



Implementation of MKopa Solar Services for Poverty Eradication

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Abstract M-Kopa Solar is the market leader in 'pay-as-you-go' energy services for off-grid customers; the service has proved to be a key component of poverty reduction in East Africa .Despite its market, the product is undergoing challenges with many users experiencing complication with operation security, flexibility and reliability issues, such have an impact on efficient management in the normal. The study was based on descriptive survey research design. Data was achieved from; Kenya, Uganda and Tanzania. Data was analyzed by: Narratives, discussion and comparison. Finding show that; Infrastructure supports MKopa, implementation of MKopa Solar has not been a success; though in isolated cases - poverty reduction specifically in some parts of rural areas have shown fruits; the success of MKopa Solar stems from making solar products affordable to low-income households on a pay-per-use installment plan. Its innovation has been able to utilize several solar appliances, fertilizer, cooking stoves, Phone battery charging and Lighting. It has penetrated digital payments, attracted low costs of solar & LED lighting in the region. There is need for more service to ensure that the information generated by MKopa Solar is consistent without delays, undue changes that demand further manual help Service should tailor information concerning MKopa in such a way that it cannot be tampered with by others. There should be sufficient MKopa Solar controls to curb tampering and a wide research area.

Keywords Mobile Money Transfer, Mobile Network Operators and MKopa Solar

Introduction

Over three years, MKopa Solar has developed an innovative approach to energy delivery in East Africa, "M-Kopa started with a powerful idea: using mobile phones could provide Kenyans with electricity for less than a dollar a day [1], Looking beyond M-Kopa, a focus on gathering data is critical in order to build the customer and product insights that allow the industry to achieve profitability and sustainability. This uses solar power and telecommunication technologies, mobile payments, and a motivated sales and support network to deliver a reliable service and cost savings to low income customers [1-2]. MKopa Solar is the global market leader of "pay-as-you-go" energy for off-grid customers Launched in Kenya in October 2012, MKopa Solar now provides solar power to over 150,000 Kenyan homes. MKopa Solar began pilot operations in Uganda mid-2013 and is now scaling up across the country. M-Kopa began pilot phase sales of the household solar lighting units in Kenya in 2012, in Uganda in 2013, and in Tanzania in 2014. In 2016 M-Kopa sold an average of just over 12,000 units per month across the 3 countries [3]. The proliferation of mobile money accounts, beginning with M-Pesa in Kenya, catalyzed the digitization of payments, effectively creating a current account for unbanked consumers and serving as a channel for remittances. Ninety-nine percent of individuals who purchase an M-KOPA solar system do so on a credit basis and without the need to collateralize high-value goods that can be repossessed in default – a near impossible task in rural settings of East Africa. Instead, M-Kopa confidently



lends to these consumers by embedding a GSM chip into each device, making it possible to remotely turn off the system at times of non-payment [4-5].

MKopa solar is considered to produce a type of energy compared to Solar PV which can be adapted to a wide range of off-grid applications and to local conditions, ranging from lanterns to household systems to village-powering mini-grids. In the last decade (2008–18), the global installed capacity of off-grid solar PV has grown more than ten times, from roughly 0.25 GW in 2008, to 2.94 GW in [2]. Currently, off-grid solar solutions constitute about 85% of all off-grid energy installations, comprising of solar home systems (about 50%) and solar lanterns/solar lighting systems (about 35%). This is followed by rechargeable batteries (10%) and mini-grids (2%) [1, 4], this will contribute to the global.

MKopa Solar is a critical success factor we contend that cutting down costs will strongly impact on Poverty alleviation, in East Africa, particularly in Kenya, Uganda and Tanzania rural areas. MKopa evolution comes clearly in the 3 Countries. Study summary includes: It s content ,Stock Holders in the field of MKopa Solar within East African region, Energy Bill operations for revenues has been examined in details, considering; MTN, Airtel and Safaricom's-Mpesa has been examined to shed light on the billing, subscriptions and transaction.

The paper goes ahead to discuss Mobile Money-Payment Engine .The study is hinged on the Systems Theory, M-Kopa net currently connects the embedded SIM card, engineered. So Low-Income for Households has been proved to Lean on MKopa, such has been well rooted and discussed. On geographical scope the study examined Tanzania tracing its data catchment in Dar Salam (upland zone- west and north of the City, the middle plateau and lowlands), in Kenya data was collected from Tranzoia/Bungoma Counties and Uganda at Entebbe-Wakiso District. Findings in this study answers the questions about long-term implications on locally available cheap power for home basic needs, literature on poverty eradication has been fully reviewed; Technological Innovation of systems, Pay as you go, especially in terms of MKopa's marketing practices, power application and cutting down cost of living in the long run to reduce poverty, Conclusions and Recommendations are fully compiled in the study.

Global Solar Energy

The regions installed solar capacity reached 280 GW by the end of 2018, dominated by China with 175 GW. The European Union represented the world's second-largest solar PV market, mainly driven by Germany with 45 GW cumulative installed capacity by the end of 2018, followed by North America with 55 GW, of which the United States accounted for 90% [4]. Europe would represent the third highest region by 2030, with 291 GW of solar PV capacity installed [5]. A similar picture is expected on a 2050 horizon, when Asia would still dominate the scene at almost half of the cumulative global capacity installed (4 837 GW). Within Asia, China would dominate the scene, with a CAGR of 9% over 2018 leading to the projected capacity of around 2 803 GW by 2050. North America would have the second-highest installed solar PV capacity, reaching 437 GW by 2030, with more than 90% of these installations in the United States [5]. Europe would represent the third-highest region by [2, 4-5], with 291 GW of solar PV capacity installed. A similar picture is expected on a 2050 horizon, when Asia would still dominate the scene at almost half of the cumulative global capacity installed (4 837 GW). Within Asia, China would dominate the scene, with a CAGR of 9% after 2018 leading to the projected capacity of around 2 803 GW by 2050. North America would have the second-highest installed solar PV capacity, reaching 437 GW by 2030, with more than 90% of these installations in the United States [5]. Europe would represent the third-highest region by [2, 4-5], with 291 GW of solar PV capacity installed. A similar picture is expected on a 2050 horizon, when Asia would still dominate the scene at almost half of the



cumulative global capacity installed (4 837 GW). Within Asia, China would dominate the scene, with a CAGR of 9% over 2018 leading to the projected capacity of around 2 803 GW by 2050 [9].

M-Kopa Labs was established in 2016 to accelerate the company's ability to innovate on its product offerings by conducting early stage research and development on higher impact products that are more difficult to find ways to commercialize in the market [6]. MKopa Solar at that time was growing rapidly, and any free cash was invested back into the core business to accelerate this customer expansion – and with it the life changing impact of lighting. With that context, MKopa Solar Labs pursued several grant funding sources to enable its R&D on products that would expand the company's impact beyond lighting [7].

Although MKopa Solar is reaching scale it does not yet generate free cash flow to invest in new product development beyond its immediate product suite. In addition, as new (larger) products require more up-front capital expenditure, the risks associated with bringing new products to market increase substantially – and become more challenging to fund from equity/debt capital. Grant funding has an important role to play until the market opportunity is fully proven [8].

M-Kopa's innovation approach is one of design, test and adjust. And thanks to its rich customer data, leveraging a deep understanding of off grid energy and financial services consumption habits. The MKopa Solar solution is designed around a game-changing technology - mobile money (Mpesa in Kenya). The founders realized that being able to move a small amount of money around, at a low cost, could revolutionize energy access. They discovered that off grid households in Kenya study spending about 50-60 cents every day on dirty and dangerous kerosene, because of a lack of alternatives and only having enough disposable income to buy small daily amounts of any household necessity.

Study by [9, 35-36] contend that MKopa Solar addresses the off-grid customer base with solar home systems, Kenya Power and Lighting Company(KPLC) addresses the on-grid customer base, providing power through traditional grid infrastructure directly into the homes of those who have been connected. Much of the discussion around energy access is focused on these two categories, dividing customers and households purely by grid connections. One of the central findings of MKopa Solar's Shell Foundation funded market analyses is of much more nuanced market segmentation between on grid and off grid; MKopa Solar identified three additional and distinct groups of customers that do not fit cleanly into either category [11].

M-Kopa Services

M-Kopa is able to offer good quality solar energy systems, collecting payments in small amounts and allowing customers to choose when and how much they pay. Study by [13], show that the success of MKopa Solar stems from making solar products affordable to low-income households on a pay-per-use installment plan. Customers acquire solar systems for a small deposit and then Purchase daily usage "credits" for US \$0.45, or less than the price of traditional kerosene lighting [14]. After one year of payments customers own their solar systems outright and can upgrade to more power. Convincing low-income, off-grid consumers to enter into a long-term payment obligation remains a 'push sale', rather than a 'pull sale'.

Mini-grids are often suggested as a solution but there is little evidence that supports their economic viability. Grid installation is a costly and lengthy process and the initial cost of connection remains high for most consumers [19]. Simply shrinking the supply-side scale fails to fix the cost/price challenge and neglects household realities. Typically, low-income families have lower energy needs and smaller budgets than grids are traditionally designed for and their homes are spread over wide areas [17, 20].

Energy Bill

All revenues are collected in real-time via mobile money systems (such as M-PESA in Kenya) and embedded GSM sensors in each solar system allow MKopa Solar to monitor real time performance and regulate usage based upon payments [21]. This connected design means that MKopa Solar is processing vast amounts of data (i.e. over 10,000 mobile payments per day) via the company's proprietary cloud platform, MKopa Solar net [21]. In Kenya Daily payments for MKopa, is a credit based solar lamp that is topped up through the MPesa service, it Safaricom's second biggest paybill customer after Kenya Power. Customers pay to access its solar lamps.



The lamps are programmed in such a way that they automatically switch off whenever customers default on the daily payments. Mobile payment innovators such as Vodafone and Safaricom created and scaled M-Pesa, a highly successful mobile payment system without which M-Kopa would not have been viable. MTN and AirTel scaled mobile money platforms in East Africa specifically in Uganda is one of the most active markets for PAYG solar in the world. MKopa Solar has been recognized for its pioneering business model and scale, notably winning the 2015 Zayed Future Energy Prize, being selected as the top New Energy Pioneer at the 2014 Bloomberg New Energy Finance awards and earning the 2013 FT/IFC Excellence in Sustainable Finance Award [22].

Mobile money acts as the payment engine for customers and MKopa Solar's sales agents. To use that effectively, the company has developed a proprietary, patented technology platform called MKOPA net that organizes the management of mobile payment instructions, plus the data and information required to run the MKopa Solar service [23]. MKopa Solar is able to offer good quality solar energy systems, collecting payments in small amounts and allowing customers to choose when and how much they pay. MKopa Solar can disable systems remotely if payments are missed, or reactivate them when customers catch up [24].

Cloud-based platform: M-Kopa Net that remotely monitors systems' performance, synchronizes mobile money payments with devices, and measures repayment performance for every account. However, strategic partnerships with innovators in adjacent markets have played key roles in M-Kopa's aim to reach one million low-income customers by 2020.

Mobile payment innovators: Vodafone and Safaricom created and scaled M-Pesa, a highly successful mobile payment system without which M-Kopa would not have been viable. This has been critical for optimizing product design and improving customer support through remote device analysis and updates. The embedded solution (a modem, SIM card, and functionality for data processing) all add to the bill of materials and the total lifetime cost of the unit. This has necessitated some important technology choices creating a formalized model of the entity and thereby enabling the ability to study the entity by which groups of elements and their properties may be studied jointly in order to understand results [21].

MKopa in Kenya

In Kenya, MKopa Solar, headquartered in Nairobi, Kenya, is the market leader of pay-as-you-go energy for off-grid customers. Since its commercial launch in October 2012, MKopa Solar has connected more than 175,000 homes in Kenya, Tanzania and Uganda to solar power, and is now adding over 500 new homes each day. Study done [2] indicated that MKopa have already been connected 90,000 Kenyan homes to clean energy and with this upcoming suite of Safaricom branded devices. Study by [33], show that company estimates that the reduction in daily charges from Sh50 could increase MKopas daily to pups to 20,000, from just about 1,000 a year ago. Kenya power's playbill Transactions stand at an average of 135,000 per day. The proportion of Kenyans connected to the national electricity grid is below 30 per cent of the population, leaving many households to rely on kerosene for lighting. Outside of Kenya know there are a further 14 million households of MKopa on off the grid in Uganda and Tanzania. The combined 20 million household East African market the primary target for MKopa3 comes with a solar powered radio and mobile phone charger.

MKopa Solar started with a one light system that could charge phones, but found through user research that customers wanted bigger systems with more lights. Although at a relatively early stage, MKopa Solar's Customer Care team already consists of over 60 members (around one third of the organization as a whole), and is key to ensuring the organization stays oriented around their users. In addition, MKopa Solar track devices for usage, performance, and monitoring payments [22].

The active monitoring of units allows for real time information about on-going operations. Here an embedded computer sends information to a central server about the user's consumption, photovoltaic energy production, battery voltage and any operational problems that could result in the unit failing.

MKopa in Uganda

Jesse Moore, Managing Director and Co-Founder, MKopa Solar contend that "We are very proud of the MKopa Solar. M-KOPA Solar Lights up over 20,000 homes in Uganda and more so over 20,000 off-grid Ugandan



homes connected in 15 months- Scaling up distribution nationwide in 2015 • M-KOPA III solar lighting and charging solution for only UGX 1,400 per day 24 March 2015, Entebbe, Uganda–M-Kopa Solar today announced that it has connected over 20,000 off grid homes in Uganda affordable solar power. It is now expanding its distribution nationwide and targeting to add 50,000 more homes by the end of 2015. MKopa is helping Ugandans get rid of kerosene, improve their standard of living and save money all at once.

Vodafone and Safaricom created and scaled M-Pesa, a highly successful mobile payment system without which M-Kopa would not have been viable. MTN and Air Tell scaled mobile money platforms in several African countries, in Uganda, one of the most active markets for PAYG solar in the world MKopa Solar Uganda has added more than 20,000 customers in the past 15 months [32]. According to [30-31] study MKopa Solar Uganda:

“In Uganda MKopa Solar is now connecting over 500 new homes to solar, such is witnessed in eastern Uganda: Mbale, Nabumali, Bungokho, Bubulo, Bukobelo, Namaloko Bukhofu, Butiru, Namweke, Busumbu, Sibanga, Munamba, Kisawayi, Lwakhakha, Magale and Bumbo. MTN and AirTel scaled mobile money platforms in several African countries, including Uganda, one of the most active markets for PAYG solar in the [31]. According to Moore (2013), the penetration of solar energy use in Africa is still very low and expects that MKOPA will enable low income population to access affordable home lighting. "We are not just lighting homes, but also enabling children to do their homework at night as well as providing convenient unlimited mobile charging at home," added Mr Collymore. MKOPA has 95,000 customers and wants to grow its clientele base to one million homes by 2018

MKopa Solar in Tanzania

In the late 1990s when the Tanzania Traditional Energy and Environment Development Organization (TaTEDO), based in Dar es Salaam, won funding from international donors to implement a large solar photovoltaic's project, the Tanzanian niche began to evolve (Byrne 2011). Its first training workshop, in Dar es Salaam in May 2000, led to the creation of the Tanzania Solar Energy Association (TASEA) 19. Membership of TASEA quickly grew as TaTEDO moved to other parts of Tanzania to run further training workshops (e.g. TaTEDO 2000). TaTEDO began to emerge as an important factor in the Tanzanian niche.

This study reveals that Tanzania, major sources of power are natural gas, petroleum, and hydropower. Out of the total installed power capacity of 1,264 megawatts (MW), 568 MW is from hydroelectric power, 685.4 MW is from thermal power, and other renewable energy contributes less than 82.4 MW [28]. According to Bureau of Statistics and the Rural Energy Agency report [28] only 32.8% of communities in Tanzania has access to electricity, whereby urban areas have more access to electricity (65.3%) than the rural areas (16.9%). Out of the total electrified households, 74.9% and 24.7% are electrified with national grid and solar power, respectively. Solar energy is only 24.7%. In Tanzania, solar energy is used as a source of power by 24.7% of the households with access to electricity. Potential solar energy resources are found in the central parts of the country [33]. There are high solar energy levels ranging from 2800 to 3500 h of sunshine per year and a global Horizontal radiation of 4–7 kWh/m²/day [33]. According to the World Bank, Tanzania has a solar energy Potential greater than that of Spain and wind energy potential greater than that of the US State of California [28]. With such great potential for solar energy resources, Tanzania is naturally appropriate for producing solar energy as a feasible alternative source for modern energy supply and rural electrification. The solar energy market in Tanzania has drastically grown and increased over the last few years. Currently, the potential solar energy resources in Tanzania are used in different parts such as solar thermal for heating and drying and photovoltaic for lighting, water pumps, refrigeration purposes, and telecommunication [34]. One important factor was its involvement with Umeme Jua, a Dutch-Tanzanian joint venture, that began to develop a marketing model in the country from around 2001 [34-35]. This KARADEA Solar Training Facility (KSTF) became an important source of technician training in the East African region. Perhaps 200 technicians received training there over the ensuing ten years or so along with many others who would occupy managerial roles in PV projects across the East African region [35]. Interestingly, almost no Tanzanian technicians who were trained at KSTF managed to start PV businesses in their country. There was little market activity and practically no funding to help them get started. EAA, in its part, would only occasionally install community service systems in Tanzania. Nick Hughes,



Chairman and Chief Strategy Officer, leads new product and new market activities for MKopa Solar. Until 2009, Nick was Head of Global Payments at Vodafone Group, where he started MPESA in 2004.

M-Kopa Operations

M-Kopa net currently connects the embedded SIM card, engineered into each MKopa Solar system, with the mobile money platform. It manages each systems performance, disabling it if Payments are missed and reactivating it when customers catch up. As of March 2015 MKopa Solar had employed over 500 full time staff across Africa and sells through a network of 1,000 direct sales agents. It has also commenced licensing its technology to partners in other markets. M-Pesa is operated by Safaricom and Vodacom, mobile network operators (MNO) not classed as deposit-taking institutions, such as a bank. M-Pesa customers can deposit and withdraw money from a network of agents that includes airtime resellers and retail outlets acting as banking agents. The service enables its users to: deposit and withdraw money, transfer money to other users and non-users, pay bills, purchase airtime and transfer money between the services and, in some markets like Kenya, a bank account. A partnership with Kenya-based Equity Bank launched M-KESHO, a product using M-PESA's platform and agent network that offers expanded banking services like interest-bearing accounts, loans, and insurance.

Low-Income Households Lean on MKopa

In Kenya, MKopa Solar drew upon the Financial Access studies and the work of the FSD Trust¹¹, which used financial diary methodology to understand how low-income households handle cash flows. These studies show that the vast majority of low-income families use a wide range of informal financial management tools to smooth volatility. Household cash often flows from multiple sources and the amount of disposable income can vary by as much as 60% in any given month. Combined with sporadic expenditure (on items such as school fees, home repairs, or medical emergencies), these factors leave people struggling to find ways to ensure cash is available when they need it. The advent of mobile money has helped make transactions quicker and easier but this development alone does not remove the need for families to find ways to borrow and save small amounts, constantly maintaining options to acquire funds should they need them in an emergency. This balancing act represents a form of risk management in low-income households.

MKopa Market Innovations

Solar-powered fridges: Embraco, the world's leading player in cooling technology, collaborated with M-Kopa for two years to create hyper efficient refrigerators capable of running solely on solar power. Solar-powered water heaters: Bosch is leveraging advancements in the hardware design industry to create water heating solutions that can affordably run on solar power to minimize energy loss and maximize efficiency. MKopa provides High-quality hardware is one dimension of the value proposition to underserved households and enterprises. Channels to market and IT infrastructure are two business-to-business opportunities that PAYG providers can pursue. Research indicates that in 2018, M-Kopa received over 30 million mobile money payments – each one signifying a vote of confidence. With limited available cash on hand, our customers opt to send \$0.50 - \$1.00 every day to M-Kopa for solar appliances, fertilizer, cook stoves and more.

PAYG solar in Africa was born out of the wide-spread adoption of mobile phones, high penetration of digital payments and the plummeting costs of solar PV and LED lighting. M-Kopa's founders knitted these enabling factors together with a GSM SIM card inside a solar home system to allow for remote machine-to-machine communication, IoT control, receipt of payments and device crediting, and delivery of reliable energy services. Like most pioneers, M-Kopa built and designed core components of its operations from the ground up.

The M-Kopa solar is converging toward multi-light solutions that anchor a credit relationship with underserved individuals, at the same time as customer needs and tastes are adjusting upwards with increasing financial stability. This signifies latent demand for higher-order energy services, as seen with the launch and adoption of solar-powered TVs and low-power fans, stereos, and other electronics, including M-Kopa's forthcoming PAYG solar-powered refrigerator.



Methodology

Design, Data Collection and Geographical Location

The study employed a cross-sectional descriptive survey. Surveys are a popular method of collecting primary data. The study focused on data from three countries of Eastern African (Kenya, Uganda & Tanzania);- Regions of interest were -Trans Nzoia and Bungoma Counties-Kenya; Central Province (Entebbe)-Uganda and Dar Salam in Tanzania. Interview schedules and Key Informants were used to collect qualitative data. Data was analyzed, by techniques of Narratives, discussion, comparison and literature reviews. The Survey utilized stratified random design in achieving the homogenous population of respondents. Data gathered from the interviews with suppliers of MKopa Solar system and organizational adopters, were collected during eight interviews that took place over the phone. Certain barriers and drivers that were considered to be more significant in influencing adopters' decision were identified. The interview was exploratory in nature, it proved useful as it was a preparatory ground and it helped to refine procedures for the interview with consumers.

Dar es Salaam –Tanzania

From data collection tools, key Informants Interviews and Interview guides (2019) were employed, Data was Collected from Dar Es Salaam in Tanzania [30], is located in the eastern part of the Tanzanian mainland at 6°51'S latitude and 39°18'E longitude. With an area of 1,350 square kilometers (km²), it occupies 0.19 percent of the Tanzanian mainland, stretch in about 100 km between the Mpiji River to the north and beyond the Mzinga River in the south. The Indian Ocean borders it to the East. The beach and shoreline comprise sand dunes and tidal swamps Coastal plains composed of limestone extend 10 km to the west of the city, 2-8 km to the north, and 5-8 km to the south. Inland, alluvial plains comprise a series of steep-sided U-shaped valleys. The upland plateau comprises the dissected Pugu Hills, 100-200 m in altitude [24]. The City is divided into three ecological zones, namely the upland zone comprising hilly areas to the west and north of the City, the middle plateau, and the lowlands, which include Msimbzi Valley, Jangwani, Mtoni, Africana and Ununio areas, [30].

Entebbe-Uganda

Data gathered by interviews guides and Key Informants from Entebbe municipality, the town derives its name from the Luganda word 'e ntebe' (meaning 'seat' or 'chair') referring to the rocky seats on the shores of Lake Victoria which were carved by Mugula, a Muganda traditional Chief in the early 18th Century. "Entebbe" Although it had that traditional linkage to administration of justice Entebbe only became the capital city of Uganda in 1894 following a decision in 1893 by the then colonial Governor Sir Gerald Portal to relocate from Kampala. This decision was later rescinded by the independence Government and the capital reverted to Kampala leaving Entebbe with the State House, the International Airport and a few Ministry Headquarters and government departments. Entebbe lies at 0°04'N, 32°28'E and is 37 kilometers South East of Kampala the capital city of Uganda. It is situated in Wakiso District boarding Lake Victoria in the South.

The Municipality is located on a peninsular into Lake Victoria covering a total area of 56.2 km², out of which 20 km² is water [27-28].

Trans Nzoia County-Kenya

According to [31], the County borders the Republic of Uganda to the West, Bungoma and Kakamega Counties to the South, West Pokot County to the East, Elgeyo Marakwet and Uasin Gishu Counties to the South East. It covers an area of 2,495.6 square kilometers. The County has five constituencies namely Kwanza, Endebess, Saboti, Kiminini and Cherangany and has 25 electoral Wards. Trans Nzoia is a cosmopolitan County with cultural diversity and is among top fifteen densely populated counties in the country. The 2009 Population and Housing Census enumerated a total of 818,757 persons in the County. Of these, 407,172 were male and 411,585 female. The inter-censal growth rate was 3.6 percent between 1999 and 2009. The population for the County in 2018 is projected to 1,111,686 persons of which 551,302 are male and 560,384 are female. The County is drained by rivers Ewaso-Rongai, Noigamaget and Sabwani which are the major tributaries of river Nzoia which drains into lake Victoria. The major topographic features of the County are Mt. Elgon and the Cherangany Hills which also form the largest natural forest cover [31].



Bungoma County-Kenya

According to report by Transforming Bungoma County [29], Bungoma County Government was established in 2013 as per the Constitution of Kenya 2010 which provides for the two levels of government. It is inhabited by the Bukusu, Tachoni, Batura, Sabao, Iteso and other Kenyan communities who reside side by side in peace. The County is generally cosmopolitan and has good representation of both local and foreign expatriates. Colonial period Some of the notable achievements attained during this period included: a robust cooperative movement, which was a role model for the country and the railway stations at Webuye, Sudi, Bungoma and Myanga which revolutionised the transport system in the County. The County lies between latitude 00 28' and latitude 10 30' North of the Equator, and longitude 34 20' East and 35 15' East of the Greenwich Meridian. The County covers an area of 3032.4 Km². It borders the republic of Uganda to the North west, Trans-Nzoia County to the North-East, Kakamega County to the East and South East, and Busia County to the West and South West. Map 1 shows the location of Bungoma County in Kenya. The major physical features include Mt. Elgon, several hills (Chetambe, Sang'alo and Kabuchai), rivers (Nzoia, Kuywa, Sosio, Kibisi and Sio-Malaba / Malakisi), waterfalls such as Nabuyole and Teremi. Mt. Elgon and Sang'alo hill have attractive caves. The altitude of the County ranges from over 4,321m (Mt. Elgon) to 1200m above sea level. The County has only one gazetted forest, the Mt. Elgon forest reserve which measures 618.2Km², and one National park, which measures 50.683 Km² [29].

Findings and Discussions

Question: Respondents were asked if MKopa was well received: Answer was that MKopa Solar system was Well-received among rural householders, indicating it is significant, this reveals how a commercially available technology supports sustainable practices (i.e., using solar energy).

Question: Respondents were asked if MKopa demonstrate the application of research-based design guidelines, whether it would provide to useable systems; Answer was that normally MKopa demonstrate the application of research-based design guidelines, which leads to useable systems. This study contends that such promote sustainable behaviors and supports poverty reduction in East Africa.

Question: Respondents were asked if MKopa was flexible: Answer was that MKopa Solar was flexible and that it observed systems flexibility , it supports several unexpected practices, such as warming Chicks (poultry) Provision of lighting in rural areas (Housing, security, battery charging, phone charging).

Question: Customers asked if they gained from MKopa salors and if they appreciated "M-Kopa's Customer Care" as provided by their companies: Answer was that MKopa Solar—After-sales services offered to Customers. The majority of customers said that they were satisfied with the company's support staff, adding that they were polite, accessible via the phone, and capable of answering their questions.

Question: Customers were asked if MKopa solars provided better services: Answer was from few users, that MKopa Solar was able to get replacements for broken bulbs or flashlights at the MKopa store in Town, this was another aspect of customer support which was appreciated. This was operated regularly in terms of SMS messages sent by "M-Kopa Customer Care" that were participants' most frequent engagement with the Company.

Question: Customers asked if MKopa salors contributed to economical gain: They pointed out that MKopa Solars improve economic situations by realizing savings and earnings.

Question: Customers asked if MKopa salors payments for solar systems is a serious extra expense which affects basic needs: The answer on payments for solar systems was a crucial expense, ranking just below school fees, food and medical needs.

Question: Customers asked, they indicated that M-Kopa are less easy to understand when evaluating prototype systems. Study findings are aligned with others that suggest that once households have access to basic appliances (i.e., light bulbs), they then aspire to own others that require high wattage levels (e.g., TVs, refrigerators, and microwaves).

Question: Customers asked if they were willing to own the solar product or just pay for the electricity MKopa Solar used initial tests to get user feedback on this question, "the answer, overwhelmingly, was that customers wanted to own the product, the rest of the business model for that demand". MKopa drives the World catch,



attracted rural sustainability, it draws community togetherness-because of house hold sharing (support of phone charging, with neighborhood).

Question: Customers asked on normal application of MKopa, who capitalizes the application of solar appliances: The answer was that the women of these households are the ones who capitalize on solar ownership, enjoying increased agency in the home and, thereby, shifting the role of women in rural Communities.

Question (KII): Do MKopa Solar system enable more time to pursue productive activities: The answer reveal that nearly half of the customers acknowledge that an M-Kopa Solar system enables more time to pursue productive activities.

Question: Customer asked whether M-Kopa Customers directly generated income through local phone charging services the application on solar appliances: The answer was M-Kopa customers' directly generated income through local phone charging services, hosting movie screenings, or using solar lighting for a business.

Question (KII): Manager asked whether M-Kopa Customers MKopa Solar add resources to enable daily operations: The answer was that there is a need for domestic devices that do not stimulate consumption but instead offer alternatives and raise awareness about it".

Question (KII): Manager asked whether M-Kopa Customers MKopa Solar are fully available in outlets nationwide in Kenya through the Safaricom distribution network. The answer was MKopa Solar was conceived as a solar powered system that offered a more cost effective energy solution to parts of East Africa.

The respondent added that since many rural areas specifically in Kenya and Uganda are dependent on agricultural yields for income, which can result in variable access to funds.

Question (KII): Manager asked whether M-Kopa Customers payment for the service is manageable, flexible and easily workable. The answer was payment for the service is flexible, allowing customers to adapt payments to their income. The pay-as-you-go plan is designed such that customers pay for a period of one year, after which time they own the system outright.

Discussions of the Study

The study indicates that MKopa Solar provides solar home systems that innovatively couple machine-to-Machine technology (M2M) with a micro-payment solution. The system includes embedded GSM technology for monitoring and metering usage, while its pay-as-you-go service carries the advantage of no large initial cash outlay. Similar findings done by MKopa [31], reveal that nearly half of the customers acknowledge that an M-Kopa Solar system enables more time to pursue productive activities, whether that is getting a new job, working longer hours, or supporting a business. Research indicate that an estimate of more than 140,000 M-Kopa Customers directly generated income through local phone charging services, hosting movie screenings, or using solar lighting for a business in 2018. This has increased household budgets by as much as 32%. Secondary data when analyzed by [28] show that majority of new television owners in Kenya feel that they are more engaged in civic and political life since getting their system. First-time television owners in off-grid homes widely report an improvement in their lifestyle because they feel more informed. According to MKopa [32], reveal that Rural households in East Africa own few assets that can be secured as collateral against loans from traditional financial institutions.

Ninety-nine percent of individuals who purchase an M-Kopa solar system do so on a credit basis and without the need to collateralize high-value goods that can be repossessed in default – a near impossible task in rural settings of East Africa. Instead, M-Kopa confidently lends to these consumers by embedding a GSM chip into each device, making it possible to remotely turn off the system at times of non-payment [34]. Similar study by M-[34], indicates that access to information off-grid homes with radio, smartphones and television now have access to similar information channels as the citizens in developed markets. One-in-three M-Kopa households have a TV, with many more benefitting from access to critical information. We have also put over 30,000 internet-enabled smart phones in the hands of our customers.

Similar study by [33] shows that currently MKopa solar is able to provide full-time employment to 855 staff globally, 50% of whom are women. It has more than 2,100 active direct sales representatives (DSRs) across East Africa; 60% of these solar entrepreneurs are aged 30 years or younger, and have been recruited from the



last-mile communities that we serve. Since 2012 it has invested over \$63 million in recruiting and sustaining our workforce.

Similar study by [33] shows that M-Kopa brought to market a solar energy solution that Enables Customers to save between \$4-5 per week on average 3 and can be repaid over time. The combination of affordability, Flexibility and savings supports customer's financial resilience to unexpected shocks and the ability to save available cash for larger, lumpy expenses, like school fees. MKopa solar offers key issues, phone charging, and radio batteries drive over 90 per cent of user's energy consumption, with kerosene accounting for over 50 per cent of total energy costs 4.

Quotes on MKopa Solar by World Leaders

Quotes'' for MKopa Solar from world leaders: "M-Kopa has brought the benefits of solar lighting to thousands of rural homes, enabling our children to study, relieving our mothers from the burden of fetching firewood and burning kerosene late into the night" – **President Kenyatta, July 2015** "M-Kopa started with a powerful idea: using mobile phones could provide Kenyans with electricity for less than a dollar a day" – **Bill Gates, December 2015** "We are incredibly proud to have been anchor partner of M-Kopa and to see this Kenyan success story starting to go global"- **Bob Collymore Safaricom CEO, February 2014** "After a year of payments, for the next 7 years you now have power and light in your house, you can charge your phones and that 50 cents a day is the same amount you'd be paying for kerosene" – **Barack Obama, July 2015.**

Conclusion

Finding show that the system's design contributes to its success. These findings also raise questions about the long-term implications of such systems—especially in terms of how MKopa's marketing practices introduce people to consumption practices in isolated cases of East Africa . Findings also revealed that the implementation of MKopa Solar has not been fully successful as a result of the top down Energy services, however in isolated Cases it is a "green" solution which is poverty reduction in Rural, areas Nzoia County. Infrastructure supports MKopa results revealed that implementation of MKopa Solar has not been a success however in isolated Cases poverty reduction in rural East Africa has shown fruits .It shows that the success of MKopa Solar stems from making solar products affordable to low-income households on a pay-per-use installment plan. M-Kopa innovation show that its able to utilize several solar appliances, cooking stoves, phone charging. All in all MKopa has penetrated digital payments, plummeting low costs of solar & LED lighting in East Africa.

Recommendations

East Africa countries have great potential to develop MKopa Solar energy. However, exploration efforts have largely emphasized timely and sustainable utilization of the available resources renewable energy such as solar. The governments of (Kenya, Uganda and Tanzania) along with other stakeholders, should complement existing policies and strategies to address issues related to renewable energy development. There is need to provide a sound business and investment environment to local and foreign people who can provide capital towards MKopa Solar energy technologies and development, more training and awareness made available to the public about how to invest and use MKopa Solar. There is need for public service to ensure that the information generated by MKopa Solar is consistent without delays and undue changes that demand further manual help. Public service should tailor information Concerning MKopa Solar in such a way that it cannot be tampered with by a number of operators

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