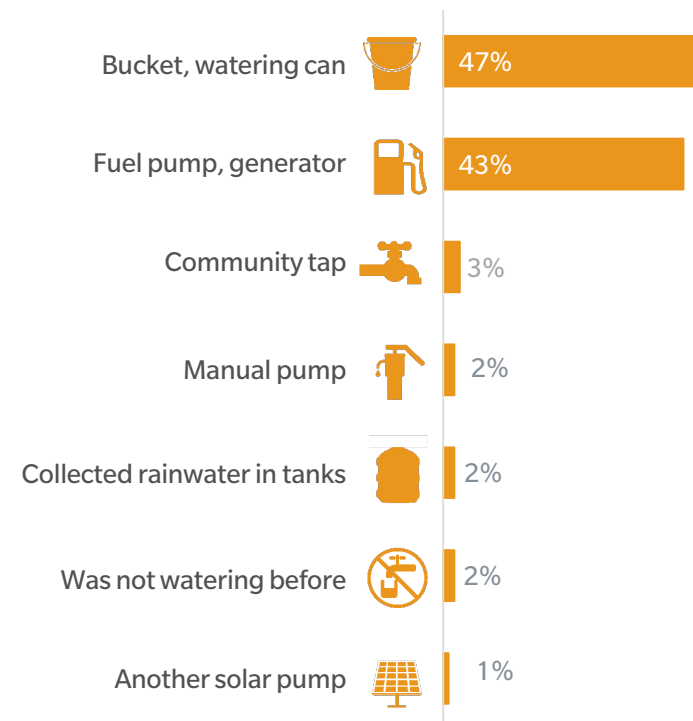


On average, male customers formerly spent 9.2 hours collecting water each week, whereas female customers spent 7.0 hours.

Primary water sources



Top former irrigating methods



"We now have water in the house and we are not straining to fetch it manually from the borehole."
--Anonymous

What are customers' farming practices?

Getting to know customer farming practices can help us understand use cases

To better understand what SWP customers are using their pumps for, we asked questions about their farming practices. **92% of customers farmed crops.** On average, each user had a farming area of approximately 5.2 acres, of which he/she irrigated 1.6 acres. Those who kept animals, on average had 22 animals and kept them on 1.5 acres.

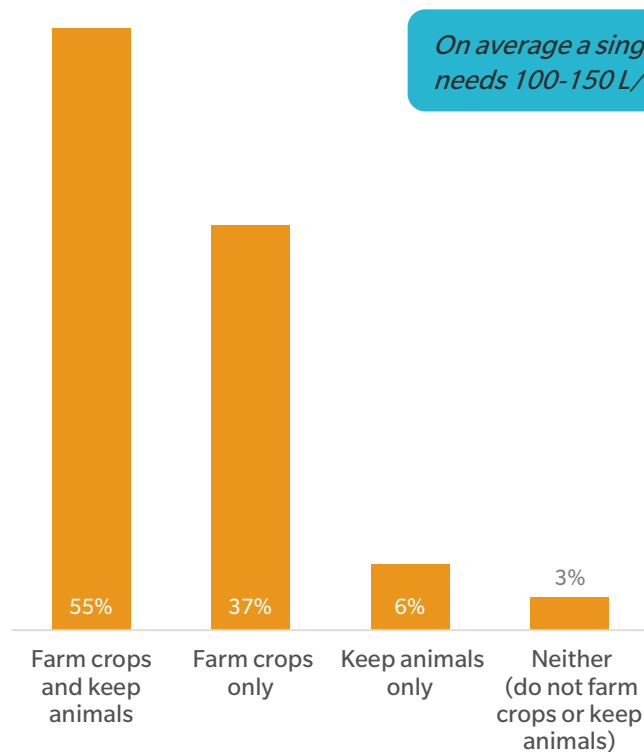
After accessing the solar pump, **75% of customers continued to irrigate the same size of land** as before. The remaining 25% irrigated a larger area of land. We don't know if this is related to pump capacity or customer preference.



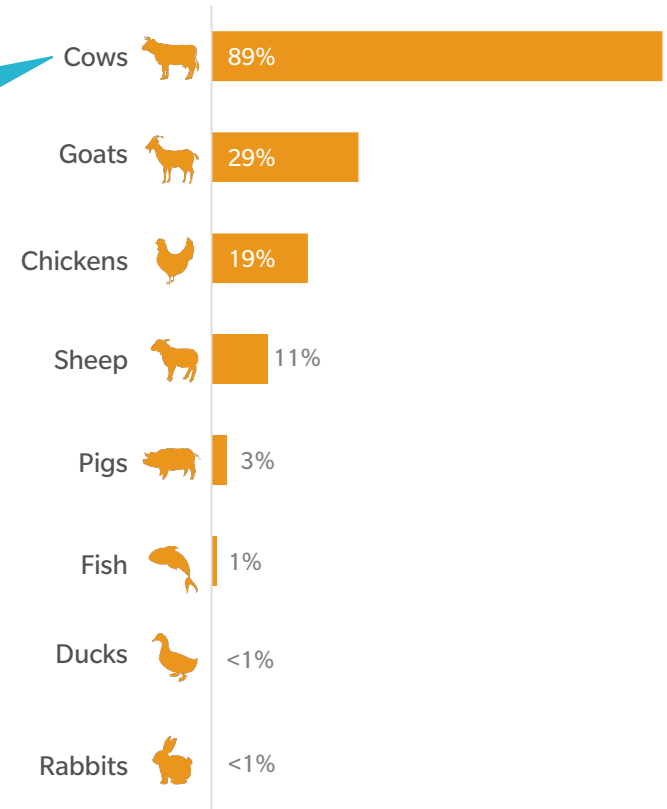
Female and male customers were similarly likely to use their pump for irrigation (81% vs. 78%, respectively).

Female customers were more likely than their male counterparts to use the pump to collect water for domestic use (47% female vs. 33% male).

Most common customer farming practice



Most common animals reared



What are customers' farming practices? (cont.)

Getting to know customer farming practices can help us understand use cases

We asked further questions around farming practices to see if there was any correlation between purchase of the pump and production of higher value and/or more water-intensive crops.

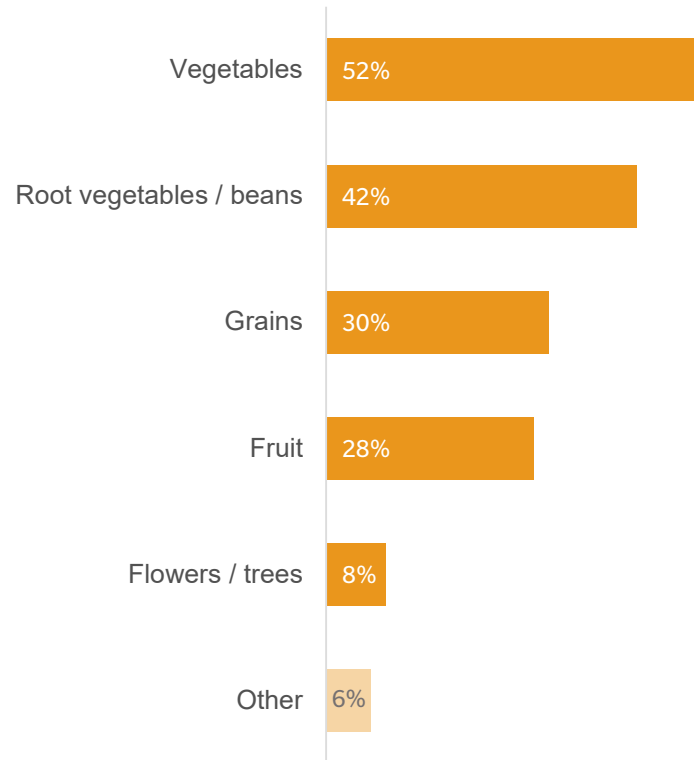
We found that vegetables and pulses were farmed most frequently. Within vegetables, tomatoes (20% of farmers), spinach/kale (16%) and cabbage (10%) were most frequently farmed. Within root vegetables and pulses, beans (19% farmed this), potatoes and gourds (12%) and onions (8%) were the top choices for farmers.

There is growing evidence that impact of irrigations is maximised in Horticulture due to

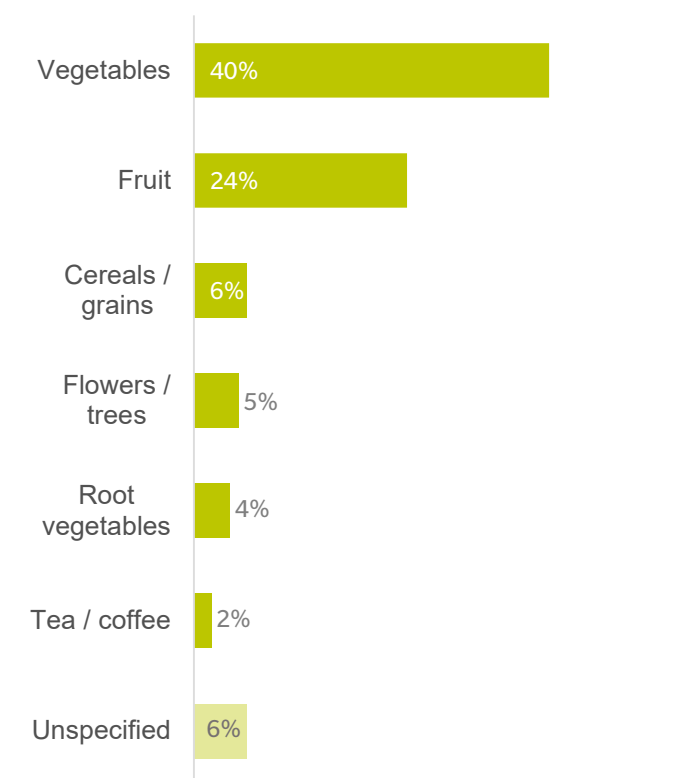
- Higher market prizes and growing demand for horticulture
- short-term cycles that require the high temperatures of the long dry season (when prices are higher), allowing horticulture irrigators to cultivate more than three crop cycles per year ¹
- Domination of smallholder farmers in the sector, with direct links to subsistence farming. In agrarian sub Saharan African communities, women traditionally grow fruit and vegetable crops for their families.

¹Mwangi, J. K. & Crewett, W. 2019. The impact of irrigation on small-scale African indigenous vegetable growers' market access in peri-urban Kenya. *Agricultural Water Management*, 212, 295-305.

Most common crops farmed



Most common crops irrigated



What are some of the non-agricultural uses of a SWP?

We found out more from customers who don't use their pumps for irrigation

22% of the solar water pump customers we spoke to do not use their pumps for irrigation or farming. The majority of these customers use their pumps for domestic or institutional use (e.g. mosques, construction sites, schools). Many of these customers continue to rely on petrol and electric pumps.

Domestic use	Children's home	Vocational institution and mosque
<ul style="list-style-type: none"> Alice uses her solar pump at home. She lives by herself and made the decision to purchase a solar pump to save her energy and time. Prior to purchasing her solar pump, she used to spend on average two hours per week pumping water manually from a borehole. Now that she has the solar pump, she is considering taking up farming and purchasing a tank to store water. <p><i>"I was getting water manually and I used to get tired so I wanted something that I can use faster without spending a lot of effort. I think that the water pump is good and I want other people to have it and benefit as well."</i></p> <p style="text-align: right;">– Alice Mwai</p>	<ul style="list-style-type: none"> Kamau uses his solar pump at the children's home that he runs, mostly for drinking water and cooking. He mentioned that the home might use it for irrigation later on. The children's home currently uses a fuel pump to extract water from a nearby borehole. They pump around 200 litres of water per week. Kamau mentioned that they are in the process of selling their fuel pump so that they can buy another solar water pump. <p><i>"I run a children's home and felt the need to start a project to sustain the children by planting crops that is why I bought it but at the moment it is not being used for the purpose it is being used by the children to pump water and to cook. I want to start farming in the home so that we can have something to sustain ourselves. This pump is using solar technology. I am even selling our old petrol pump, so I can buy another solar pump from [company]."</i></p> <p style="text-align: right;">– Kamau Hika</p>	<ul style="list-style-type: none"> This customer uses his solar pump at the two vocational institutions and the mosque that he runs, mostly for drinking water and washing. Prior to purchasing the solar pump, he and his community used to manually fetch water from a nearby borehole. He estimated that they pump around 1,000 litres of water per week. He was interested in when the company he purchased from would open up a shop nearby so he could encourage more people to purchase too. <p><i>"I deal with pumps and install them, so I was curious about it. It is used mostly in the mosque and for the institutions for pumping water. The water is mostly used for drinking and is used for washing in the mosque. I would say the pump is really strong and good but please improve and have a lot of pieces and reduce the prices."</i></p> <p style="text-align: right;">– Anonymous</p>

Case study

Meet Tirus, a dairy and spinach farmer from Kenya



TIRUS MWANGI

- Tirus made the decision to buy the pump because he was struggling to pump manually from his nearby borehole. This was not his first solar purchase. Tirus previously used a solar home system in his home and was familiar with the technology.
- Tirus pumps about 2,100 litres of water each week on average. He mostly uses the water to irrigate his spinach, provide drinking water for his 13 cows, pump water for domestic use. Tirus' solar water pump is now the only source of water for his 3 acre farm.
- Since purchasing the solar water pump, Tirus has seen an increase in his productivity and income. He also said that the pump has improved his quality of life very much. He said that his next purchases would be a water tank and a solar lantern to improve his farm even more.



"I have seen a very big change as my kales did really well at first. Then I harvested and planted spinach which are doing well and if you come and visit me I will give you some to carry home with you."

"I would recommend this pump, as we used to mostly use a manual pump. This solar one is very good because it is less tiring."

"My spinach have grown really well, I had planted kales before and they did really well too."



Customer profile



Experience

- How did customers hear about solar water pump technology?
- What motivated customers to purchase?
- Why did customers choose the company they purchased from?
- What challenges are solar water pump customers facing?
- Benchmarking ease of use
- Case study
- What are some of the non-agricultural uses of a SWP?

Impact

Next steps

“Right now, I am able to give my cattle water and I don’t have to hire anyone, I do that myself. I used to feel that the cows were not getting enough water because I used to get tired and I could not fetch enough but now they have more than enough.”

Christine Banga, SunCulture customer

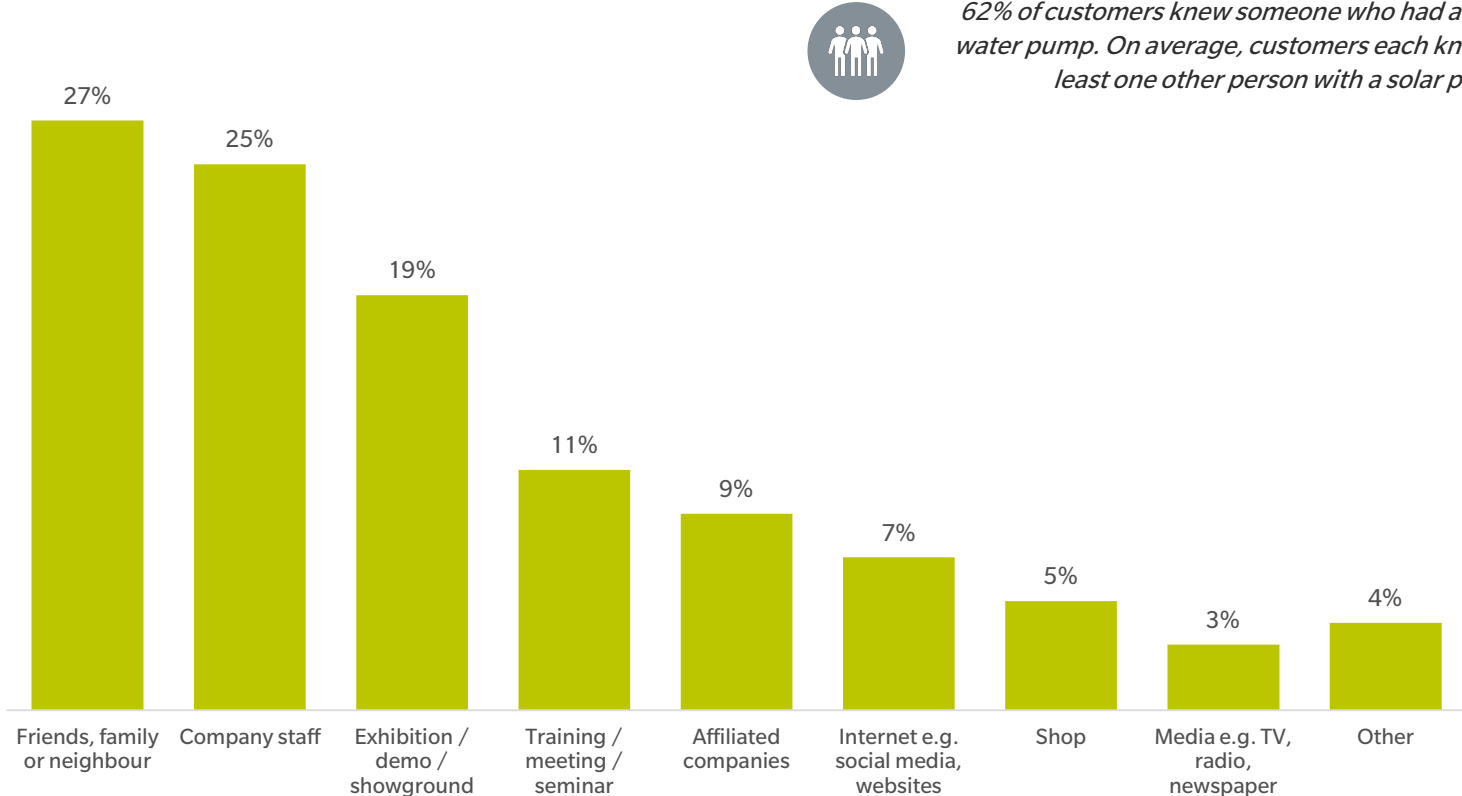
How did customers hear about solar water pump technology?

Looking at the most effective marketing methods and learning about customer acquisition

To gauge customer access and familiarity with solar technology, we inquired about prior ownership of solar lighting as this may reduce perceived risk of trying new technology. These questions also help us to build customer profiles around innovation and expected uptake. **In 64% of households, customers had owned a solar lighting product** prior to purchasing their water pump. Yet, 57% of customers had not heard of solar technology for water pumps before.

We ask questions on who in the household made the decision to purchase to get a better understanding of who marketing efforts are reaching and whether sales efforts might be targeting men and women better. **In 76% of households, it was the male adult alone who made the decision to purchase the solar water pump.** In 12% of households it was the male and female adults together. In 9% of households, it was the female adult alone – in all of these cases the female was registered as the customer.

Top acquisition channels



62% of customers knew someone who had a solar water pump. On average, customers each knew at least one other person with a solar pump.

What motivated customers to purchase?

Understanding customer motivations offers insights on how to target and market to future customers more effectively

Ensuring that motivations for purchase are met is important, particularly in markets where word-of-mouth referrals are key. Negative messaging from dissatisfied customers could prove damaging to future demand and uptake. Similarly if marketing messages are perceived as misleading, they can erode trust in the brand.

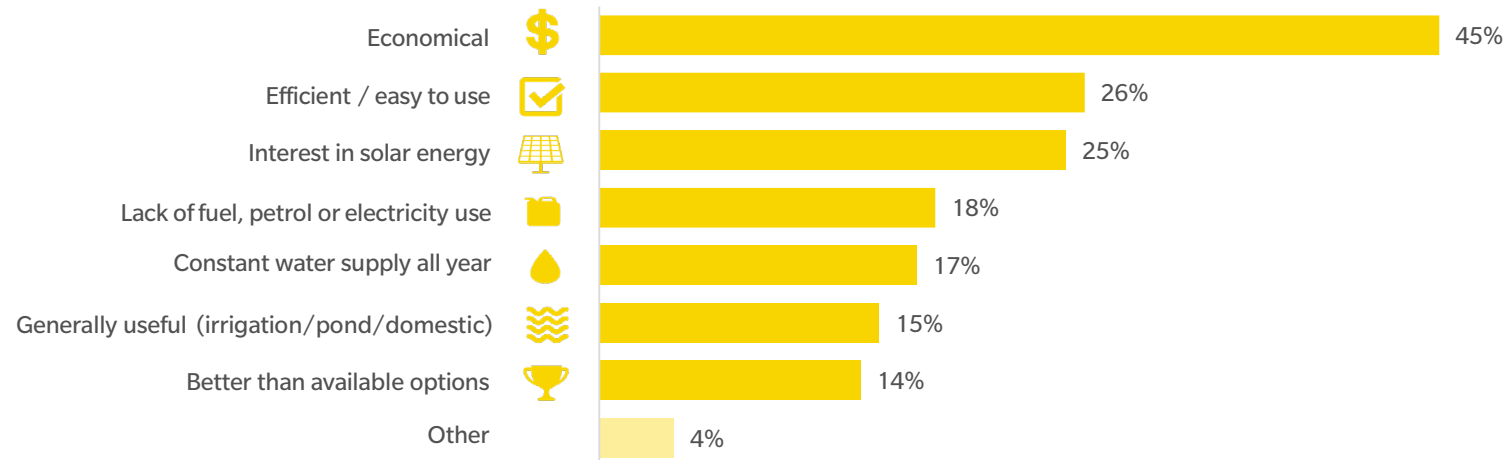
The top motivation for purchasing a solar water pump was **to save money** and have an option that was **cheaper than their previous solution**. These drivers are echoed in a recent survey of over **400 farmers in Tanzania** who irrigate by other methods, not SWP. In that same study, the availability of the irrigation method is also a significant purchase driver. Water supply concerns an ease of use of the technology are the other cross cutting drivers in both SWP user and users of other irrigation methods

In general, we found that customers who previously used fuel-powered pumps were more likely to purchase for economic reasons, whereas customers who irrigated manually were likely to purchase due to the solar pumps' ease of use and time savings.

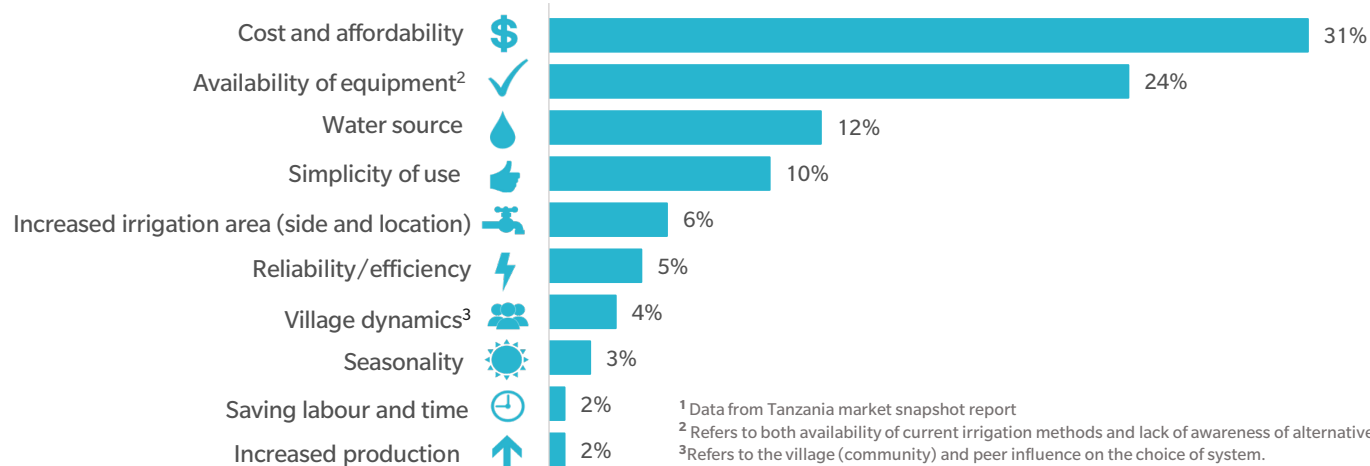


The provision of constant water all year around was a more common purchase motivator for female customers (26%) than male customers (15%). Conversely, higher proportion of male customers (47%) were motivated by saving money time on irrigation than female customers (34%).

Most frequently mentioned motivations for purchase



Factors affecting purchase of current irrigation technology¹



¹ Data from Tanzania market snapshot report

² Refers to both availability of current irrigation methods and lack of awareness of alternative irrigation methods e.g SWP

³ Refers to the village (community) and peer influence on the choice of system.

Why did customers choose the company they purchased from?

Finding out customer choice drivers can help attract more customers in the future

It is useful to find out why customers not only decided to purchase a solar water pump, but why they specifically chose the company they bought from. This can help companies to tailor their marketing material when attracting prospective customers.

The top reason attracting solar water pump customers to the companies they ultimately purchased from was product pricing and affordability.

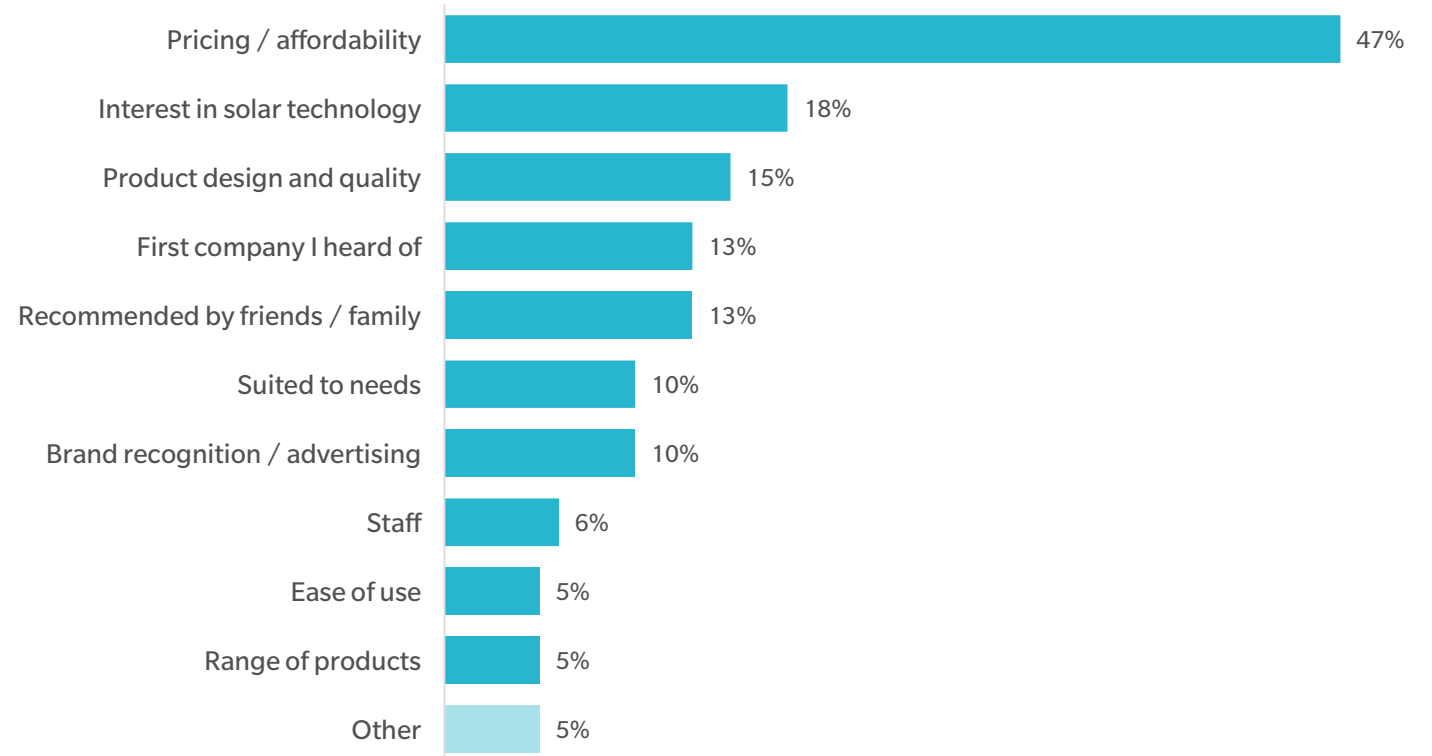
When considering which company to purchase their pump from, male customers were more likely to consider pricing and affordability (51%) than female customers (25%).



On the other hand, female customers were more likely to have selected the specific company they purchased from due to a word of mouth recommendation (25% of female customers vs. 9% of male) or because they were interested in the solar technology (25% of female customers vs. 17% of male).

This provides insight on effective sales strategies and marketing messages and demonstrates how to make adjustments to reach more women.

Top customer reasons for choosing the company they purchased from



What challenges are solar water pump customers facing?

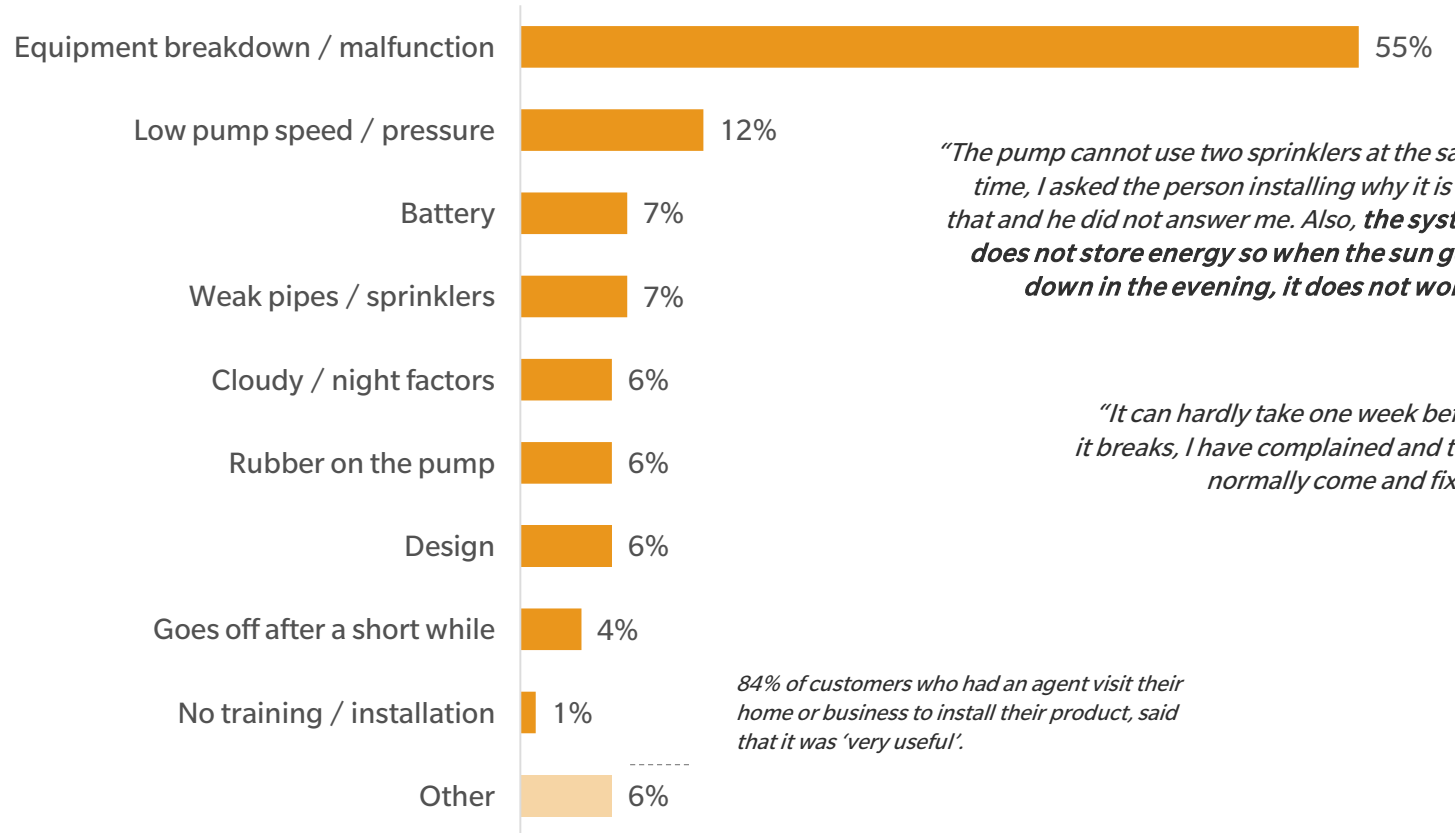
Technical issue awareness will help the sector improve satisfaction and new customer uptake

To capture feedback and challenges, we asked questions around customer experience. Of course, each company may be aware of these challenges on the whole. However, this is key feedback from real users in the field that are critical to consider in product design and development, targeting and marketing, training and after-sales support. It should be noted that these interviews took place between 2016 and 2018, when many of the companies who participated in this study were in the process of iterating on their product design.

45% of customers we talked to said they had experienced a challenge with using their solar water pump. Often, the customer themselves didn't know what the challenge was, so could not be specific about the issue. As challenges are self-reported they could stem from mismatched expectations, misuse, or technical difficulties. These issues can often be addressed with more detailed training and instruction at the time of purchase.

When asked about ease of adoption and use, **98% of customers said that it was 'okay' or 'easy' to adopt** and use their new pump, but 2% mentioned that it was complicated.

Most common solar pump challenges



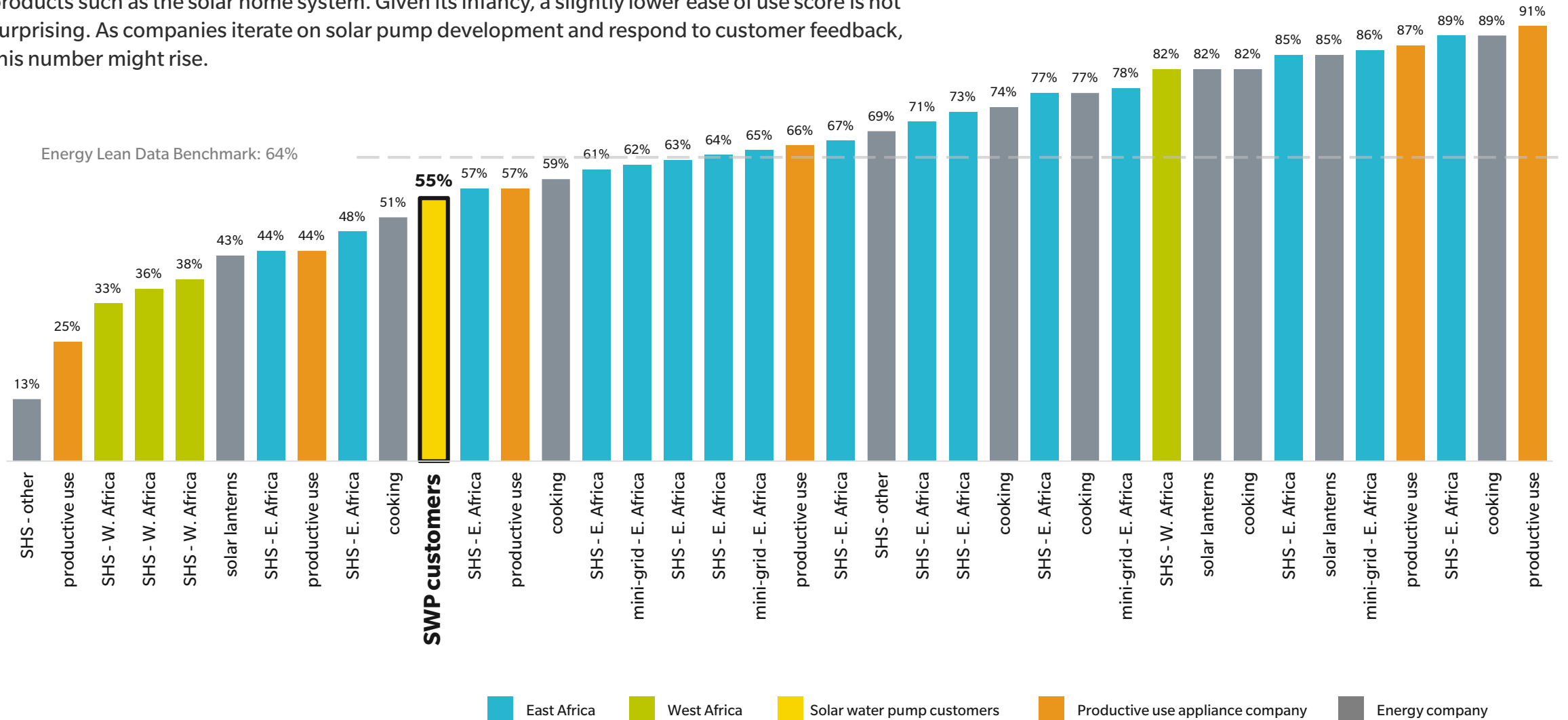
*"The pump cannot use two sprinklers at the same time, I asked the person installing why it is like that and he did not answer me. Also, **the system does not store energy so when the sun goes down in the evening, it does not work.**"*

"It can hardly take one week before it breaks, I have complained and they normally come and fix it."

84% of customers who had an agent visit their home or business to install their product, said that it was 'very useful'.

Benchmarking ease of use

The solar water pump is a relatively new product in comparison to more established off-grid products such as the solar home system. Given its infancy, a slightly lower ease of use score is not surprising. As companies iterate on solar pump development and respond to customer feedback, this number might rise.



Case study

Meet Galiwango, a coffee and banana farmer from Uganda



GALIWANGO GEOFREY

- Galiwango bought his solar pump after attending an exhibition and seeing a group of people talk about power saving technologies in agriculture. He doesn't know anyone else with a solar pump and had not heard of the use of solar technology in agriculture before. He paid for the pump upfront in cash.
- Before the SWP he used a watering can to irrigate his crops, but has stopped using it since purchasing his solar pump. On his farm, he grows coffee, banana, maize and vegetables; but mostly irrigates the 3 acres of young coffee and the vegetables.
- Galiwango recommends the pump to all of his friends and family because of its cost effectiveness and because it's easy to use.

“Before I bought the pump, I would not manage to provide enough water to crops during the dry season and I was losing out.”

“I no longer spend a lot of time irrigating crops and the exercise is not very exhausting as it was before. My life is better because I am not using a lot of time and energy while carrying out the irrigation.”

“I am still trying to study the yield, but I expect good yields this season because the crops are looking well.”



Customer profile

"I am able to pay school fees well and on time and I see my life improving even more. I now want to do away with hunger which sometimes affected my family."

Moses Gichuhi, Futurepump customer

Experience



Impact

- Has pumping expenditure reduced since solar purchase?
- How satisfied are customers with their solar water pump?
- Exploring commentary behind the Net Promoter Score
- Benchmarking Net Promoter Score (NPS®)
- Do users think their solar water pump is good value for money?
- Benchmarking value for money
- Are there good alternatives available?
- Benchmarking access to alternatives
- Have solar water pumps impacted customer productivity?
- Are solar water pumps improving quality of life?
- How have solar water pumps impacted quality of life?
- Benchmarking quality of life
- Case study: Institutional use

Next steps

How satisfied are customers with their solar water pumps?

Understanding customer dissatisfaction drivers can help to boost retention

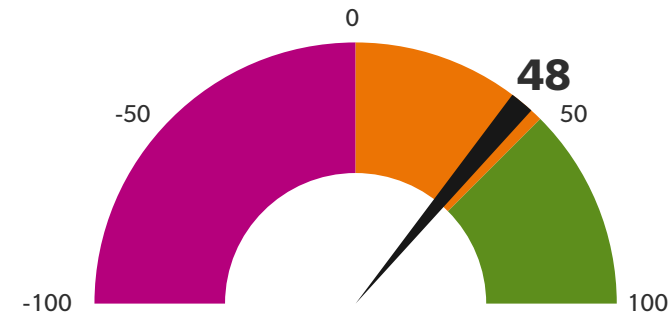
The Net Promoter Score® (NPS) is used globally, across many sectors and geographies, as a gauge of customer satisfaction and loyalty. We capture data on this in our interviews as it is a useful proxy for customer loyalty and satisfaction.

The NPS for solar water pump customers is 48, which is good. Anything above 50 is considered very good. **Interestingly, 45% of all customers, regardless of their rating, mentioned that they had recommended the SWP to their friends and neighbours already.**

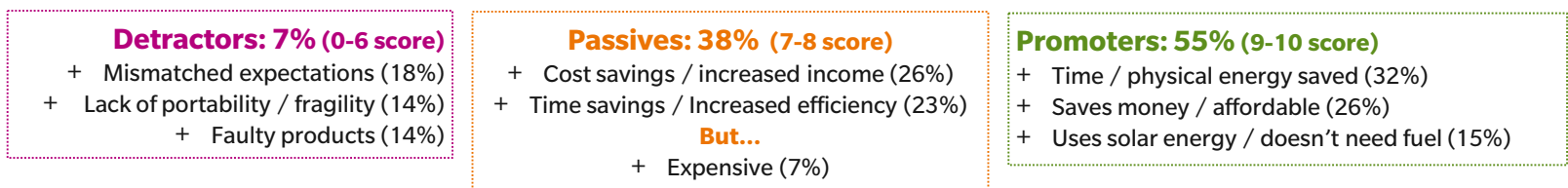
We asked customers to explain the rating they gave which provided useful insights on value proposition, as well as ideas for ways to improve satisfaction. The three boxes on the right show the top reasons customers gave for their rating. There is more information in the appendix on this too.

You can see how other global companies score on the NPS [here](#).

The NPS question asks “on a scale of 0-10, how likely are you to recommend the solar water pump to friends or family, where 0 is not at all likely and 10 is extremely likely?”



Net Promoter Score = % of promoters - % of detractors



Has pumping expenditure reduced since solar purchase?

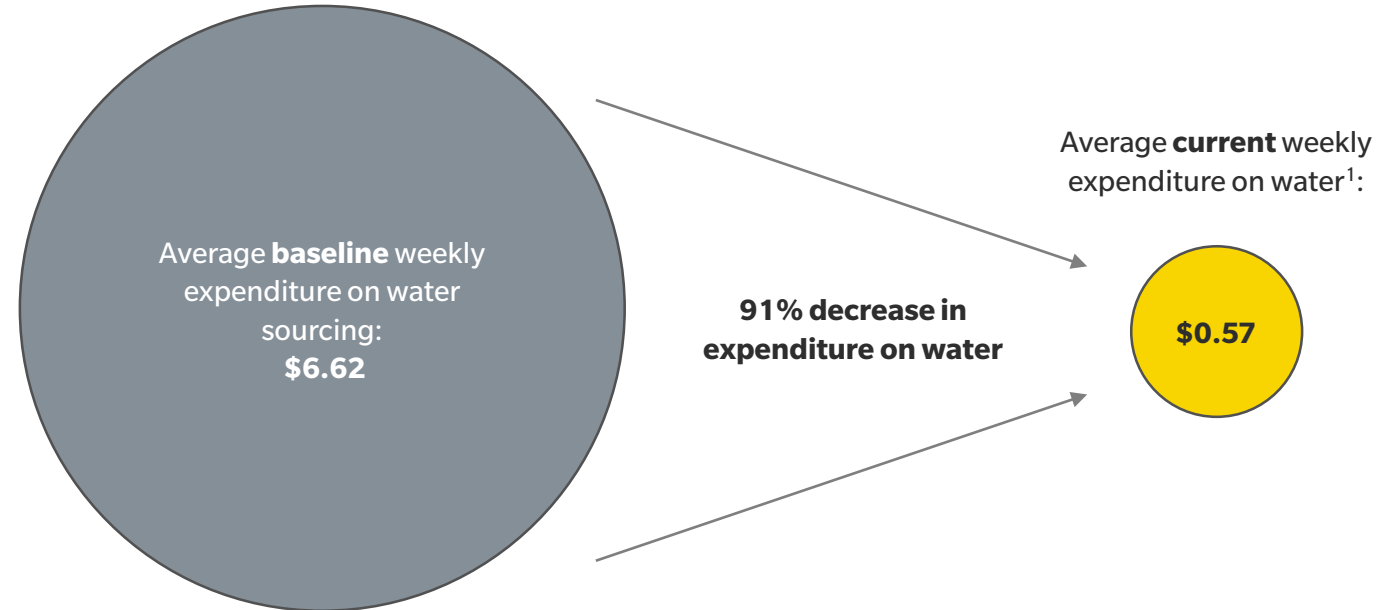
Gauging financial impact on customers

We asked customers whether their spending on acquiring water (either for additional labour, fuel for pumps, or purchasing water) had changed since purchasing their solar water pump. We didn't ask them to include consideration of repayments for the solar water pump when thinking about this.

Prior to solar access, **customers spent \$6.62 (USD) weekly on fuel or hired labour to help with pumping prior to solar pump access.** Overall, weekly average expenditure dropped to \$0.57 (USD) per customer, after access to a solar pump. This could be tied to replacement of former irrigation methods - **87% of customers said their new solar pump is their only irrigation method now.** This change in weekly expenditure represents a **91% decrease in spending on pumping** (not including solar repayments). Interestingly, 75% of customers continued to irrigate the same size of land as before. We don't know if spending on other methods has decreased due to affordability, i.e. needing to divert money to make repayments, or due to the pump meeting watering needs.

Only 3% of customers continued to use former pumping methods after access to their solar water pump, with a further 17% using them 'sometimes'.

Comparison of spending on water acquisition, prior to and post solar pump access



Male customers spent a higher average amount on irrigation prior to SWP purchase (\$7.21, vs. \$3.84 weekly for female customers). Interestingly, female customers, on average, reduced their expenditure post-SWP purchase by 95%, compared to 91% for male customers

¹Not including SWP repayments

Are there good alternatives available?

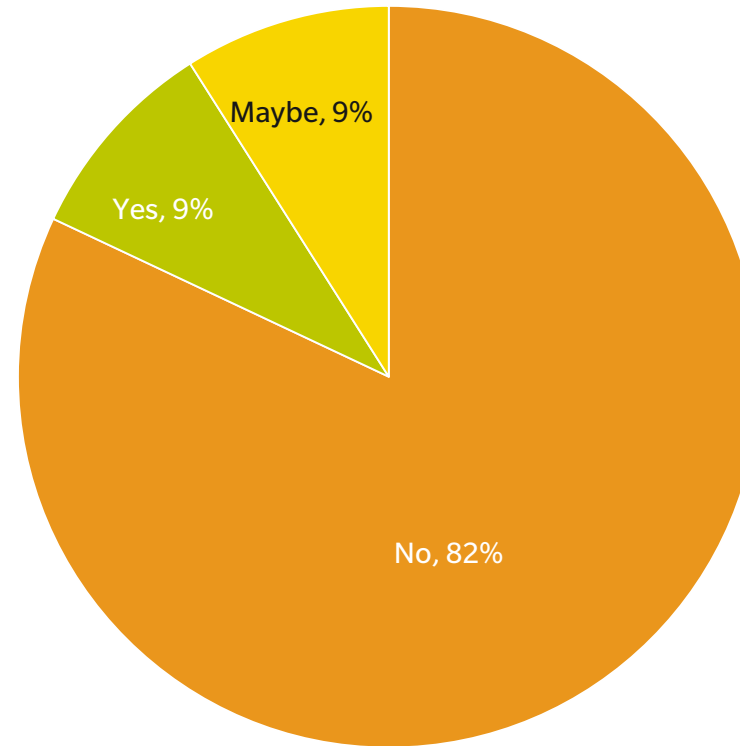
Understanding customers' decision-making and competition within the SWP market

We asked customers if they could “easily find a good alternative to the solar water pump.” **9% said they could find a good alternative and 9% thought that maybe they could; the majority said no.**

Lack of availability/options was the second more influential purchase factor, after cost, for irrigating non-SWP users who were **surveyed by CLASP** in Tanzania. The fact that lack of alternative options remains even after adoption of SWP indicates the market landscape is non-competitive at this stage. Consumer have few options with the inherent risk of skewed pricing that may be higher than the true market price.

As the market grows and more competitive pricing is achieved, resolving customers challenges and improving customer satisfaction may be key to customer retention and demand from new customers who hear about options through word of mouth.

Could customers easily find a good alternative to their solar water pump?

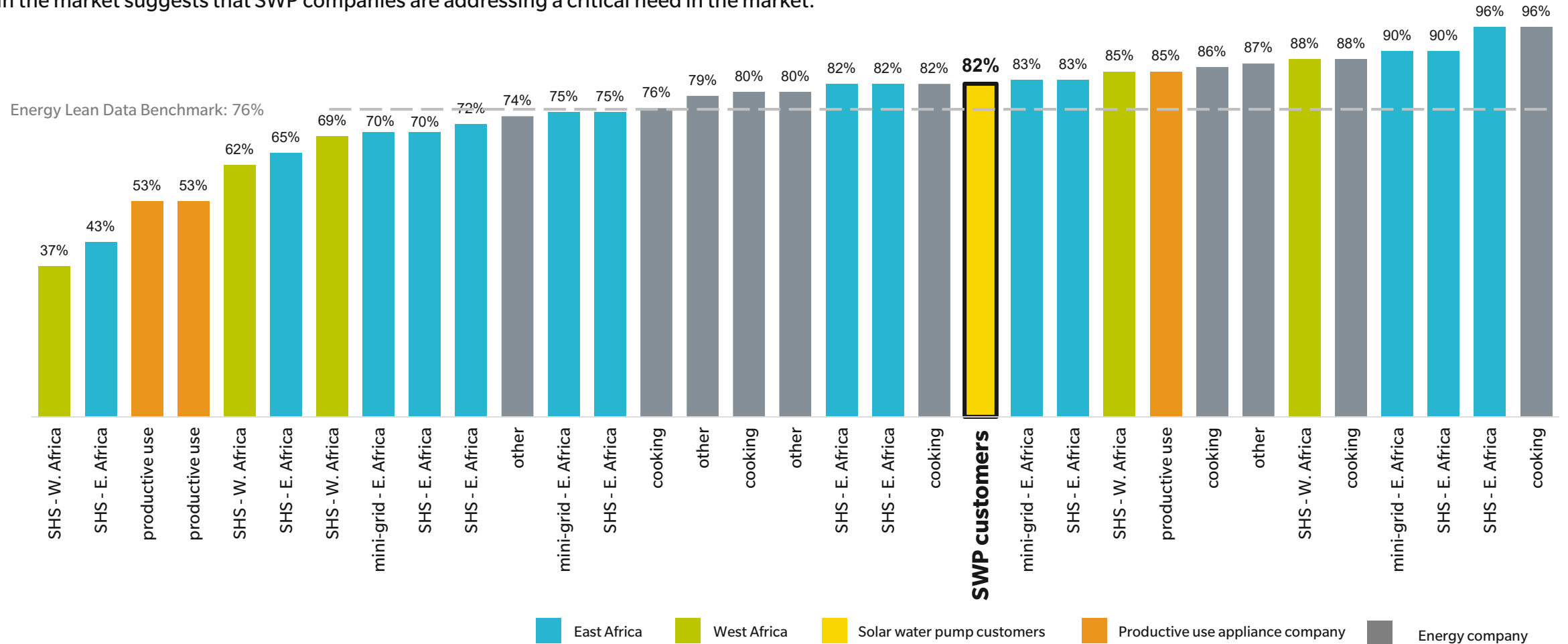


“I was using a petrol pump which was quite costly. I even went to Davies & Shirtliff which was quite costly, but then I decided to buy this one. Even though, at first it is expensive, you will find the running cost is low after a while.”

Mark Chacha, SolarNow customer

Benchmarking access to alternatives

This indicator looks at awareness of and access to alternatives in the market and gives us an idea of how critical the company is for providing access. The relatively high proportion of SWP customers who report a lack of alternatives in the market suggests that SWP companies are addressing a critical need in the market.



Have SWPs impacted customer productivity?

We asked customers about changes to their general productivity – they often responded in terms of their yield or income. **75% of customers said that their productivity had increase since using their solar water pump.** The vast majority of those who said they hadn't seen changes in their productivity talked about it being too soon to tell. Unsurprisingly, we may see that the impact of agricultural-related products have a longer time lag between adoption and results, which isn't the case for other energy products like solar home systems or lanterns where we tend to see changes in behaviour and impact very quickly.

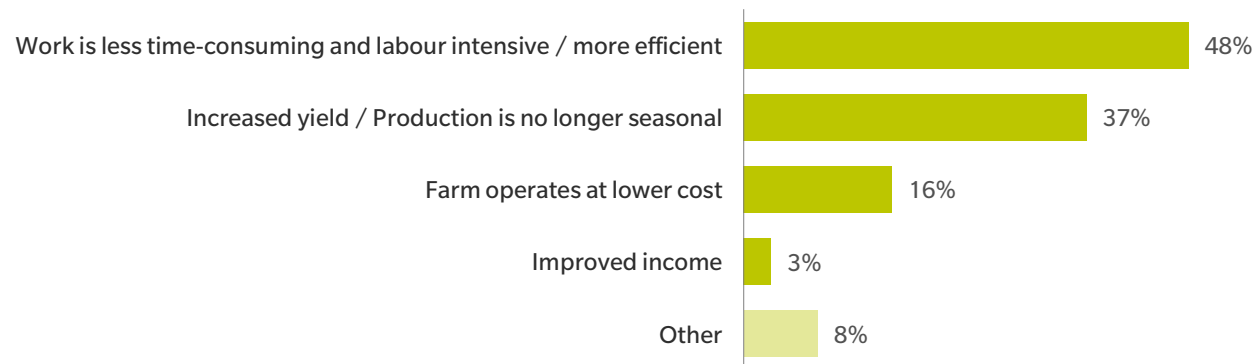
The majority of farmers (67%) reported that their yields had increased since they started using their solar water pump, 10% of these farmers were also able to derive **increased income from these improved yields.** Other farmers who consumed the extra produce themselves mentioned **improvements in their family's nutrition and diet** due to it.

A minority of farmers (10%) also mentioned deriving an extra income through loaning out their solar water pump to friends and neighbours. On average, this group generates an additional \$20.65 (USD) per week.

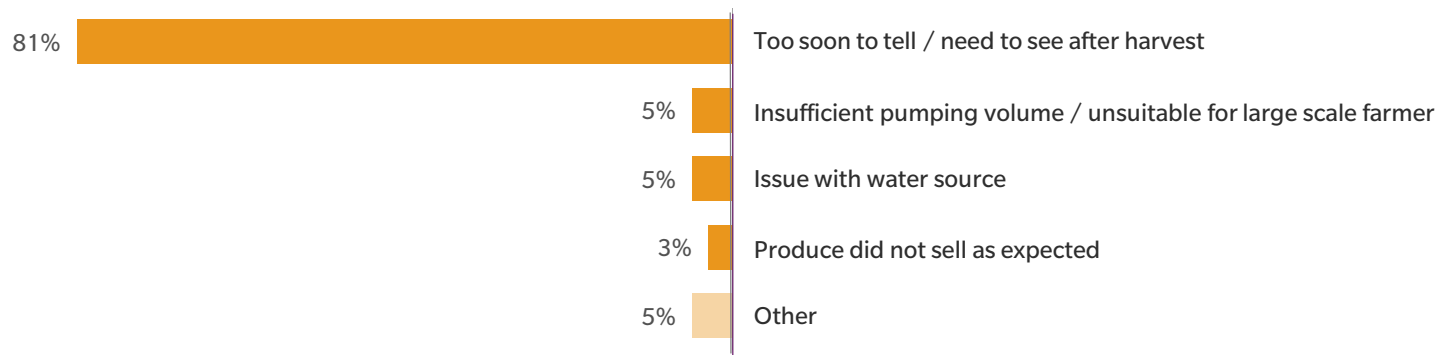
Q: Have you seen any changes in your work or productivity since using the solar pump? (n = 286)

Open-ended, coded by Lean Data

75% of customers said that their productivity had increase since using their solar water pump.



25% of customers said that their productivity had decreased or there had been no change since using their solar water pump.

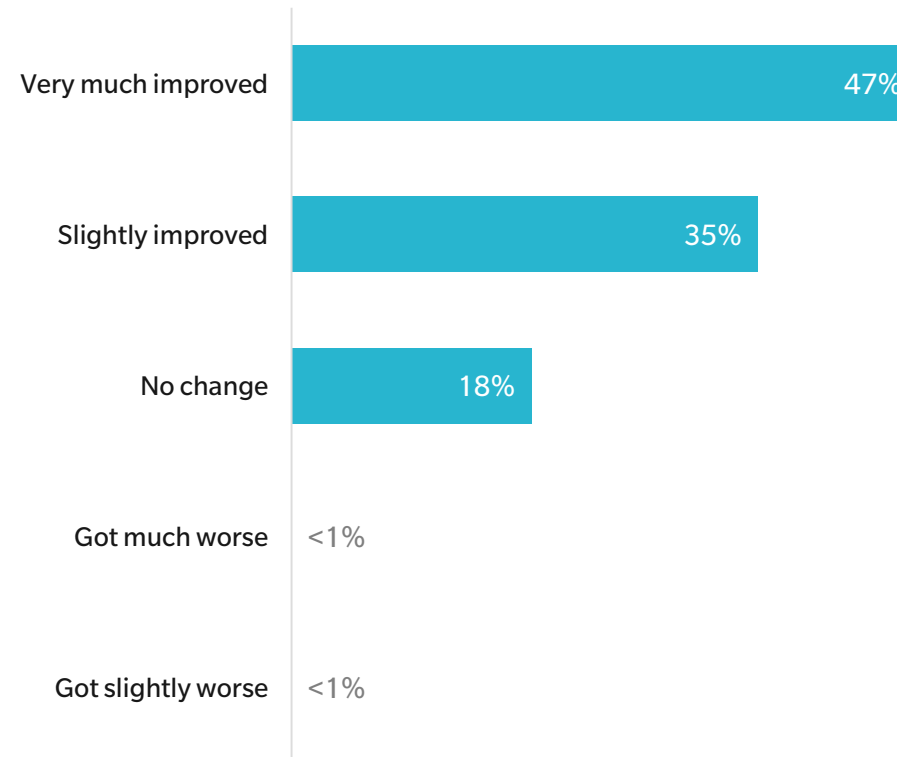


Are solar water pumps improving quality of life?

To gauge depth of impact, customers were asked whether their quality of life has changed because of their solar water pump. **82% of solar water pump customers say that their quality of life has improved.** The next page explores the common themes shared by those whose lives improved.

For the **18% of customers who reported 'no change'** to their quality of life, the majority said that it was **too soon to tell** or that they needed to wait until after their harvest to determine an answer (81%). Other top complaints were that the volume of **water pumped was too little** (5%) or that there were **issues with their water source** (5%). The **remaining 1% of customers** who said the water pump had negatively impacted their quality of life mentioned that they **hadn't used their product yet or that they needed a bigger pump.** They could view this as negative impact as they are still making repayments but not yet reaping the benefits of their product. Interestingly, these themes echo those of the customers who didn't see changes to their productivity (page 35), suggesting they are interlinked.

Customer reporting the extent to which their quality of life has changed since purchasing their SWP:



Very Much Improved:

"I am now saving time and money because I no longer spend on watering crops and I am using the small savings to renovate my house."

Slightly Improved:

"My life has slightly improved because I now have an additional income that I didn't have before. This income has helped me finish roofing my house. I also get my daily meal and other basic needs from this income."

No Change:

"I stopped using it because of the rains but for the few days I used it, I can say that I did not spend any amount on production."

How have solar water pumps impacted quality of life?

Increased income, improved standard of living and savings on fuel and hired labour were the top reasons customers mentioned

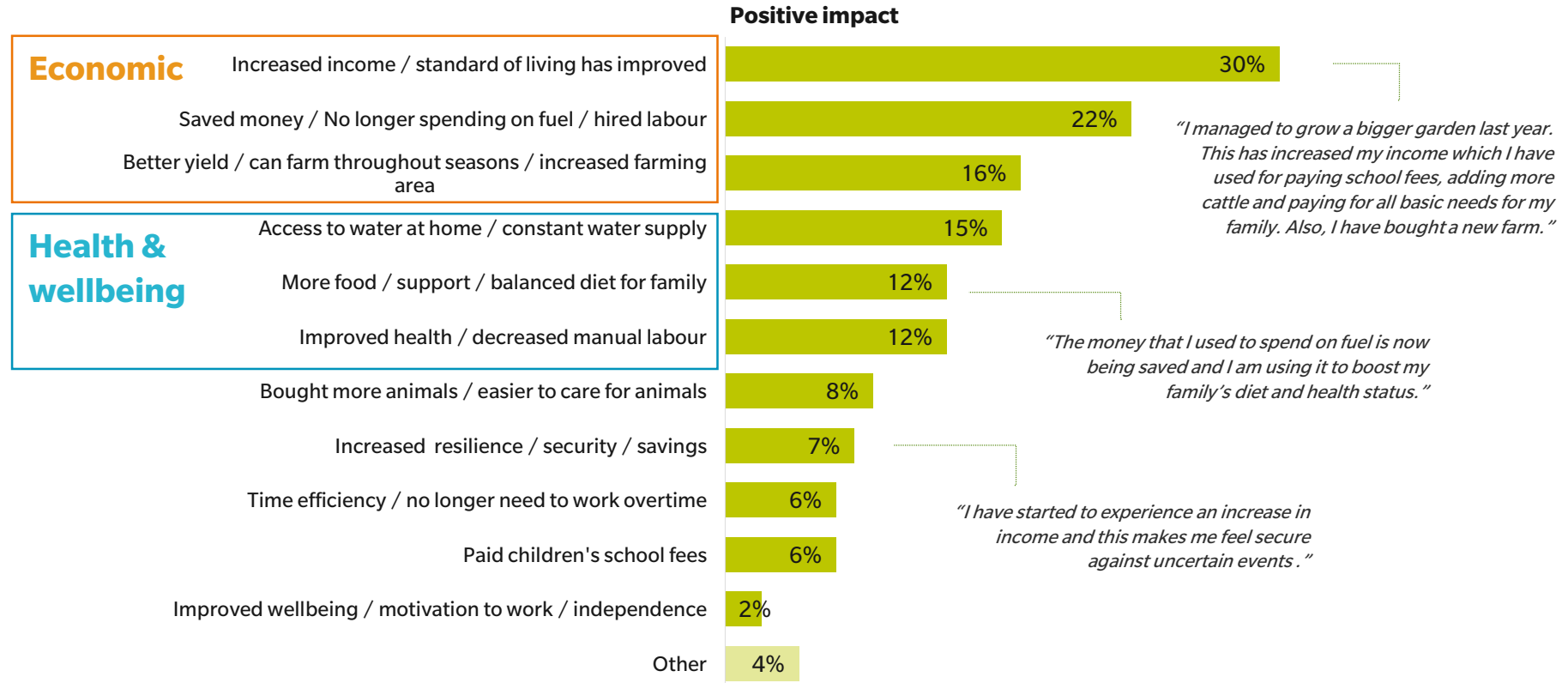
82% of customers said their quality of life had improved since purchasing their solar water pump (see previous page). We asked customers to describe these changes to understand which outcomes SWP customers value most. This question is open-ended to allow customers to define impact and benefit for themselves.

Customers mentioned improved standard of living, increased income, cost savings and better yields as reasons why their quality of life had improved.

A large proportion of the quality of life improvements are economic in nature, with the next cluster related to health and wellbeing. This underscores the SWP's unique potential of lifting users out of poverty whilst simultaneously benefiting other aspects of their life.

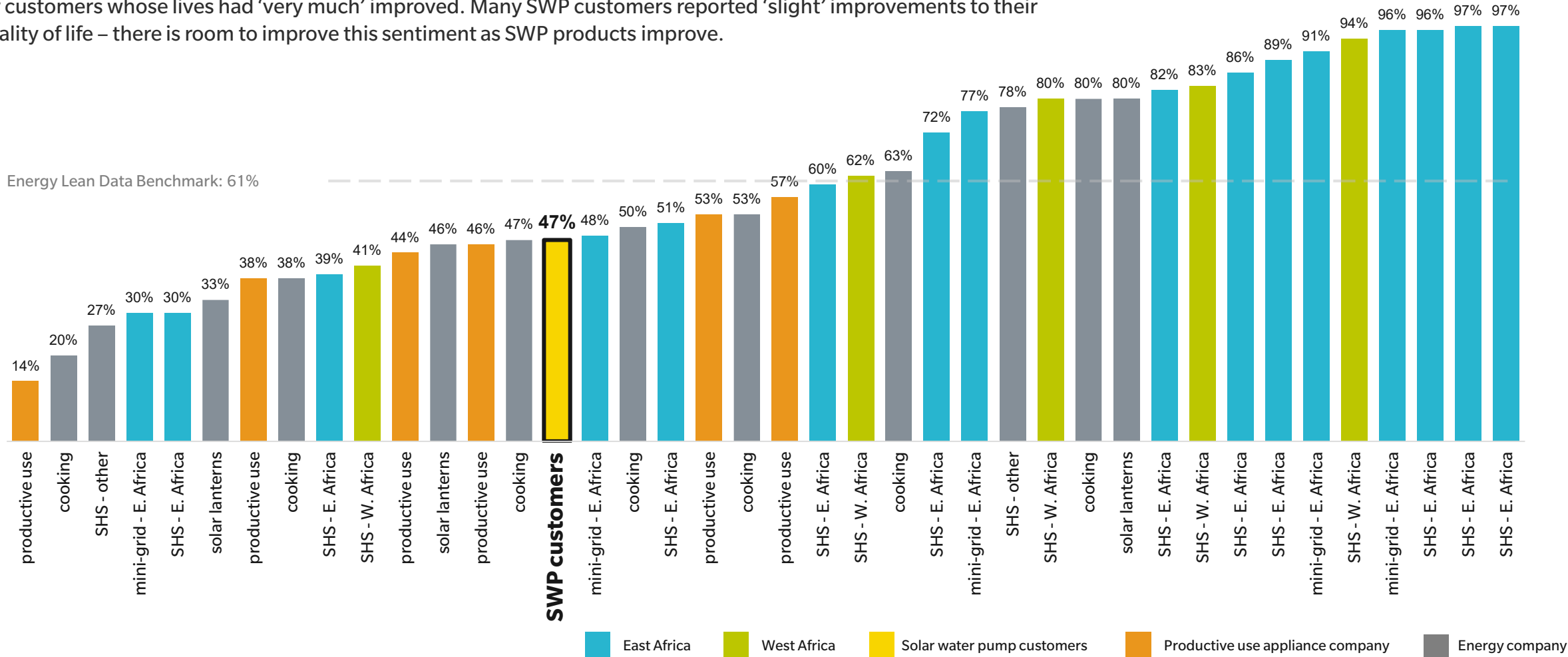
Q: Please explain how your quality of life has changed. (n = 324)

Open-ended, coded by Lean Data



Benchmarking quality of life

We often see that poverty reach and quality of life improvements are positively correlated i.e. lower-income families often have less choice and opportunity and therefore access to a product/service can have more of an impact of quality of life. Although it seems SWP customers are underperforming against the benchmark, the benchmark only accounts for customers whose lives had ‘very much’ improved. Many SWP customers reported ‘slight’ improvements to their quality of life – there is room to improve this sentiment as SWP products improve.



Case study

Meet Wenslaus, a sweet potato farmer from Kenya



WENSLAUS BARASA

- Wenslaus farms sweet potatoes, vegetables, onions and tomatoes. He has a lot of rivers around where he lives, so he was looking for a cost effective pump to better irrigate his farm.
- Since using the water pump, he has produced an increased yield and been able to sell the surplus potatoes he produced. This has resulted in a higher income for him. He also loans out his pump to friends and charges them for it, which means he makes an additional 1,400 Kenyan shillings (US\$13.85) per week on average.
- Wenslaus said that his quality of life has very much improved since purchasing this pump and he's happy that he he's able to help others around him as well.

"The people from the international potatoes centre visited my farm and they told me about the water pump. They said that if I get the pump, I will be able to work faster."

"Before, I was farming sweet potatoes on a quarter of an acre, but now I have planted one acre of sweet potatoes."

"I am now able to buy sugar because I can make some money from the people who I loan the pump to. Life has improved and I am also helping other people as well. I am able to get money both from my farm and from the pump."

Case study

Meet Malinda, a maize and watermelon farmer from Tanzania



MALINDA CHANGWE

- Malinda has a 3 acre maize and watermelon farm and rears cattle and hens. He also supplements his farming income with fishing and another side business.
- Malinda bought his solar water pump to replace the fuel water pump he was previously using. His motivations for purchasing were primarily economic. Malinda used to spend about 26,250 Tanzanian shillings (US\$11.39) per week on water acquisition for his farm, he now spends nothing on this (not factoring in pump repayments).
- Since purchasing his solar water pump, he has continued to irrigate his 3 acres and experienced an increased income. He enjoys using his pump because he says it is durable, reduced his farm's expenditure and works very well.

“I am in a region where the sunny season is longer than the rainy season, so I decided to buy and use the solar water pump. I can use it most of the time and escape the expense of buying petrol.”

“Because the solar water pump has no other expenses so I irrigate my farm so freely a factor which [has caused] my farm productivity to change. Now I get more products due to irrigation that I am doing so I get money for selling it, also I get enough food for my household.”

“To me, my solar water pump is my life so I will never rent it to other people because he/she will not care for it the way I do and it will not last for as long a time as I want.”



Customer profile

“A day of irrigation used to be a stressful day and no one would want it come around. But nowadays, we are a bit relieved.”

Balikuddembe Godfrey, Futurepump customer

Experience

Impact



Next steps

- Additional customer feedback
- Assorted customer voices
- Conclusions: what's next?

Additional customer feedback

We end each interview with an open-ended question; it highlights questions, queries, and complaints



64%

had a suggestion or question, primarily around **storing solar energy, improving pump design and speed, improving customer training and reducing installation times**. Questions were often enquiries about payment methods and availability of further pumps. Reading these questions provides information to help improve sales and marketing materials and can help companies pre-empt customer questions and mitigate customer reservations.

"I would like to venture in horticulture but I have only one pump and my farms are not in one place, so my question is can I get another pump before I finish paying for this?"

"I want to say thank you for the work they are doing. Can the solar have somewhere to store the energy so that we can use it at night?"



12%

had a negative comment – many customers expressed **frustration with installation fee and lead times, issues with sprinklers and prolonged repair timelines**. Others talked about general wear and tear. Building a deeper understanding of customer issues and complaints can direct companies to what's top of mind for their customers and base their customer training around most frequently experienced issues.

"I would like them to be honest with the specifications they give about the pump. The measurement is off. I have to pump and use jerrycans for irrigation, it cannot work with a sprinkler."

"First they should be efficient there was a delay in delivery from the day we agreed. They did not come, I am a busy man if they don't turn up on the day we agree it really messes with me, I have to schedule another day to wait for them. They should act fast if there is a complaint I need the pump working and it has not being repaired, I will lose all my cabbages. Lastly try to do some marketing so many people need to be made aware so that they can use it, it is very helpful."



Male customers were slightly more likely to say something positive (28%) than female customers (24%), they were also more likely to have suggestion for their SWP company (39%) than female customers (29%).

Assorted customer voices

We love hearing customer voices. Here are some that stood out.

Positive feedback

"It is very smart and very presentable especially the design, I am an agricultural contractor and I have across many pumps but the [company] pump is just perfect. My only suspicion is that it may get stolen as it very good, maybe you should come up with an insurance package or make the pump available to most people so that they can purchase and not think of stealing mine."

"Life has improved and I am also helping other people as well. I am able to get money both from my farm and from the pump."

"For now I am okay, I can only say that the pump has changed my life and made my work easy. I want to have a solar light, how can I get it?"

"Life is okay and spending on fuel is now history but some times the pump is not strong enough while some other days it is very effective."

"I just pray that the system is long lasting, many people are going to look for it. I am also happy that when I got some challenge I was helped."

Opportunities for improvement

"I think I need to urge the government that if possible. It supplies such pumps to serious farmers in the country at subsidized costs because there is a lot of potential in them."

"Some people from the company were to come for the crops but they did not come, so I would like to know how they work because we are living in a stressful life since they are not communicating."

"They should increase the length of the pipe so that it can serve the large part of the farm. They should also provide extra pipes and sprinklers."

"You should upgrade the sprinklers and the tanks. Also, if you could bring a field officer or agronomist to come and see the way the tanks are working. We are not pastoralists that are going to move so they should visit often to see how we are faring. We have complaints about how the sprinklers work. It should have a battery to power it once the sun goes down we need to irrigate at those hours that is the time the crops need water yet the pump cannot run because there is no sun."

Constructive criticism

"My advice is to add batteries in your pump so we can irrigate even during morning and evening instead of using it while there is sunlight which is not good to our health and not advisable to irrigate during a day."

"When I bought it I was told the pipes are 100m when it was brought they were 60m I am not sure if it is a step back or ahead with my 2 acre farm. Also, one sprinkler is not working. The ones that are working do not have a stand, I have to improvise a manual one. Also, could you make a flexible pipe that can be folded after use? The one that is there does not look durable when one folds."

"Sometimes there is tear and wear, so you can make it somehow robust so that it can last. What happens if my water well runs dry up so can it pump a water from a borehole which is 35 feet."

"[company] sends me an SMS every month that I owe them money but I always pay every month. Tell them to stop sending me the SMS."

Conclusions: what's next?

What can we take away from this work and what are we doing to address

Key conclusions and on-going efforts

- **There is significant potential for substantial economic and wellbeing impact from the acquisition and use of SWP.** This report does not attempt to quantify this impact due to the inherent limitations of the methodology. The methodology used is based on customers views accessed after a few months after sale and can only deliver directional insights. There is a need for longitudinal studies to understand & quantify impacts. EforA coalition is developing an impact measurement framework to help guide effort in longitudinal impact quantification.
- **The SWP customers are facing challenges characteristic to a nascent market.** Customers are facing challenges that need to be unpacked and addressed for continued trust in the technology and growth of the sector. EforA has numerous efforts addressing the challenges of appropriateness of technology and quality of the appliance.
 - Global LEAP SWP competition and RBF – to highlight best in class technology and incentive sales of that technology
 - Developing Test methods for SWP- to create a quality benchmark for the sector
 - Technology Roadmap for SWP to highlight technology gaps towards scale
- **Scaling the SWP sector has potential to deliver larger benefits to smallholder farmers.** To help quantify the market and provide consumer intelligence for the sector EforA Coalition had proceed the following reports:
 - State of the Off-Grid Appliance Market Report (SOGAM): Market research on total addressable market for SWPs and sales penetration with deep dives for 8 countries
 - Consumer research :Tanzania snapshot report and field trails
- **Continued dialogue with solar water pump customers** is crucial to understanding their experiences and informing decision-making, design, and delivery of this technology

Questions?

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Sources

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³ Holthaus, Jennifer & Pandey, Bikash & Foster, Robert & Ngetich, Bernard & Mbwika, James & Sokolova, Evgenia & Siminyu, Philip. “Accelerating Solar Water Pump Sales in Kenya: Return on Investment Case Studies,” in *Solar World Congress 2017: IEA SHC International Conference on Solar Heating and Cooling for Building and Industry*, (Abu Dhabi, United Arab Emirates : International Solar Energy Society, 2017).

Appendix: Exploring commentary behind the Net Promoter Score

Qualitative responses help us to recognize the drivers behind solar water pump users' NPS scores

Promoters: 55% (9-10 score)

...loved the time savings, reduction in physical exertion and use of solar energy

*"The main advantage of this pump is that once you pay the initial cost, **you can forget about any other expenses and all you need is sunshine.**"*

*"I have been discussing with my friends that this solar pump is good for agriculture because it **saves fuel** which **decreases my costs** of production."*

*"The pump is very advantageous because it **minimises production expenses** which allows a farmer to get some profits from the business."*

*"I am extremely happy with the service provided by the pump because it is **only using the sun, which is free**, and I always advise my colleagues to try it."*

*"This system is **very efficient** because it uses **no fuel** and it ensures a **regular supply of produce** to markets and hence, a **regular income.**"*

*"I have introduced many friends they saw it and they were like **"wow!"**. They really like it but **the problem is they do not have boreholes.**"*

Passives: 38% (7-8 score)

...liked the time and cost savings but mentioned challenges with affordability

*"I have **encouraged the people around me to purchase**, I also give the pump to my relatives so that they can know the importance and also purchase, but they are **afraid of the price.**"*

*"I have told them but a lot of people **don't know where to get it**, they **fear the price**, they think it is **too expensive.**"*

*"Most people in this area do **not have money** unless if you have any **other mode of payment**. But I told them the advantage of the pump."*

*"I would say it is a good thing, it helped me as I **was getting tired from fetching water manually**. I am now sick and can't do much in the house and it is my wife who does all the work, so the **pump is helping.**"*

*"Many people are asking about the pump but the problem with our area is **reaching the water** if one **dug a water well is not easy**. I tell them because of the advantages it has."*

Detractors: 7% (0-6 score)

...were critical of the fragility and portability of the pump and struggled with faulty products

*"I have recommended many people but I have given these low marks because the pump has **two problems**. The pump **can not be pulled, carrying it is a problem**. It also **pumps water slowly**. The best part is that you don't have to be in the farm because it **can work on its own** and it does **not have extra cost.**"*

*"For now, I cannot recommend it as it has **really disappointed me**, it has been **repaired five times** and even now it is faulty. I am not using it at the moment, I have **reverted to use of petrol.**"*

*"I have recommended some people but since it is **not working well for me** I **stopped telling people.**"*

*"The solar water pump is **cheap and easy to use**. The only challenge that I have encountered is that **you can't irrigate very early in the morning** before the sun comes out, remember this is the best time to irrigate a garden. Also, I find **the pump very heavy when carrying it to the lake.**"*

Appendix: More detail on the Lean Data energy benchmark

The Lean Data energy benchmark is made up of the average performance of 39 energy companies across 13 countries over the last 2-3 years. It includes companies working in solar lanterns, solar home systems, off-grid refrigeration, solar water pumps, solar TVs, improved cookstoves, LPG distribution, and more.

On the right, we have outlined which companies are in our database. Individual company data and results are anonymous and identifiable.

Note: we have conducted Lean Data projects for some companies in multiple countries or for multiple products; so in total, 39 companies are, or will be, included.

The geographical distribution of these projects is 61% East African, 19% West African, 17% South Asian and 4% other (includes southern Africa, North America/Caribbean).

Companies included:

- | | | |
|--------------------|-------------------------|----------------------|
| + ARED | + Green Energy BioFuels | + PEG |
| + Arnergy | + Greenlight Planet | + PowerGen |
| + Azuri | + Greenway Grameen | + Promethean |
| + BBOXX | + Husk Power Systems | + Redavia** |
| + BioLite | + KopaGas | + RUH |
| + BURN | + Lendable | + RVE.SOL |
| + d.light | + Lumos** | + SELCO |
| + Devergy | + M-KOPA | + Simusolar |
| + Easy Solar | + Mobisol | + SolarNow |
| + Ecozen | + Nizam Bijili | + SparkMeter |
| + Fenix | + Oolu Solar | + Standard Microgrid |
| + Frontier Markets | + Orb Energy | + SunCulture |
| + Futurepump | + Pawame | + Winsol |

**projects ongoing/not complete yet