

TANZANIA MARKET SNAPSHOT

Horticulture Value Chains and Potential for Solar Water Pump Technology

EXECUTIVE SUMMARY

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EFFICIENCY FOR ACCESS COALITION



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 have the potential to make modern irrigation accessible and cost-effective for nearly 500 million small-scale farmers worldwide.

The UK-funded Low Energy Inclusive Appliances (LEIA) Programme identified solar water pumps (SWPs) as one of its priority products due to their immense potential for productive use and agricultural productivity.

In March 2018, the Efficiency for Access Coalition (the Coalition) convened a Solar Water Pump Market Development Roundtable in Nairobi, Kenya. The event brought together over 40 industry leaders who identified 30 actions for the Coalition to take forward. The top priority that surfaced was to “conduct research to size the total addressable market and segment by geography, customer type, and willingness to pay.” This report was designed to address this research need.

The geographic focus of the report is Tanzania, but it is envisioned that the methodology can be replicated in other emerging solar water pump markets and there are learnings that are applicable to the market more broadly. In the coming years, the Coalition will undertake more research to address the needs of market stakeholders, including global market sizing and additional research to better understand the customers’ needs and the socioeconomic impacts.

This research was developed by CLASP in collaboration with Simusolar for the Low Energy Inclusive Appliances (LEIA) programme, a flagship Programme for the Efficiency for Access Coalition.

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ABOUT THIS STUDY

This study unearths new market intelligence on irrigation patterns in the Tanzanian horticulture sector. It fills important gaps on the adoption of solar irrigation technology and provides actionable insights for actors looking to increase adoption of solar water pumps (SWPs) in Tanzania and beyond. Its purpose is threefold:

i Characterise a sample of 407 farmers in three agricultural regions of Tanzania

ii Size and characterise the market for SWPs and potential customers

iii Develop a set of strategic guidelines that catalyse the market for SWPs

The Tanzanian horticulture sector is a small but dynamic agricultural segment, with exports valued at US\$591 million in 2016 and an annual growth rate of 9 to 12% per annum.^{1,2} Previous reports have highlighted the opportunities of solar irrigation unlocked by the high levels of solar radiation throughout the year and across the country.^{3,4,5}

To understand and characterise the market for SWPs primary data were collected from 67 key stakeholder interviews, 81 focus group discussions and 407 individual farmer surveys. The study's geographical reach included three important horticultural regions:

- Arusha and Kilimanjaro regions (Arusha – Kilimanjaro);
- Morogoro and Iringa regions (Morogoro – Iringa); and
- Singida region.

Data collected included geographic location, farm size, types of irrigated crops planted, current usage & preferences in irrigation systems, capital and operative costs, attitudes to financing mechanisms, and obstacles to growth. Some of these factors were selected to develop a market segmentation method. These findings were then used to understand the elements that are pre-conditions for adoption of solar water pumps. A method to develop value propositions for different farmer segments was also determined.

1. Cambridge Economic Policy Associates Ltd 2016. Global Agriculture and Food Security Program (GAFSP) Private Sector Window. Agribusiness Country Diagnostic - Tanzania., 122p.

2. MatchMaker Associates 2017. Horticulture Study Phase 1: Mapping of production of fruits and Vegetables in Tanzania., 39p.

3. AHK Kenya 2016. Bio-und Solarenergie in Tansania. 146p.

4. Holthaus, J., Pandey, B., Foster, R. E., Ngetich, B., Mbwika, J., Sokolova, E. & Siminyu, P. 2017. Accelerating Solar Water Pump Sales in Kenya: Return on Investment Case Studies., Solar World Congress. Abu Dhabi UAE., 10.

5. Hartung, H. & Pluschke, L. 2018. The benefits and risks of solar-powered irrigation - a global overview., 87p.



KEY FINDINGS



Understanding potential users

- Sixty-nine percent of the farms surveyed are below 2 hectares. The average head farmer has completed primary studies (92%), carries out some level of horticulture commercial activity (98%), and sells on average 71% of the farm's produce (as opposed to household consumption), mostly at farm gate (43%) or in their local market (21%).
- Sixty-nine percent of farmers sell their produce during the dry season, when the crops reach their highest prices. Water for irrigation is available throughout the year for 72% of the farms surveyed, typically from surface sources (e.g. rivers, streams and lakes) (53%) and hand-dug wells (36%). Seventy-seven percent of the farmers interviewed hire extra labour to attend the farm, which carry out an average of 54% of the cropping activities. Finally, 50% of head farmers engage in off-farm activities for generation of extra income.



Farmers' use cases: Irrigation area, crops, requirements, source of water, depth, and distance to water source

- In this survey, as well as in previous Tanzanian surveys, the uptake of SWPs was found to be zero.^{7,8} Previous cases of deployments of SWPs in other countries indicate that explanations for the lack of uptake in Tanzania may include: i) low levels of awareness and familiarity with SWPs^{9,10}; ii) the high level of initial investment, and the high risk associated to this capital item—including theft¹¹; and iii) the lack of viable financing options for SWPs.
- Forty-one percent of the farmers interviewed use manual (buckets) systems and 2% rely on rainfed crops. Diesel pumps (36%), canals (18%) and mechanical pumps (2%) are second, third and fourth choices, respectively.

From a technical point of view, the selection of a particular irrigation system by farmers is a multi-factorial choice

- based on geophysical parameters. For example, manual irrigation correlates to the use of hand-dug wells, which in turn correlate to the largest gross irrigation needs. Similar dependencies were drawn for diesel pumps correlating with hand-dug wells and surface water sources, high irrigation needs, and large irrigated areas. To ensure optimum design of SWPs for horticulture, recognition and understanding of these interactions is important.

Farms using canals and diesel pumps as irrigation systems combine the largest irrigation areas, the highest irrigation needs and the highest estimated horticultural incomes in the sample surveyed. A likely explanation is that

- some farmers with canal access also own a diesel pump, which enables them to extend water availability during dry seasons, leading to higher production. These irrigators present a good profile for SWP adoption. Mechanical, manual and rainfed irrigators present significantly lower incomes than the former group.
- The potential of increasing irrigated areas through transition to improved irrigation technologies is latent. This potential—defined as the percentage difference between total farm area and irrigated area—is highest for users of rainfed systems (75%) and for manual irrigators (62%).¹²



Financial factors in selection of irrigation systems

- In Tanzania there are barriers for farmers to access institutional loans and financing mechanisms, which can be traced back to farmers' socioeconomic factors, the scarce instruments offered by financial institutions and other factors. For example, stakeholders interviewed in Dodoma, Tabora and Singida consistently indicated that there are no commercial sources of financing for irrigation equipment (or any other farm expenditure) readily accessible by farmers.

6. Mayala, N. M. & Bamanyisa, J. M. 2018. European Journal of Research in Social Sciences Assessment of market options for smallholder horticultural growers and traders in Tanzania, 6, 27-42.

7. Keraita, B. & de Fraiture, C. 2012. Investment Opportunities for Water Lifting Technologies in Smallholder Irrigated Agriculture in Tanzania. AgWater Solutions project, 34p.

8. Ministry of Agriculture 2017. 2016/17 Annual Agriculture Sample Survey. Initial Report., 99p.

9. IRENA 2016. Solar pumping for irrigation: Improving livelihoods and sustainability. 36p.

10. Hartung, H. & Pluschke, L. 2018. The benefits and risks of solar-powered irrigation - a global overview., 87p.

11. Ibid.

12. In the context of this report, 'irrigated area' refers to farmers that actively irrigated with means other than rain. Note that farmers had the option of selecting more than one irrigation system in use; some farmers using rainfed systems also declared other irrigation system, thus bringing down the percentage difference from the expected 100% to 75%.

KEY FINDINGS

- Low income associated with horticulture can be caused by the choice of inefficient irrigation systems, whilst the same factor can also drive farmers to adopt inefficient, low cost irrigation means (e.g. rainfed systems). Breaking this cycle will require stronger interventions than facilitating substitution with other irrigation technologies such as SWPs.
- Diesel pumps are the second most used irrigation technology in our sample, which indicates that the extra capital required to buy these—as compared to cheaper mechanical or manual alternatives—is not an unsurmountable hurdle for the uptake of better pump technology. Therefore, the high investment for SWPs—often mentioned as the main barrier to adoption—should not be seen as an intractable situation, as long as other purchase factors are met.
- Farmers growing most crop types have similar incomes and are spending similar amounts in purchasing irrigation equipment.
- In our sample, 56% of farmers across all irrigation technologies were dissatisfied with their irrigation system. Fifty percent of diesel pump users reported being dissatisfied. In the latter case, the high dissatisfaction could be partly attributed to operational costs, which may open a point of entry for SWPs.



Factors influencing purchase decisions for irrigation technology

- We detected eleven key factors of purchase for irrigation systems. The top five factors in terms of the number of mentions by farmers were: cost and affordability (31% of sample), availability of the equipment and inputs (19%), water source availability (12%), simplicity of use (10%), and awareness about other irrigation technologies (6%). A sixth category was formed using two technical purchase decision parameters; irrigation area (5%) and reliability/efficiency of the irrigation solution (5%).
- Based on the six groups above, we developed six farmer typologies that correlate well with irrigation characteristics. These were: the cost-driven farmer, the distribution-reliant farmer, the water conscious farmer, the effortless farmer, the unaware farmer and the technical farmer.



Market potential, segmentation and strategy

In this study, the market size for all types of irrigation technologies in Tanzania was estimated to be US\$86.2 million in 2018 and expected to grow to US\$151.3 million by 2022. As relatively new entrants, SWPs will need to carve a market share out of existing and established irrigation options (e.g. canal irrigation, diesel and mechanical pumps).

We developed two a-priori segmentation methodologies based on market orientation and irrigation technologies. These two approaches indicated a more or less homogeneous horticultural market for irrigation systems. We therefore used the farmer typologies previously developed to provide a potential basis to segment the market. Having said this, future market research work for SWPs should be performed in other agricultural sectors (e.g. dairy, grains, livestock production), as it is likely that horticultural applications could effectively be treated as a single-segment market.

- **The most receptive points of entry for SWPs were detected in the following groups:**
 - **According to purchase drivers:** The technical farmer & the distribution-reliant farmer (2018 combined market size: US\$25 million), which overlaps with the diesel pump switchers in bullet point three below and the three main categories of farmer market orientation.
 - **According to farmer market orientation:** Commercial farmer & market oriented farmer (2018 combined market size: US\$59.8 million).
 - **According to irrigation technology:** Diesel pump users & canal irrigation users (2018 combined market size: US\$46.4 million). For farmers using both (i.e. canals for rainy seasons and pumps for dry seasons), the point of entry is the substitution of diesel pumps by SWPs, initially as a seasonal option and eventually as the all-seasons option.

RECOMMENDATIONS

We recommend that individual manufacturers and distributors of SWPs address the following:

- **Cost/affordability was the top purchase decision detected in this study.** We recommend that companies manufacturers and distributors:
 - Carry out market research to detect the purchase price point for different groups;
 - Carry out a detailed analysis of operational expenditure as compared to SWPs; and
 - Design credit/financing mechanisms that bring the annual payments of SWPs in line with the levels of annual capital and operating expense for competing technology.
- **Availability of equipment and inputs** was the second most important purchase factor. In order for SWPs to diffuse successfully throughout markets, SWP supply chains must meet farmers near their farms and provide or link customers to spare parts suppliers.
- **Simple, easy to use equipment** was also a significant purchase decision driver. Appropriate design by manufacturers and packaging by distributors is therefore essential. Training farmers and their suppliers on how to use their equipment, and developing the capacity of on-the-ground staff to attend to technical and marketing queries are also important.
- **Awareness** of solar pump technology is extremely low and uptake is non-existent in our farmer sample. Significant **marketing efforts** and campaigns that educate potential buyers to will be important to prepare territories for sales. Campaigns should also be extended to the preferred local/regional suppliers and spare parts stockists.
- **Value proposition** statements should be modelled around the following points: affordable irrigation solution with accessible financing mechanisms, minimum operational costs, an extended sales & service network, training, simple operation and equal or better reliability and irrigation performance than competing technologies.
- SWP should also consider the addition of **complementary products**, such as drip irrigation equipment. This strategy has been shown to work in other regions.^{15, 16}

Finally, there are a number of additional actions that can be taken to catalyze the SWP market for all players, including:

- **Awareness:** Development of permanent demo sites, programs and awareness campaigns
- **Knowledge and capacity building:** training, train-the-trainer and ongoing support.
- **Consumer credit:** farmer-friendly financing is central to affordability and perception of cost
- **Accessibility or availability of solution:** well-developed supply chains for SWP equipment, possibly including a network of distributors of equipment and spares when possible.
- **Agronomic support:** input supply and advice, agronomic capacity and market access support.

Given that there is no common industry association or umbrella organization that can undertake overarching activities on behalf of the SWP industry, it is up to the individual companies to determine their own level of preparedness to tackle one or more of these activities, and the time horizon to achieve these.

15. Hystra 2017. Reaching scale in access to energy. 103p.

16. Hartung, H. & Pluschke, L. 2018. The benefits and risks of solar-powered irrigation - a global overview., 87p.