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Empowering Communities in Marginalized Surroundings: Opportunities from Collaborative Community-Managed Electrification and Advanced ICT

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Marginalized communities in Africa present a challenge for sustainable and equal development. Opportunities for breaking out from poverty are scarce. Electrification has been seen to act as an important enabler for improving livelihood in such surroundings. However, the activities and services that are enabled by electricity are often the desired outcomes. Aspects of special importance relate to improved earnings: business development and entrepreneurial work. Such activities are usually supported with advanced ICT. However, the introduction and operation of such systems requires substantial resources. In this paper, we explore collaborative practices that may lower these resource demands. Accordingly, we present a case study conducted in an African marginalized community showing how collaborative introduction and operation of electricity and advanced ICT infrastructure were sustained by the local community members. We also show the processes that were followed in engaging ICTs. The study is based on a research and piloting project that seek ways to establish a community-centered ICT infrastructure for electricity and Internet connectivity enabling the members of the marginalized community to get access to digital services. We argue that the experimented infra-structure will give the community an opportunity to improve their livelihoods by using the Internet and access to information for eLearning, e-government services, and a wide market for selling local products. Importantly however, our findings include the collaborative remote support for the deployment and usage of the infrastructure improving sustainability. Such a new approach can be considered of importance given that traditional electrification and digitalization projects often degrade or even cease to exist soon after handing over everything to the community.

CCS CONCEPTS • Human Computer Interaction (HCI) • Accessibility • Collaborative and Social Computing

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* Place the footnote text for the author (if applicable) here.

Additional Keywords and Phrases: ICT4D, electrification, digital services, sustainability, community-centered ICT

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1 INTRODUCTION

Marginalized areas have become a focus of development as nations seek to address poverty that associate with such surroundings [1]. This marginalization is often a result of geographical location, cultural, socio-political and economic factors [2]. Information Communications Technologies (ICTs) and supporting infrastructure are seen as tools for promoting development in such communities [3]. Such initiatives are often based on community projects that are sponsored by the government or non-governmental organizations or the private sector. However, there are concerns over such projects as their implementation and sustainability remains scarce [1, 4, 5]. Thus, cases have been reported of ICT projects implementations that have failed to make a meaningful contribution to marginal areas [3]. Community ICT projects are complex and their success often depends on various environmental and contextual factors [5] something that makes lessons learned from one case not easily transferable to the next [6]. It is against this background that this study presents a reflection of an ICT for Development (ICT4D) project that was implemented in Namibia. The aim is to establish measures that were taken to ensure a sustainable implementation of a community ICT and electrification project in a rural African marginal community. Successful implementation of this project will result in empowering the impoverished rural community members.

This paper is organized as follows: Section 2 explores the literature on sustainable techniques for the implementation of ICT4D projects and subsequent forms of empowerment. This is followed by the research methodology and a presentation of the steps that were taken during the project initiation. Furthermore, the section presents project stakeholders, challenges and supporting frameworks, and outlines different forms of empowerment from this study's project. A discussion and conclusion marks the end of this paper.

2 LITERATURE REVIEW

2.1 Sustainable Implementation of ICT4D Projects and Electrification

There are different views on what constitutes sustainability in ICT4D projects. Pade-Khene et al. [1] suggests that sustainability can be arrived at by sustaining the access to ICTs or by sustaining the developmental outcomes that emanate from the ICT project. In an effort to define ICT4D sustainability, Meyer and Marais [4] separated systems of key project stakeholders namely the donor (sponsor) system from the beneficiary system -- the benefiting community and the ICT system that deliver services. Hence, sustainability is determined by systematic drivers that are based on who, among stakeholders, defines change; a multi-perspective understanding of the capacity and readiness of the beneficiary system; and the extent of alignment between the project and 'natural' agents of change within the beneficiary system [4,5]. This definition suggests a shift in

focus “from a donor system that is innovating on behalf of the beneficiary system, to innovation that is driven by the beneficiary system in response to its natural dynamics” [4:4].

A number of ICT4D projects can be identified in the literature. One such example includes a telecentre, a non-profit establishment that seeks to bridge the gap between those with access to ICTs against those without access [7]. The use of telecentres is common in many developing countries such as South Africa, Tanzania, India, and Kenya. Furthermore, Lorini et al. [6:246] researches on the iNethi Network that is set up in “two under-resourced communities in Cape Town” in which a participatory partnership approach for sustaining ICT4D projects is proposed. This will increase community ownership of the project and the development of services valued by participants thereby yielding more benefits to the target communities [6]. In particular, iNethi Network offers wireless Internet access, computing re-sources for the community members to communicate, share information and create local content. NGOs and local community leaders among others initiated this project. The establishment of the iNethi Network is characterised by key activities of initial community engagement, coming up with a governing board composed of representatives from different stakeholders, a policy framework (Acceptable Use Policy) guiding the use of the ICTs, building the wireless infrastructure and developing local services: platform for social networking, chatting, file-sharing and designing web sites [6].

In addition, Pade-Khene and Lannon [5:1] reflects on how sustainability is being attained in an ICT4D project known as the “Mobile Social Accountability Monitoring” (MobiSAM) that focuses on the digitization of citizen engagement. Thus, MobiSAM project focuses on the use of mobile phones in facilitation a two-way communication between citizens and government with the aims of enhancing service delivery. Pade-Khene and Lannon [5] identified the key stakeholders in the project and went on to establish how knowledge transfer was facilitated within the project. They noted that learning reduces uncertainties and complexities around ICT4D projects. Thus, “learning allows donors and project implementers to realise the true contribution of ‘taken-for-granted’ perspectives of local beneficiaries” [5:1] a development that is expected to promote sustainability.

Another ICT4D project for promoting development in marginal areas include that reported in Wadkar et al. [3] that focus on promoting the accessibility of agricultural knowledge using ICTs in rural India. Furthermore, Pade-Khene et al. [1] proposes a guideline for managing ICT4D projects based in rural areas with the aims of enhancing sustainability. While electrification is important for ICTs, there appears to be little focus on electricity when reporting on ICT4D projects. Focus is on the ICT component. However, individuals in marginal surroundings have limited or no access to electricity [8]. Approximately 85% of households based in the rural areas have no access to the main electricity grid in Namibia [9].

2.2 Empowerment Opportunities from ICT4D Projects

This study follows Alao et al.’s [7] approach to an ICT4D project in an attempt to understand how a collaborative community-managed electrification and advanced ICTs project empowered the members of the target community. Marginal areas are a primary source of poverty; hence, ICT4D projects can play a pivotal role in empowering individuals in these communities. Poverty alleviation is the top most priority for the United Nations according to the 17 Sustainable Development Goals for the period 2015 -to- 2030. Dasuki and Quaye (2016) in Alao et al. [7] defines empowerment as the process of enabling one to gain a substantial new capability that allows for the performance of specific action. This suggest that, if empowered, individuals in marginal communities will be able to achieve goals and targets that were previously impossible to attain. It is important to realise that before accepting the use of the technology, marginalized community members go through various

process as they embrace the technology [10]. Understanding these processes and how technology diffuse in such societies is important in this study given that technology is more likely to be accepted by those with pre-existing advantages such as self-efficacy in technology use and being a member of a society of technology users who can easily share experiences and help stimulate other members' trust in technology use [11]. The next paragraph analyse the process of technology acceptance among members of a marginal community and goes on to explain how empowerment can be realised by using the technology.

Members of marginalized communities are less likely to embrace technology because of weak social connections which implies that they probably cannot visualise how the technology can be used [11] for empowerment. This has serious implications on Human Computer Interaction (HCI) practitioners if they are to propose solutions that will be acceptable across heterogeneous societies [10, 11]. Hui et al. [10] proposes a metaphor that can explain how technology diffusion occurs among members of a marginal community. They propose awareness and willingness, self-efficacy, and "overcoming digital obstacles" [10: 9].

Awareness and willingness to use digital tools occurs as a result of regular personal interactions among members with the same goal over using the technology. Such interactions will stimulate technology awareness and skills development on how to use the technology for empowerment. Self-efficacy can be realized through regular collective meetings to discuss the technologies to use. This is complimented by phases of trial and error in order to understand how the technology can be harnessed in a useful way. Lastly, collectively overcoming digital obstacles involves members of the community pulling resources together so that they overcome challenges that cannot be resolved at individual level. Such resources can include skills, funding, movable and immovable assets that can be used to enable the use of the technology. Once the members of the community find their way into engaging the technology, it is expected that they will benefit from different forms of empowerment. Empowerment can be categorised into different groups namely community, political, economic, cultural, gender, psychological, social and information empowerment [7, 12].

Community empowerment is a broad-based capacitation of a group of individuals with a shared goal [13]. For example, using technology to mobilise individuals with a shared interest or agenda or mutual benefit. Such goals or benefits could come in the form of security or shared growth among community members. Political empowerment relates to equipping individuals in such a way that they can have a say in the manner things are done or organised [7]. Pandey and Zheng [10] adds that political empowerment is more about capacitating citizens such that they have a transparent relationship with the government in a way that allow them to participate in matters that relate to service delivery. On the other hand, economic empowerment ensures that individuals have the skills that enhances access to a source of income and improve their livelihoods [7, 10]. Cultural empowerment is being free from socio-cultural norms that may restrict one from using computers [7]. In addition, culture empowerment includes educating one about different or forgotten indigenous traditions, cultural identities, rituals and language [10]. Gender empowerment involves capacitation that promote equality, freedom of expression and the right to be heard across the gender divide. Pandey and Zheng [10] notes that gender empowerment within ICT4D is often used to give women equal opportunities so that they can enable social change or pursue their own choices. On the other hand, psychological empowerment can be attained by using ICTs to enhance the well-being of an individual. This may include improving confidence or overcoming personal problems and/or insecurities [7]. Alao et al. [7] went on to suggest that social empowerment focuses on helping individuals gain control of their lives. This could be through sharing ideas or communication. Lastly,

information empowerment relates to the use of ICTs to unlock the opportunities for one to advance their skills or knowledge about a subject of interest. This also includes the up skilling of those involved.

3 METHODOLOGY

This study follows a pragmatism research philosophy [5]. A triangulation of different qualitative data sources is used focusing on observations, discussions during meetings, online chats and documentations that were generated during the project. This data was gathered over a period one year: December 2019 to January 2021. In particular, notes that were generated from observations and minutes of meetings held were used. A WhatsApp group that was created to facilitate communication between beneficiaries and the implementation team is used as a source of online chats data. Accordingly, this study reports on findings that were arrived at from participation and observation by the implementation team. Focus is on the most important events that relate to the objectives of this study [6]. The gathered data was collectively analyzed using a thematic analysis of these different sources of qualitative data that was collected. Coding was used to classify emerging themes according to those found in the literature. The first round of data analysis involved identifying individual codes followed by a comparison of the identified codes taking note of similarities, differences, and possible explanations. Here, triangulation data analysis was adopted where data from different sources is collectively analyzed supporting the identified themes. Focus was on identifying the processes of ICT engagement and subsequent forms of empowerment. For ethical reasons, clearance for this project was secured from the relevant government Ministry. All participants were informed that this was a research project where multiple data sources were going to be used to gather data for research purposes. Furthermore, an informed consent was secured from participants for this project.

4 THE PROJECT OVERVIEW

This project is a pilot-demonstration of rural electrification and advanced ICT implementation in a small town in the northern part of Namibia. The project is a result of international collaboration between the industry, universities, and public sector. The project is anchored on three main technical pillars electricity, connectivity, and access to digital services for empowering marginalized communities. The initial engagement for this project saw members of a university backed by the industry approaching a relevant public office to gain approval for the research project to be hosted by the local town council. Table 1 shows an overview of the project timeline.

Table 1. Project initiation activities.

Timeline	Activity/Event	Outcome
04/2018	Visiting ministries and stakeholders	Project approval and stakeholder identification
12/2018	Site visits (including local town council)	Baseline survey-data collection and sites evaluation
02/2019	Research project and Town Council delegation meeting	Discuss project pilot setup including electricity and connectivity provisions, and the initial time schedule was set.
12/2019	Pilot system installation and commissioning	1st pilot system: Due to component delivery delays, a preliminary version of the pilot system was commissioned jointly on-site with project experts and electricity supply started.
03/2020	Pilot system upgrade to originally planned configuration, WIFI network coverage was extended with additional Wi-Fi hotspots.	Off-grid electricity system solar generation and battery energy capacity was doubled, and connectivity network was extended to cover larger area and more users. The practical work was completed by local members with support from remote-connected experts.

4.1 Stakeholders

The project stakeholders are the sponsors, the universities (project implementation team), public sector (relevant Ministry and town council) and the beneficiaries (the community members). The project implementation team constantly engaged all stakeholders and offered continuous remote support to the beneficiaries to overcome any technical and operational challenges. Five households initially benefited from the electrification and internet connectivity. However, upgrades on the WI-FI saw the network expanding to the surrounding community members (external stakeholders) in addition to the five beneficiaries living in electrified houses.

4.2 Development Efforts, Challenges, and the Supporting Structure

The common challenges that were experienced during the first months of the project include the unequal use of electricity among beneficiaries. This was, temporarily, down to below-planned-capacity electrification solution consisting of solar power production with 1.8 kWp generation capacity, Li-ion batteries with 3.6 kWh energy storage capacity and an inverter that had a maximum AC output power 5 kW. This system was meant to supply electricity to basic consumer appliances: charging mobile phones, radio, TV, fans, LED lighting and powering the ICT equipment. It appears some of the beneficiaries started using high power consuming devices. This caused a run-out of the energy capacity: the batteries lost all charge around midnight. This led to a quick introduction of an energy-metered quota system that managed the electricity distribution and load control (switching on/off) per-household. In order to enable informed usage of electricity, the mobile-accessible real-time electricity monitoring portal was developed and made accessible to beneficiaries.

Even when electricity was evenly distributed across households, another electricity usage and consumption related problem that led to system outage surfaced. This time around, an “unintended simultaneous high consumption of electricity” over-whelmed the system leading to a shutdown due to energy drain from the battery exceeding the set state of charge (SoC) limit level. Another challenge resulted from the battery’s failure to fully charge due to over-cast skies, especially with the temporary solution. This was a frequent problem as the project was started during the rainy season. A system level electricity consumption detector, estimate/forecast, limiter functionalities and weather report functionality were quickly developed to navigate away from these problems. The weather report facility paved way for the allocation of electricity according to the anticipated battery life. The situation was improved when the system was upgraded with originally planned components, which doubled the system energy capacity. The system upgrade was done March 2020.

Furthermore, approximately six months (05/2020) after initial electrification and the setting up of computer network with a free Wi-Fi, the project started suffering from a high demand of Internet. This could be due to the national lockdown following COVID-19 outbreak that forced all participants to be at their residence most of the times. This forced the project implementers to screen devices that could access the Wi-Fi using the MAC addresses. The idea was to keep the main bandwidth of Internet access to the five families that were involved in this pilot project. However, a system upgrade that was later done increased the network coverage.

Technical knowledge transfer and remembering of roles proved to be a minor challenge during early months of the project. Thus, beneficiaries were expected to provide minimal technical support of restarting the system if it fails to automatically kick start following power outage when the solar powered battery storage was under the SoC limit and not supplying energy before sun rise and next charging event. Nonetheless, the project implementers remotely monitored the system and often used the social media to warn beneficiaries that they

have a look at the system, and in the case of system shutdown due to too high energy consumption advice and at the same time train the beneficiaries to re-start the system, were necessary. Some of the beneficiaries appeared confident in performing this role: *"when the power went off around 06h30am, I knew the battery got dried. I then patiently waited for the sun to rise for the panels to start receiving energy. I kept myself busy without worrying up until 09h00. It came to me that maybe we need to restart the system since it was already to 11h00 and electricity hasn't come back yet. I went to see what was it and worked together with [name supplied] and got it right within a minute. Honestly I wasn't nervous, stressed, panic nothing because I knew there was nothing big than just to restart the system."*

Other challenges include the emotions raised as a result of the noise from the solar-battery-charger-inverter unit in conditions when the battery SoC was running low. This caused noise pollution for those nearby even though the beneficiaries indicated ignorance on the matter.

Changes in day lengths due to yearly variations in the pilot site meant that the sunrise and sunset times were changing. This resulted in solar panels with less hours of electricity production compared to the month introduction. Moreover, there are more rains and cloudy days during the summertime when the day is longer. This necessitated an adjustment on the electricity control and distribution system leading to shorter "unlimited" daytime usage. Lastly, there were occurrences of the electricity system tripping due to faulty devices that were connected on the electricity network. This forced a constant restarting of the system.

4.3 ICTs Engagement Processes and Use by Beneficiaries

As indicated earlier, the pilot system has been designed and built to offer beneficiaries electrification, connectivity (free Wi-Fi) and access to digital services. The idea was to avail these resources and observe how the beneficiaries would engage the use of ICTs leading to empowerment. The beneficiaries' use of facilities offered by the system are analyzed through the lens proposed in Hui et al. [10] and Dillahunt [11]. The section goes on to report findings related to the empowerment framework/theory.

We observed the role of social connections at play in the willingness to try out the technologies that were availed to beneficiaries courtesy of access to the Internet. A female entrepreneur who is in a business of event decorations explained that her grade 12 son informed her about using WhatsApp video call and pictures to enhance communication with customers and advertising. This reflects the role of in-person meetings with a son in promoting awareness that instigated the willingness to use technology. Another couple in entrepreneurship started using WhatsApp status to advertise their wares after observing how their contacts using the same application for social recreational purposes. Self-efficacy was mainly arrived at through regular trial and error until a technology useful way was found: *"I used to receive many orders for event decorations. Sometimes I would forget the specifics of a particular client's order and then I send them a wrong product. They would return it, complaining that I made a wrong product something that led to financial loses. However, using WhatsApp video calls, courtesy of the available free internet, allow me to talk to my customers and show them a demo for any product. They have to see it first through these calls and confirm if I am making the right thing before I proceed to produce the whole order. Sometimes I simply take images and send them on WhatsApp so that the client can confirm if the demo matches their request."* Participants also indicated that they gained self-efficacy in using other social media platforms to advertise their products.

In addition, those searching for jobs indicated that they have become aware of using the government's websites and the social media to seek for employment. Participants became aware of these technologies

courtesy of their social networks. Similarly, students who benefited in this project shows that it was the government and their schools that made them aware of online learning. *"My schools reported many COVID cases and we were asked to use online learning"*.

The next sections present findings on the empowerment theory:

Community empowerment. The outcomes from the beneficiaries' use of the system suggest that they attained community empowerment and now share an interest of working together in solving their problems. This was observed in comments that were made by one of the participants during the discussions*: "so if we don't have Internet, then we are not able to alert ourselves mostly communicating with the main house where the system sits".* This was in reference to secure the system as the members felt that it was under the threat of theft. As such, members were deliberating how they could all contribute to a common goal of securing the system by alerting each other of any suspicious events. In addition, a reflection of a willingness to share resources further brought in some form of cohesion and togetherness among community members. *"We use it* [electricity] *to charge our phones and help our neighbors with theirs too. On the contrary, I was not having electricity* [before this project], *it was hard for me to charge my phone, so I used to foot to the road to have my phone charged with some cost per charging"*.

Economic empowerment. Results from the study findings suggest that the project promoted economic empowerment in different ways among the participants. A couple of beneficiaries indicated that electrification at their home enabled them to work from home i.e. powering the hot glue gun used in the manufacturing of decorations for events. For others, they could do online business transaction or use the Internet to secure employment: *"[I] do online banking, online business/marketing of products".* Another beneficiary adds, *"When it comes to the direction of mum, she has to market her business and this is all possible by means of the free Wi-Fi that we have."* This beneficiary went on to state *"there are some job markets that are available on Facebook, Google. Also, if there is a free Wi-Fi, we are able to find out about the job market throughout the country."* Nonetheless, the access to free electricity has given some families an opportunity to cut costs on buying equipment needed for lighting. *"This has put an end when it comes to the fact of purchasing torch cells or candles and right away am pretty sure that I have forgotten the price of candles neither for cells."*

Gender empowerment. Gender empowerment was attained through equipping women with tools that allowed them to participate in income generating activities. Thus, the electrification and ICTs opened the opportunity for women who were beneficiaries of this project to also do the work that is traditionally reserved for man who are assumed the breadwinner. For example, a couple – a wife and husband – managed to work from home when doing their carpentry work. Traditionally women in Africa mainly perform house chores of cooking and cleaning. However, availing electricity at home meant that the husband could move his workshop to his residence where he got a helping hand from his wife. In that way, the wife managed to do an additional task that is traditionally associated with men: *"currently I use the drilling machine for my wife because she now work from home due to Covid-19".* The husband went on to explain that: "*this has enable me and my wife to work from home because we do carpentry work for bed room and kitchen cupboards, and we take them to the business site, and most of the time we are even selling from home."* Figure 1's far left image shows a couple at work. In addition, accessing electricity and the Internet enabled a mother who is a beneficiary of this project to use her hot glue gun to make her products and market these online using free Wi-Fi. Figure 1's middle and left image shows some of the products made by the mother in question.

Figure 1: Impacts and outcomes of electricity and connectivity: A couple at work, promoting women empowerment (left). Event decorations made by a female entrepreneur using a hot glue gun and marketed online with the help of the free Wi-Fi (middle and right).

Social empowerment. Observations from the project suggest that the beneficiaries experienced social empowerment. For example, one beneficiary mentioned that the *"Internet has improved our lives in a sense that it made it easier for us to communicate with our relatives, friends and colleagues, even those that resides overseas."* This involves the use of social media and electronic mails. Others could now afford to make video calls and interact with loved ones: *"I'm able to see my daughter through video call, I can call online if I don't have calling credit on my phone".* One of the beneficiaries emphasized the value of social empowerment to beneficiaries by stating that communication would be difficult without the free Wi-Fi. Lastly, the availability of electricity enabled children *"to watch television…..especially that, they now have access to cartoons."*

Information empowerment. Beneficiaries of the pilot system showed to have benefitted from information empowerment of this project. Electrification and access to the Internet help students to access their study material online. Internet was used as a source of information for helping children with school activities: *"my daughter uses it [internet] for online learning".* A student who is a beneficiary to this project also attests that they use the Internet for enhancing their knowledge through searching for information on search engines. In Namibia this is important as only a small fraction of youth have the opportunity to access online learning and material. Information empowerment proved popular among school going children who used online learning following the COVID-19 necessitated national lockdown. Nonetheless, elders use the Internet to stay up to date with what is happening by reading online. Internet access appeared to be an important part of the overall pilot enabling access to latest information on COVID-19 situation among the beneficiaries.

5 DISCUSSION AND CONCLUSION

Many ICT4D projects often fail to yield positive results for beneficiaries. There are suggestions that people in marginal areas are less likely to engage ICTs in what they do – be it education, entrepreneurship and seeking employment – because ICT adoption favors those with pre-existing advantages [10, 11]. As such, it was important to report on findings regarding the engagement of ICTs showing how this happens in the case of marginalized communities. We argue that individuals in marginalized communities need to engage ICTs in order to realize empowerment. This can be useful to HCI experts when designing technological solutions that can be adopted across the populace irrespective of socio and economic status.

Observations shows that the success of ICT4D projects lies on appropriate engagement of important stakeholders and continuous communication and coordination of activities among them. This includes the beneficiaries and those on the regulatory and political front. In particular to this study, these included members of the community, the hosting town council and officials from the line ministry. Similarly, Lorini et al. [6] also report the importance of community leaders in setting up an ICT4D project a crucial aspect. Furthermore, the prevalence of technical challenges suggest a continued close integration, communication, and collaboration by the promoters of the project and technology. An interesting finding was the opportunity to operate in a remote mode, which was partially forced by COVID-19, and required fresh approaches. These call for clear guidelines on how the resources will be allocated and used while identifying roles of key stakeholders. Lorini et al. [6] introduced the idea of an acceptable use policy. Aligned with those findings, this project also recommends coming up with rules of operation for fair and equal usage and distribution of resources. Arguably, these are some sort of obstacles found in community networks that need to be collectively resolved by all the members.

Findings in this study confirmed the role of social networks in promoting the use of technology as reported by Hui et al. [10] and Dillahunt [11]. Study findings suggest that awareness and willingness to use the technology was a result of regular interactions of members in a social environment. In some instance, the use of the technology reached high self-efficacy levels thereby making life easy for entrepreneurs when communicating and marketing products. Nonetheless, it is not clear to what extent the COVID-19 outbreak and a national lockdown influenced the desire to use the technology besides the factors suggested by [10]. Given that COVID-19 limited face to face interactions, this arguably motivated the need for alternative solutions for the continuation with interactions given that this is important for those who are in business.

Through empowerment, the project showed that it can improve the livelihoods of the beneficiaries. This was made possible by electrification and advanced ICTs that opened the window for beneficiaries to access various services. As such, the project opened opportunities for business and entrepreneurship, support for business initiation, support for online school participation while at the same time maintaining the social fabric. This was reflected by community, gender, economic, social and information empowerment that characterized the uses of the project resources. This is interesting given that beneficiaries tend to use such resources for recreational purposes [7]. Arguably, the national lockdown due to COVID-19 saw the project play a pivotal role given that people were forced to study and work from home. Interestingly, beneficiaries did not seem to use the resources at their disposal for government services. This could be due to a poor e-Government or lack of awareness.

This project confirmed the importance of social ties across population demographics when promoting the awareness and willing to use technological resources [11]. This project also demonstrated the importance of combined electricity and connectivity to a marginalized community. However, so far, we have been able to address the collaborative introduction and ramp-up of such infrastructure. Sustainable and independent enough operation in the future is still a question to tackle. Hence, future research can focus on coming up with a market and pricing model that would be affordable for beneficiaries and the future service providers: how to enable paying and use of services to beneficiaries' economic benefit in a self-sustaining manner.

References

[1] Pade-Khene, C., Mallinson, B. & Sewry, D. 2017. Sustainable rural ICT project management practice for developing countries: investigating the Dwesa and RUMEP projects, Information Technology for Development, 17(3), 187-212

[2] Ortiz, J., Young, A., Myers, M., Carbaugh, D., Bedeley, R. T., Chughtai, H., Davidson, E., George, J., Gogan, J., Gordon, S., Grimshaw,

E., Leidner, D., Pulver, M. & Wigdor, A. 2019. Giving voice to the voiceless: The use of digital technologies by marginalized groups.

[3] Wadkar, S. K., Singh, K., Mohammad, A. & Argade, S. D. 2017. Sustainability of the Rural ICT Project: a Case Study of aAQUA e-Agriservice, Maharashtra, India. Proceedings of the ICEGOV, New Delhi, India.

[4] Meyer, I., & Marais, M. 2015. Design for Sustainability: Countering the Drivers of Unsustainability in Development Projects. The Journal of Community Informatics, 11(3). Retrieved from http://cijournal.net/index.php/ciej/article/view/1169.

[5] Pade-Khene, C. & Lannon, J. 2017. Learning to Be Sustainable in ICT for Development: A Citizen Engagement Initiative in South Africa. 14th International Conference on Social Implications of Computers in Developing Countries (ICT4D), Yogyakarta, Indonesia.

[6] Lorini, M. R., Densmore, M., Johnson, D., Hadzic, S., Mthoko, H., Manuel, G., Waries, W. & van Zyl, A. 2018. Localize-It: Co-designing a Community-Owned Platform, p 244 - 257. In Krauss, K., Turpin, M. & Naude, F. Locally Relevant ICT Research. Communications in Computer and Information Science. 10th International Development Informatics Association Conference, IDIA 2018 Tshwane, South Africa, August 23–24,

[7] Alao, A., Chigona, W. & Lwoga, ET. 2017. "Telecentres bridging digital divide of women in rural areas: Case of Western Cape, South Africa", Partnership for Progress on the Digital Divide 2017 International Conference, 24-26 May 2017, San Diego, USA.

[8] Bidwell, N. J., Siya, M., Marsden, G., Tucker, W. D., Tshemese, M., Gaven, N., Ntlangano, S., Robinson, S. & Eglinton, K. A. 2013. Walking and the social life of solar charging in rural Africa. ACM Transactions on Computer-Human Interaction (TOCHI), 1-33.

[9] Namibia Statistics Agency 2016. Namibia Inter-censal Demographic Survey 2016 Report. Available at: https://cms.my.na/assets/documents/NIDS_2016.pdf.

[10] Hui, J., Nefer R, B., Wendy, C., Suzanne, C., Danny, C. D., Frances, W., Kentaro, T., & Tawanna, R. D. 2020. Community Collectives: Low-tech Social Support for Digitally-Engaged Entrepreneurship, In the Proceedings of 2020 CHI Conference on Human Factors in Computing Systems, pp. 1-15.

[11] Dillahunt, T. R. 2014. Fostering social capital in economically distressed communities, In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 531-540.

[12] Pandey, P., & Zheng, Y. 2019. Unpacking Empowerment in ICT4D Research. In International Conference on Social Implications of Computers in Developing Countries, pp. 83-94. Springer, Cham.

[13] Laverack, G. 2006. Improving health outcomes through community empowerment: a review of the literature. J. Health, Popul. Nutr. 24(1), 113–120.