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Sadiki Kalula[1], Mussa Ally[2], Zaipuna Yonah[3]

Scholar[1], Senior Lecturer[2], Consultant[3]

School of Computational and Communication Sciences and Engineering

Nelson Mandela African Institution of Science and Technology

Arusha -Tanzania

ABSTRACT

As evident as the contribution of broadband internet in developed countries' economies has been, many developing countries have taken initiatives to exploit the same. However, the efforts are not reflected in the rural areas broadband adoption as reported by global Information and Communication Technologies (ICTs') ranking bodies. This study aims to analyze the factors towards the uncorrelated relationship between the broadband initiatives against broadband adoption in rural parts of Low Middle-Income Countries (LMICs) looking from the supply side, exemplified here by Tanzania. The initiatives considered are National ICT Broadband Backbone (NICTBB) and Universal Communication Service Access Fund (UCSAF). The study deployed a Qualitative Research Method (QRM) exploiting semi-structured interviews for data collection. 23 interviews were conducted with personnel from the aforementioned entities together with their collaborating agencies. Thematic analysis was opted where vigorous coding and data cleaning resulted in five themes characterizing poor broadband adoption; infrastructure, affordability, digital skills, contents' relevance and services, and statistical reporting. The majority of the response (84%) agreed that the ranks reflect what is found on the ground hence more work is needed from the supply side on enforcing adoption in rural areas. Nevertheless, 16% of the coded responses maintain a view that improper statistical reporting due to statistical model mismatch and data unavailability from local statistical agencies to some extent causes the poor adoption ranks in the global ranking bodies. This article should provide insights to policymakers towards creating/improving and implementation of broadband plans/policies, and as a result, exploiting broadband contribution to countries' Gross Domestic Product (GDP).

Keywords: *Broadband, LMICs, Adoption, Rural Areas, Internet.*

1. INTRODUCTION

Several countries in the world have realized the potential broadband has to boost countries' economies hence attracting huge investments in broadband infrastructures [1, 2]. It is being reported that a 10% increase in mobile broadband penetration can yield a 1.8% increase in Gross Domestic Product (GDP) in middle-income countries and a 2% increase in low-income countries [3, 4]. It is for that data, many countries have embarked on efforts to exploit the potentials the broadband could offer be it in education, health, agriculture, governance, and the likes. Despite the efforts, there seems to be un-even coverage and usage of broadband in developing countries as urban parts seem to receive more attention from broadband providers compared to rural parts hence contributing to the digital divide [5].

Low Middle-Income Countries (LMICs) account for 90% of the world's unconnected with 98% of the uncovered population [6, 7]. Connecting the unconnected campaigns are focusing mostly in rural areas where the majority of the unconnected population is found [8-10]. A few examples from LMICs which have put down some initiatives to enhance connectivity are seen from Tanzania, Cambodia, Bangladesh, and Bolivia to mention but a few [11-16]. The efforts are more directed to the rural population of LMICs as there is a strong disparity when it comes to adoption compared to urban; people living in rural are 37% less likely to use the Internet compared to those living in urban areas [6]. It is being reported that most of the LMICs perform poorly in the global Information and Communication Technologies (ICT) rankings as far as the broadband adoption is concerned; as seen in ICT Development Index (IDI) by ITU, Mobile Connectivity Index (MCI) by GSM Association, and Network Readiness Index

(NRI) by World Economic Forum (WEF). Many scholarly works have been published outlining the factors towards the poor Internet adoption of rural parts of many LMICs; infrastructure, affordability, ICT's skill set, contents and services being among them [10, 17, 18]. It is hence the task of this article to analyze those factors from the broadband supply-side perspective in relation to poor broadband adoption against the put initiatives in the LMICs' rural areas context; Tanzania being the case study. Tanzania has been chosen due to the fact that its environment and economic status alongside the carried initiatives are well fitting to represent most of the LMICs when it comes to broadband sector. Moreover, a researcher is residing in Tanzania hence getting the required data would not be faced with financial limitations. In the remainder of this article, the following will be presented; introduction, study background, literature review, methodology, results, discussion, and conclusion.

2. STUDY BACKGROUND

Among the governments' roles in building broadband is to provide policies and plan to stimulate demands and spur adoption [35]. The policies are results of evaluation reports on both supply and demand-side broadband challenges. Several countries in LMICs have their broadband plan and strategies in place; to mention but a few, Tanzania National Broadband Strategy, Mauritius National Broadband Policy, etc [36, 37]. Among the components of broadband plans is supposed to be the research unit which is supposed to track the progress of established plans looking at the established objectives. The global positioning on ICT (specifically broadband) ranking for Tanzania and other LMICs necessitates a study to analyze the reasons for poor performance despite the initiatives hence the improvement of the broadband plans.

It has been evident that the availability and usage of a pervasive and reliable broadband network have led to the fruition of internet-based services not only in urban areas but also in rural areas of developing countries [19]. Regrettably, there are 3.1 billion people globally who live under a broadband footprint but they are not using the service; most of them are found in the least developed countries in Africa and Asia [5, 20]. The recent global slowing down of internet penetration rate is also alarming; annual growth has slowed from 12% in 2016 to only 7% in 2017 and this trend is expected to continue if the factors causing them are not worked upon [21].

ITU's Broadband Commission has been advocating for worldwide broadband connectivity and usage by leveraging the broadband ecosystem hence meeting SDGs by 2030 [22]. However, the adoption of the Internet seems to be prevalent between and within countries; rural areas being the most affected areas [9]. Initiatives have been put out by countries in LMICs to enhance broadband penetration in rural areas, few examples are mentioned here. Cambodia came up with a Rectangular strategy IV which among other things, aimed to promote connectivity of fiber backbone and successfully achieving 37,441 km which resulted in an increase of mobile subscription but still Internet subscription is still low [23]. Tanzania too established UCSAF and NICTBB to foster rural connectivity but still 86% of the rural dwellers are unconnected compared to 44.6% of the urban dwellers [24]. The situation in those two countries is the reflection of what is happening in other LMICs [6]. Despite such initiatives in the LMICs which host a large percentage of global population, it is still reported that the usage gap is six times larger compared to coverage gap. [22].

Tanzania has graduated to a Low Middle Income Country in 2020 with a GNI of $1,080; GDP growing at a rate of 6.7% from 2014-2019 [25, 26]. It has a population of 55.9 million people; 66.2% of its population lives in rural areas [26]. Tanzania has a telecommunication subscription of 88% of the total population with mobile networks occupying 99.9% of that. Tanzania's internet penetration sits at 48% of the total population with the majority accessing it via mobile devices [27, 28]. The major Mobile Network Operators (MNOs) in Tanzania are Vodacom (T) Ltd, Airtel, Tigo, Halotel, TTCL, and Zantel with subscriber shares of 30.2%, 26.1%, 25.6%, 14.4%, 2.1%, and 2.0% respectively [27]. All operators have a total of 14,187 broadband-able sites (3G and beyond) out of 25,502 existing sites (Table 1) [29]. The country is yet to enjoy broadband contribution to its full potential as the ICT sector contributes only 1.5% of the gross national income [7, 26]. In order to accelerate socio-economic development, the access and availability of affordable and reliable broadband services must be enhanced hence several initiatives have been laid out to cater for the same especially in disadvantaged areas [7]. The construction of National ICT Broadband Backbone (NICTBB) countrywide as well as starting the Universal Communication Service Access Fund (UCSAF) are among the few initiatives to foster broadband penetration. Despite the implemented initiatives, Tanzania's Internet penetration has grown only by 6% between the year 2016-2020 compared to 15% between the year 2011-2015 [27]. Moreover, in NRI ranks; Tanzania has overall scored 33.93% being among countries with low broadband subscription regardless of the telecommunication infrastructural investments [30]. Furthermore, with ITU's IDI, Tanzania scored 1.81 positioned at 165/192 economies with 9.22 active mobile broadband subscriptions per 100 inhabitants [31]. In addition, GSMA's MCI score for Tanzania on internet connectivity is 40.1/100 as ranked by the latest annual GSMA report [7].

Table 1: Tanzania Telecommunication Coverage

MNOs	Technology					
	2G	3G	4G	Fixed LTE	5G	Grand Total
Airtel	2143	1316	783			4242
Halotel	2683	1912	438			5033
Smile			106			106
Tigo	2939	2226	633			5798
TTCL	150	337	174			661
Vodacom	3236	2693	1338	38		7305
Zantel	164	1919	274			2357
Grand Total	**11315**	**10403**	**3746**	**38**		**25502**

3. RELATED WORKS

Though the world is celebrating the greater achievement when it comes to broadband connectivity, significant disparities in adoption persist between and within countries [9, 22]. With a landmark of half the world population connected (three-quarters of the users found in LMICs), the growth in penetration has been slowing down[6]. The slowdown is due to the slow acceleration of network rollouts in many developing countries especially rural areas [21]. This is largely attributed to the fact that the current economics of mobile network operators is struggling to find viability in markets with subsistence-level incomes and/or in sparsely populated regions [32].

Most of the broadband-related research works have been looking into addressing the broadband availability in rural areas of LMICs but yet forgetting that availability is not always translating to adoption [18, 33]. Simba *et al* proposed a Public Private People Partnership (PPP) framework to address connectivity but did not go further to address adoption [34]. In places where the connectivity is available but intended to serve institutions in rural areas, Byanyuma *et al* came up with the Broadband last mile connectivity model for effective bandwidth utilization in rural areas but the model only works in places where broadband is already available but not 100% utilized. In addition, Byanyuma's model did not go beyond connectivity; adoption was left out [35]. Sedoyeka *et al* designed a WiMax-based model to address connectivity in rural areas but the model too did not go beyond ensuring connectivity [36]. Moreover, There were also some other coverage models; Broadband island, Nokia Siemens village network as well as Rural Netco Shared Broadband model, but unfortunately all of the mentioned models were keen in addressing only the coverage gap [18]. Addressing coverage issues only leads to another problem called Usage Gap; those living under broadband footprint but not using it. The Usage Gap is currently six times larger than the coverage gap compared to how it was in 2018 (4.5 times) [6]. A lag is observed between creating conducive environment for broadband Internet connectivity and strategies towards pushing for adoption of the same. This is being reflected in several reports on broadband adoption status in rural areas of LMICs [7, 30, 31].

Investigating the factors towards poor broadband adoption in the rural areas of developing countries is not a new research topic as many scholars have invested their quality time on it; mostly focusing on socioeconomic and demographic factors. To mention but a few studies, Birba *et al* found that broadband adoption in sub-Saharan African (SSA) countries is related to urbanization, infrastructure, level of education, sex, age, and macroeconomic variables [28]. Martinez-Dominguez et al conducted a study in rural Mexico identified age group, education, and income as factors towards broadband adoption [37]. Another study done in Cameroon and Gabon identified education level, English skills, computer literacy and gender as among the factors towards broadband services [38, 39]. Pejovic *et al* suggested that factors for broadband adoption in SSA are not only related to the provision of connectivity but rather the location of access, connectivity speeds, and the cost of the connection must all be considered [40]. Moreover, West cemented that affordable services, diverse content, reasonable costs, reliable infrastructure, uncensored information, and local language translation are what a person going online considers to adopt the service in the developing world [41]. World Economic Forum, WEF's white paper on broadband adoption pointed out four major barriers for internet adoption; infrastructure, affordability, skills, awareness and cultural acceptance, and local adoption and use which is often due to a lack of local content [42].

The aforementioned studies in broadband adoption have been exploiting micro-data libraries collected from different surveys which may sometimes not be representing the real output as there are chances that people intended for the study may not be included in the sample [43]. In addition, most of the scholarly works on the broadband adoption area are focusing on the demand side forgetting that there are also players on the supply side for which their insights and intervention towards adoption also matter

[44, 45]. This limited research from the supply side as to why despite the efforts, the adoption rankings are still not colorful for LMICs' rural areas deserves a study.

4. METHODOLOGY

4.1 RESEARCH METHOD & STRATEGY

A Qualitative Research Method (QRM) was considered suitable to address this study topic since the method offers wide exploratory capabilities for tackling the subject matter [46]. As the study is sought to analyze the factors causing the poor broadband uptake despite the initiatives then stakeholders from the supply side around the mentioned initiatives were the key participants in this method hence a case study strategy had to be exploited. Case study design helped to understand the linkage between initiatives and the outcome considering the selected cases [47, 48].

4.2 SAMPLING

Since QRM requires a small but subject-oriented sample then key institutions around mentioned broadband initiatives had to be considered hence the choice of NICTBB and UCSAF [46]. Expert sampling belonging to the purposively sampling category was used to select contacts within entities for the study based on their job descriptions and experiences. Expert sampling is used in occasions where experts in a particular field are the subjects like in this study [49, 50]. However, the aforementioned entities from the supply side are not standing alone entities, they work with other supporting entities from the same supply side in their day-to-day activities hence MNOs, Tanzania Communications Regulatory Authority (TCRA), and Ministry of Information and Communication Technology (MoICT) were also involved in the study. The choice of participants was based on job description of each at different levels in relation to the study; strategic level and tactical levels; directors, managers, and senior personnel. 30 contacts were expected (6 from each entity) for data collection but only 23 contacts were enough for data saturation.

4.3 DATA COLLECTION METHODS

This study opted for semi-structured interview as it seeks to get in depth information regarding the conflicting agenda of broadband initiative against the adoption rankings [46]. Semi-structured interview allows for exploration of perceptions from interviewee and provide opportunities for more probing and clarifications of answers [51]. A total of 23 semi-structured interviews were conducted. In addition, secondary data were used as they add some insights on the problem being studied [52]

4.4 DATA ANALYSIS

The study adopted thematic analysis as it suits the analytical agenda of the study's objective. The approach has been chosen because it offers a way to address the issue at hand through pattern identification across data collected [53]. The thematic analysis employed both inductive and deductive approaches to get the themes. The collected data from interview recordings were manually transcribed followed by intensive coding towards themes generation. Once the themes/constructs were identified, the descriptive analysis was employed to find out which among the constructs had more impacts on poor broadband adoption. Moreover, the triangulation technique was opted to check for reliability, suitability, and trustworthiness of the findings before producing article [54, 55]. The triangulation was made possible through cooperation from the personnel from the contacted entities.

5. FINDINGS

The collected data went through a vigorous process of coding and cleaning using Microsoft Excel to establish themes. Among 5 produced themes, 4 were deductively generated while 1 was inductively generated. Deductively generated themes were infrastructures, affordability, digital skills, and contents' relevance and services while inductively generated theme was statistical reporting. Table 2. shows the summary of themes and the number of times they were surfacing and coded from each of the participating entity contacts. The findings are here below presented theme-wise citing the main talking points during the interviews.

Table 2: Themes Occurrence

Themes	Coded Responses from Entities around Themes					Total Coded Responses
	NICTBB	UCSAF	TCRA	MoICT	MNOs	
Theme 1 : Infrastructure	10	8	4	5	8	35
Theme 2 : Affordability	8	4	5	3	5	25
Theme 3 : Digital Skills		7	3	6	3	19
Theme 4 : Contents' Relevance & Services	1	2	4	5	3	15
Theme 5 : Statistical Reporting	4	5	4	2	3	18
Total Coded Responses/Entity	23	26	20	21	22	112

5.1 INFRASTRUCTURE

Enhancing broadband adoption starts with having telecommunication infrastructures in place. As far as broadband infrastructures in the rural parts of Tanzania are concerned, UCSAF, NICTBB, MoICT, TCRA, and MNOs both have roles to play.

UCSAF is tasked with the role of delivering infrastructures to those less economically viable places and as of recently, it has been able to reach 2680 wards all around Tanzania funding 1,068 sites spending Tsh. 161 billion. It works by subsidizing the MNOs some percentages of the fund to build the telecommunication infrastructures. The majority of the infrastructure being built operates in 2G and a few in 3G and 4G. The government of URT has directed UCSAF that all the sites built from 2021 must be operating at 3G and beyond. *"It is the wish of UCSAF to upgrade all the 2G+ sites to 3G and beyond but the major constraint we are facing is a budget deficit"*, said one of the interviewees from UCSAF.

NICTBB aimed to connect the whole country using the high-speed fiber backbone towards creating an information society as envisioned in ICT 2016 policy. "*Among the initiatives which have been able to push broadband adoption in Tanzania and neighboring countries is a fiber backbone project*", bragged one among the interviewee from NICTBB. NICTBB's project has already delivered 7,560 Km of fiber backbone (phase I & II), phase III is continuing expected to add 400 Km of fiber backbone. Also, Phase III has delivered state-of-the-art Data Center and MPLS infrastructure in Dar es Salaam. The government of URT in the financial year 2021/21 has set up funds to deliver fiber backbone in all the districts and major towns in the country in the same phase III. The final phase, phase V is still on hold, it will deliver last mile broadband connectivity country-wide. 80% of the installed 200Gbps is being utilized with plans underway to upgrade to 400Gbps.

MoICT being the custodian of all ICT-related matters works on all policy-related matters towards pushing the broadband agenda; NICTBB and UCSAF are all under it. Through the ICT 2016 Policy, the government vowed to have reliable, interoperable, and sustainable ICT infrastructure that supports ubiquitous national connectivity. Recently, the ministry has issued a directive in the newly established national broadband strategy through UCSAF that all the new projects for mobile communication infrastructure should be beyond 3G hence pushing broadband penetration in the rural areas. The ministry also works with other ministries responsible to make sure there are access roads and electricity to rural areas. The infrastructures need services and maintenance hence with proper access roads then it will be easy for MNOs.

TCRA claim to have made it easy through regulatory procedures for MNOs to obtain country-wide license to build infrastructures. The regulator is also allowing infrastructural sharing between MNOs saving them from infrastructural cost. When the issue of low-cost infrastructure popped up e.g Huawei Rural Solutions, Ericsson, etc.; the authority responded that it has always been open for a few adjustments in terms of regulations and licensing to accommodate such initiatives. Since the majority of the population is accessing broadband services via mobile devices, MNOs have been an integral part to deliver such communication in rural areas. UCSAF is working hand in hand with MNOs to serve the disadvantaged/hard-to-reach areas. *"Our challenges with these UCSAF's projects are on the backhaul infrastructure as some of those underserved areas being located far away from our backbone sites hence more cost on us"*, said one among the interviewee from MNOs.

5.2 AFFORDABILITY

Among the reasons hindering broadband adoption for rural areas in developing countries was affordability both in terms of data tariffs and broadband-able devices and hence it was categorized as a theme in this study. All the stakeholders mentioned in the study were inquired about how each entity is addressing affordability in its angle.

UCSAF interviewees when inquired about the affordability of services in the rural areas, the response was for now their main concern was ensuring service availability. The fund expects after a certain period of time people around the service area will be financially able to afford the service. One interviewee made a reference to a clause in their act of establishment which forces the MNO to run the infrastructure for 5 consecutive years before thinking of abandoning the area if it does not bring profit expecting that the locals will be able to afford services within a period of 5 years.

NICTBB did brag that after the implementation of phase I, the cost of international bandwidth went down by 88% from USD 1500 per Megabyte to USD 180 per Megabyte. Phase II launching in 2012 lowered the price more significantly by 30%. They further mentioned that the cost is based on the bandwidth purchased and not the distance run of the data. With all these reductions, the effect went down to tariffs provided by MNOs. *"You know we offer the cheapest data services in East Africa"*, bragged one of the interviewees from NICTBB.

TCRA's standpoint on affordability is that the matter cuts across both sides; the MNO, government and customers as each is supposed to be accommodated fairly. In the year 2020, TCRA came up with the cost range of Tsh. 2-9 per Megabyte for which the MNO will be able to do business and the government will collect taxes. *"Going below that price to achieve affordability may cost the operators when it comes to OPEX, some may even fail to survive which is not the thing TCRA is looking forward to",* said one of the interviewees from TCRA. TCRA also claims to be in the process of building its own assembling plant to lower the devices' cost.

MoICT boasts itself as being the custodian of all the efforts done by NICTBB, UCSAF, and TCRA through its good policies. The ministry is open to regulatory/policy adjustments as long as they will lead to end-users getting services at an affordable price without affecting both MNOs' and the government's revenues.

MNOs' perspective on the issue of affordability of tariffs was strictly based on business as they aim at recovering their operational and capital expenditures hence survival and profit. They refuted the claims that their data tariffs are unaffordable and asserted that affordability to them is in line with being able to run their companies. Taxes imposed on them by the government popped up as among the reasons for the seemingly high cost of data tariffs.

5.3 DIGITAL SKILLS

Digital skills in this study relate to people's readiness to understand, accept and use the technology with regards to skills and awareness. UCSAF contacts claimed to have their fair share on how the fund is imposing digital skills through training to both secondary and primary school teachers. Tanzania's new ICT-inclusive curriculum puts emphasis on digital skills as one of the subjects for which pupils have to sit for exams. However, lack of qualified ICT teachers seemed to be a hurdle hence the fund had offered to build capacity for such teachers. The fund has so far offered training to 1621 teachers. *"These pupils are the future working class/earning class and impacting them with digital skills through their teachers will in turn with time turn a society to digital one",* suggested an interviewee from UCSAF.

"This being ministry responsible for ICT related matters in the country has a huge role to play ensuring people have digital skills set towards achieving information society", quoted one among the interviewees from MoICT. The ministry in collaboration with the ministry responsible for education introduced the ICT syllabi both at the primary and secondary levels. Moreover, the ministry has been conducting several programs through radios and TVs to cement digital literacy in different aspects. MoICT is the custodian of NICTP 2016 of which among the policy statements include the creation of a supportive environment for the development of digital skills and expertise.

TCRA through its Directorate of License and Tracking has been organizing public awareness programs/campaigns for the people as among means to foster the creation of a digital society. The regulator sometimes does these campaigns in collaboration with MNOs through radio shows and road/market shows. MNO's prominence has been to inform their customers/potential customers about the services they offer. Making people aware of the services they offer will have a positive impact on their business hence fueling broadband adoption.

5.4 CONTENTS' RELEVANCES & SERVICES

This theme is about how the contents relate to the expected subscribers in terms of addressing their day-to-day challenges/activities, the availability of such applications, trust issues, and security. Moreover, the quality of services offered by the provider in terms of network quality in the service areas, availability of customers' network-related needs e.g. top-up vouchers, sim cards, etc.

UCSAF interviewees had less to say about this theme as their act of establishment had nothing to do with the contents. However, they are required to ensure the quality of services in the area where the fund's projects have been carried out. The Fund has set the Key Performance Indicators (KPI) for which the service providers must adhere to. In addition, they have a special department which follows up on the quality of service in terms of networks' performances. As it was for UCSAF, NICTBB's interviewees had less too to talk on this particular theme. On ensuring the quality of services, NICTBB is implementing a robust mesh network to ensure network resilience hence better services to its customers.

TCRA has a major role to ensure the content are regulated and fit the consumers' demands. The regulator oversees the quality of services offered by the licensee (MNOs) and sees if they meet the agreed standard as per their license. A person/company is not allowed as per the Electronic and Postal Act of 2010 to provide content services unless terms and conditions regarding the license have been adhered to. MNOs' business relies on ensuring quality services to their subscribers and hence quality is among the thing being considered very serious. Content-wise, MNOs have been creating content for their subscribers since the user will not only be charged some token when using it but also they will sell data bundles. MNOs have also been working with innovators to address several challenges through the development of content; MNOs provide funds while innovators offer solutions.

Among the NICTP 2016 challenges, the lack of relevant content suitable to the people of URT was among the issues that needed to be addressed. MoICT is hence coming in as a key player in this particular theme. MoICT's role is to enhance innovation in e-service as well as promote local content and hosting. The ministry also has a special directorate responsible for overseeing the cyber security related matters. The government of URT is showing a good example in embracing ICT in its day-to-day operations e.g. payments through Government Electronic Payment Gateway (GEPG). The government has put down the agency, e-Government Authority (eGA) responsible for providing oversight while enforcing the e-governance and all ICT-related e-service initiatives. The government of URT has also put down a state of the art datacenter managed by NICTBB which is able to host content locally.

5.5 STATISTICAL REPORTING

This theme came along as stakeholders (interviewees) were looking at what has been achieved so far contradicts what is being reported by global ranking bodies. UCSAF claims to have been done a lot in terms of infrastructure but that is not reflected on both locally quarterly TCRA's released reports as well as global ones. Moreover, NICTBB's contacts were also too skeptical on how reporting in terms of statistics is being done considering what has been implemented so far. "*The backbone project by NICTBB with what has been implemented so far was supposed to put Tanzania on a map when broadband infrastructures are mentioned in East Africa and Africa at large*", says the interviewee from NICTBB. They emphasized that when looking at rankings, if the status of the broadband was properly communicated to global ranking bodies, Tanzania could have been performing better than it does now. The interviewee went further to complement how the tariffs and internet costs were cut down due to the backbone and hence if tariffs are among the ranking factors, Tanzania was supposed to do better in the global ranking bodies.

TCRA; being responsible for quarterly released telecommunications reports had a lot to give in this theme. Tanzania being an ITU member like many other LMICs is following the same model when it comes to statistical telecommunication reports. The statistics expert from the regulator mentioned some missing data from Tanzania in the reports released by global bodies may to some extent be contributing to the country's poor performance in the global ICT ranks. The reports are supposed to contain data from both the demand and supply sides. Unfortunately, TCRA's quarterly released reports only contain supply-side data. Demand data are supposed to come from household surveys which have to be done by another agency, the National Bureau of Statistics (NBS). Household's data are supposed to be found in a censor conducted by NBS after every 10 years but the censor does not include the majority of such data. MoICT has created a special task force to work on all ICT indicators (both supply and demand-side) hence all the ICT's activities/milestones are reflected in reports released by TCRA.

6. DISCUSSION

This section discusses the findings reported in the earlier result section. The modality of discussion is following the generated themes. Moreover, the analysis is based on the surfacing percentage from the coded response for each of the themes as per the interviewee's feedback (see Fig 1.).
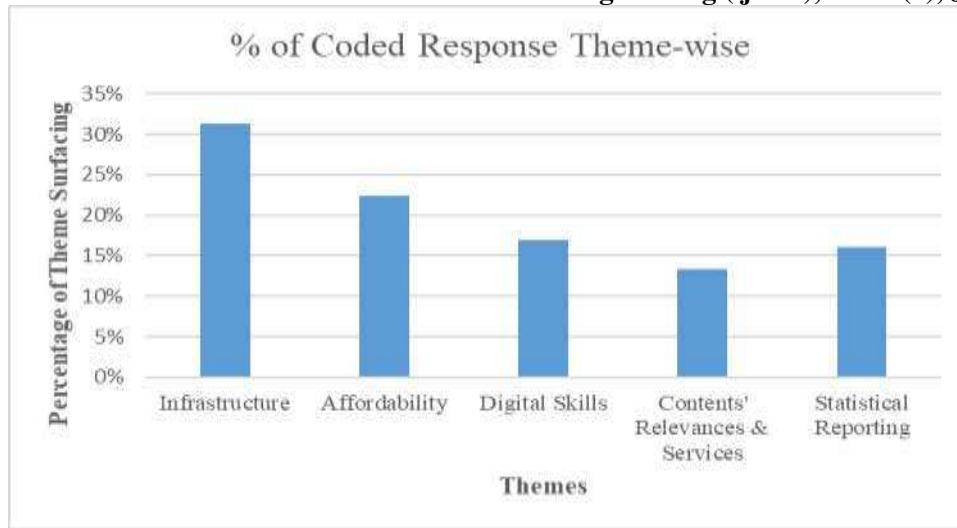
Fig 1: Theme Surfacing Summary in the Coded Responses

Infrastructure being the primary factor towards the poor broadband adoption, got the majority of the interviewees talking about it as among reasons towards poor performance on global. Fig 1. shows that 31% of the coded response were in line with the fact that infrastructure plays a primary role in broadband adoption. It is hence for sure that initiatives of both UCSAF and NICTBB on addressing infrastructural issues are noble. However, the aforementioned initiatives have not been able to translate into usage hence adoption therefore reflected by poor performance on global rankings. Through Subsidization Projects, UCSAF has been funding the construction of telecommunication infrastructure in rural areas but the majority of the projects (90+%) are 2G which can not live to the true definition of broadband as far as speed is concerned. Although directives have been given to turn those existing 2G sites to 3G and beyond sites, financial limitation is a barrier for implementation hence more government's financial commitment is required. In addition, NICTBB's plan to have Points of Presence (PoPs) in all the districts will not be sufficient to address the adoption problems as rural areas extend beyond districts. Backhaul infrastructures to deliver services to rural areas from PoPs is among the challenges faced by MNOs hence UCSAF, NICTBB and MoICT need to work on this important component of the network architecture. Moreover, less-cost last mile infrastructure solutions if opted will provide coverage at a cheaper cost since MNOs fear from economic viability of rural areas. TCRA and other government entities must come in to ease the regulatory policies and bureaucratic approval processes for such solutions e.g. technology neutral license, spectrum prices, etc. This will not only allow MNOs but also other small private entities in collaboration with UCSAF to address the issue of service universality for non-commercial viable areas as it has been done in other places [56, 57].

From fig 1; affordability for both tariffs and devices had a fair share of the coded responses (22%) as among the factor towards poor broadband adoption in rural parts of Tanzania hence a true reflection of what is being reported by ICT's global ranking bodies. UCSAF's act is referring to universal service as those with quality, available to everyone regardless of the location, and must be affordable. However, that is not the case in Tanzania as affordability threshold has not yet being met. Although NICTBB claims that Tanzania offers the cheapest data plans across East Africa, still the price per 1 Gigabytes does not meet the entry level broadband service rate. Broadband Commission defines data plan as affordable when 1 Gigabyte of data cost less than 2% of the monthly income per capita; 1 Gigabyte costs 5.11% of average monthly income in Tanzania. Since people living in rural areas are characterized with low income, they are made to choose whether to buy data tariffs or cater for basic needs and eventually the basic needs would be given a priority. UCSAF being responsible with service universality can work with other responsible entities (government and private) hence coming up with strategies to make broadband affordable. Among the strategies is to create Zero Rating Practices for application in health care, education, agriculture, governance, etc. in universal areas. The Zero Rating Practices have proven to be a success in several LMICs on increasing the broadband usage hence adoption; examples were seen in Philippines and Paraguay [41, 58]. Apart from Zero Rating Practices, UCSAF can create special zones in the universal areas in which the tariffs can be subsidized hence allowing low income people to be part of expected information society. Creating special tariff zones is even now used by MNOs in Tanzania to increase their revenues e.g. Universities offer, Northern Zone offers, etc. hence UCSAF can adopt the same for defined universal areas. Moreover, MoICT can work together with the revenue authority to reform a tax framework that can strike the balance between enhancing broadband and collecting government revenues hence improving affordability. Reducing the excise duty in mobile airtime which stands at 17% to 12% would increase mobile penetration by 2.4 million unique subscribers which will eventually boost GDP by $438 million, five years time after tax reform [59].

Digital skills were also a talking point in the coded responses; occupying 17% (see Fig. 1). This theme was about digital know-how, awareness, as well as literacy level concerning the Internet for people living in rural areas of Tanzania (representing LMICs

at large). Having infrastructures, ensuring affordability while people have limited digital skills will not provide Tanzania with the 80% broadband penetration by 2025 as envisioned by the government of URT. ITU is seeing education as a pivot to improve awareness, digital literacy, and skills; it is even among the considered indices ICT ranks. The government of URT (& others in LMICs) should focus on improving the learning environment to accommodate the digital-based syllabi introduced in schools/colleges/universities. For old-age rural dwellers are not in schools, responsible agents should prepare special programs to enforce digital literacy illustrating the benefits of broadband in their daily lives. These instructional training brought changes to the digital India being witnessed today as it was able to bring more people online and hence the same can be achieved for other LMICs [60].   ITU looks at the proportion of individuals with ICT skills, mean years of schooling, gross enrolment ratio both in secondary and tertiary level to rank a country on digital literacy therefore more commitment needed on achieving the aforementioned. Tanzania has updated the curricula to include ICT subjects but lack of infrastructures in schools, lack of devices and well-trained teachers act as barriers to the initiative.

Contents' relevance and services also surfaced in the coded responses of the data collected; occupying 13% of total coded responses as among the reasons towards poor broadband adoption. Globalization has made a the spread of content very easy but end users are not benefitting as some contents are not relevant to their problems/daily activities and are not understandable due to language barriers. It is obvious that if the individuals would have the contents in their language, it could have become easy for them to engage and hence find a technology hosting that content useful. For example, it is more likely for a farmer in the rural areas to use applications that will tell about crops-related issues from farm inputs to sales after the harvesting season. This has been illustrated in Ghana by Cocoa farmers who are enjoying the technology which has been able to connect 15 communities with the industry hence generating additional revenues and improving their livelihood [41]. Applications being made should be tailored to local challenges hence people see them as means to address their problems. This theme is also concerned with the service part; referred to in this article as quality and availability of services. On issuance of a license, the service provider is adhering to service standards as per license however there have been quite a number of complaints about the quality of service especially on the Internet which may influence a person not to use the service. In the rural areas, sites may go off air for quite some time due to technical issues, electric power cut off, etc., and hence service being unavailable to people around the area. The responsible agencies should work towards ensuring the quality of service as well as availability is maintained as per service agreement. There are still some people who do not trust the apps especially when money transactions are involved and this is because of the incidences reported concerning online safety. The directorate responsible with cyber security needs to do more on creating safety online space as the ranks on this category are not colorful.

Last but not least, improper statistical reporting also got a mention (Fig. 1) as among the factor towards the uncorrelated relationship between broadband initiatives against what is being reported by global ranking bodies. From 16% of the coded response, interviewees were opinionated that a lot has been done in the broadband area but are not reflected in the global ranking bodies. As Tanzania is an ITU member, the quarterly reports produced locally by TCRA were supposed to adhere to the ITU statistical model which has three indices; access, use, and skills [31]. However, TCRA quarterly reports are still based on the 4 ICT's performance indicators identified by the 2007's review team from the then ministry concerned with ICT; indicators being a number of internet service providers, volume of traffic, tariffs, and teledensity [61]. Moreover, NRI uses 4 pillars with sub-pillars inside them; pillars being technology, people, governance, and impact which are different with one used by TCRA for locally produced reports [62]. Hence, it can be said that there is a huge indicator's model mismatch between the one used by TCRA compared to those used by global ranking bodies. Apart from statistical reporting model mismatch, the other issue in this theme was data unavailability when needed by global ranking bodies. ITU in its new IDI proposal document highlighted the difficulty in getting data required for rankings in Tanzania and other LMICs [63]. Among the sources of data for mostly global ranking bodies especially on household data are countries' survey bureaus; NBS in Tanzania's case. NBS's latest household survey did not incorporate the household survey data in the ICT required for global reporting. When data is not available in a certain index, the country is ranked looking at data from countries with similar features e.g. economic level. This totally misguides the rankings as it mixes countries with data availability together with countries with unavailable data in the same ranking basket. Data unavailability is also a result of the responsible authority/entities not reporting their milestones in the international arena. As the study is looking at initiatives done by NICTBB and UCSAF, a lot seems to be done as far as infrastructures are concerned. However, that is not being reflected in the global rankings when compared to neighboring East African countries. Citing out a few examples, Tanzania has a network of fiber backbone of 25,910km (NICTBB and Halotel fiber network added) while Kenya has 5,200km, Uganda has 1590km, and Rwanda with 3000km [64-66]. Tanzania with that huge fiber network in NRI's access pillar which includes infrastructure is ranked 117/134 while Kenya is ranked 99/134, Uganda ranked 112/134, and Rwanda 100/134 [30]. Moreover, all the ministries' offices in Tanzania capital; Dodoma are connected in that fiber backbone allowing government activities to employ ICT but on the NRI's people pillar in the sub-pillar concerned with governance ICT usage Tanzania is ranked 83/134 [30]. Therefore, if the ICT's milestones were made to be known globally, Tanzania could have performed much better in global ranks considering the efforts being made so far.

7. CONCLUSION

The study analyzed the factors causing the uncorrelated relationship between the broadband initiatives and positioning in global rankings in rural parts of LMICs; Tanzania being the case study. Employing a qualitative approach, both inductive and deductive techniques identified 5 interrelated themes (1) infrastructure (2) affordability (3) digital skills (4) contents' relevance and service and, (5) statistical reporting. For infrastructure, the analysis suggests that infrastructure should go down to address more than availability as having infrastructures does not guarantee usage although it is a primary component. Also, the financial commitment towards delivering the true broadband service to rural areas must be there as stakeholders in infrastructure made claims concerning financial limitations for government-funded projects. Moreover, the infrastructure should focus on delivering broadband services as the majority of them operate at 2G technology. UCSAF is advised to re-define the universal service to include broadband as universal service obligation. For affordability, many LMICs including Tanzania are not meeting the affordability index as set up by Broadband Commission. Reason outlined as the cost of bringing infrastructures to rural areas, taxes imposed in the mobile sector as well as network maintenance results in tariffs being high. As it is well known that people living in rural areas have a low income then governments could take charge and subsidize some amount to MNOs so that they can provide service at an affordable price. The government is also advised to go with Zero Rating Practice in those applications intended to be used in the rural areas. Moreover, tax framework in mobile service should looked at as it has been proven to be able to lower costs for both tariffs and devices. The suggested solutions could be possible if the government looks at the ICT sector as a catalyst to fuel efficiencies in other sectors. For digital skills, the results outlined the efforts for bridging the skills gap through different means e.g. syllabi re-engineering for schools, awareness campaigns, etc. However, the efforts are facing challenges as lack of ICT infrastructures in schools and lack of qualified instructors hence skills gap not closing as faster as it was intended. For contents' relevance and services, the analysis has shown that work needs to be done in these areas as most contents are not relevant to daily challenges for people living in rural areas both in terms of language as well as contents being tailored to their problems. Availability of services, as well as the quality of service, also needs a serious eye as it may hinder service adoption when the quality of experience is bad. Lastly for statistical reporting, the study has shown how the data being reported by global bodies can be contradicting as they may be not representing what is really transpiring in the broadband sector on the ground. This was due to statistical reporting model mismatch, data unavailability, and the country not making enough efforts to brand itself on broadband initiatives and achievements in the international arena.

The study was analyzing the factors for the uncorrelated relationship between broadband initiatives against positioning in the global ranking bodies for LMICs' rural areas looking from the supply side. As presented, the ranks are to higher percentage the reflection of what is on the ground for many LMICs' rural areas. Nevertheless, LMICs putting work on improving statistical reporting can help the international ranking bodies to report the real achieved milestones in the broadband and ICT sector at large. The themes generated alongside their analysis are expected to provide insight that will inform policymakers and hence brings about interventions to address broadband adoption in the rural areas of Tanzania and other LMICs. For enhancing adoption, more research is needed on devising sustainable cost-effective adoption models for rural areas of LMICs as broadband has already been proven to contribute GDP in developed countries. Future research should be directed on cheap and sustainable backhaul solutions as well as sustainable last-mile frameworks.

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