TRAGEDIES IN TRANSLATION: FOSTERING COMMUNITY NETWORKS IN THE 'GLOBAL SOUTH'

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ABSTRACT

Community Networks (CNs), or locally owned, managed and operated telecommunications networks, have attracted recent interest as connectivity solutions for people without affordable access to mobile telephony and/the internet in rural regions in the Global South. To rise to this interest technologists and activists, who seek to build techs or advocate for policies that better enable CNs, translate between meanings in technology and policy discourse, and meanings that reflect, and constitute, rural communalities. This paper analyses some of the tensions that arise in translating between these different meanings. To do so I draw together insights from participating in the African CN movement and setting-up a rural Namibian CN over the past five years; observing advocacy for CNs in the 18-months; and, my 10-month multiple case research of rural, community-based telecoms in Argentina, Mexico, India, Indonesia, South Africa and Uganda in 2018.

I begin by illustrating how activists seeking to improve the regulatory environment for CNs leverage certain meanings that are produced in the ways that governments, authorities and telecom companies organize and control transmission and distribution. Advocates who support indigenous and rural communities to build, own and manage their own low-cost GSM, Wi-Fi and/or internet services, for instance, must negotiate between semantics in communities, complexities about the commons, and meanings that are universalized by dominant infrastructures. My illustration emphasizes the thingification of relations, by referring to how radio spectrum is conceptualized as an entity for commodification rather than a potential for service. Next, I consider how people in organizations, like NGOs and university technology departments, who seek to demonstrate the benefits of CNs, and allied technologies, in rural development can get caught in processes of selective objectification and valorisation. Widespread models of 'sustainability' promote monetary metrics over more nuanced evaluations of human connectivity in assessing benefit and costs. Relatedly, these processes also ascribe value to certain sorts of labour (e.g. software and network engineering) rather than the social co-ordination that, my data suggests, is integral to CNs.

Valuing certain sorts of labour can contribute to limiting CNs and to reproducing inequalities within CNs; for instance, women more often undertake unpaid labour in CNs. Further, this valorisation promotes the visibility of certain sorts of achievements. Conversations about community achievements in setting-up CNs, for instance, often reference particular equipment and tasks and these are often imbricated in performing certain types of identity, such as masculinity. This may undermine the potential of CNs to engage with the capabilities of different local inhabitants and leads me to summarise some insights about women's experiences in using, setting-up and operating rural CNs. Another translation that can affect a CN's capability relates to temporality. Thus, I conclude my analysis by describing tensions that arise in

meanings about time when CNs receive external funding, for instance, in order to scale-up. Contrasting temporalisms can reorient CNs away from their collective intent, and community origins, when they must become accountable to extrinsic constructs of time, associated with funding, rather than constructs that are inseparable from local human relationships or tasks.

INTRODUCTION

Community Networks (CNs) have attracted increased interest in the past twenty years as a way that communities in the Global South, without affordable access to telecommunications, can autonomously 'connect themselves' to mobile telephony, and/or a local intranet or the internet (e.g. Siochrú and Girard, 2005). Various organisations are involved in supporting rural communities to 'connect themselves' by establishing CNs. Experts in networking and other computer fields working in national and international universities and national not-for-profit initiatives support people in rural communities and teach them about technology; researchers of ICT for development (ICT4D) experiment with technologies and approaches to sustaining CNs; and national and international coalitions organise engagements to build the "CN movement" and advocate for policies that better enable CNs. This socio-technical infrastructure, comprised of people, values, practices, tools and relations, translates between meanings in technology, policy and economic development discourses, and practices that constitute the emergence of CNs in rural communities. This paper introduces some of the ways these translations unsettle local social infrastructures that are imperative for CNs to emerge.

My analysis synthesizes insights from observation of and engagement in different CNs in the Global South over nearly ten years. This includes interactions with university researchers, staff and volunteers support organisations, peer groups and activists advocate for policies that better enable CNs, as well as members and users of CNs. These interactions emerged in engaging with the set-up of CNs in South Africa and Namibia, following the African CN movement, working with activists in an NGO, and a 10-month multiple case research of rural, CNs in Argentina, Mexico, India, Indonesia, South Africa and Uganda. Because of the scope of the data informing my insights and the interdependencies of socio-technical infrastructure I present my analysis thematically, referring to related literature in introducing each theme. Thus, the literature review, next, is restricted to outlining key relationships involved in fostering CNs in Global South and briefly indicating the potential for the infrastructuring CNs reinforce certain power relations.

Infrastructuring CNs in the 'global south'

While definitions vary, there is some consensus that a CN must be owned by the community where it is deployed, operate in a democratic way, and actively involve local people in design, development, deployment and management (e.g. Declaration of Community Connectivity, 2017). This definition holds more obviously for CNs in Europe and north America where tech enthusiasts initiate their own networks in the places where they live, and the population served by the CN has some existing familiarity with technology and access to the means to install it. Usually, however, in the contexts in which the concept of CN is used to address digital exclusion in the Global South technical competency and technology resources are rarer, thus CNs are stimulated and supported by people who do not inhabit rural communities. Undoubtably there will be many rural telecommunications arrangements in the Global South that people do set-up and operate themselves in their rural locales, such as sharing wi-fi hotspots, and are unaware of or do not identify with the analytic category 'CNs'. Indeed, settling on a definition for CNs for the diverse contexts of the Global South is as replete

with tensions as defining the word 'community'. CNs in Europe and north America usually strongly associate with motivations to decentralize telecommunications (Filippi and Treguer, 2015), however our research about CNs in the Global South (Bidwell and Jensen, 2019) included a wide range of institutional models including cases that were stimulated by local governments, with relatively little involvement and sense of ownership by local inhabitants, which reflects cultural and socioeconomic contexts.

Rey-Moreno's (2017) survey in twelve different African countries found that the origins of all 37 CNs he identified, including those with African founders, had links with Western institutions, including NGOs and universities. While perhaps not as widespread, CNs in Latin America and Asia also emerged from international university collaborations or have indirect links because they were stimulated by local universities. For instance, the national university collaborated with the University of Washington on deployments in isolated villages in the Philippines (Barela et al, 2018; and the Universidad Católica Perú collaborates with Spanish universities in Spain on networks in the Amazon (Rey-Moreno et al, 2011). Sometimes associations between CNs and local and international universities are part of university social responsibility or internship programmes. Frequently, however, associations are part of research in the academic fields of computing, communication or international development studies. Research on and with CNs in the global south provides technology researchers opportunities to experiment with, for instance, open, distributed infrastructure (e.g. Braem et al, 2013), TV White Space technologies (e.g. Hadzic, et al 2016), or user interfaces (e.g. Jang et al, 2018) sometimes in purposive ICT4D interventions. Often these relationships fund technology deployments and sometimes training local people. Sometimes initiatives don't originate as but became research projects, for instance Macha works in Zambia and Murabinda works in Zimbabwe became the subject of a PhD (e.g. Backens et al, 2009, Mpala and van Stam, 2012).

There is more research that involves interventions with technologies and models of sustainability in relation to CNs in the global south, than studies about CNs that independently emerged. Indeed, a brief search for 'CNs' in the ACM Digital library shows that the authors of all but one of the top 20 most recent papers about CN(s) studied in the Global South were about CNs that academic researchers helped to establish. Further, most of the research was about technology, or ICT4D, rather than more socio-technical aspects. This interest holds even in less academic literature. For instance, over half the 44 articles in a book that emerged within a recent book on CNs mostly focused on technologies used, technical skills and/or technical regulatory issues (see: Global Information Society Watch 2018).

While academic research, and civil society accounts, about CNs in the global south tends to focus on technical systems, frequently the researchers have strong commitments to democratizing communication and information access (see: Giswatch, 2019). Some CNs are set-up with support from international civil society organisations that pursue open access. For instance, the Open Technology Institute, a non-profit that works at the intersection of technology and policy (https://www.newamerica.org/oti/about/) seed funded and provided technical support for some African CNs. Meanwhile, the Internet Society (ISOC) a major international non-profit that receives its revenue from .org domain names, significantly contributed seed and development funding for CNs in the global south in the past four years.

Along with support to specific CNs, civil society organisations such as ISOC and the Association for Progressive Communications (APC), have also been active in recent years in supporting regional relationships between CNs and advocating for policies to enable CNs. ISOC contributes to building the "CN movement" by supporting regional summits; its most recent one the Third African CN Summit in 2018 involved CNs from 20 African countries

(www.internetsociety.org/events/summit-community-networks-africa/2018/). As much as there are now different fora for people from CNs' grassroots communities, arguably closer relationships emerged between people in external organisations working on their behalf. Energetic alliances and collations exist between international organisations, like ISOC and APC, and country-level advocates for CNs, such researchers in universities and NGOs, to lobby governments to improve the legal and economic circumstances for CNs.

The technological emphasis of research about CNs, including in the Global South, tends to apply the word 'infrastructures' to technological networks, nodes services, hardware and software, and management architectures interfaces and Internet components (e.g. Plagemann, 2008, Khan et al, 2013Fuchs, 2017). Such work assumes certain bottom-up socio-technical arrangements, but does not explore their politics, values, practices, tools and internal and external relations. Stefano and Magaudda's (2018) analysis of the cultural frames and political ideologies in bottom-up infrastructuring work of CNs is fairly unique by drawing attention to how participants in CNs often begin with a purely technical focus but develop convergent political views and practices (based in leftist and anti-capitalist movements) and the particulars of an innovation trajectory, localized outside conventional spaces of research and development. They suggest that CN members perform "a kind of 'artful infrastructuring' of technologies, organizational models and political visions into an effective participatory process of technology development". However, this situation differs from that in which external technologists who aim to localise technological agency and connectivity assist rural inhabitants in to set up their own CNs.

Technologists and activists that promote and foster CNs tend to, albeit often reluctantly, universalize and integrate their practices with more centralized structures, such as wider legal and technical discourses and funding regimes. This inherently conflicts with intentions to create the ground for authentic local participation, adoption and appropriation beyond its initial scope (see: Le Dantec and DiSalvo, 2013). Indeed, as Filippi and Treguer (2015) explains the history of communication technologies is replete with scenarios where technologies started as a decentralized, sometimes subversive structures, and progressively evolved into concentrated clusters of power. Zanolli et al (2018) describe cases in Brazil which tackle how the infrastructuring of CNs reinforce certain power relations. Their feminist infrastructuring work aims to create CNs which foster relationships between diverse women and "non-hegemonic groups" and often deliberately opts against pursuing objectives that are prioritised in many CN projects in favour of focusing on making collective spaces that are welcoming and supportive to different people and their values and practices.

SITUATING INSIGHTS

My analysis is situated in active participation in the CN movement over the past decade, by setting up and promoting CNs in southern Africa, observing advocacy for CNs for 18-months, as well as more formal research studies.

Socio-Technical Interventions

My engagement with CNs began in 2008 in rural Eastern Cape, South Africa, although for the first three years I was unaware of the broader CN movement, or indeed the term 'CN'. In 2008 I undertook ethnography while living in a traditional village (Bidwell, 2009) and my insights and relationships led to my collaborating researchers installing Wi-Fi between three headmen. The Wi-Fi did not sustain, however, insights from its failure and my longer term ethnographic

action research in adjoining villages in the next 3-years (Bidwell, 2010, Bidwell et al, 2010, Bidwell et al 2013, Bidwell & Siya, 2013, Bidwell, et al 2014, Bidwell, 2016) scaffolded the emergence of Zenzeleni CN (Rey-Moreno et al, 2012, 2013, 2015).

When I moved to Namibia in 2014 I began to promote the CNs, such as in a workshop and keynote at the National IT summit, and collaborated in research bids with international advocates and technical researchers involved in CNs. In 2015, I gained funding for a Namibian NGO's rural Wi-fi and mentored a student to start a CN in a village near my home, Groot Aub (Louw et al, 2018). More broadly I was involved in the first African Summit on CNs in 2016, assisted a bid for women-driven CNs in Africa (www.afchix.org/afchix-announced-as-one-of-usaids-womenconnect-challenge-winners/) and ran workshops introducing women to CNs in Ghana and to fostering links between CNs practitioners and researchers in Asia, Africa and Latin America.

Observations of Advocacy

At the end of 2017 the Association for Progressive Communications (APC) contracted me to research social and gender impacts of CNs as part of a team of two women and five men. As well as my multiple case research, the team researched the technologies and business-models deployed by CNs and policies affecting CNs. They also actively liaised with CNs, civil society groups and regulatory authorities globally and prototyped technologies. Over the project, team members increasingly worked with CNs and civil society groups in responses to consultation about regulatory frameworks, such as spectrum licensing. We all also had extensive experience in technology in the global south, and three of the men had, like me, also founded CNs. Three of the team lived in southern Africa, one in Mexico, one in Canada and one in Portugal and we met as a team at the commencement of the project, a year later at the Internet Governance Forum (IGF) and at the conclusion of my research. In between we met online every week to coordinate and update as the research and advocacy progressed and the team. Updates and discussions were supplemented by regular posts to Slack channels dedicated to the project, which shared insights, opinions and materials about various topics related to policy and impacts of telecommunications. Our lively discussions encouraged and supported different perspectives and integrated reflection on ongoing insights about international policy advocacy, technical advances and experiences of CNs.

Multiple Case Research

My main focus in the APC project was to gain insights about relationships between social, gender, economic, political and ICT factors in people's access to, use of, and interactions with their local CN in the global south. As explained in detail in Bidwell and Jensen (2019) my research focused on six rural CNs . These six were selected by the APC project team from about 40 potential CNs based on: the CN's visibility to APC's contacts; distribution across three continents; rural location; length of establishment; languages spoken; interest expressed by the initiatives, logistics and predicted accessibility of sites in short visits; the potential for the set to represent diverse impacts, business models, technologies used and services provided; and, insights from a review of online documentation of 23 CNs in 19 countries.

It is impossible to determine whether these cases are typical, especially significant, deviant or extreme. Certainly, their country contexts have varied development indexes: high for Argentina, medium for South Africa, Indonesia, Mexico and India; and low for Uganda. Five of the CNs provide Wi-Fi-based internet connectivity and one GSM-based voice and SMS services (Table 1). As common for CNs globally, most use low cost equipment operating in license exempt frequencies and involve Wi-Fi hotspots connected to upstream broadband connections that use Wi-Fi. CNs in Uganda,

South Africa and India provided public internet access for a small monthly or daily subscription, augmented with public access ICT centres in Uganda. Wi-Fi also provided internet access into local authority offices in India and Indonesia, and into households in Argentina and Indonesia. Local community involvement in the CNs also varied. Local authorities had roles in all CNs except in Argentina but varied in their influence in the CNs and relationships with the people in the local community.

Country	Type of connectivity	Study		1: Founders, leaders, champions and technicians in support organisations		2. Managers, coordinators, and operators in rural villages		3: Users		4: People who do not directly use the network	
		Dur-ation (days)	Rural sites where data gathered Villages: V Tiny rural town: T	M	W	M	W	M	W	M	W
India	Wi-Fi hotspots in public places and links in local authority	12	8 Vs (most in 2 Vs)	5	3	13	1	19	11	9	6
Indonesia	Wi-fi hotspots and links in local authority premises and shops	8	2 hamlets in V	10	3	3	3	11	11	9	9
Mexico	GSM network	9.5	2 V and 1 T (most in T)	2	2	2	1	15	21	2	1
Argentina	Wi-Fi routers in households	13	3 V, but most in 2 Vs	3	2	6	5	12	11	0	0
South Africa	Wi-Fi hotspots in homes of tribal authority	13	4 Vs, most in 1 V	4	1	5	2	11	15	7	5
Uganda	Wi-Fi hotspots and links in public access ICT centres	11.5	4 Vs, 1 T and refugee 'camp' (Most in T)	9	3	6	3	25	9	5	35
	Total			**33**	**14**	**35**	**15**	**93**	**78**	**33**	**55**

Table 1 Numbers of people participating in different categories across studies

A total of 152 women and 172 men participated in observations and in focus groups discussions (FGDs) and interviews, which were structured by different topic guides, and recorded by audio and, when participants permitted, video. Some participants also gave details about their interactions with CNs in diary accounts during dedicated in-depth interviews over a week or as a part of another interview or FGD. FGDs and interviews were often supported by data from soft and hard documents, such as media illustrating participants' use of the CN. I recorded interfaces to applications and systems comprising the CN and, records in sign-in books, posters, instructional manuals, signs etc.. I also observed participants' interactions with each other and with documents, equipment, devices and other objects in settings. Sometimes these arose is specific activities such as an intensive workshop that an umbrella organisation hosted for the CNs it supports, a drama group, or during my own participation in activities.

Participants were connected to CNs in varied ways because the CN's were differently organized. A total of 50 people were participants of type (1) initiators, leaders, champions and technicians in umbrella and support organisations, who did not live in the rural areas in which CNs are deployed. The remaining 274 participants who inhabit the villages or very small rural towns in which the CNs are deployed can be broadly grouped into three overlapping, types: (2) Managers, coordinators, volunteers and operators; (3) users of CNs in rural villages; and, (4) Non-users, or people living who have not used it directly themselves because they cannot or chose not to, or because other people mediate their interactions. I sought to include people with diverse characteristics, age, education, employment, income etc to gain insights to different dimensions that might shape access to, involvement in and benefits from CNs. This included seeking equal numbers of women and men in all categories. However, while men constituted 78% of nine founders, initiators or champions; 70% of workers in umbrella or support organisations on CNs in villages women comprised 65% of non-users.

Over 80% of interactions were mediated in Luo and Nilotic dialects, isiXhosa, Hindi, and central Javanese, Mexican or Argentinian Spanish and translated into English, simultaneously whenever feasible. In four countries interpreters had some relationship to the CNs. I sought to separate interviews and FGDs with men and women, facilitated by men and women interpreters respectively, but rarely achieved this and less than a third of the 34 small or large FGDs included only women participants and interpreters. Ex situ analysis, after visits, coded the data to create concepts synthesise themes and distil theories about relationships between practices, benefits and impacts. Grounded analysis yielded common and contrasting characteristics among the different CNs and interrelated themes, such as features of the CNs and qualities of the impacts they had in their specific settings (see: Bidwell and Jensen, 2019).

ANALYSIS

I synthesise the diverse and detailed insights, accumulating in my involvement in interventions, observing advocacy and multiple case research, to distil four key themes. My account organises them by building on meanings that associate with motivations for commons-based approaches towards spectrum, that permit CNs to use spectrum in some bands without licenses - an argument that has been a prime constituent in advocacy for democratic access to telecommunications for over a century (Wong and Jackson, 2015).

Thingifying the Commons

Generally rural CNs involve wireless transmission, such as wi-fi and occasionally GSM, to avoid costly cables over long distances, thus communities must usually apply to regulatory authorities to purchase, or gain exemption from, licenses to use spectrum, which presents various hurdles (e.g. Rey-Moreno et al, 2015). Amongst various suggestions for regulations that will better enable CNs, advocates argue that people with low-incomes, particularly those in rural areas, are poorly served by market-based approaches, which treat spectrum as property and grant licenses for exclusive use of certain frequencies in a specific geographic area. For instance, in South Africa, assignments of GSM spectrum go unused in economically-poor rural areas because a few telecom companies value-price cellular and broadband services for markets, usually in urban areas, that can afford their tariffs (Avila, 2009, Bhagwat et al. 2004). While governments control spectrum, however a few telecom companies work together to keep prices high and influence regulation and policy-making (Filippi and Treguer (2015) and regulatory authorities are often lenient on or subsidise regulated firms, leading to many allegations and cases of "regulatory capture" in Europe or involving European companies in Africa,

Latin America or Asia (Filippi and Treguer, 2015). In arguing for commons-based approaches, activists are often obliged to adopt a metaphor that pervades technical, social, and regulatory perspectives and expectations by likening spectrum to land (Wong and Jackson, 2015). Common resources, of course, take diverse forms, including physical entities and intellectual and cultural products that can or cannot be fenced or bound, like land, water, music, software; and, intangible social goods like caring for the elderly. However, since some resources, like spectrum, cannot be fully open access and unmanaged, the land metaphor, while more contiguous with assumptions about private property in a market-based approach, has become normalised in thinking about an unlicensed approaches (Song et al, 2019).

The land metaphor is also convenient in discussing spectrum and other aspects of configuring CNs with rural communities, since their everyday reality often involves sustaining livelihoods by managing resources together, and may have protected their life-styles by claiming communal sovereignty. For instance, the local tribal authority allocates lands for homes among families in the constituent villages where the South African CN, and inhabitants jointly share access to forests and pasture (see: Bidwell et al, 2013). At least publicly, there are expectations about working together and achieving consensus in managing the communal land which helps to anchor discussion about setting up and operating the Wi-Fi (Rey-Moreno, X). Similarly, in the area in where the Mexico indigenous community owns and manage their own low-cost, open source GSM base station, the right to own land requires participation by households in communal work and to the decisions of the traditional assembly. Local governance arrangements that link self-determination to land provide a context for discussing how a CN operates according to a shared commitment with some agreed rules, and the metaphor of land can appeal to citizens that oppose legal and economic regimes that want to privatise rights to resources, regardless of traditions of communal land management. For instance, indigenous participants in the Mexican CN mentioned threats to water, and some participants in the Argentinian CN are involved in protesting mining initiatives.

While the land metaphor provides a convenient explanatory framework it illustrates a problematic reification. The founder of Rhizomatica, the support organisation that supports the Mexican cases in my research, and who was also part of the APC project team explains that spectrum:

> "is really a potential – the potential to communicate over the airwaves. It has been turned into a thing in order to extract value from it and assign its use in an orderly fashion. These two visions (thing vs. potential) conflict when communities want to use spectrum to communicate how they see fit". Peter Bloom, November 2018 [1]

It is not really inevitable that commodification accompanies turning a potential into a thing, however such thingifying/reifying certainly acts to deemphasise social community processes that are, as Elinor Ostrom (1990) points out, integral to common pool resources, like spectrum. Physical resources are often a reference point for collective efforts towards a common goal, but thingifying into bounded entities obscures that commons are not just found and used but produced through social organisation. For instance, in the Mexican indigenous community and South African villages expectations for communal participation and volunteer work are integral to local land

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[1] www.apc.org/en/news/whats-new-spectrum-%E2%80%9Clets-make-sure-we-can-use-it-what-needed%E2%80%9D-conversation-peter-bloom

management. People in these communities produce, reproduce, circulate and exchange diverse resources, including intangible social goods like care, in managing other resources; and cohesion can be unsettled when certain resources gain precedence. The role of social processes has led to contemporary theoretic emphasis on acts and processes of 'commoning', that entwine production and use (e.g. Fournier, 2013), however, in supporting communities in developing CNs, explanations often focus on things. For instance, in one workshop facilitators in an support organisations helped participants visualise the values, that their network is based on, with lines to connect together points on a large paper graphic. The focus in the activities was on the connection itself rather than social processes that make and sustain those connections.

Reifying into bounded entities also introduces conceptual distinctions between producers and between users. There can be no real clear cut allocation of electromagnetic radiation for specific use by individual humans, "users" to whom specific parts of spectrum are allocated can only be envisaged as organizational entities such as MNOs and "complementary" or "small-scale" operators in in technical and regulatory discussions, that can. The construction of users at this level focuses on only particular roles in realising the potential of spectrum for communicating, and also makes the social processes involved invisible by encapsulating them. When it comes to the level of CNs, distinctions between people who are, and are not, part of the collective with useage rights are porous (Fournier, 2013), after all people use CNs to communicate with other people whose point of access is via market-based owned spectrum.

Monitising and Valorising Production in CNs

People in organizations, like NGOs and university technology departments, that support CNs in the global south must often justify CNs according to widespread models of 'sustainability' that promote monetary metrics over alternative evaluations of the benefit and costs of human connectivity. Indeed activities that introduce the concept of CNs to communities in the Global South increasingly centre on sustainability from a business perspective. For instance, the "business model canvas", that is widely applied in community social enterprises, has been used in three international programmes that I observed in the past six months. While community resources are somewhat assumed and its categories such as 'customer segments' 'cost structure' and 'revenue streams' shape constructing CNs in particular, monetary ways. Activists' recommendations for enabling environments for CNs are also predicated on economic arguments, suggesting an inevitability. For instance, they propose that wider access is more likely to result when regulation opens up markets and encourages more operators and/or services to address the needs of underserved parts of the market. Thus, arguments include competitive pressure to reduce data costs imposed by mobile operators and enabling "young entrepreneurs to address the digital divide by putting affordable, accessible tools in their hands" for CNs points to "the power of frictionless innovation" (Song et al, 2019) and industry growth (e.g. Huerta, 2019). Not only do these arguments assume certain capitalist structures and market logics are inevitable, but their emphasis on drivers in and impacts on economies tend to neglect how the community, on which a CN is based, inherently involves work to achieve cooperative relationships through sharing work, knowledge and so on.

An overt sense of communality featured in interviews and discussions for five of six cases I studied (Bidwell and Jensen, 2019). Participants in all cases mentioned many examples of assisting others in communication or accessing information, from setting up others' access, facilitating messages or a call on WhatsApp for people without access,

and using online services on others' behalf. Women in the Indonesian case, for instance, explained that since few of them owned phones they communicated with each other by sending and receiving messages through neighbours; meanwhile, some of the elders in the cooperative that manages the South African CN are unable to use the internet on their phones themselves but they still tried to help others connect to the Wi-Fi.

Sometimes the CN cases manifested existing collectivist principles, and other times the CNs were a vehicle to foster solidarity (Bidwell and Jensen, 2019). The CNs in South Africa and Mexico are founded on customary governance structures, ancestral and family ties, and cultural norms and values about communality. Some participants in the Mexican CN specifically said they supported the CN because it enabled access to more disadvantaged inhabitants not because it enhanced their own access to telecommunications, and many referred to communal participation in setting up their CN, when many local people together erected the mast in the mountain. Meanwhile, the Argentine CNs attracts people with communalist interests and participants explained the importance of "being there" when 35 people gathered to relocate a node. Members of the Argentine CN mentioned that the CNs communal characteristic can serve as a bridge between different parts of local society, for instance, intergenerationally; and older members referred to cooperative traditions and solidarity movements. The case in Uganda tries to re-establish unity in communities where war and some post-conflict actions, scattered and destabilised communities, undermined people's trust in institutions, neighbours and even family members, and contributed to high unemployment and disaffection among the youth. The founder of the Uganda CN prioritised peaceful coexistence in all activities by emphasising traditional practices of coming together in dialogues to manage disputes, such as about land or water, and this was reiterated in various ways by participants at the different CNs it supports such as how youth share their individual talents to help each other.

Promoting monetary metrics over alternative evaluations of the benefit and costs of human connectivity has paradoxical consequences for CNs, by reinforcing their interdependence with capitalism and contributing market relations within the commons. Generating income can be a motivation for involvement in the South African, Indonesian and Indian CNs. For instance, several members of the cooperative that manages the South African CN said part of their motivation for the CN was to provide them and their children with jobs and obtain remuneration, However, there were tensions around whether their attendance at meetings, decision making, overseeing cell phone charging or selling subscriptions warranted remuneration. In Indonesia middle aged women explained that younger people were increasingly drawn to profit sharing initiatives associated with the Wi-Fi and were disengaging from communal activities. Participants in Argentina also explained that some CN members do not understand the collective approach and that, over the past year, the CNs had decided to limit the impact on CN members by "free riders", who use the network without becoming part of the collective.

Along with an impulse to thingify and monetise resources in stimulating the growth of CNs, there is also a tendency for proponents of CNs to emphasise some resources more than others in producing the commons within CNs. Conversations with different participants about their achievements in setting-up CNs often reference particular equipment and tasks (Bidwell, 2018). Facilitating people in rural communities in developing technical skills, aims to challenge expert-based, decision-making practices and enable communities to participate fully. Yet, at the same time the emphasis illustrates a technocratic infrastructuring of CNs that ascribes value to certain sorts of acts. Technical people who develop soft and hardware and who install and maintain the equipment for CNs are, of course essential. However,

the potential for communication within the CN is equally realised by formally appointed administrators, such as in the Mexico, Indian, Indonesian and South African CNs who subscribe users and take payments, and by a great variety of people who contribute other resources to enable the CNs management, organisation and use. Indeed, participants in the Argentine CNs noted the importance of competences in managing complex social relationships, and said that more time can be spent coordinating to schedule activities, to ensure people could undertake tasks together, and making arrangements and preparing all the necessary equipment than actually undertaking technical tasks.

In umbrella organisations supporting CNs employees in technical or coordination roles were paid, however within villages payment tended to be for computer-based and technical tasks. In the six case studies I spoke to people in 84 explicitly recognized roles in CNs and umbrella organisations, from network administrator to cooperative member, that did some kind of recognized work to keep the respective CN going. "Work" was more likely to be recognized to have a role if it involved technical tasks, since 51 of the roles had technical components and 33 did not. Further, while half of the roles with technical tasks were remunerated, only a quarter of the other roles were. The network administrator in Mexico, for instance, receives a small stipend for his work, a young woman is employed to manages subscriptions to the Wi-Fi in Indonesia, in South Africa two local roles are paid through the support organisation's budget, one is purely technical the other is mixes social and technical management. and these are often imbricated in performing certain types of identity, such as masculinity by references to erecting poles and climbing towers and these achievements are mostly associated with men.

Excluding by Commoning: Gender and Technology

As several authors point out e.g. Nightingale (2019) inclusion is not an inevitable result of strong communitarian relations and power relations are embedded in processes of commoning. Certainly collectivism can suppress or ignore the perspectives of the least powerful people, Zanolli et al, 2018 , and CNs can reproduce inequalities within local inequalities. For instance, Shewarga-Husssen et al, (2016) observed that while women's invisible labour may sustain a rural CN in Africa economically, operational decisions are often made by men. Local gender norms and gendered divisions of CN labour can intersect with gendered technologies. For instance, women in community radio are more likely to undertake secretarial duties and cleaning Zanolli et al, 2018; while the geeky identity of the technology activities can perform in excluding women in community connectivity projects (Dunbar-Hester, 2010).

Local gendered power relations in many of the cases I studied often meant that women bear much of the volunteer labour in communities. Two women participants in South Africa mentioned that women, including those with roles in meetings to organise the CN, were expected to cook and serve dinner without payment. In Mexico we observed only middle-aged women undertake Tekio community work, which unlike the roles or president, vice-president, secretary and police officer which receive a stipend, is not remunerated. In Indonesia women in the village's community volunteer organisations spent all morning preparing elaborate lunches for ourselves and the workers in the chief's office administration who used the network. The women volunteer for twelve different village organisations that undertake welfare work, while ten of twelve youth are also involved in the collective work of village's enterprise office, receive a share in the profits and currently all twelve workers are boys and young men.

Local gendered power relations conflate with valorisation of technical rather than other skills. I actively sought to recruit women participants in cases. However, while I spoke to 36 men in support organisations or CNs at village level who undertook technical tasks, only 15 women undertook technical tasks and women were more likely to be non-users than

men. Men are more likely than women to undertake technical tasks in CNs and, since technical rather than other tasks are more often remunerated, men were also more likely to be paid for their work, for instance 25 men but only 8 women who undertook technical tasks were paid. Women also described being chastised for climbing, and concerns that if they did climb they might disrupt teamwork which reflects both gendered power relations that determine who gets to ascend ladders, and gendered conventions about duties to teams. One umbrella organisation is actively addressing gender imbalance by recruiting many more women interns, yet these positions are unpaid.

Community Meshworking not Networking

In addressing the exclusion that arises in commoning Nightingale (2019) focuses on 'becoming in common', to emphasise the need for continual reflection and adaptation to ensure practices include. The ongoingness to which she refers resonates with observations about the temporalities of developing relational assets needed for neighborhood sharing in London (Light and Miskelly, 2019), and in the community in which the South African CN later developed (e.g. Bidwell, 2013). The processes of external structures that seek to support the development of CNs, however, do not reconcile well with this ongoingness. For instance, as Zanolli et al (2018) also express interactions with external technologists are often focused on teaching particular content or techniques in a short period of time, which makes it difficult to foster 'becoming in common' for the purposes of more inclusive CNs. Unlike a connection within a telecommunication network, which can be decomposed into and diagnosed as a fairly instantaneous event, commoning involves connections that are embedded in the ongoing trajectories of people's ongoing.

Most of the technologists and other workers in support organisations and advocates for CNs had a deep sensitivity for the complicated social relations that are involved in CNs, yet their interactions with them were likely to be remote and with only occasional opportunities to spend time in villages with them. Resource constraints restricted more frequent trips of technologist from support organisations and many considered that more continuous involvement undermine's local communities' autonomy. Yet, infrastructuring is an ongoing process and not delimited to the design or set-up of participatory projects (see: Dantec and Carl DiSalvo, 2013), and the technical and social fabric of a CN emerges from, and is embedded in, the details of people's ongoing lives. Thus like Light and Miskelly (2019), I was drawn to Ingold's concept of the "meshwork" to describe the relational character of CNs and how community relations produced as people move in life along paths that diverge, converge and twist and knot together (see: Bidwell, 2018). The Argentine CNs illustrated, for instance, connections forged between newcomers and people whose families have lived in the area for generations, through their ongoing interactions with their CNs. The nuances and dynamics of this cohesion and solidarity, critical to community, cannot be reified as a static resource, like land, nor can it be charted in a box on a business canvas, or visualised by drawing lines to join together values.

In repeated workshops and engagement this year participants from different CNs mentioned, with some vigour, that the temporalism of ongoing community relations can be unsettled when external schedules are imposed. We certainly experienced this in a CN in Namibia. For the first three years the emerging CN was self-funded, depending on a mule system to share previously downloaded content then shared its internet connection. Then, in 2018, a start-up provided a better base station for content and ran workshops to assist inhabitants in developing content, then we obtained a small grant to buy equipment to scale-up and joined a pan-African project, which funds workshops and a stipend for a local coordinator. After so many years of working without funding, according to local timescales and resources, suddenly,

two funding streams introduced deadlines which created significant tensions in the very relationships that had sustained the CN so long. Contrasting temporalisms can reorient CNs away from their collective intent, and community origins, when they must become accountable to extrinsic constructs of time, associated with funding, rather than constructs that are inseparable from local human relationships or tasks.

CONCLUSION

The metaphor that likens spectrum to land illustrates an impulse to thingify (reify) relations in infrastructuring CNs in the Global South. Reification enables tying economic value to producing the commons, and in contexts oriented by technical concerns and particular evaluations of connectivity, it tends to associates with technical labour rather than the work involved in sustaining community. Selectively valorising technical acts in producing the commons not only undermines some of the benefits of CNs (Bidwell and Jensen, 2019), but reproduces local inequalities; for instance by conflating with local processes and structures of gendered labour to exclude women (Bidwell, 2019). Addressing exclusion requires reconciling the relational qualities of producing the commons in infrastructuring CNs in the Global South.

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