



# HOW CAN SOLAR-POWERED ASSETS EXPAND HOUSEHOLD INCOMES?

The Case of SunCulture's Rainmaker

MERCY CORPS AGRIFIN

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# Introduction

Globally, more than USD 1 billion has been invested in off-grid solar powered systems since 2012, with this value doubling every year.[1] Much of this has come in the form of grants and concessional finance from donors, development finance institutions and impact investors. More recently, commercial investors have also made significant investments in off-grid solar companies, showing the increasing maturity of the sector.

Declining costs of solar panels and batteries have made the technology more affordable to produce, and the introduction of pay-as-you-go (PAYGO) models has significantly reduced the upfront cost to consumers – opening up a much larger market at the base of the pyramid for off-grid solar products. These trends have driven major progress in meeting basic lighting and appliance needs of rural households in Africa and Asia.

Most of the focus in off-grid solar has been on consumptive use of energy; solar home systems which provide energy for lighting and entertainment appliances such as TVs and radios.

This is natural given the rural and edge-of-grid energy gap where most households lacked access to modern energy sources and struggled to meet even their most basic lighting needs. Further, nascent off-grid solar technology could only meet relatively lower capacity energy needs.

Across Africa today, an emerging wave of off-grid innovators are helping rural households increase their productivity with solar energy. This marks an important trend which sees the off-grid solar space moving beyond purely consumptive energy use (lighting, cooking, entertainment etc.) to a focus on productive use – which can include a diverse range of commercial and income-generating activities.

This will exponentially increase the impact of off-grid solar solutions by:

- Enabling households to increase their incomes and build up their capital base
- Contributing positively to overall productivity of smallholder farmers
- Promoting environmentally sustainable agricultural practices.

# Introduction

One of several cutting-edge innovators providing productive off-grid solar use is [SunCulture](#)[2], a company that develops and commercializes technology solutions for smallholder farmers based in Kenya, with aspirations to expand throughout Africa.

RainMaker, SunCulture's flagship product, is a high-quality yet affordable solar irrigation pump designed for smallholder farmers and their households. It can pump water from as deep as 100 meters to use for crop irrigation and livestock rearing, as well as domestic uses.

To-date, the RainMaker has helped farmers to increase their yields by up to 150%[3]. In addition to increases in productivity and yields, by using renewable energy, smart farming products like Rainmaker reduce household expenditure on fossil fuels and protect the environment by reducing emissions and promoting drip irrigation. This uses 80% less water than furrow irrigation[4]. In early 2017, AFA helped SunCulture to develop the right distribution channels and partnership models to ensure its products meet the needs of its target customers and can reach them effectively through innovative and trusted distribution channels.





# Introduction

SunCulture proceeded to launch *Rainmaker2* powered by ClimateSmart™ [5] in January 2019. RainMaker2 powered by ClimateSmart™ is a smart solar-powered irrigation kit that brings best in class precision irrigation to smallholder farmers in Africa for the first time.

By combining this technology with an Internet of Things (IoT) platform, wireless sensors, and advance machine learning algorithms, SunCulture is able to predict trends to optimize performance in real-time and offer affordable, easy-to-understand precision farming tools that were previously unimaginable for a smallholder farmer.

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For example, SunCulture's Ag-Optimized soil sensors and internet-connected weather stations allow the company to provide customers with weather forecasts and precision irrigation timing alerts by SMS, as well as alert farmers if they need to apply more fertilizer to their farm. RainMaker2 with ClimateSmart™ enables digital dry run protection to automatically disable a farmer's RainMaker2 pump and notify them if their well runs dry.





# Productive Use in Off-Grid Solar

- In Sub-Saharan Africa, only 6% of cultivated land is under irrigation.[6] This is partly due to lack of access to micro-irrigation systems for smallholder farmers, who together still produce up to 80% of Africa's output.[7] The vast majority of cultivated land in Africa is rain-fed and highly vulnerable to volatility in rainfall and drought resulting in globally low per-acre yields and often of poor quality. Globally, irrigated land contributes more than 40% of global food production[8] despite comprising only 20% of land under cultivation (the other 80% being rain-fed land, much of which is in Africa). This provides some perspective on the value being lost for African smallholders without irrigation.
- Operating at the water-energy-food nexus, SunCulture recognizes the interlinked nature of water, energy and food resources, in that any actions that affect one of the three sectors is likely to cause a change in all of them. Most companies applying (and frameworks supporting) approaches for managing these interlinked resources simultaneously – especially for **productive use** – are in the early development stages. There remain many lessons to be learned on what it takes to scale up such use models.



# Productive Use in Off-Grid Solar

## The rural household “Productivity Ladder”

- SunCulture uses the concept of the *productivity ladder* to convey the core value and impact of their products. The ladder represents the progressive expansion of income-generating activities over time using productive assets, allowing households to earn higher (and more regular) incomes and build up their capital base. Households must increase their productivity first to make use of and benefit from more sophisticated solutions up the productivity ladder. For example, the income generated from greater yields through irrigation can help to sustainably support a farmer to finance the purchase of a tractor and, critically, ensure that he / she will be able to make the full use of the capacity of that tractor through access to other complementary resources such as irrigation.
- Increasing household productivity can only happen over time and in strategically progressive steps. For SunCulture, the first step in getting rural households onto the *productivity ladder* is moving water. Water is the foundation of farming, enabling farmers to increase crop yield and livestock output, in turn generating income to reinvest in growing their farming business. Once this first step on the *productivity ladder* is established, it can be used as a base upon which to access other productive assets.





# Productive Use in Off-Grid Solar

## The rural household “Productivity Ladder”

- As a farmer increases milk production from providing more water to her cows, she can reinvest the greater returns from higher milk sales to purchase better inputs including more fodder and veterinary medicines. Over time, increased income can enable the farmer to build up their capital base[10] and invest in further assets. For example, a milk chiller can help to reduce spoilage and preserve income. In Kenya, up to 33% of milk produced is lost to spoilage in storage and transportation before it can be sold or processed.[11]
- If a farmer can afford a refrigerator or other chilling unit, he / she can increase volumes of milk sold day to day and boost incomes by up to 40%[12] given additional flexibility to wait for competitive prices. In some markets, farmers can also receive a premium for selling milk that is chilled. Beyond cold storage, farmers can use their accumulated capital to expand their operations – buying new dairy cows for milk production, diversifying in other crops / livestock, expanding land under cultivation.



# Productive Use in Off-Grid Solar



*While the progress from SunCulture and similar solutions are promising, moving rural households up the productivity ladder remains a challenge.*



*Social innovators should take into consideration the following design principles when tailoring their products to move rural households up the productivity ladder successfully.*

# Productive Use in Off-Grid Solar

1

## Use Customer-centric Design Thinking

Many solutions targeting smallholder farmers fail because they do not take into account the specific needs and experience of their target customers. After several years of product testing and customer feedback, SunCulture learnt that smallholder farmers needed a water pump which was durable, easy-to-use, and adaptable.

They set up a customer research hub in Nanyuki in rural Kenya in order to be close to its customers and iterate quickly with the customer feedback loop which proximity afforded. Small modifications to the product and services pre- and post-sales have gone a long way to improving customer experience and ensuring the product delivers value.



# Productive Use in Off-Grid Solar

2

## Provide End-to-End Solutions

SunCulture focuses on each stage across the product lifecycle: **research & development, manufacturing, supply chain & logistics, sales, financing, delivery and installation, agronomy advice and after-sales support.**

Sunculture follows the Four 'Ifs' of customer service:

- If the product is not tailored to customer needs, it will not deliver optimal value.
- If financing or flexible payment terms are not available, customers will not be able to afford it.
- If the customer does not know how to use it properly, confidence will be lost.
- If no one is available to fix or replace a part, then it will fall into disuse.

This requires firms to get more deeply involved in value chains than their counterparts in urban markets or, alternatively, to explore partnerships with others who can plug those gaps.

# Productive Use in Off-Grid Solar

2

## Provide End-to-End Solutions

Producing high-end technology and sophisticated products is not enough on its own; end-to-end solutions are required in rural markets where supporting industry and services are not present or under-developed.

This requires firms to have more of a service mindset, rather than a product sales orientation. With the RainMaker, SunCulture has developed a plug-and-play product that can be installed and ready to use quickly and efficiently with limited scope for malfunction or misuse. It is modular and suitable for farms of different sizes and topography, for which additional solar panels can be added on to increase capacity and water flow.

# Productive Use in Off-Grid Solar

3

## Bring Financing Solutions to the Table

Affordability is the single biggest constraint to extending access to productive assets in Africa and Asia. Most local banks consider farmers credit unworthy and productive assets too capital-intensive to finance. In this sense, organizations focusing on moving households up the productivity ladder need to bring financing solutions to the table alongside the product. Payment terms must be flexible and smoothed out over a suitable period of time to allow for income from use of the asset to help pay for it.

Development actors have a critical role to play here in providing concessional financing in form of direct credit lines or portfolio guarantees to buy down some of the risk borne by early movers. Critically, the *Rainmaker* is affordable – approximately 550 USD for a basic irrigation kit – and flexible payment terms are available on an innovative *Pay-As-You-Grow* basis. Solar home system PAYGO financing models provide a good corollary for what is needed to scale up productive assets for rural households.



# Productive Use in Off-Grid Solar

4

## Explore Innovative Distribution Partnerships

Reaching rural customers is difficult and costly due to lack of basic infrastructure and sparsely populated areas. For this reason, solutions providers must be creative and partner with organizations which have relationships with and access to smallholder farmers.

For example, firms can partner with distributors of complementary or adjacent products who already have a foothold in target areas or donor-funded programs who have long-standing relationships with large groups of farmers.

With the support of [AFA](#), SunCulture is implementing such a distribution strategy which looks at diverse channels and partnerships with distributors, retailers, financial institutions, and off-takers. It is also deploying different market entry strategies across its countries of operations which accounts for the variance in distribution channels and partners in each market.

# Productive Use in Off-Grid Solar

4

## Explore Innovative Distribution Partnerships

To support farmers successfully move up the productivity ladder, access to various resources and finance is critical. As highlighted in the core of SunCulture's approach, farmers also need access to other resources – including modern inputs, information on better agricultural practice, water, market access, and better post-harvest technology to make the move up the productivity ladder. Strides made in technological innovation have made productive assets accessible. This can drastically enhance farmers' productivity and resilience without access to the grid.

The financing of these assets continues to be a challenge, but the PAYG model has transformed the market to enable greater access to these assets. It has laid the ground for other innovative models such as "PAY-Grow", which can unlock accessibility of more expensive productive assets. To make the move up the productivity ladder achievable, market ecosystems require development across a variety of partners including agribusinesses across value chains, financial service providers, technology start-ups, cooperatives, governments, development partners. Rapid trial-and-error pilots are needed to complement these ecosystems, and should be encouraged.



*With AgriFin's support, SunCulture is implementing a distribution strategy which looks at diverse channels and partnerships with distributors, retailers, financial institutions, and off-takers.*



# Summary

While the journey up the *productivity ladder* is not linear, these productive assets (and the greater earning power and capital base which they provide) can help increase farmers' resilience to external shocks such as drought, pests, medical expenses, and so on.

SunCulture sees its future as a platform for productive assets (and services) to help rural households move up the productivity ladder over time. It can leverage complementary distribution networks to ensure this and other value-adding products reach its customers at the last mile.

The **Pay-As-You-Grow** model is central to this platform. Once a farmer has purchased a solar water pump, a credit history and track record of repayment is created, opening up the possibility of financing new products on favorable terms.



# Summary

The PAYGO model in the solar home system space is already doing this with its next generation of products including, smartphones, TVs, and refrigerators. The platform play does not need to be closed-looped and brand-exclusive. SunCulture is already exploring innovative partnerships with manufacturers of complimentary products who can layer on their offerings onto its platform.

Productive use in off-grid solar presents a huge opportunity for impact yet also a unique set of challenges. Productive assets – such as those for irrigation, refrigeration, freezing, heating, food processing, etc. – are more power-intensive and require higher capacity systems than your typical 80W home system. As a result, such productive assets are often more expensive and present a greater financing challenge for PAYGO models which aim to finance purchase of the asset by consumers (and thus require a lot of capital to do so).





# Summary

Furthermore, while the technology for AC grid-connected and diesel appliances is in many cases highly mature (water pumps, refrigerators, agro-processors such as small-scale husking machines or milling machines, etc.), up until recently there has been little innovation across these different productive uses for DC products.[13] The technology for DC productive assets is still underdeveloped and more product iteration is required.

As a result, there is a significant opportunity for innovators to experiment with technology improvements and new business models to make their products more efficient and affordable to customers. Given the cost of current technologies (grid and diesel mostly), they are often competing for a new market with customers who simply cannot afford alternatives. SunCulture is a prime example of a company which is making these technology and business model innovations to serve a larger, previously-unserved market. AFA has been focusing on building these ecosystems through facilitating partnerships to serve farmers supporting the designing, piloting and scaling of innovative products and services, to demonstrate that one can serve farmers sustainably.



# References

- [1] 2018 Off-grid Solar Market Trends Report, GOGLA (2018).
- [2] Other innovators at the water-energy-food nexus include FuturePump, Lorentz, Jain Irrigation.
- [3] Based on SunCulture customer data and analysis conducted by Dalberg Advisors.
- [4] Energy and environment Partnership (EEP) Southern and East Africa, “[The Solar Rain Maker](#)”
- [5] 12 months after launching the RainMaker, SunCulture launched an improved second version, Rainmaker2 with Climate Smart, featuring improved flow rates, longer battery life, and an IoT-connected proprietary control system.
- [6] FAO AQUASTAT datasite
- [7] AGRA (2017) - <https://agra.org/wp-content/uploads/2017/09/Final-AASR-2017-Aug-28.pdf>
- [8] FAO (nd). Achieving sustainable gains in agriculture.  
<http://www.fao.org/docrep/014/am859e/am859e01.pdf>
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- [12] Dalberg analysis
- [13] A battery is a major example of DC-power supply.





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