Rural Uncommoning: Women, Community Networks and the Enclosure of Life

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Shared use of small-scale natural commons is vital to the livelihoods of billions of rural inhabitants, particularly women, and advocates propose that local telecommunications systems that are oriented by the commons can close rural connectivity gaps. This article extends insights about women's exclusion from such Community Networks (CNs) by considering 'commoning', or practices that produce, reproduce and use the commons and create communality. I generated data in interviews and observations of rural CNs in seven countries in the Global South and in multi-sited ethnography of international advocacy for CNs. Male biases in technoculture and rural governance limit women's participation in CNs, and women adopt different approaches to performing their communal identity while using technology. This situation contributes to detaching CNs from relations that are produced in women's commoning. It also illustrates processes that co-opt the commons in rural technology endeavours and the diverse ways commoners express their subjectivities in response.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing**;

Additional Key Words and Phrases: Community networks, rural HCI, gender, commoning, global south

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1 INTRODUCTION

Shared use of small-scale, natural commons, such as forests, fishing grounds, pastures, water and wildlife, is vital to the daily subsistence of over two billion people, particularly rural inhabitants [43]. Many rural societies have sustainably managed the commons for centuries [184], formed new cooperative associations for sharing [48] and organised to protest enclosure and extraction [48, 80, 86]. As they do not involve market activity or contribute to GDP, commons are often ignored or considered a deficiency for 'development' to remedy [43] and, influenced by Hardin's 'tragedy of the commons' [107], ICT4D projects often focus on individualised technologies (e.g., [188]). The failure of market-based internet and mobile telephony systems to provide rural inhabitants with access, however, has rekindled interest in shared ownership of local networks that treat telecommunications as a public good oriented by the commons. Potentially, rural women might get the greatest benefit from these arrangements as they are less able, than rural men or urban women, to access telecommunications [241] and also depend most on the commons. In fact, rural women

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have led defence of the commons; from land enclosures in Europe, 500 years ago, and from logging, mining, dams and commercialisation in low to middle income countries (LMICs) in the present day [85, 86]. Yet, as I show in this article, the relations created as rural women produce, use and reproduce the commons can be detached from Community Networks (CNs), or locally owned, managed and operated telecommunications networks.

CNs have been proposed to fill connectivity gaps for over 15 years in LMICs [217] but, in the past 4 years, influential civil society and development organisations have intensified their support for them, particularly for rural areas. Seeking to reorient the future of telecommunications, advocates have been building a ‘movement’ for CNs in the ‘Global South’. This project envisions that network infrastructure is a ‘managed as a common resource by the community where it is deployed’ [22, 125] and shares values with an increasing range of grassroots technology initiatives (e.g., [157, 163–165, 229–232]) to ‘re-common’ assets so that communities can sustain collective activities in their neighbourhoods [15]. Over history, the resources involved in telecommunications have come to be treated as privately owned property [223] and the ‘enclosure’ of radio spectrum frequencies profoundly effects rural places, where the cost of cabling over long distances is prohibitive. Around the world, a few large telecom companies not only price their services for people who can afford their tariffs but also dominate telecommunications regulation and maintain exclusive control of certain frequencies, including those that they do not use in rural areas because they prioritise provision to high revenue urban markets [11, 25, 97]. Such enclosure prevents small operators from filling connectivity gaps by using increasingly affordable equipment, such as solar-powered Wi-Fi meshes, Low Power FM (LPFM) radio or GSM base-stations (e.g., [7, 33, 58, 219]). Thus, telecommunications quality in rural areas remains low and current trends suggest that most of the 3 billion people who will remain unable to access telecommunications by 2025 will live in rural areas of LMICs [97, 250].

The digital gender gap is most pronounced in rural areas of LMICs [124]. Not only do rural women comprise 25% of the world’s population but rural areas have the widest gender differences in mobile internet use, access to phones, SIM cards, data, ICT centres and computer education (e.g., [56, 98, 160, 162, 174–176, 227, 255]). Women constitute the majority of many rural populations in LMICs and the enclosures created by privatisation affect women most acutely. In her studies of land enclosures Silvia Federici shows women are most affected by the loss of both access to resources for survival and a ‘web of cooperative relations’ in which they developed autonomous viewpoints [83, 84, 86]. Indeed, advocates from around the world emphasised gender inclusion in the characteristics of CNs they described at the 2016 Internet Governance Forum (IGF) in Guatemala:

We embrace the potential of community networks as a vehicle for transformation that increases the agency of all community members, including by fostering gender-balance. Community networks are structured to be open, free, and to respect network neutrality. Such networks rely on the active participation of local communities in the design, development, deployment, and management of shared infrastructure as a common resource, owned by the community, and operated in a democratic fashion. Declaration on Community Connectivity (2016) [22, 125]

‘Fostering gender-balance’, however, is challenging given male-biases in both the international technoculture of CNs and governance of rural CNs in LMICs [28–31, 40]. In this article, I consider how these male-biases entangle in a technology paradigm that is not entirely commons-oriented to produce a kind of gendered enclosure. I extend my earlier analyses of interviews and observations in CNs in rural India, Indonesia, Argentina, Mexico, Uganda and South Africa, which found that women are less likely than men to access or influence rural CNs or be paid for their labour in

supporting CNs [28–31, 40]. I also draw data on generated in participatory observations of a CN in rural Namibia and multi-sited ethnography of international advocacy for CNs.

While my reflection extends consideration of women's participation and sociopolitical concerns (e.g., [28–30, 114, 174]), this article is not merely about women's exclusion from CNs. There are already prodigious insights about how ICTs in rural development magnify extant gendered power structures (e.g., [183, 206, 227, 235, 255]) and my prior accounts discussed how women are rarely a focus in the burgeoning literature about CNs. My analysis in this article, however, specifically focuses on women and 'commoning', or practices that produce, reproduce and use the commons. Commoning is distinct from 'communality', or a more general condition of group solidarity, and the values and feelings associated with this state that have received attention in HCI's accounts about rural inhabitants in recent years (e.g., [6, 39, 55, 109, 221, 247]). Commoning emphasises the actions and relations that create common pool resources (CPR) [184] but are de-emphasised by the reifications that enable scaling up, enclosing and extracting from the commons.

Along with drawing explicit attention to commoning in the field of rural HCI, I contribute insights about rural 'commoners' in LMICs to a growing literature on the commons (e.g., [15, 90, 149, 157, 163–165, 229–232]). Consideration of commoning in HCI, Participatory Design (PD) and computer supported cooperative work (CSCW) have not explored either how commoners perform their identities or the relations created by women's commoning. My analysis shows rural women adopt different strategies to perform their identity when they use technology, which can sensitise HCI to the contingencies of communality. By uncovering disconnects between CNs and the 'web of cooperative relations' [84] that women create in commoning, my analysis also shows that even technology arrangements that aim to be commons-oriented can become detached from relations that maintain the commons. Such insights can help to sharpen awareness to some of the social processes involved when the market co-opts the commons (e.g., [48]) and the complexities of facilitating policy bridges between community-based technology endeavours and the international telecommunications space. For clarity, throughout this article, I distinguish 'CNs' (people, sociotechnical relations, technologies and infrastructures of operation, governance, etc.) from technical 'networks' (e.g., antenna, Wi-Fi signals, routers, servers, cables, etc.). However, technological equipment is a sociomaterial collective too, as I make clear in the related work next.

2 RELATED WORK

The philosophy of CNs supposes that it is feasible and desirable for some telecommunications resources to be held in common rather than be state- or market-controlled. This view arises in relation to sociotechnical imaginaries, or national and international perspectives that are embedded in policies on worthwhile futures and ways to attain them [248], such as promoting universal access to telecommunications. It also arises in relation to local perspectives on identity, social life and social order. I introduce some of these relations in Section 2.1, to outline how advocates for CNs co-construct sociomaterial spaces that enable participation in a CN or in the broader CN project. I describe how the categories 'rural' and 'Global South' construct this space and how the institutions involved constrain women's participation.

I begin Section 2.2 by outlining how CN discourse often refers to common resources as things, rather than commonings or practices that produce, reproduce and use these things. I then consider how commoning shapes people's identities and how agency in CNs is subject to colonial, patriarchal and capitalist powers that can devalue women's contributions. I end by motivating for exploring interactions between gendered sociotechnical imaginaries and rural practices of commoning in CNs and proposing that these interactions can produce a type of enclosure, which limits women's access and the relations that their commoning creates.

2.1 Making Spaces for Rural Community Networks in the Global South

There is consensus that inhabitants of the place where a CN is implemented must own and be actively and democratically involved in the CN's design, deployment and management. This holds more clearly for urban CNs in high income countries where inhabitants have the technical and economic means to install networks in the places where they live. In addressing a lack of such means elsewhere advocates for CNs, as this section describes, contribute to the symbolic production of ruralities and rural identities, and to certain materialities in rural places. Their efforts reproduce certain distributions of power and thus, the section concludes by summarising how the gendered technoculture of CNs overlooks barriers to women's participation despite their majorities in many rural populations.

2.1.1 CNs and the Production of Rurality in the Global South. Discourse about CNs actively produces certain rural identities in response to telecommunications policy, regulation and funding regimes. Almost throughout the world, rural areas have the lowest living standards when measured by income, consumption, poverty, infant mortality, health or access to services, particularly in countries that are starting to urbanise and industrialise [252]. Since national differences thwart a single definition, the category 'rural' in telecommunications discourse, draws on criteria used by each country, which may refer only refer only to relative concentrations of populations or include other socioeconomic structures (e.g. [240]). Of course, telecommunications contribute to, as well as reflect, rural materialities. The Telecommunications Union (ITU), for instance, describes relationships between sparse transport networks, electricity, the inability of inhabitants to acquire devices or pay for services and the resistance of major telecommunications companies 147 to delivering provision to rural areas [120, 123].

The gap created because telecommunications providers do not provide affordable connectivity in rural areas presents opportunities for technologists in civil society and academia. Some CNs are set up with seed funding from international organisations that relate technology to policy, such as the Internet Society (ISOC), or pursue open access, such as the Open Technology Institute [182]. Others are set up by universities in the Global North and South, and their collaborations, (e.g., [19, 196]) to experiment with technologies that might not gain interest in areas where alternatives exist; such as open distributed infrastructure TV White Space technologies and user interfaces (e.g., [45, 102, 129]). Indeed, a survey of 37 CNs in 12 African countries found all had links with Western institutions [196].

Dependencies between university research and CNs are less explicit in the Global North where they are set up, operated and maintained by tech enthusiasts and hackers from their homes based on peer relationships (e.g., [3, 4, 7, 16, 47, 64, 65, 89, 101, 133, 169, 191]). With some exceptions such as Broadband for Rural North in England and First Nations CNs in North America (e.g., [7, 70, 168, 207]), many rural CNs in Global North extend an urban CN (e.g., [60]) or are supported by urban-dwelling technologists (e.g., [57]). Nonetheless, engagement in rural and urban CNs in the Global North can usually be described as 'recursive' [230], since groups associated with the CN exist because of their care for their respective networks. Undoubtedly there are rural inhabitants in the Global South who establish independent networks, such as sharing Wi-Fi hotspots, however, those identifying with the category 'CNs' rarely exhibit recursion. With scarcer local technological competence, CNs in the Global South are usually initiated and maintained by technologists far from their sites, who work with local institutions and authorities (e.g., [7, 218, 198, 241]). Thus, the Declaration on Community Connectivity [125] states that CNs can be 'operationalised, wholly or partly, through local stakeholders, NGOs, private sector entities and/or public administrations' [125].

While technologists and activists involved in rural CNs design, develop, deploy or advocate with a sensitivity to local specificities, they also contribute to the symbolic production of ruralities and the identities. The ‘urban culture’ of technology design, in general, tends to construct rural technological needs relative to urban places [41] and this is no different for CN advocates as they engage with funders and users of their interventions and research. Funding applications, for instance, refer to the ‘rural–urban digital divide’ that the ITU applies to differentiate rural inhabitants’ telecommunications access [122]. Since digital divides are less severe in highly industrialised economies, rural identities are also shaped by a vocabulary used in international development (e.g., [118, 237]). Thus, while activists might use ‘Global South’ to reflect south–south solidarity (e.g., [238]) and avoid the hierarchy implicit in the term ‘developing world’, the category homogenises and is geographically vague (e.g., [52, 170, 214, 234]).

2.1.2 Distributing Power in Policy and Technological Artefacts. Postcolonial relations are also entangled in building an international movement for CNs. In the Global North, CNs are motivated to decentralise telecommunications, oppose concentrations of power [60, 64] and create infrastructures in response to their specific geopolitical ecologies and colonial histories [70]. In fostering CNs in the Global South, however, technologists and activists combine these commitments with more utilitarian pursuits to democratise communication and information access (see [7]), including representing ‘the unconnected’ in policy spaces.

Over the past 5 years international civil society organisations have been energetically building a movement for CNs. For instance, after many years of support for CNs, The Association for Progressive Communications (APC) received significant funding from Canada’s and Sweden’s international development agencies, and ISOC launched CN Fellowships with the Mozilla Foundation [173]. In many countries there are significant regulatory hurdles for CNs to legally transmit (e.g., [197, 199]); thus, often advocates for policy improvement in the Global South do not dwell in the rural areas of the CNs they represent, which differs from situations where local collectives represent themselves in policy spaces, such as Free/Libre Open Source (FLOSS) [51]. Like many initiatives that start as decentralised, subversive structures [64], to tackle telecommunications monopolies, the movement has its own concentrated clusters of power. Indeed, opposing the concentrations of telecommunications infrastructure may even be a low priority for rural people. For instance, Cuban CN users would prefer their government to provide connectivity than maintain networks themselves [78].

To promote CNs to policy-makers and funders, advocates appeal to logics about innovation that originate in urban centres in the Global North. They assert, for instance, that CNs can benefit industry growth and regional commerce and help people to use technology to solve their own problems (e.g., [113, 123, 220]). Such logics are widely promoted as replicable in the Global South (e.g., [52, 61, 128, 136]), and have influenced professionalisation and commercialisation of services in CNs [49, 104, 110]. Yet, they implicate the market in the commons and reproduce colonial power. Certainly ‘connecting themselves’ can foster senses of collective efficacy, which is vital for people who have few prospects to build social ties beyond the places in which they inhabit (e.g., [139]), but claims that local values, practices and collectives oppose technology’s ‘super-colonialism’ [244] may be too bold. Undoubtedly, technologists supporting CNs make considerable efforts to mitigate expert power and paternalism (e.g., [95, 137, 158, 218, 243]) they rarely, however, consider the ways that the artefacts, abstractions, conventions, standards and protocols they use are embedded with beliefs and norms. For instance, while setting up and operating a rural Zambian CN involves ‘a constant rehearsal of local African values and practices’ [177] it tends to treat the actual hardware and software components, architectures and interfaces as socially inert. In the Global North,

separating ‘the technical’ and ‘the social’ shapes participation, adoption, appropriation and cohesion between members of CNs [60, 146] and this distribution of power may be amplified in the Global South [75].

2.1.3 Gendered Spaces. Distributing power to technical decisions in CNs significantly affects women. There are, respectively, more and substantially more women than men in rural areas of South and East Asia and sub-Saharan Africa [88, 99, 119] and increasing fractions of older women [254]. Rural women also have less access, than rural men or urban women, to telecommunications (e.g., [56, 98, 115, 118, 121, 172–176, 227, 250]) and gender gaps in internet access are most pronounced in the Global South [122]. However, to improve regulations that support CNs, global advocates rarely mention the specific challenges for women and debates about policies that affect CNs are gender blind [28]. This reflects the sparse representation of women both in telecommunications discourse [121] and in CN technoculture and advocacy.

Despite commitments to democracy and disrupting the ‘old-school engineer way’ [73] CNs and allied tech countercultures such as LPFM radio, FLOSS and DIY-making, attract younger middle-class, college-educated people and associate with white masculinity (e.g., [60, 64, 71–74, 76, 147, 151, 152, 155, 193, 194, 202, 209, 233, 256]). The ‘nuts and bolts identity’ of CNs [133] and the ‘dudecore’ [73] of tinkering and making-do technoculture inhibits people who do not identify with being a geek [73, 133], and activities in CNs and allied technocultures can enact certain family identities, such as fatherhood and DIY [210], yet be incompatible with family life [133]. Addressing the identity of technology activities is integral to feminist hacker and maker groups who produce facilities, relationships and tools that integrate, for instance, safe and welcoming spaces (e.g., [92, 93, 209]) and ‘feminine heritage’ [204].

Women are often ‘hidden behind the scenes’ on the fringes of CNs in the Global North, sourcing materials, catering, paying for electricity and providing transport and child-care [133]. While interested in using the network in their homes [133], the sites of installation on roofs are separate from the places where women have more control [73]. Locating equipment outside of domestic spaces has profound effects in the Global South, where constraints on women’s mobility, privacy, daily routines and admittance to places limit their access to telecommunications, as found for public Wi-Fi [174]. My earlier analysis of some of the data presented in this article shows that women’s capacity to learn about and undertake certain technological tasks and participate in decisions about CNs is limited by the locations where Wi-Fi is installed [28]. My prior analysis also suggests that treating Wi-Fi as gender-neutral in debates about regulation reflects the vast difference between the scales of the spatial politics that limit women’s access to their local CNs, that orient regulatory debates and the mobilities of CN activists who participate in these debates [28, 29].

The effect of the intersection of gender, age and rural location on inclusion in technology endeavours is severe. Women over 65 years comprise growing fractions of rural populations in the Global South [253] and face specific challenges in access to ICTs. As well as being least able to charge phones or use public Wi-Fi [174, 228], older women are more socially isolated and have less physical mobility and access to land [242]. Articles in a recent book about CNs in 40 countries mentioned young people or youth 64 times but older people or elders only 18 times and rarely as participants in ICT activities [7]. A feminist CN in Brazil that prioritises racial, ethnic, sexual and gender inclusivity and fitting around domestic concerns noted the absence of older women [256], and only 2 of 44 articles recognised differential access related to age (see [62, 134]). This partly reflects a lack of diversity in the CN movement; for instance, while authorship suggests potential to unsettle racial biases, just 4 articles were written only by women compared with 20 written only by men (see [7]).

2.2 Commoning and the Commoner for CNs and Rural Women

In this article, I relate incompatibilities between debates about policies that affect CNs, rural deployments and women's practices to commoning, or the collective practices that produce, reproduce, and use the commons (e.g., [156]). While advocates' discussions about the commons with regulators refer to spectrum, they also consider common resources in other ways. The commons, of course, is a more general theme in envisioning alternatives to the state and the market in resource production, exchange and use (e.g., [23, 42]), and permeates discussion of the sharing economy, crowd-sourcing, open-source software development and peer production, and collaboration in participatory design (e.g., [15, 20, 59, 96, 135, 140, 103, 157, 163–165, 212, 229–232]). Thus, next, I introduce how CN discourse is selective about the practices and relations that make and sustain commons in its focus on the commons as resources. Then I refer to analysis in HCI that informs my understanding that states of communality and commoner identities are both contingent and intersectional. To conclude my discussion of related work I suggest that the combination of CNs' gendered spaces and divisions and commodification of labour may act as type of enclosure.

2.2.1 Reifying the Commons: Common Resources and CNs. The commons is both a paradigm and a social process in which a community creates value for, and governs the use of, shared resources. Common resources take diverse forms including physical entities and intellectual and cultural products that can or cannot be enclosed, like land, water, software; and, intangible social goods like caring for elders. Ostrom's (1990) studies renewed confidence in the commons [184], which had declined with Hardin's (1968) emphasis on the tragedy of resource overuse [107]. She demonstrated that societies sustainably manage depletable common pool resources (CPR) by maintaining rules and relations of trust, reciprocity and cooperation.

The CN movement's liveliest discussions about the commons have been about practices of allocating use of wireless spectrum frequencies for communications to entities, such as national telecommunication providers, broadcasters and small-scale operators. The two main mechanisms for allocation are analogising spectrum to be a common resource, and making spectrum private property by granting licenses, according to market principles [248]. Currently governments allocate more spectrum to the market because a few telecom companies influence policy and regulation. These companies also collaborate to maintain high prices and regulatory authorities are often lenient on, or even subsidise, regulated firms. As a result of this 'regulatory capture' [65] companies around the world control spectrum that they do not use across vast territories, such as in low-income rural areas of South Africa [11, 25]. Opposition to this status quo describes the advantages of 'open access-spectrum commons' to users, cost-effectiveness and innovation [24], and different ways that users can create and enforce rules and/or use technical approaches to mitigate overuse, such as bandwidth management and best-effort delivery [65].

Proponents of CNs apply Ostrom's principles for governing the commons [184] to various telecommunications resources. The Declaration for Community Connectivity recognises CNs by 'Collective ownership', where 'the network infrastructure is managed as a common resource by the community where it is deployed' [125], while advocates have also called for private actors to assign fibres for commons use when they lay backhaul cables across public land [17, 178]. Indeed, Ostrom's principles [184] are demonstrated by some European CNs such as guifi.net, which was created and is maintained by thousands of people [100] who contribute work or equipment and observe rules, contractual agreements and good practices to ensure the network performs [16].

Some decolonial critiques draw attention to the way the terminology of 'commons resources' reifies the commons (e.g., [63, 81, 215]), insisting that the commons is primarily an activity and set of relations. Technologists supporting communities that are developing CNs, though, often focus on things rather than on the practices and connections that made and sustain those things

[31]. Indeed, the impulse to reify is particularly acute in the ‘language of technology’ [12] and the metaphor that likens spectrum to land is normalised in discussions of regulation and management (e.g., [220]). The metaphor is certainly convenient in discussing spectrum with rural communities whose everyday livelihoods involve collectively, managing the natural environment and whose histories involved protecting this relationship from expropriation and privatisation (e.g., [167]). Yet, land was rarely considered a thing in many societies prior to European colonisation. To Aboriginal people, for instance, the term ‘country’ describes a relational system of living with copious ecological, genealogical and symbolic interconnections such as between flora, fauna, rock, water, fire, movements and ancestral memories (see [203]). That is, reifying the commons not only enables enclosure [64, 65] but selectively emphasises some practices and relations that make and sustain commons more than others [31]. The role of social processes in the commons has led to contemporary theoretic emphasis on ‘commoning’, which entwines production and use in reproducing the commons, as I introduce next.

2.2.2 *Commoning and the Subjectivities of Commoners.* The concept of commoning is increasingly used in discussing platform co-operativism, the ‘sharing economy’ and sustainable neighbourhoods. The concept aligns with commitments to democracy and more equitably distributing labour and resources (e.g., [157, 229]) and has been applied in approaches to environmental sustainability problems, local resilience and adaption, building social movements and connections among people including between rural and urban inhabitants (e.g., [15, 90, 94, 149, 150, 163–165, 222, 229, 230, 232]). Analyses consider logics about ownership, governance, management and cooperation as communities form and meet shared goals, and also how the market can co-opt the commons, undermine collaborative processes and take from common property in delivering products, services and systems. HCI has not, however, specifically related communalist subjectivities to commoning. Thus, next, I briefly describe some characteristics of commoning, in relation to design, and draw on other work in HCI that might help link commoning to the state of communalism, logics about personhood and the creation of self-identity.

Baibarac and Petrescu [15] synthesised principles from the literature (e.g., [44, 105, 116, 224]) in a framework for co-designing digital tools to prompt and sustain commoning. They found that effective processes engage multiple stakeholders; are situated in existing practices but involve ‘local’ experimentation and enable new practices and knowledge to emerge; support ongoing collective ownership, production and adoption of knowledge; locate accountability locally and stimulate recursive engagement; and, support communication with other groups and external expertise. I have shown that the co-design of apps to support collaboration by the Argentine CNs described in this article manifested all the principles in Baibarac and Petrescu’s framework except intervention by external specialists [30]. The app emerged in CN members’ ongoing mutual interactions and supported local awareness of local details [30], an approach that aligns with perspectives that commoning lies in the minutiae, and that ‘becoming in common’ is partial and transitory and must be repeatedly performed [179]. Practices in the Argentine CNs also correspond with a perspective that commoning is achieved when people work out ways to participate in the lives of others who differ from themselves by casting their past experience forward to join with theirs, rather than looking back on they are similar [117].

It’s not simply that people achieve commoning by autonomously and rationally choosing to be a collectivist or communalist not an individualist. Instead, practices of solidarity, rather than self-interest, such as not ‘free-riding’ a CN’s services, are shaped by regulatory systems such as social norms and conventions, body practices, moral guides and institutions (e.g., [178, 245]). Members of an Italian CN, for instance, develop convergent practices by engaging in the CN’s processes over time [60]. The HCI literature has considered relationships between technology, communalist

subjectivities and regulatory systems. For example, I, and others, have proposed that norms and conventions embedded in technology privilege a logic that personhood exists prior to interpersonal relationships [26, 27]. This logic about personhood contrasts with the African Ubuntu philosophy that assumes that neither community or individual is prior, and being human depends on the simultaneous and dynamic constitution of other humans; or, as Eze (2010) explains the following:

We create each other and need to sustain this otherness creation. And if we belong to each other, we participate in our creations: we are because you are, and since you are, definitely I am. [82, pp. 190].

While ethnography suggests that daily life in communities that practice Ubuntu actually go along in ways that are ‘at once both and neither personhood-as-pre-existent and/or personhood-as-acquired’ [27], HCI literature tends to dualise individualist and collectivist subjectivities rather than engage with their dynamics and ambiguity. However, in discussing identity in relation to technology more generally HCI accepts as Butler (2005) puts it: ‘the “I” has no story of its own that is not also the story of a relation’ [46]. Referring to Butler’s theory about how subjectivities are formed, Light (2018) explains that identity is inscribed onto a person’s body when others repeat social practices that cite norms that were already legitimated, such as when “‘It’s a girl!’” anticipates the eventual arrival of the sanction, “I pronounce you man and wife.” [148]. Light and others refer to a person’s agency in choosing to reject some regulatory systems and accept or partially acquiesce to others when they negotiate power relationships. Histories of power are, of course, engrained in subjection, and agency lies along the same axes of the norms that limit it. For instance, a mother’s experience of ‘motherly care’ does not feel externally imposed [18]. This reasoning may apply to the formation of the commons subject. A commoner’s subjectivities are ambivalent, practices are always contingent [5, 216, 245] and commoning relationships are intersectional, since gender, race, caste, age, disability and other social relations of difference entwine to shape a person’s experience of power [179]. Contingency and intersectionality are exposed in the way CNs frame women’s work in rural communities in the Global South, as I next propose.

2.2.3 Uncommoning: Co-opting the Commons and Selective Enclosure. Commoning around a collective interest is sustained by everyday practices that forge mutual, affective, embodied bonds. Local ownership is considered vital to sustaining CNs (e.g., [7, 83, 177]) and the HCI and ICTD literature shows that situating communication infrastructures in the values and practices of rural communities in LMICs can help to ensure services fit local needs, livelihoods and particular types of, and roles in, communication (e.g., [2, 13, 37, 38, 50, 66, 77, 112, 142, 172, 180, 181, 221, 226, 247]). Yet commoning also creates exclusions and ‘uncommon’ relations since, there are differences in shared practices and daily engagements amongst members, even in groups with strong communitarian traditions, for instance because of caste amongst women foresters [179]. CNs’ gendered spaces, described in my prior analysis [28, 29] and summarised in 2.1.2 and 2.1.3, are conflated with divisions of labour and, as I discuss next, this relates to commodification.

Even when encouraged to focus on technical skills, women in CNs in the US find it difficult to resist gendered divisions of labour and, in the allied technoculture of community radio in Brazil women are more likely to be cleaners and secretaries than technical managers [256]. Academic studies on CNs in the Global South perpetuate this division. Consider how a paper about a Filipino CN describes women’s enthusiasm for repair work and calls for advancing from ‘the status quo of enlisting only a few males in leadership positions for maintenance work’ [129], yet a subsequent study interviewed three times as many men as women about repair and quoted men 10 times more often [130].

Tensions also arise because the systemic devaluing of women's contributions, shown in allied technocultures [151, 152], combines with the commodification of labour in the paradigm of innovation drawn upon by CN discourse in the Global South. Analysis of a Cuban CN reminds us that a paradigm that makes a virtue of hands-on work romanticises labour and economises citizenship [78]. Indeed, the economic focus of 'entrepreneurial citizenship' [128] hides the contribution of different groups, in particular older women. Consider, for instance, how neither media (e.g. [21]) nor academic reports (e.g. [200, 201]) about a South African CN focus on the economic and operational roles of women's unpaid labour in the CN's achievements [114]. Consider also how older women regard their unpaid care labour, in supporting their university-educated sons and grandsons in an Indonesian biohacker collective, to be a duty [153]. Indeed, while young Indonesian men publicly distinguish their endeavours from the exploitative structures of capitalistic enterprise and foreign commentators celebrate the collective's opposition to colonialism, older women were more restrained in claiming such emancipation [153].

In this article, I consider the confluence of CN technoculture and rural practices of commoning in the Global South and propose that CNs can act as enclosures that keep women out. My analysis is influenced by Achille Mbembe's considerations of technology's role in postcolonial 'borderisation', in which spaces become uncrossable for certain populations [166], and Silvia Federici's description of how enclosures undermine women's self-sufficiency and construct social hierarchies and divisions based on gender, race, and age. Federici argues that subsistence women, from English peasants in the 1400s to Indian farmers' and Latin American indigenous people more recently, are motivated to resist enclosures and benefited least from both postcolonial land privatisation and reinvented customary tenures. However, rather than framing commons as a resource, as Federici does, my emphasis on commoning shares Gustavo Esteva's [81] and Vandana Shiva's [215] commitments that the commons are relational activities.

3 MULTIPLE CASE RESEARCH AND MULTI-SITED ANALYSIS

This paper explores interactions between gendered sociotechnical imaginaries of CNs and practices of commoning. It extends prior analysis of data generated in multiple case research in rural areas of six LMICs [28–31, 40] by accounting for rural commoning, the emphases on resources not relations by CNs and responses in the international CN movement to my earlier analysis. I do not claim objective detachment and my work over the past decade, as I explain in section 3.1, includes technology interventions in rural areas of the Global South and advocating for CNs.

3.1 Sociotechnical Interventions

My engagement with CNs began in 2008 in South Africa's rural Eastern Cape, although for the first 3 years I was unaware of the term 'community network'. I undertook ethnography whilst living in a village and my insights and relationships inspired installing long-distance Wi-Fi between three headmen. While the long-distance Wi-Fi did not sustain, insights from its failure and my subsequent prolonged action research in nearby villages (e.g., [26, 27, 35–38]) scaffolded the emergence of a CN (e.g., [200, 201]). I promoted CNs when I moved to Namibia in 2014, with workshops at the National IT summit, funding for rural Wi-Fi and offline CN projects (e.g., [9]), and by mentoring a student who started a CN in a village near my home [159]. I also assisted a programme for women-driven CNs in Africa [1], and co-ran workshops that introduced African women to CNs (e.g., [251]) and brought together academics and practitioners [34].

3.2 Multiple Case Research

At the end of 2017 the APC contracted me for a year to study relationships between social, gender, economic, political and ICT factors in people's access to, use of, and interactions with rural CNs

Fig. 1. A node on home in one of the Argentine CNs, forested landscape.

in the Global South. The project began the APC's ongoing CN initiative [8], and our team defined CN broadly to account for the varied ways that rural communities might 'connect themselves'. We selected from 40 potential cases in 19 countries based on: their visibility to the APC; interest; rural location; spread across three continents; ease of access in visits of a few weeks; languages spoken; potential for the set to show diverse business models, technologies and services; and possible impacts from reviewing online documentation about 23 CNs. In some cases, residents of villages set up their networks, and in others external organisations, including commercial providers, set up and maintain infrastructure for one or more CNs. All cases considered their endeavours to be rural and five publicly identify as 'community networks', such as in a recent book [7]. The national settings of cases vary from low-income Uganda (2018 GDP per capita: \$643) to upper middle-income South Africa, Mexico and Argentina (2018 GDPs per capita ranging from \$6,000 to \$11,000) [253]. The 2018 Gender Inequality Index (GII) are also diverse, from more equal in South Africa to less equal in Indonesia [239]; however, there are regional differences in all cases.

3.2.1 Argentine Case. The two Argentine CNs are 70 km, or just over an hour's drive on a highway, from the provincial capital of Cordoba, where homes lie on small plots along lightly trafficked tar roads, paths through forests and arable land, and on mountains (Figure 1). The area has a warm and temperate climate, with temperatures falling to 10C in the short, dry winters and rising to 25C in summer, when there is rain, hail and electrical storms (see: [29]). The CNs are part a group of five, spread across 200 Km² in villages and a small town, that provide internet access mostly by wireless connections, directly by line-of-sight or via a few hops within the local mesh.

Members of the CNs self-organise and install their own routers to connect their households to each other, local servers hosting a shared video archive and an upstream internet. After the first CNs were established, they made arrangements with a university in Cordoba to donate 15–20 Mbps when staff and students are on campus and 250 Mbps at other times. Members collaborated to instal the tower and solar panels atop a mountain for the upstream link. The CNs offer some street access but most use is via households, which pay a US\$7 monthly fee and connect, on average, three or

Fig. 2. Looking from the small town towards the other villages served by the CN in Mexico.

four access devices at peak times. The fee funds materials, but the CNs are lenient about when payment is made. To begin with CN members manufactured parabolic antennas to reduce costs; however, as the CNs grew some members created a non-profit AlterMundi (www.altermundi.net) to support the CNs and develop a wireless router and the LibreMesh operating system software, which is better suited to their needs.

AlterMundi circulated information about my study via the CNs' various WhatsApp groups and discussed participation with CN members. They proposed I generate data about the CNs, which encompasses 100 households, a cultural centre and school, and a more recent CN that covers 15 households and typifies some of the challenges faced [30].

3.2.2 Mexican Case. The Mexican CN is 60 km, or over 2-hour's drive on a road that twists around the steep passes to the nearest urban conurbation of small city, and a further 2 hours on a highway to the provincial capital of Oaxaca. The network covers 200 km² where a primarily subsistence population of 2,500 Mixtec people live in a tiny town and in five villages that are a 15-minute drive on a gravel road or a 2-hour's walk through the densely forested, mountains (Figure 2). With a sub-tropical climate, temperatures vary from 9 °C to 29 °C with rains throughout the year, but more heavily in summer, which effects the solar-powered network. Unlike the other CNs in my study, the network provides GSM-based 2G mobile voice and SMS services. It uses low-cost, software-defined radios used for mobile base stations that, at the time of my study, used a Wireless Internet Service Provider (WISP) for backhaul.

The Mexican CN is run as a private enterprise by the indigenous assembly, through a local branch of the Telecomunicaciones Indígenas Comunitarias (TIC AC). There are over 300 subscribers who pay a US\$2.2 per month fee and top up by about US\$1/month for long distance calls. In addition to the CN, I gathered data about local WISP franchises that provide separate internet services and Wi-Fi connectivity to homes. The CN is part of a federation of 16 independent networks in TIC-AC covering 70 localities. TIC-AC is supported by Rhizomatica (www.rhizomatica.org/) based in Oaxaca and, at the time of my study, mostly staffed by people from major cities in Mexico

Fig. 3. Main village street, along which Wi-Fi access points are located in one of the Indian CNs, and terrain around the village.

and elsewhere. However, one engineer is Mixteca and another was in Chiapas for years, working with the Zapatista movement.

Rhizomatica selected the CN I studied because it shared similar challenges as other CNs in the federation and illustrated interesting gender characteristics. Only one CN in the TIC-AC federation is facilitated by a women's cooperative and the rest are governed by male assemblies. However, the president of the assembly of the CN I studied is a woman who had also been involved in legal test case through which TIC-AC had claimed the rights for people to use GSM spectrum for social purposes.

3.2.3 Indian Case. I generated data about CNs in eight villages in Palghar/Thane districts, Maharashtra. Some villages are 10 km, or a 20-minute drive through forests to a small city, others near a highway that is 100 km or a 3-hour drive to Mumbai, and some are slightly more remote. With a tropical monsoon climate, temperatures vary from 14 °C during short, dry winters to 34 °C in humid, wet summers. I gathered most data at three villages, each with a population of about 512 500 people whose homes lie on footpaths and tracks (Figure 3). The CNs provide internet access at hotspots in local administration buildings, schools and on some roads, using 5.8 GHz Wi-Fi.

The CNs were initiated by Gram Marg based at the Indian Institute for Technology (IIT) Bombay (<http://grammarg.in/>), 100 km away, as a test bed for wireless technologies and business models, originally using TV Whitespace until the experimental licence expired. The current Wi-Fi set-up is governed by Gram Panchayats and maintained by a government Common Service Centre (CSC). Users buy monthly vouchers for US\$3–11. CSC employees are from the districts served by the CNs, although not from the villages per se. Staff of Gram Marg, who not from the area, selected 8 from 25 CNs for introductory visits based on combining them with their own technical work, discussions with CSC and familiarity with Gram Panchayat staff. Then myself and a woman researcher selected three villages to focus on and I spent additional time in one of them, where we had more access to women inhabitants.

3.2.4 South African Case. I gathered data in four villages in the Eastern Cape province, 1.5-hour drive on a 75 km gravel road to the nearest small town, and another 20 km to a small city. The CN 527 covers 15 km² populated by 7,000 Xhosa people whose homes lie on footpaths and tracks on grassy hills near the coast (Figure 4). With a warm and temperate climate, temperatures vary from 10 °C during short, dry winters to 25 °C in wetter summer (see [39]).

Fig. 4. Sub-headman's homestead, in which an access point is located, and the hilly terrain of the South African CN. Photo courtesy of Carlos Rey-Moreno co-founder of Zenzeleni Networks.

Fig. 5. Terrain around one of the Ugandan CNs.

The CN provides internet access at Wi-Fi hotspots, using 200 Mbps point-to-point links and solar power. Users buy monthly vouchers for US\$1.7, which is subsidised by internet provision to local businesses. The CN is run by a co-op associated with a tribal authority that governs 12 villages, and supported by a non-profit, Zenzeleni Networks NPC (<https://zenzeleni.net>). The NPC is based in Cape Town, 1,300 km away, and now supports two CNs in the Eastern Cape. The NPC is linked to the university that was involved in establishing the CN in both this case study and in my prior research (e.g., [27, 36, 114]). At the time of my study the NPC was staffed by South Africans of different races, some of whom had family connections with the province, although not to the villages served by the CNs.

3.2.5 Ugandan Case. I gathered data in villages, towns and refugee settlements in Patonga and Gulu districts, varying from a 20 km to 150 km, or up to 3-hour drive, to a small city close to the Sudanese border. Most homes in villages lie on footpaths and sand tracks through small agricultural plots, interspersed by dry forests (Figure 5). With a tropical monsoon climate, temperatures vary from 14 °C during short, dry winters to 34 °C in humid, wet summers.

The CNs variously provide free access to solar power and computers and some internet access at hotspots in local administration buildings, some schools and public ICT centres in villages. A non-profit enterprise BOSCO (<http://boscouganda.com/>) undertakes installation and maintenance at 28 sites, over a vast area, but centres are managed by local groups and funded by external donors. The CNs are located between 20 and 250 km from BOSCO headquarters, however, all BOSCO staff originate from the areas, including from some of the villages served by the CNs I visited. BOSCO selected five sites including a huge refugee settlement, a small town, several

Fig. 6. Village streets and a home in a plot around the Indonesian CN.

villages and a CN associated with a women's care group. Based on preliminary analysis of initial interviews I spent additional time with women and men who ran small businesses using the solar power system.

3.2.6 Indonesian Case. The only case in my study that did not self-identify as a CN is in a village 40-minute's drive through 25 km of paddy fields, forests and lowlands, from the small capital town of Central Java. The village comprises five hamlets across 15 km² and is populated by 5,900 people whose homes lie on small plots along an agricultural canal, a lightly trafficked tar roads, aligned in 558 grid, with alleys in between (Figure 6). With a tropical climate, temperatures remain around 32 °C 559 year-round, with extreme humidity and rain in most months, particularly in summer.

I gathered data about a Wi-Fi internet installed by a commercial WISP and financed by the village authority. The Village-Owned Business Entity, BUMdesa, takes a 20% commission on monthly subscriptions from the 50 households that were connected at the time of my visit. BUMdesa and the Chief's office have Wi-Fi access, and a small restaurant and shop sell hourly and daily vouchers. Pusbindes, a voluntary 'ICT evangelist' organisation supports the village's ICT enterprises, but not 565 the network specifically. Pusbindes volunteers are based in the small city and originate from other 566 villages in the area. Their work and the work of the village has been recognised by international 567 awards [40]. We also visited three other network types in Indonesia introduced by an ICT activist 568 contacts.

3.2.7 Participants and Ethics. In total 152 women and 172 men participated in focus group discussions (FGDs), interviews and observations during 66 days across 10 months. They connect to their CNs in varied ways as the organisations vary in each case, but can be grouped into four overlapping categories (Table 1). Ethics reviews of the proposed methodology [40] and subsequent reports were conducted by APC staff, independent of the project team, all of whom live in the Global South, including some of the countries involved, have expertise in human rights, gender and feminism, close grassroots relationships and are mostly women of colour (e.g., www.apc.org/en/wrp, www.apc.org/en/strategicpriorities2020_2023). I sent detailed written and audio information about the study and consent processes to support organisations, for them to translate, and solicited and responded to their feedback.

Table 1. Total Numbers of Men and Women in Overlapping Categories of Participant Types Across All Six Cases [29]

Type	Participants	Women	Men
1	Initiators or champions in external support organisations	2	7
	Technicians and coordinators in external support organisations	14	33
2	Leaders and operators in rural villages	15	33
3	Users in rural villages. Might also be in Type (2)	78	93
4	Non-users in rural villages. People who do not use the CN directly because they cannot, chose not to, or are mediated by other people. Might also be in Type (2)	57	31

Ethical compliance at rural sites varied. While I do not identify participant or village names, local anonymity can be impossible since participants of Type 2, 3 and 4 live in the same or nearby villages, except in Uganda and India where cases included many more sites. More potently, as my findings discuss, while host support organisations or the CNs recruited participants of diverse ages, education, employment and income they did not always recruit equal numbers of women and men, or separate FGDs for women and men as I suggested. Some of the women I interviewed in India and Indonesia had permission from male family members, and I attempted to ensure that interviews and FGDs would not pose any danger to women in restrictive marriages and parental/in-law relationships. I did not request recruiting diverse gender identities or sexualities as customs and laws at many rural sites makes visibility or discussion unsafe. Of 34 FGDs, 10 included only women, 8 comprised only men (excluding myself) and 11 comprised 65% men.

Over 80% of interactions were mediated in Hindi, Javanese, Spanish, isiXhosa and Luo and Nilotic dialects that were translated into English, often simultaneously. In four cases interpreters were associated with the CNs. For two cases both men and a women interpreters were provided and in two cases only a woman. In one of the two cases when only a man interpreter was provided, women arriving for a FGD told him to sit outside and translated between themselves. In the other case when the support organization provided only a man interpreter, I asked for a specific woman, who was able and eager to interpret, but was told by that she could not be relieved from her work.

3.2.8 Instruments. I generated most data in interviews, lasting a few minutes to 2.5 hours; FGDs of up to 3 hours; observations; and documents during 66 days across 10 months (for full methodological details see [40]). I adapted topic guides to structure FGDs and interviews as themes emerged, and audio and video recorded if participants permitted. Interviews with participants of Type 1 and 2 (Table 1) yielded data on motivations, organisation, decision-making, management and operation of CNs. FGDs with users and non-users of CNs yielded data on the use, relevance and contribution of the CN to personal and communal life; local communication ecologies and the CN as a sociotechnical system; specific effects of the CN in communication and information practices; and constraints on access, and their relationship to people's lives.

Some FGDs and interviews with users also generated data on the details of participants' experiences of CNs in diary accounts. Participants reconstructed 'scenes' [145] in the day in which their CN featured in some way, and I asked open-ended questions about what they were doing, who they were with, etc. I also interviewed, and observed participants' interactions with each other, equipment or other things in less contrived settings. Sometimes observations and interviews arose in a CN's or support organisations' planned activities, such as a workshop or a drama. Other times engagements arose spontaneously, such as while I sat observing or waiting for transport in a plaza or under a tree, while eating at a cantina or participating in morning exercises with women in a

park or evening fiesta dancing practice. Data in interviews and FGDs also included soft and hard documents, such as media illustrating use of the CN (e.g., WhatsApp messages) and I recorded interfaces to applications and systems comprising the CNs and posters, signs, maps, etc.

After visits I coded data and created concepts and theories about practices for each case. Analysis yielded common and contrasting characteristics amongst cases and interrelated themes, such as features of the CNs and qualities of their impacts in their specific settings. Interpreters in each case validated my formative and summative accounts. I maintained remote contact with hosts and some participants in the 3 years since my visits. I have also met and observed participants of Type 1 from five cases at four international civil society meetings and CN summits that inform my analysis with multi-sited meanings, as I describe next.

3.3 Observing CN Advocacy and Movement Building

As well as my multiple case research, the APC project team studied the technologies and business-models deployed by CNs and policies affecting CNs, prototyped technologies, liaised with CNs, civil society groups and regulatory authorities globally, and responded to requests for consultation about regulations. The team comprised five white men, aged mid-thirties to sixties, and two women, a woman of colour and myself. We all had extensive experience in technology in the Global South, and like me, three of the men had founded CNs. We lived in Mexico, Canada, Portugal, South Africa and Namibia and, thus, physically met only at the project's inception, a year later and when my research concluded. In between we met online weekly and posted to dedicated Slack channels almost every day to update on research and advocacy and share materials about policy, technical advances and impacts. Our lively discussions encouraged different perspectives, and activists responded to some insights as they emerged (e.g., [67]), such as more deliberately involving women in policy consultations. My field trips were coordinated with a senior male APC team-member who studied the technical infrastructure and business models in many different CNs [40] and stayed only a few days during my visits to the cases described in this article.

My multi-sited [161] engagements with CN advocacy and movement building actually began several years before my contract with the APC and continued afterwards. In 2016, I was involved in the first African Summit on CNs in Nairobi, in 2019, I attended the fourth African Summit on CNs in Dodoma and, in between, I participated in associated WhatsApp groups. I also participated in fora about CNs at the International Governance Forums (IGF) in Paris and Berlin in 2018 and 2019, and online and offline groups involving CNs advocates from around the world. This includes discussing insights from the multiple case research presented here, and activists' responses to this analysis.

3.4 Synthesis and Reflexivity

To explore relationships between the sociotechnical imaginary of CNs and rural commoning I extend on past analysis. During the multiple case research I drew on Feminist Standpoint theory [108] to generate data about meanings situated in local contexts in ways that recognise that the lived experience of the CNs' users and non-users yields an awareness of inequalities. My analyses also drew Kumar's application of 'feminist solidarity' [143] since my reflections about women's agency and challenges in any one case shaped my sensitivities in other cases. My decolonial and feminist sensitivities were further entangled in the complexity of participating in a project to advocate for and support CNs. Feminist technoscience reflections on a commons-oriented project show that we construct the world when we design research to give voice to and emphasise the local and marginal positions of normally invisible people [213]. As I drew together multi-sited observations about advocacy and movement building, I noticed tensions with principles of the commons and, since my contract ended, I re-examined my data through a lens of commoning. Thus, this article

summarises some published findings, presents others in more detail, and relates both to unpublished data on the rural commons. I incorporate translations of participants' spoken words directly in my account, as well as block quotes to show data for specific themes.

My positionality is also, of course, tuned by my experiences in sociotechnical interventions over the past 10 years (see 3.1), the precarity of my living situation, and other aspects of my identity that bear upon technology, commoning and rurality. I am a middle-aged, white, single, cis woman who has lived at least 30 km from a town for 15 of the past 18 years; three in far north Australia, a few months on rural Mozambican and Irish islands, and the rest in rural South Africa and Namibia, including 3 years living without mains electricity. In earlier years I lived in rural and urban areas of Africa, Asia, Australia, the Middle East and UK, over half the time by choice. My felt bias, however, is rural; be that everyday experiences of isolation and immobility, weather, neighbourly reciprocity and frictions, to atypical events like fires, drought, cyclones, violence and wild animals. While most familiar with dwelling rurally, my peripatetic, educational and economic agency differ from participants in villages who will position me as an outsider, not least because of my race and settler status. My sensibilities with respect to my rural home and setting up CNs in African villages made me an insider with a few participants in support organisations who must delicately manage interpersonal relationships in close proximity to their home and economic circumstances that differ from the Global North. However, activists interacting with policy-makers considered me an academic researcher.

4 ANALYSIS

CNs in the multiple case research benefited their rural communities in many ways providing connectivity for the first time, saving users up to 90% of the communication costs charged by national telecoms companies, enhancing local economies, through income from employment and trade, and local education and welfare [40]. However, the CNs most directly benefit the people who use or are paid to operate them, which tends to exclude women who comprise 50%–70% of local identities. I introduce this masculine bias by discussing relationships between the identities and approaches to governance in the rural communities in *Governing the Commons* (4.1). I begin, in *Local collective ownership: traditions and migrations* (4.1.1), by describing relationships between ownership, communalism and ancestral connections or relocations to the areas where the CNs are sited. Then, in *Governing CNs: gender and age* (4.1.2), I discuss how governance structures in the cases comprise more men and older people than for CNs in the Global North. This contributes to reproducing certain identities about technology, as I illustrate next, in *Uncommoning by the Language and Identity of Technology* (4.2). I explain how rural inhabitants associate technological skills with younger people, in *Youth bias in technological Tasks* (4.2.1), and equipment with masculinity and certain divisions of labour, in *Male bias in technological Tasks* (4.2.2).

Associating technology with youth and masculinity has important implications for practices of commoning in CNs, as I discuss in *The Enclosures of CNs* (4.3). In *Excluding Relations Made in Women's Activities* (4.3.1), I show how constraints on women's access to the CNs limit the social and environmental relations that are made as women move between activities that comprise their everyday commoning access to the CNs within their activities and movements, such as cooking and farming. Further, the language and identity of technology, reproduced in the CNs, undermines the self-sufficiency that enables equitable cooperation, as I describe in *Limiting freedoms: gendered and intergenerational dependencies* (4.3.2).

In *Uncommoning Labour* (4.4), I discuss the implications of gender and generational associations and paid and unpaid labour for commoning in the CNs. I describe the limited local employment opportunities, in *Situating work in land and mobility* (4.4.1), and then summarise relationships

between the CNs, local identities and values about cooperation, in *Persisting and revitalising communal values* (4.4.2). Next, in *Women's unpaid care labour* (4.4.3), I explain how customs and expectations of labour intersect with valorising of technological tasks, such that women contribute work to the CNs that is often unacknowledged and usually unpaid. Paradoxes emerge in relation to the importance of telecommunications to youth employment, elders' concerns that access promotes attitudes that undermine communal values, and increasing ambivalence amongst youth about unpaid labour, as I describe in *Ambiguities for youth and unpaid labour* (4.4.4).

In *Managing Commoner Identities* (4.5), I discuss women's strategies in response to expectations of their care labour. Some pursue independent enterprises because they were excluded by a CN, as I describe in *Women and enterprise* (4.5.1), yet are careful to manage expectations of commoning, as I illustrate in *Caring identities* (4.5.2). Women with greater exposure to places beyond the rural sites were most likely to reimagine their identities in relation to commoning and ICTs, as I indicate in *Women's aspirations beyond rural places* (4.5.3).

I conclude my analysis, in *The Gendered Visibility of Commoning* (4.6), by considering how CN movement building and advocacy contributes to de-emphasising the commons that women produce. In the rural CNs, valorising equipment and skills that associate with masculinity makes women's commoning invisible, as I describe in *Equipment embodies rural commoning* (4.6.1). This invisibility is amplified by the impulses of advocates when they present CNs to policy makers and funders, as I explain in *Scaling and enclosing the imaginary of the commons* (4.6.2).

4.1 Governing the Commons

The recursive character of CNs in the Argentine case was most similar to CNs in Europe, north America and Australia, where maintaining the network enables the group associated with the CN to exist. All the other CNs in the multiple case study associate in some way with pre-existing rural governance structures. Extant authorities and institutions are directly involved in the Indonesian, Mexican and Indian CNs, and indirectly in South Africa and Uganda. As I describe next, in several cases governance emerged in the traditions of populations that have inhabited the area where the CN is sited for generations, and ownership expressed these identities. Governance structures often involve people with limited exposure to technology and comprise mostly men. In this section I elaborate on details of data, that my prior accounts only briefly summarise, to show relationships between ownership of the CNs and traditions about the commons (4.1.1) and then how local governance involved mostly older men, and separated social and financial aspects from technical decisions (4.1.2).

4.1.1 Local Collective Ownership: Traditions and Migrations. Participants considered local ownership and governance of their CNs important and sometimes explicitly related this to their traditions about the commons. Local populations in half the cases studied had ancestral ties with the areas in which the CNs were sited and governance emerged in their customary authority structures. Collective ownership and governance of some CNs expressed local identity, for instance all participants at the sites of the Mexican CN are indigenous Mixteca people whose right to own land entails their household's participation in both communal work and a traditional assembly that manages local resources including the CN's operation. The assembly is officiated by a President and Vice-president, roles conferred by other inhabitants, and different men and women participants described their sense of ownership of the CN, for instance 'The owner is the [customary] authority...We like it because of [our] control'. They said they had to solve their telecommunications gap themselves because 'We indigenous people are discriminated by the government maybe because we are a small population and resources, we get little'. A former President of the assembly explained:

As the authority from the last period, we were worried to find a company that could bring the phone service. Before there was a Chinese company that came with a pilot program to see if the Huawei program worked. In that period, it worked for months, almost a year, but because of the monthly 100 Pesos that we have to pay, it wasn't affordable for many of us. So, as the authority from past years, we looked for a company that would provide the service. Fortunately, a guy from this community worked with [the Founder of Rhizomatica, the support organisation]. That was an initiative because we realised it was a need. It was so nice that our sons living in the States could speak with their family at any time. So, we spoke to [the Founder of Rhizomatica], who gave us all the information and sent it to the authority. We liked the way he worked. Then he personally came with his team and gave us more information and convinced us and asked us for all the paperwork that was needed, like the assembly paper, from the Municipality.

Ownership also associates with local identities based on ancestral connections and communal land in the South African case. All ten members of the co-op that governs the CN are inhabitants; eight are headmen, sub-headman, or their spouses, who are part of the tribal governance of the villages served by the CN. Village governance roles are usually inherited, sometimes across eight generations, and imbue the CN with a sense of sovereignty; as a woman co-op member expressed by referring to a leader in the liberation from apartheid, 'we are an example of Mama Albertina Sisulu. We are the owners of this project'. Families of participants in the rural village where the Indonesian case is sited had also lived locally for many generations and the village's elected Chief explained that he had 'the initial idea to build the tower' to provide connectivity to his village. He sought to comply with the government's mandatory requirements for integrated village information systems and paid for installation costs from a federal allocation that aims to ensure village authority offices are online.

The Indian CNs also related to local authorities, Gram Panchyats, pursuing community development goals linked to national programmes. However, many who work for the Gram Panchyat are not local to the villages in which the CNs are sited and where 'tribal' people originate. Indeed, ancestral ties varied in half of the cases I studied. In Uganda some participants resettled or settled their villages after war and the organisation that supports the CNs, BOSCO-Uganda, seeks to establish unity within communities that were destabilised by conflict, post-conflict and relocation. Sub-county administrative leaders identified potential sites for CNs, however in many villages they were organised by groups of younger people, independently of village authorities.

Only the Argentine CNs were fully independent of extant local authorities, and included 'newcomers', who migrated permanently to the area during its gentrification in the past 5 or 6 years, and 'natives' whose families had lived locally for generations. Newcomers are often well informed about laws that permit squatters to eventually own the land they occupy according to certain conditions; and the founders of the Argentine CNs, who are mostly newcomers, sought to build bridges with natives in governing the CNs.

While the CNs relate to traditions about the commons in the different cases, both governance structures and concepts about sovereignty have complex relationships with colonialism, which contribute new hierarchies and emphases in self-determination. The designation of headmen in Africa and Asia, for instance, derives from indirect rule in British colonies (e.g., [69, 171 246]). Meanwhile, in response to their postcolonial oppression, indigenous groups in Latin America have sought to claim territory not just exercise customary responsibilities as custodians of homelands. Indeed, the land commons in all cases is affected by transnational economics. Members of the Mexican CN mentioned threats of water privatisation schemes, members of the Argentine CNs

had resisted local mining endeavours, and we drove passed a hydro generator that exports power internationally in order to reach the Ugandan villages where BOSCO's solar set-ups are the only electricity source [32].

4.1.2 Governing CNs: Gender and Age. While processes differed between CNs, most governance was undertaken by men, and often included many elders. The Indonesian elected Chief and Indian Gram Sabah, supported by local government employees, communicated executive decisions to household heads. In contrast, the Mexican assembly, comprised of all household heads, voted on decisions about the CNs, and the smaller South African co-op and Ugandan local groups took decisions themselves. Generally, governance decisions focused on financing, expenditure on equipment, relationships with providers, locations of access points, employment of operators and pricing and rules about access, not technical decisions, such as about network configurations. In all cases, except Uganda, CNs were governed by older people which reflects both migration by younger people to urban areas and decision-making by 'heads of household' and existing authorities. In Indonesia, Mexico, South Africa and Argentina the districts rural populations comprise fewer people aged between 20 and 40 years, relative to national averages, because they leave for education and employment. On the other hand, only 22% [68] and 14% [236] of the respective Indian and Ugandan local populations were aged over 40 years. People involved in Gram Panchayats and meetings in the Indian CNs are older, but the Ugandan CNs were governed mostly by people under 30-years.

Despite relatively more women in most of the cases' local populations, only decision-making in the Argentine CNs was not strongly male biased. The local population for the South African CNs is 70% female [200], but women were in a ratio of 3:7 in the co-op governing the CN. Meanwhile, representation of households at the assembly governing the Mexican CN is a ratio of 1:25 women to men, although the assembly's current President is a woman. In Uganda, where 51% of the local population is female, and women comprise 60% of the population aged over 60 years [236], women were in much lower proportion in overseeing the CNs except for one women-driven CN.

The proportion of females in the district's rural populations in the Indian and Indonesian cases in the past decade are 49% and 50%, respectively [14, 68] and there are few or no women in the structures governing their CNs. In Indonesia a man in his thirties who uses the Wi-Fi explained that over 25 people from the village people attended a meeting informing about the plans for the CN. However, when asked about this meeting a group of six mothers, aged 37–64 years, said 'we were not invited' and their husbands did not explain the plans because 'they felt we would know nothing about it'. In fact, local norms about male governance had meant that when no other candidate would stand against the popular incumbent Chief in a recent election, the Chief's wife had stood in order for the election to take place.

4.2 Uncommoning by the Language and Identity of Technology

Unlike CNs in the Global North, which emphasise peer relationships between people who govern, set up, operate and use equipment in their own neighbourhoods, most of the networks studied were created and maintained by technicians in support organisations located far away. Thus, governance decisions about financing, expenditure, everyday business and access were separate from technical installation, maintenance and operation and, as found for radio projects, decisions enacted boundaries between 'the technology' and 'the social' [76]. In interviews in most villages technological tasks included using computers to manage subscriptions to the CNs as well constructing, installing and maintaining the network, such as soldering boards, assembling wires, setting up and caring for routers and antennas and so on. In most cases technological tasks were undertaken by men who are younger than those governing the CNs and, as I describe next, this situation reproduces certain identities for technologies and technologists, as I describe next. This

situation reproduces certain identities for technologies and technologists, which contributes to particular divisions of labour in producing the commons of the CNs.

4.2.1 Youth Bias in Technological Tasks. AlterMundi in Argentina is the only support organisation geographically located within the CNs studied. The non-profit arose when the CNs' founders applied their experience to developing a low-cost tool-kit to make it easier for people with few technical skills to set up and maintain CNs [30]. AlterMundi's collaborations with universities emerged after the CNs formed. In contrast, the CNs in India and South Africa arose from research projects initiated at universities, 100 km and 1,300 km away respectively, and the not-for-profit organisations in Uganda and Mexico are also based up to 250 Km from the CNs that they set up. Resource constraints restrict frequent trips to CNs by support organisations and many interactions to maintain the networks are remote. All support organisations aim to build capacity in the CNs; however, this often focuses on computer literacy and economic management of the CNs not setting up or maintaining networks.

Members of both the South African co-op and Mexican assembly referred to the metaphor of 'walking together' with their support organisations. They insisted that they made the decisions about their network, fluently referred to the equipment used, funding sources and phases of their networks, although uncertain about the details of procuring and installing equipment. As a 31-year-old father in Mexico explained, 'we live in the field and it's what I like. We sometimes don't manage the technological stuff'. Few of the South African co-op members I spoke to use the internet or own smartphones; and, in India, a woman Sarpanch (head of a Gram Panchayat) in her late thirties explained that the internet was used most by a man operator who, like other administrators in the Gram Panchyats, lived in the village only for work, and she 'uses mostly handwriting and pen to write everything down'. The engineers in BOSCO-Uganda install and monitor networks, advise local groups, who manage the ICT centres that host access points, about computer hardware such as buying a mouse, and teach CN members computer literacy, entrepreneurship and life skills. The CNs in Indonesia and India rely on commercial and government entities, respectively, to maintain the network equipment, while support organisations focus on computer literacy.

The urban locations of the support organisations tend to mean their workforce is much younger than decision-makers within the CNs. Whereas the median ages of participants in support organisations ranged between 28 and 37 years, the median ages of people overseeing CNs in villages ranged between 32 and 55 years (see [40]). Only the Argentine CNs consistently involved older people, up to 70 years in age, in learning and applying technical skills [30]. The South African support organisation encouraged people of diverse ages to learn to install nodes in workshops, however, co-op members often insisted that they wanted youth to be technically involved; for instance, a co-op man said:

We are old, we were interested to put their children first. There are some things we don't understand, but we want to give the computer to children, the [network] software.

Generally, participants in villages in which the CNs are sited, associated computer literacy and networking skills with youth. As conversations with older non-users of the CNs in South Africa and Indonesia unfolded, I learnt that this related to lack of confidence in technology and uncertainty about the personal relevance of the internet rather than disinterest. Certainly, technology literacy and familiarity reflect spoken and written language abilities, which differ between age groups in most of the rural populations. A teacher in the high-school in an Indian village explained, for instance, 'mother and father they are actually illiterate, so, the student uses the smartphone'. The support organisation in South Africa produced training materials and some interfaces, such

as for billing, in the local language of isiXhosa, however, most of the CNs' network interfaces are in English. Indeed, in Mexico and India even the interfaces that local administrators and Village level Entrepreneurs (VLEs) use to register subscribers and recharge data are in Spanish and English, respectively, not the languages spoken by most local older people. This situation reproduces certain identities for technologies and technologists [2] and contributes to divisions of labour in producing the common resources of the CN.

4.2.2 Male Bias in Technological Tasks. Divisions of labour in producing the common resources of the CNs are also gendered. While I sought to recruit equal numbers of women and men of all participant types (Table 1), women comprised under a quarter of all participants that worked on technological tasks in villages or in support organisations. Written literacy and second language fluency is lower for women than men in most of the CNs' local rural populations; for instance, females receive 2 years less education and 33% and 74% of females are literate compared with 53% and 80% of males in the localities of the Indian and Mexican CNs (e.g., [79, 186]). However, it is not only educational attainment that limits women's involvement in technical tasks and in all cases I spoke to women in villages who had attended tertiary education. Both women and men employees of Rhizomatica, in Mexico, spoke of educational and cultural factors that contribute to an absence of women applicants for technical positions in the support organisation. Indeed, five of the six support organisations were founded by men and comprise more men, especially in technical roles; for instance, the organisations that support the South African and Mexican CNs employ two and four men, respectively, to develop software, install, administer or monitor the network. In villages, associations between technological tasks and masculinity are conflated with male dominance in CN governance, and temporal and spatial constraints that deny women access to places to learn about and undertake technological tasks [28, 29].

Participants in all cases referred to pervasive associations between technological tasks and masculinity, and 'machismo' in some reactions to women's technical knowledge. Women in the Argentine CNs, where both women and men undertake technical roles, spoke of being patronised by men with network expertise, which they attributed to the culture of telecoms; 'engineering has rotted their minds', one woman said. In fact, as my prior analysis describes [30], participants in all cases spoke of perspectives that women were not sufficiently strong to climb towers. Women often spoke of adjusting to equipment; in Argentina a woman in her fifties said that although she carried her heavy ladder when necessary, she tried to take younger people which also helped them to learn, and another, in her mid-thirties, said that her autonomous care of her node was at the expense of a good signal because she could not climb high on her ladder. The issue, however, is not about women's physical strength. Rather, constraints reflect gendered power relations and how certain equipment are infrastructures for performing certain masculinities. In India a mid-twenties woman agilely climbed a tree to pick mangos in the privacy of her garden, while women in Argentina were also scolded for climbing ladders when pregnant and refrained from scaling towers because they worried that other members might judge their cautious ascent as delaying a team activity.

External support organisations' ideals about gender inclusion and fostering local ownership often conflict. For instance, Rhizomatica asks indigenous assemblies to include women in all operational roles, yet assemblies appoint young unmarried women to register subscribers and keep records only because they consider these to be secretarial tasks. Rhizomatica's employees said that the indigenous assemblies distrust women in technical installation and will speak only to men in their organisation about their CNs, even about non-technical aspects. When support organisations do recruit women technicians to internal roles, rural norms can deter them from going to villages. For instance, women comprise half of the team of engineers and researchers in the Indian support

organisation but they preferred to build software and router prototypes in the lab in Mumbai and avoided rural deployments. Meanwhile, a young woman network engineer in BOSCO-Uganda said it was vital she went to CNs but felt uncomfortable because there were no women at village ICT centres. She also said that her husband might forbid her to go to villages if she were married. Indeed, temporal and spatial constraints restrict women's access to places where they can learn and undertake technical tasks. Five years ago, for instance, researchers in South Africa taught groups of men and women in villages to install and operate equipment for their CN, but only men completed the sessions which were scheduled at times that were incompatible with women's routines. Women in the Argentine CNs said family responsibilities interrupted their focus on technological tasks [30]. While the gendering of technological work may be a predictable division of labour, it contributes to the way the CNs create a type of enclosure. Indeed, equipment in many CNs is sited in secure places that are inaccessible to women, such as public buildings or schools, which contributes to exclusion from technical decisions, in similar ways that their access to these places limits their use of the CNs, as I describe next.

4.3 The Enclosures of CNs

Only two of the six cases produced demographic data about users of the CNs and none had data about people's access to end-devices, sometimes because CNs sought to ensure users' privacy. Bearing in mind that I sought to recruit as many women as men of all participant types in my studies, the ratios of women to men users ranged from 1:1 to 1:3 and in five cases there were many more women than men non-users (Figure 7). Gendered constraints on access were most extreme in Indonesia, Uganda and India, where Gender Inequality Indexes are higher [239]. In Uganda, for instance, I spoke to women and men in ratios of 1:3 users and 7:1 non-users. Women users in my studies spanned a narrower age range than men users, in contrast to age distributions in the respective general populations. Further, the locations of access points limited how women integrate use of the CN into moving between their daily activities to grow, harvest and cook food from the land. As I summarise next, this not only restricts women's self-reliance and cooperation, with respect to the CNs, but relations between the CNs and women's everyday commoning.

4.3.1 Excluding Relations Made in Women's Activities. CNs in four cases had deployed only a few access points in villages, such as at ICT centres, schools, sites for local administration or authority. My prior analysis described social, temporal and physical constraints that limited women and girls' access and involvement in technical tasks at these places [28, 29, 40]. However, these locations also impede situating the CNs in multiple social and environmental relations that are woven into women's everyday work.

Concerns about safety curtail women's mobility in many places and at certain times of day and limited their privacy when accessing the CNs' services. For instance, young women users in their twenties in India said that they only accessed the Wi-Fi because their homes are within range of the signal from access points at the Gram Panchayat. They described ensuring their mothers know their movements each day, such as when they work in the fields, giving their phones to their brothers if they receive a call from an unknown number and escaping physical violence from men. Accessing the Wi-Fi in a courtyard or a veranda of a home usually meant a poorer signal. Safety concerns also effect the timing of women's access. A young South African mother explained she saved 10% of her prior communication costs because she walks to the end of her garden three times a day to obtain a signal from the CN, in between cooking, childcare and gardening. Indeed, home access to the GSM network was vital to some participants in the Mexican case where a middle-aged woman said prior to the CN she had to walk to have valuable human contact and at night 'people were locked in their houses and alone'. Nonetheless, family members in Mexico

Fig. 7. Numbers of people involved in village-level operations and who used and/or did not use the local CN who spoke in interviews, focus groups, observations and meetings [40].

reported unsolicited messages to teenage girls. In Argentina, password protection was applied to some access points after a woman living alone was disturbed by men tenants of a neighbouring house who stood outside her home free-riding at night; meanwhile, staff of BOSCO-Uganda said that boys intimidated girls and women at some ICT centres, while some parents did not allow their daughters to attend and mix with boys at others.

When women were present in places where access points were sited there were often constraints on what they could do there. For instance, in Indonesia, most of the 25 men staffing the Chief's administration office or volunteering with the village's business enterprise accessed the Wi-Fi but only 8 of 13 women I spoke to who spent time in these places, as volunteers or staff, used the hotspots. In fact, in all cases the gendered ownership of space meant women had less privacy than men. Despite repeated requests for places that were comfortable for participants, FGDs and interviews sometimes occurred in sites of local administration where more men work. Further, when women invited us to talk in alternative places, men often loitered around. Gendered access was extreme for younger women. On average there were relatively fewer women, than men, CN users between 25 and 40 years. The median ages for men and women non-users I spoke to varied for the different CNs; however, women non-users tended to be younger than men non-users (medians ranging from 22 to 38 years for women and 29 to 47 years for men). Users and non-users' comments in some cases suggest that not only are younger women less likely to use CNs, they may actually use commercial operators instead.

Women, more often than men, spoke of the incompatibility of access with their movements between domestic and agricultural work. For instance, in India a woman in her twenties explained that she accessed the Wi-Fi, which is in range of her home, only in the evening. Each day her household chores begin by walking to the forest for firewood, and then between 9:00 AM and 4:00 PM she works on her agricultural land. Women in Uganda explained that it took hours to walk between their homes, agricultural plots and ICT centres, and a woman technician in BOSCO spoke of the barriers that arise because of the tempo of women's labour. Certainly sign-in books at ICT centres recorded that women attended for shorter durations and less often than men; and, in FGDs and interviews women attended to children they bought with them and left early. In Mexico a mother of pre-teen children who works 15 hours a day to prepare food and serve customers in her little cantina said she did not have time to sit and use the local Wi-Fi to access social media. She explained the first few hours of her morning routine:

I wake up with alarm clock on the phone. I first make tortilla in my house, from 3:00 AM. At 6:00 AM I have finished making tortilla and start giving breakfast to my children. Then I feed the animals, chicken, rabbit and pigs. Once I've finished at home I go to the cantina; around 8:00 AM and I will call my husband to ask when is he coming to have breakfast and what is he doing?

She, and other middle-aged women in Mexico, described the convenience of their CN's comprehensive GSM coverage when they spread their daily work between tending shops in the main street and coffee plantations and bee hives in the forests. Indeed, in all cases whenever I was outside, I observed women walking to and from fields, carrying water, firewood, reeds for roofing and food they had harvested, sometimes together, sometimes alone. Their access to tangible spaces, such as forests and plantations, contrasted with their access to signals from routers mounted on the walls of buildings. As found for CNs in the Global North, women's access is partly about its compatibility with domestic spaces, child-care and activities women do together. Even women who did not do agricultural work mentioned time constraints; for instance, two women pre-school teachers in India take their class to the primary school to use the Wi-Fi in learning, such as videos of songs, but said that they did not have time to sit and use it for their own activities. However, for most rural women in the Global South 'feminine heritage' [204] comprises agricultural work and, thus, CNs' limited coverage constitutes a type of enclosure that excludes the different relations that women weave in their movements between hearth and earth.

4.3.2 Limiting Freedoms: Gendered and Intergenerational Dependencies. The language and identity of technology, reproduced in the CNs, undermines the self-sufficiency that is integral to equitable cooperation. My prior accounts describe how participants, in all cases, spoke of assisting others to access information and communicate, including physically setting up others' access, facilitating messages or calls for people without access, and using online services on others' behalf, in face-to-face intermediation or through other media [28, 29, 40]. While this illustrates communality it also shows that limited access constrains the freedom to co-operate based on mutually agreed objectives and rules.

The CN users I spoke to tended to be younger than the populations in their provinces, particularly in South Africa (mean: 28 years) and Indonesia (mean: 30 years). Barriers for older people linked to language, education, familiarity with technology and lack of confidence. For instance, I spoke to few non-users in Mexico because, as the assembly's Vice-president explained, they were not only older and unfamiliar with technology but also tended to speak only the indigenous language. Indeed, a quarter of older participants in Mexico owned simple phones, which connect to the CN's GSM services better than smart-phones, and many participants who are involved in the

authorities governing their CNs access only older technologies. For instance, a woman Sarpanch in India sends SMS to village headmen who cannot use WhatsApp and several older members of the Co-op overseeing the South African CN do not own phones that can access the Wi-Fi and preferred an earlier intranet system that used special handsets to make VoIP calls between villages (see [200]).

Women and older people often relied on others for access. Some CNs' authorities adapted to people's communication constraints. For instance, in India a man Sarpanch uses an online SMS server to send messages about meetings to a phone in every household to inform those who do not access the Wi-Fi; this, however, excludes women who are rarely acknowledged as household heads. In Indonesia, women aged over 40 who could not access the CN's Wi-Fi said that they knew about our FGD because neighbours came to their homes to pass on an invitation posted to a WhatsApp group. Although CN users in their village insisted that those with access would always help those without, women gave many counter examples and spoke of problematic dependencies. A son pays the electricity bill online for his father in his late forties, meanwhile several women spoke of difficulties that arose when a family member was unavailable to help them. Two women recounted that when their children were sick or injured, they were unable to speak to others, including to a husband, and another could not contact people when her husband died. As I develop further, selectively undermining self-reliance by CNs contributes to decommoning.

4.4 Uncommoning Labour

Participants' perspectives on, and work in, commoning reflects local economic and employment circumstances, mobilities and customs about the commons. However, practices of producing, reproducing and managing commons, such as land, were not always applied to the CNs' resources. The South African CN has two salaried full-time roles in coordination and technical maintenance. Subscribers' monthly payments are handled in Indonesia by a salaried employee of BUMdesa and, in Mexico, by the CN's administrator who receives a stipend from the indigenous assembly while, in India, VLEs earn commissions by recharging subscribers' data and making online payments for local customers' TV and electricity bills. Neither the Argentine nor Ugandan CNs pay for labour, although employees of the support organisations are remunerated from grant funding. Members volunteer in the Argentine's CNs for accounting and coordination roles and install and maintain network equipment themselves, according to an ethos of self-reliance and peer-support, although occasionally a member may pay another to install a router for them [30]. As I explicate next, while participants related cooperative and communal values to their CNs, certain valorisations of tasks and expectations about unpaid labour deterred younger people, including women.

4.4.1 Situating Work in Land and Mobility. Livelihoods, in most cases, primarily depend on subsistence farming supplemented by modest trade and remittances from family members working in distant cities and countries. Traders buy inhabitants' soya beans, maize, millet and charcoal in Uganda; mangos and other fruits in Indonesia; coffee in Mexico; fish and shellfish in South Africa; and, in several cases, sand illegally. Local cooperatives operate for fair trade coffee processing and packing in the Mexican villages and, in Indonesia, BUMdesa manages the village's amusement park, agro-tourism, orchid plantations and annual mango festival. Various communal rules apply to land and produce. The Indonesian village prevents farmers from monopolising mango production, by limiting plantations to one hectare, and every family has at least ten mango trees in their homesteads or plots and donates some fruits from every tree to the mango festival. Land ownership in the Mexican case depends on communal participation, and customary rules in the South African case determine the use of communally owned land for dwelling, gardening and grazing (e.g., [39]). In the Ugandan case, refugees receive small plots of land to cultivate for subsistence,

and some Argentine participants had availed of a law that permits dwelling on untitled land provided they fence, maintain and use it. Although many women I spoke to laboured on agricultural plots, local customs favoured male ownership or custodianship of land; indeed, nationally women's ownership of land ranges from 8% in Indonesia to 16% in Uganda and Argentina [87].

Inhabitants in most cases depend on subsistence farming as there are few local employment and income opportunities. Remunerated occupations in the villages served by the South African CN labouring and domestic work for second-home owners and a few small tourist and environmental-management operations, and social welfare work in health and education NGOs. Occupations and income interrelate with mobilities. In the Mexican case, some inhabitants invest in small businesses, such as shops and taxi services, with capital earnt whilst they were expatriates. In upper middle-income Argentina, newcomers tend to have white-collar jobs, such as software developers, university lecturers and authors whilst 'natives', with ancestral connections, tend to have manual or service jobs, such as domestic workers, building contractors and broom-makers [30]. In the Indian, Argentinian and South African cases some people, particularly younger men, commute daily or weekly to the nearest city for work and sometimes movement is inward, for instance teachers travel to the Indian and South African villages every week.

4.4.2 Persisting and Revitalising Communal Values. Participants in villages in all cases described persisting or revitalising cooperative values in relation to their CNs, variously associated with local identities and principles. The South African CN builds on public expectations about working together. For instance, co-op members who cannot use the network themselves, because they did not own a suitable phone, tried to help others connect to the Wi-Fi and linked the network's technical infrastructure to bringing together local society, reducing poverty and for 'the whole of the [area's] people to benefit'. Co-op members mentioned local building skills to create the CN's infrastructure, for instance, as man said: 'We have the ability to build the [building] structure, the only thing we need is the money for material'. In the Mexican CN, where the indigenous community's self-determination depends on their communal participation, participants referred to their endurance by tenaciously applying such skills. For instance, an elder storyteller recalled a date in the late 1970s when the road that winds through the mountains finally reached their isolated town because local people laboured 'from six in the morning to six at night' and 'without using a tractor'. Another elder said, 'We are 100% poor, and lack economic resources, but we work hard', and he and other men explained that when the CN's antenna was erected men and women undertook voluntary tekio work to clear the land and carry sand, water and alcohol up the steep mountain.

Some participants discussed the roles of their network in local identity and cohesion. The village in Indonesia produces superior mangos and men in their thirties and forties who work in BUMdesa, the Village-Owned Business Entity, spoke of the role of the CN in promoting their village's identity through social media:

BUMdesa Director: In first mango festival, social media was our strength. Two years ago we installed the tower in October, and by November [the time of the festival] we quickly benefit.

BUMdesa Secretary: All villagers here who have Facebook – two weeks prior to festival. The reason why we hold festival to let them [the public] know. We want to show the name of our [village's] mango.

A Gram Sabah in one of the Indian villages said the CN mitigated social fragmentation that accompanies mobile internet use as well as reducing costs. He referred to the role of the access point in togetherness:

When people are using mobile internet, they are just sitting at one location and they are using the internet, but when they come to the Gram Panchayat then they will be more, more we feeling, not we feeling, I mean we feeling, [translator: he is saying togetherness]. The thing of togetherness will be more. People can actually exchange more news and information because they can come here and they do that, which is not happening nowadays people start using mobile phones and they use separate. So, that's two things, So, one is it is going to be more cost effective if the people use internet here because it is very cheap, not like 400–500 rupees, and the other thing is it will lead to more togetherness in the village, which is very necessary for the development of the village.

Participants in Uganda also described how practices of commoning in the CNs reinvented traditions. BOSCO-Uganda tries to re-establish unity in communities that were traumatised by war and displacement for decades and now host millions of refugees. Severe conflict, and some post-conflict actions, scattered and destabilised communities, undermined trust in institutions, neighbours and even family members, and contributed to youth disaffection. BOSCO's founder prioritises traditional practices of coming together in dialogue to manage disputes, such as about land or water, and organising host-refugee events, like football matches. He rationalised cohesion and reciprocity by explaining, 'you won't go anywhere with excluding because tomorrow you might need the people that you exclude'. BOSCO cultivates an ethos of sharing skills and information among CN users according to traditions of Wangoo, or talking around a fire, by arranging computers facing each other on tables at the rural ICT centres that host access points. CN members use the internet to individually and collectively market their produce and cut-out 'the middleman who come and cheat them'. Some spoke of enjoying helping people in their villages to negotiate fair prices on produce. Increased income from produce and offering services, such as photocopying, enables members to rent the building for their ICT centre, and a young man user said, 'through the computer centre we have been more united'. A centre manager explained that he always sees a few members walking together to church or to their gardens, and an older man said that engaging youth in activities motivated them to avoid 'doing bad things'. Indeed, youth in two ICT centres organised drama and dance activities, rekindling traditions from the past, as one explained:

The idea of a drama group started way back in the settlement camps when people were all scattered [from their original villages]. The elders thought of doing something together [to preserve] cultural practices, rituals, celebrating birth, and community work. When camps were decongested the different groups scattered again.

The Argentine CNs had facilitated connections amongst inhabitants with varying historical local ties, who would not have otherwise met, to socialise, do business and protect their neighbourhoods. CN members decide collectively to accept new members and, as a 60-year-old man who immigrated to the country explained,

The ones who are part of the network are those that have a tendency to do social things. It allows me to distinguish people who are similar to me.

However, Argentine members also spoke of different approaches to communality [30]. Participants who were newcomers more often related the CNs to political commitments, explaining how they mobilised resistance to a proposed mine, while those whose families who had lived locally for generations more often related the CNs to affordable connectivity and said the mine bought employment. Perspectives on property also differed. A man offered a high site for the huge tower

at his mountain home because he shared the founders' mind-set, not because he wanted the internet, while a woman was upset when members climbed the roof of the home she shared with her husband without her permission to help her remove a redundant tower that had been mounted on it. CN members also debated how a captive portal, to limit the duration of sessions by free-riders, might better engage households that had extended the network by installing repeaters without becoming part of the collective.

4.4.3 Women's Unpaid Care Labour. While participants related cooperative and communal values to their CNs and to livelihoods, such as fair access to markets, the valorisation and gendering of technical tasks are conflated with expectations of women's volunteer labour. Paid roles were overwhelmingly for technological tasks and, thus, were mostly done by men. Even when technically skilled women are available to work in support organisations, they can work unpaid. Interns at BOSCO-Uganda, for instance, said that up to 40% of university computing students are women; yet, while BOSCO ensures gender balance in internships, it paid only full technicians, all of whom were men. Men are also at least three times more likely than women to be paid in the four cases where work is remunerated in villages. The VLEs, who earn commissions in the Indian CNs, and the coordinator and technician in the South African CN are all men. Women's labour, however, is integral to the CNs from hosting and catering for meetings to organising equipment.

Male co-operative members governing the South African CN described tensions about whether their own or their wives' roles in charging phones and selling subscriptions should be remunerated. In Mexico, participants said only the male carpenter was paid when community members undertook voluntary 'tekio' work when the CN's tower was erected. However, I observed only middle-aged women, tidying and gathering trash as part of voluntary weekly tekio work and men household-heads in assembly meetings. Women members with key roles in the South African CN, such as co-op secretary, said that during meetings they were expected to serve dinner, without pay, which may involve several hours preparation to gather wood for the fire and collect water.

Perspectives in the Argentine CNs yield insights into expectations of women's care labour in commoning. Both men and women members were conscious of the complexity and extent of work involved in socially coordinating the CNs, and of gendered divisions of labour where 'women are downstairs coordinating things, fetching tools, all the families are with the kids' while men were on roofs during installations and repairs. Women spoke of fitting care labour around their technical tasks, rushing from place to place to undertake their CN, family and work duties and integrating their responsibility for re-distributing or replacing equipment and materials into their routines. A woman in her mid-fifties described spending an hour every day to respond to specific requests on the CN's lively WhatsApp groups, and of being woken by messages asking her to realign antennas after others had experimented on the network [30].

The contribution of women's care labour was not always acknowledged in CNs. In the Indonesian case, a women employee of BUMdesa receives a salary for managing subscribers' monthly payments. However, women volunteer for a dozen different welfare and education groups, separate from BUMdesa, that deliver public services, such as monitoring pregnant women and infants, pre-school teaching and feeding low-income families. Throughout my visit these welfare volunteers spent at least 3 hours every morning preparing elaborate lunches and morning preparing elaborate lunches and morning and afternoon snacks (Figure 8) for myself and the salaried men who use and decide about the network in the Chief's office.

4.4.4 Ambiguities for Youth and Unpaid Labour. The Indonesian women volunteers, mostly aged over 40 years, said that BUMdesa attracted younger people because they received a share in its profits. Most of the 15 part-timers working for BUMdesa are young men high-school

Fig. 8. Typical snacks and lunch prepared every day by women volunteers in Indonesia during my visit.

students who organise motorbike parking for the weekend amusement park and sell tickets to the fruit plantation. BUMdesa workers can access the Wi-Fi, unlike the welfare volunteers who attributed younger women's withdrawal from their groups to their use of phones connected to the mobile internet. Frequently, younger people's unpaid technological assistance occurs in homes, helping parents and grandparents, rather than in the wider community, where older people will teach children about computers, such as the secretary in the Chief's office in Indonesia and operators of internet cafés in Mexico. Indeed, a young woman interpreter said that Mexican indigenous youth are increasingly reluctant to assume unpaid roles in their communities while younger members of the Argentine CNs said that older generations show more concern for neighbours. Older members spoke of cooperative work in the past, for instance, an Argentine woman in her fifties said:

I have a consciousness, for instance as a child [my] parents would go and help people clear land. It was common, it was ordinary. I always had that sense. I don't care about money, came from heart if I have the ability to do it.

Elders recognised the importance of internet and phone services to youth employment, but had concerns that access promotes attitudes that undermine communal values. In the Mexican CN an older man said 'the new generation must not forget the tradition as well as the new technology' and employees of Rhizomatica, the support organisation, explained that some of the other CNs had discussed age barriers on phones and sought to temporally shut their networks to ensure attendance at traditional assemblies. Meanwhile, the Chief in Indonesia limited youth's access to the Wi-Fi after finding some downloading 'inappropriate' content. Older people in all cases spoke about both monitoring internet and phone-use by both their own and others' children and teens in and beyond their homes, and the role of connectivity to youth education and employment. For instance, all the older people in the co-op in South Africa said they were prompted to set up their CN to uplift their children's education and provide them with paid jobs. The role of connectivity in youth employment can also present challenges to maintaining operations. In Uganda, for instance, despite the role of ICT centres in commoning amongst youth, BOSCO reports a high-turnover of men volunteers who move to towns for paid work once they develop skills, including some who set up their own internet franchises from MNOs. Indeed, reflecting on assumptions about the value of training older people, a BOSCO employee said that computer literacy was more important for everyone compared with a few decades ago:

It's not really right to say it's irrelevant to those who are 60 and above. If they had learnt, say a typical farmer, they will be looking for money to push to the children.

4.5 Managing Commoner Identities

Sometimes women in the villages pursue independent enterprises and, when they do, they have different strategies to manage their identities and expectations of their care labour. Reimagined practices of commoning in relation to ICTs arose more often for women with wider exposure and connections.

4.5.1 Women and Enterprise. Exclusion from CNs can prompt women to pursue independent enterprises, as illustrated in a small rural town in Uganda. BOSCO enabled people to set-up 10 small shops by running computer-based business training and installing solar energy equipment for collective management. Men owned eight of the shops including three electronics repairers that share tools, and knowledge, assist each other's customers and exchange information about components with many similar repairers across the nation. Strikingly, despite this ethos of sharing expertise, the collective cut the hair salon owner's electricity supply because her hairdryer drained the battery, rather than assisting her to select a low-wattage device. 'We want a separate one [solar set up]' the woman owner said, 'there's money. If we need to, we will pay it alone'. An entrepreneurial approach is central to the 'gender-sensitive approach to connect the unconnected using Community Network models' of Afchix, a network of African Women in Computing. The project, with sites in four countries, aimed to foster business opportunities by being connected [1], and in a rural Namibian settlement near my home, began by engaging women in establishing enterprises before building the network.

In India, women who used their husband's hotspots to access the internet said they sought income to buy their own data. However, some women's enterprises involved their families. Two women in Indonesia sold hourly or daily vouchers for access to the CN at the small noodle restaurant and stationary store attached to their respective homes. One was shy about her technological ability and submissive to her husband, who insisted in being present in our interview, but the other, whose husband worked away from the village, was independent. Similarly, women operate three of the four private internet cafe and WISP franchises in the Mexican case, distinct from the CN. One middle-aged woman relied on her husband's technological support, but another, a single mum in her mid-thirties, taught herself from YouTube tutorials to run her ICT services, encouraged by her 70-year-old father who bought her first computer.

4.5.2 Caring Identities. Access to CNs amplifies differences between people and may compel the few women with access to perform their identities with care. A woman member of an Argentine CN explained that 'in most of the houses where there are couples, only the man participates'. However, by sharing the costs of equipment to join the CN, a grandmother and her neighbour learnt to install networks together and, with an age difference of 30 years, the women now run workshops for their CN. 'If we are together we can fix anything', the grandmother said, and emboldened by their new technological skills they enrolled in gas plumbing course. The course was free because there were no certified plumbers in their village, yet the woman taking their enrolment details could not understand why women would want to do the course. A woman in India explained that access to the CN's Wi-Fi enabled her to apply for jobs and ensure she was paid by uploading evidence of her work in training other local women to her office's WhatsApp group. A young Indonesian woman, able to access the CN's Wi-Fi as an employee of BUMdesa, e-marketed and sold 10 times as many mangoes as another woman who buys airtime from a more costly 3G provider. When asked about her profit the former emphasised that she pays a fairer price to low-income farmers:

[I] have one of the social causes. The brokers pay very little to the farmers. [I] make a profit and fair price.

Older women in Mexico said they subscribed to the CN because it enabled disadvantaged inhabitants to have access not because it enhanced their own communications. Meanwhile, a single mother who runs a shop that provides phone and internet services, separate to the CN, spends her weekends serving in the community police force, and every other day does women's tekio work. This mother does not subscribe to the CN, but does teach children to use computers, and explained:

[I] teach them how to copy, past, print and investigate. Now I am studying at high school on the computer. [text cut] I have two children, in the morning I sell lunch-boxes [at their school], after that I attended the clinic where the group of women doing tekio work gathered. We grow plants, bananas, oranges, coffee beans. [I] am also the Policeman, so last Friday [I] went to [indigenous assembly] and then after that [I] had [my] shift.

4.5.3 Women's Aspirations Beyond Rural Places. Changed practices of commoning and relations with ICTs arose when women are exposed to life beyond their villages. The single mother who runs her telecoms service in Mexico, for instance, lived in cities and in the United States for a decade. A 40-year-old South African single mother, who was eager to pay to install her own router to improve the CN's signal to her home, had also worked in a city far away and said, 'it's not a new thing for women to be involved in technology'. Indeed, both the Mexican and South African support organisations consider opportunities for women to travel away from their villages and meet others as important as developing their technological skills.

Women's exposure to life beyond their rural areas also, of course, depends on their access to telecommunications. For instance, two young women in South Africa explained the importance of the CN in developing their English language skills, essential to employment and secondary education, because they spent extensive time watching YouTube and searching with Google, in both 'Googlish' and isiXhosa, their home language. In Mexico, participants explained that prior to the CN they rarely communicated with family-members who live, temporarily or permanently, in cities or the USA. In Argentina, a woman in her sixties with constrained mobility, who cares for her elderly mother and a son with a disability, said that from the moment she awakes in the morning to the time she sleeps at night she exchanges WhatsApp messages with her children and other family members far away. Beyond psychological support, however, these links shape women's lives in practical ways; mothers in the Indian villages, who had constrained access to CNs, spoke of their daughters in cities using credit cards to buy their online shopping for them.

Both women and men interviewed who had lived away from their villages spoke of preferring to live rurally. Indeed, while women with more exposure to urban life and those who had only ever lived rurally often had different strategies to manage their commoner identities and relationships with ICTs, their personal priorities were often the same: sustenance, income, health, safety, calm social relations, and religious or spiritual fulfilment. Responses to my mobility varied. Based on my gender and race, men and women in two support organisations were concerned about my safety moving around rural areas independently and, assuming I lived in a city, some women in villages were curious or surprised by photos of the bush around my own home. In fact, my positionality was partly framed by a living in rural land, especially in Africa and Latin America, where access to land is often the difference between staying and migrating for work. I was conscious, however, of contrasts between owning my own garden, not negotiating (or enjoying) complex personal relationships to access land; having a hose attached to a bore hole pump by my kitchen door, not walking for hours carrying water to a plot; and being disappointed when my vegetables failed, but not going without food. In cases we contrasted the food grown in some of the verdant areas around the CNs, with those in my arid garden, and related this to cooking. In Indonesia,

for instance, I often chatted to the women volunteers who cooked each day and, in conversations about opportunities to travel overseas, they spoke of taking local produce and ingredients so they ‘would not go hungry’. Women, especially those who were younger, mentioned that they would like to travel internationally to visit CNs or participate in activities connected to the CN movement; and the APC has subsequently supported international travel for these and other women from different CNs. Our conversations did not tend to discuss my racially privileged transits across international borders but rather relationships between my mobility, technological skills, individualism, being an unmarried woman in Western culture and have a settler, rather than indigenous, sense of belonging.

4.6 The Gendered Visibility of Commoning

The arrangements of common networking equipment embody local social relations in rural CNs. However, associating certain tasks with masculinity and valorising technological skills combine to make rural women’s labour in commoning invisible. I conclude my analysis by describing how emphases in CN advocacy and movement building amplifies the invisibility of the relations women create in commoning and, thus, suggest these emphases perform in enclosure.

4.6.1 Equipment Embodies Rural Commoning. Prominent common equipment, such as masts, antennae, solar panels and routers at public access points, visibly manifest commoning. For instance, participants in the Mexican case frequently referred to the tower on the mountain they erected together. Equipment arrangements also materialise spatial and temporal patterns of local sociality. In Argentina, a woman member illustrated how familiar social geographies scaffold the network when she said a family-members’ house provided a line-of-sight that would connect everyone else [30]. In the Indian CNs men gather around access points in the evening, and young men and women in one CN said that they wanted to move an access point from a site where it provided a poor signal and was rarely used to a place where men sit together to talk.

The technical equipment materialises how commoning entwines sociality and bodies. For instance, as described in detail for the Argentine case [30], a man said ‘to be the part of the CN you have to put your body’ and other members noted the importance of ‘being there’ when 35 people gathered to relocate the tower: ‘children came and everyone carried something up the mountain, from tools to batteries’. The CNs’ founders explained that social relations form amongst members when they meet to learn to install nodes, and they associate the network’s topology to its physical and social setting through their bodies. For example, when a group of 20 first met they

... did a physical map by holding hands with those houses we could see [line of sight]. We realised that half of us couldn’t see each other—those people on the other side of the river—as trees are high. And neither did they have chance to be connected by ISP. We did the first workshop on building [the network] and six of us attended. Our objective was to connect people the other side of the river.

Network equipment also embodies more mundane rhythms and textures of commoning. A woman in the Argentine CN explained that a member’s domestic routine disturbed equipment that affected an upstream link; ‘each time he cleaned his house our network got disconnected’, she said [30]. Commoning is embodied materially in gendered ways, and more prominent equipment associates with masculinity. For instance, both women and men learn all aspects of the network’s technical set-up in the Argentine CN. Indeed, a founder observed that women often had greater dexterity to solder router boards, assemble small components. Yet, in maintaining their CN women usually coordinate the banal movements of cables and tools from house to house, while men climb ladders and mountain towers. Thus, even when all labour is unpaid, enclosures emerge around technologies and technological work.

Sometimes norms deter women from conspicuousness. A woman in the support organisation in India, for instance, enthusiastically displayed the circuitry of a router prototype she had built but, like other women in her lab, avoided installations in villages. Women's use of some types of equipment has been legitimised; for instance, I observed women gather to use equipment to weave rugs, sew and upcycle fabrics, and use the internet to e-market their products on social media and share tips over WhatsApp. Men, however, tended to treat these sorts of activities as trivial. I observed a VLE in India; for instance, cancel a video-based training session on pattern cutting after 20 women in a sewing group had waited for over 2 hours. Thus, associating masculinity with certain equipment and valorising technological skills conflate to make women's labour in producing the commons in CNs invisible.

Women's invisibility in commoning might be amplified, as I explain in the final section of my analysis, in the ways that activists and representatives depict CNs to policy makers and funders. In South Africa, for instance, co-op members said they still used the simple phones that were part of our co-design and trial of media-sharing prototypes and solar charging stations in the villages 8 years before. Indeed, in different interviews, and at events I did not attend, several co-op members linked the origins of their CN to this earlier research (e.g., [27, 35–39]). Yet, the CN's national legitimacy involves demonstrating high quality provision by emphasising sophisticated equipment. Publicity information does not tell of earlier prototype solar trolleys constructed with things bought in supermarkets and staff in the support organisation asked me to 'make it clear that the network uses good telecoms transmission equipment' even if it 'uses a 'clothes line pole' instead of a telecoms mast'. Perhaps the erasure of equipment and labour that associates with domesticity, rather than assumptions about innovation, is what prompts a women co-op member's aspirations to record another story:

We want the history of the network [written] for the growing generation. The new generation must read the history of their grandmothers and grandfathers to keep the history of this network.

4.6.2 Scaling and Enclosing the Imaginary of Commoning. The valorisation of certain equipment and labour involved in telecommunications and innovation adds to the complexities for CN activists who build capacity and awareness, and negotiate for policies to enable CNs. In this final section of my analysis, I describe some of the tensions I observed over the past 7 years that act as a kind of enclosure, which limits the potential commoning relations in CNs.

Removing regulatory obstacles is vital to practically enable and attract seed funding for rural CNs. Activists call on governments to allocate specific licenses to CNs or provide access to unlicensed spectrum, reduce time and fees involved in licensing, and facilitate partnerships with MNOs to assist in creating or maintaining CNs. However, considerable frictions emerge that conceal rural women's work. CN activists prioritise a wide geography of influence during short-term funding opportunities (e.g., [28]), flying between cities around world to participate in policy discussions and events to raise awareness of regulatory impediments. As well as supporting CNs specifically, their activities include lobbying for enabling regulatory frameworks and evangelising at international civil society fora, from dedicated events (e.g., [127]), to re:publica [192] and the IGF. These scales contrast with women's everyday rural commoning and, at distance, the issues that contribute to gendered exclusion become invisible. For instance, activists emphasise the role of CNs in extending inclusion rurally, however, their focus on technologies that have lower regulatory hurdles, such as short-range Wi-Fi not GSM, limits rural women's access because of coverage constraints [28].

To address male bias and gender-blind approaches across the telecommunications sector [28], CN activism has called for better inclusion of women in processes for telecommunication service

provision, capacity building and financing and on the boards of companies. In the past 3 years activist organisations have intensively mentored and supported diverse women to contribute to policy discussion about CNs. The woman president of the indigenous assembly in my case study represented the Mexican CNs in pioneering national legal hearings about telecommunications regulation for GSM. In the context of powerful MNO lobbies defending their telecommunications territory, activists must engender confidence in governments that ‘the unconnected can connect themselves’ and counter stereotypes about the inferiority or backwardness of rural inhabitants. Thus, they justify CNs according to models of sustainable development that use monetary metrics rather than other evaluations of connectivity and use a particular language of technology. They argue that open markets and competitive pressure will encourage operators to address the needs of the underserved (e.g., [113]) and that growth in the telecommunications industry is part of the ‘the power of frictionless innovation’ [220]. These arguments aim to reduce regulatory hurdles facing CNs but simultaneously conceal nuances of commoning. Indeed, an activist in her twenties explained that she is often the only woman in regulatory discussions and her statements about the societal value of CNs can be met with derision, divorced from ‘the reality’ of global telecommunications. Influential women, such as the Senior Vice President for Internet Growth at ISOC, have also argued for a ‘paradigm shift’ in assessing connectivity endeavours (e.g., [126]). Nonetheless, funding and policy discourses shapes the framing of labour.

The particular language of technology percolates into local CNs as the movement gains reach. For instance, 120 people from 19 African countries attended workshops, at the Fourth African CN Summit, which described sustainability strategies as ‘business-models’ CNs [127]. Indeed, the international development agency that funded my research for the APC was eager for reports on the business models used by CNs [40] and all support organisations in my study, except in Argentina, described their sustainability in business terms. I attended four international events for raising awareness about CNs, including one targeting women, which promoted the ‘business model canvas’, a tool widely applied in social enterprises. The categories used by this model, such as ‘customer segments’, ‘cost structure’ and ‘revenue streams’, construct CNs in monetary ways. They do not depict everyday commoning and women’s unpaid labour.

To explicitly recognise that it is rural inhabitants who are the experts about their own rural communities, in awareness raising and capacity building events, advocates promote local interpretations of the commons for CNs and abstract technical explanations and business models from social circumstances. Inadvertently, these abstractions perpetuate values and constraints already embedded in technologies. Some activists have responded to insights about interactions between WiFi range and women’s access, for instance an APC team-member spoke about gendered affordances at a movement building event [127]. Further, in the past year, the COVID-19 crisis has intensified the vocabulary of care that activists adopt (e.g., [10]). Yet, my observations of WhatsApp groups involving members of different CNs in Africa suggests concepts associated with the language of technology persist. The trope that CNs must be scalable in order to sustain, for instance, remains firmly intact; evidenced in my study by a South African co-op member who said, ‘we will be happy when we see this project spreading all over the world’ and likened the CN to Vodacom, a transnational MNO. Simultaneously, local CN organisers describe frictions between universal sociotechnical frameworks, technology and local practices of commoning. For instance, at an international workshop [34], representatives of 10 different CNs in Africa and Latin America repeatedly mentioned how imposing external schedules and timelines unsettles the temporality of local commoning practices, and we certainly experienced tensions in relationships in a self-funded CN in Namibia for 3 years [159] when we became accountable to time-lines associated with receiving grants and external support. Further, while all awareness raising and capacity building events emphasise ensuring women are clearly visible leading activities, women rarely comment in

discussions. In one WhatsApp group, with nearly 100 mostly black members, it is only six women (including three whites) who comment in the discussion thread.

5 DISCUSSION

The scope and the geography of my study are coherent with the spatial, temporal and symbolic politics that shape the CN movement and international activism. In my prior analysis of some of the data I also present in this article, I proposed that these scales make constraints on women and older people invisible [28] and contribute to differentiations that undermine the sustainability of rural CNs [29]. I focused on relationships between people in considering spatial and temporal constraints and did not situate my analysis in the many relations that constitute life. My analysis did not consider, for instance, the relations between sowing, weeding and harvesting plants and preparing food; between gathering wood in a forest and cooking on the hearth; between walking to plots far from home and exchanging ideas with others along the way. I did not consider relations between urban-dwellers who send remittances to rural family members or the rural produce they might receive in return. My analysis did not comprehensively engage with how being alive is about the capacity to move [166] and how commoning is not an alternative economy [81] but ‘a life support base’ that cannot be enclosed [215]. Thus, in this article, I propose that by framing local telecommunications as resources and the practices of CNs as resource-making we deny the multiple relations that make life and, specifically, the social and environmental relations created in women’s practices of commoning as they move. Hence, I suggest that current manifestations of CNs act as an enclosure from life.

5.1 Resources Rather than Relations

All the rural places in my studies, like elsewhere around the world, are bound up in transnational and national extractive relationships. Participants spoke of wholesalers cheating them in trades of mangos, soybeans and other produce, local illegal sand mining for urban building projects, and multinational companies threatening their natural water supplies. Participants also spoke of cooperating to pursue fairer trade and protest extractive industry. The contemporary struggle of rural commoners is to find ways to influence macro-scale challenges [187] by working at larger scales and creating new structures of law and institutional forms [43] to protect resources from market enclosure. Similarly, to empower rural CNs relative to telecom monopolies, advocates work with telecommunications and technology production paradigms that thingify technology practices [31] and assume market logics are inevitable and integral to citizenship [128, 154]. These paradigms treat technologies as separable from humans, and other beings, and emphasise common things rather than commonings, which limits democratic involvement in technology endeavours and hides how work is commodified [31]. The identity of network equipment in CNs, like many technologies [2], is kept distinct from local commoning by a lack of translating interfaces into local home languages, by particular standards of ‘quality service’ and by the entwining of operation with certain expertise and divisions of labour [27]. Importantly for CNs, the inadvertent appropriations of the commons distract from the multiple relations produced in commoning.

In the early days of CNs in the Global South, technologists said ‘Community owned wireless networks seek to put the physical layer in the commons’ [131]. Nowadays managers and technologists focus on business processes, scaling-up networks [111] and training more women in technological work [129], and raise funds by presenting routers and DIY practices as ‘humanitarian goods’ [211]. Empowering rural CNs, relative to telecom monopolies, appears as a softer model of privatisation dressed in appeals to the principle of the commons and the aesthetics of traditions. Historically, however, the market erodes the commons by exploiting pre-existing social ties of trust and reciprocity (e.g., [190]) and market capitalism has eroded common resources in

the Global South [48, 53]. Community ownership is central to sustaining CNs, in whatever form they take, and was important in all cases I studied. However, the CNs did not always explicitly articulate, as Linebaugh (2008) writes, that “ownership is based on human deeds not property deeds” [156].

The tensions that emerge in CNs bear a resemblance to tensions in the reinvention of communal tenure of land. Silvia Federici (2014) shows how women suffered acutely from the loss of the commons, in terms of sustaining both their livelihoods and the social relations that enabled them to meet, exchange ideas and develop their own viewpoints, autonomous from men [84]. Women have been most committed to defending natural commons, from early struggles against European land enclosures to protesting loggers, mines, dams and the commercialisation of land across the Global South [85]. Yet, while women may be more cooperative than men in decisions about using natural resources more sustainably [195], Federici also writes that women’s land rights groups in the Global South call for stronger private property laws and a rights-based system to enable women to buy, own, sell and obtain titles to land. These groups claim that customary laws were redefined in decolonisation processes to discriminate against women who provide unpaid work to male relations without having secure access to the land they farm. There is consensus that the discrimination results from the pressures of commercialised agriculture, the loss of commons, and the new hierarchies and new emphases in sovereignty that emerge as tradition interacts with neocolonialism. Nonetheless, women’s land rights groups are accused of promoting the agenda of foreign investors [189]. Male bias of CN technoculture and local governance structures in rural CNs also exclude women, as some women in my studies performed their identities directly associated with the extractive practices of ‘Big Tech’, by obtaining airtime from ventures that promote Google, using Facebook to e-market local produce, and buying goods from Amazon for their mothers. Rural women speak of discomfort with the practices of network experts and women network engineers avoid doing technical work rurally; and, women have no say in decisions about CNs and receive no monetary value from the everyday work that becomes commodified in the business models of CNs.

5.2 Commoners Subjectivities

Many rural societies have sustainably managed commons for centuries [184], yet commons-oriented rural development interventions often fail. Saunders (2014) attributes their failure to a tendency to treat the commons as a design problem and formalise institutions based on ideas about ‘rational resource users’ [208]. Rural CNs in the Global South may integrate local governance but emphasising engineering and service design, not local practices of commoning, diminishes the commons and communality. It is not only the importance of connectivity to youth [185] and migration of technically skilled young men from rural places that threatens capacities to maintain CNs, as others found such as for AirJaldi (e.g., [218]). It is also the way that current technology configurations marginalise the relations created in the commoning of women and older people. In all cases men users spanned a wider range of ages than women users and, while younger women sought alternate connectivity, some older women spoke of their isolation, dependency on family members and younger women’s detachment from communal work. ‘Becoming in common’ lies in intergenerational links that reinvent the relations comprising the commons when people of different cohorts work out how their respective lives can correspond [117]. Associating technology only with young people and men, then, limits associating technology with commoning.

Endeavours in the Global North often focus on common symbolic and material elements that already tie humans together to ‘nourish what is common’ [95, 232]. Yet my findings suggest that people perform their identities in commoning in diverse ways to strengthen the wellbeing of their families, community and their land, and a commoner subjectivity is not generalisable even within

a community. While they can face similar struggles in their encounters with CNs, women have various strategies to negotiate expectations about their commoning labour, their access to technology and interactions with technoculture, such as through their own individual enterprises. Gender never operates independently of other dimensions of inequality, and women's appropriation of ICTs depends on various interconnected features of difference, including class, caste, language, sexuality, age, mobility. Further, different contexts make different markers more salient for certain people or groups (e.g., [141, 91, 132, 205]), and women's agency, and the ways they exercise it, vary over time [54, 144, 249]. Certainly, women's agency does not reside only in resisting patriarchal norms [225] but also in re-appropriating and reconstructing these oppressions [106]. However, access to, and involvement in, CNs amplifies differences between people, thus CNs may become more sustainable by better integrating the minutiae of commoning in the daily lives of people of different ages and genders. A focus on services that integrate the knowledge practices of different generations may offer a more sustainable alternative to emphases on customers, innovation and economic growth. Older people, for instance, spoke of the accessibility of simple phones that connect to the GSM network in Mexico and a prior intranet system in South Africa [200].

Advancing diverse, local ownership of CNs requires accounting for both people's approaches at the scales that they inhabit and interactions between the rhythms, textures and dynamics of their commoning and paradigms that are not commons-oriented. The scales of international technological development and policy work and researchers 'bungee jumping' into a CN inevitably overlook many of the relations formed in the detailed movements of living. They make invisible the continuum of the body of a rural woman and the land with which she reproduces [86]. Ethnographic insights in rural communities indicate the need to go beyond an abstract solidarity by engaging with communal values (e.g. [39, 138]). My studies of CNs suggest that rather than pursuing a mythical single commoner identity, we must engage with the ways that rural commoners express their subjectivities in their practices and how new subjectivities emerge in commoning over time [179, 245].

6 CONCLUSION

CNs reveal some of the complexities that arise in accounting for communal values in rural HCI. Rural women in the Global South have often been the most committed to and cooperative in the commons. However, the male biases of CN technoculture and rural governance structures exclude women from access and decision-making, despite the work they contribute to rural CNs. This can mean that women perform their identities, within the local political and moral economies of commoning, by participating in ICT endeavours outside of CNs. Like other community-based technology interventions in rural areas of the Global South, CNs are shaped by sociotechnical imaginaries that are not entirely commons-oriented. Perhaps it is unsurprising that women adopt different strategies to negotiate their ethical self, social expectations of communal duties and achieve their personal aspirations. This draws attention to the contingent nature of the practices and performance of commons subjects. Thus, I hope to inspire HCI to further explore how people perform their identities in commoning and the situated ways they express communal values in relation to community-based technologies, in rural and urban places, in the north as well as the Global South.

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REFERENCES

- [1] Afchix. Retrieved from www.afchix.org/projects/.
- [2] Hilma N. Aludhilu and Nicola J. Bidwell. 2018. Home is not Egumbo: Language, identity and web design. In *Proceedings of the 2nd African Conference on Human Computer Interaction (AfriCHI'18)*. ACM.
- [3] Panayotis Antoniadis. 2016. Local networks for local interactions: Four reasons why and a way forward. *First Monday* 21, 12 (2016). <https://firstmonday.org/ojs/index.php/fm/article/view/7123/5661>.
- [4] Panayotis Antoniadis. 2018. The organic internet: Building communications networks from the grassroots. In *CoDesigning Economies in Transition*. Vincenzo Mario Bruno Giorgino and Zack Walsh (Eds.), Springer International Pub., Cham, 235–272.
- [5] Seema Arora-Jonsson. 2009. Discordant connections: Discourses on gender and grassroots activism in two forest communities in India and Sweden. *Signs* 35, 1 (2009), 213–240.
- [6] Niina Arvila, Anabel Fischer, Pietari Keskinen, and Marko Nieminen. 2018. Mobile weather services for Maasai farmers: Socio-cultural factors influencing the adoption of technology. In *Proceedings of the 2nd African Conference for Human Computer Interaction*. 1–11.
- [7] Association for Progressive Communications. 2018. *Global Information Society Watch 2018: Community Networks*. APC. Retrieved from <https://www.apc.org/en/pubs/global-information-society-watch-2018-community-networks>.
- [8] Association for Progressive Communications. 2018. Connecting the Unconnected. Retrieved from <https://www.apc.org/en/project/connecting-unconnected-supporting-community-networks-and-other-community-based-connectivity>.
- [9] Association for Progressive Communications. 2019. Sustainable Community Networks. Retrieved from <https://www.apc.org/en/news/meet-projects-funded-catalytic-intervention-grants-create-more-sustainable-community-network>.
- [10] Association for Progressive Communications. 2020. Beyond Connectivity: Networks of Care. Retrieved from <https://www.apc.org/en/news/beyond-connectivity-networks-care>.
- [11] Alfonso Avila. 2009. Underdeveloped ICT areas in sub-Saharan Africa. *Informatica Economica* 13, 2 (2009), 136–146.
- [12] Seyram Avle and Silvia Lindtner. 2016. Design(ing) ‘here’ and ‘there’: Tech entrepreneurs, global markets and reflexivity in design processes. In *Proceedings of the 2016 CHI Conference on Human Factors Computing Systems*. ACM, 2233–2245.
- [13] Kagonya Awori, Frank Vetere, and Wally Smith. 2016. Sessions with grandma: Fostering indigenous knowledge through video mediated communication. In *Proceedings of the 1st African Conference on Human Computer Interaction*. ACM.
- [14] Badan Pusat Statistik. 2010. Census Penduduk. Retrieved from <https://sp2010.bps.go.id/index.php/site?id=15&wilayah=Jambi>.
- [15] Corelia Baibarac and Doina Petrescu. 2017. Co-design and urban resilience: Visioning tools for commoning resilience practices. *CoDesign* 17, 1 (2017), 83–100.
- [16] Roger Baig, Ramon Roca, Felix Freitag, and Leandro Navarro. 2015. guifi.net, a crowdsourced network infrastructure held in common. *Computer Networks* 90, 150–165.
- [17] Roger Baig, Leandro Navarro, and Ramon Roca. 2016. guifi.net: Scaling up a community network. In *Global Information Society Watch 2019: Community Networks*. APC.
- [18] Jeffrey Bardzell, Shaowen Bardzell, Guo Zhang, and Tyler Pace. 2014. The lonely raccoon at the ball: Designing for intimacy, sociability and selfhood. In *Proceedings of the 2014 SIGCHI Conference on Human Factors in Computing Systems*. ACM.
- [19] Mary Claire Barela, Josephine Dionisio, Kurtis Heimerl, Manuel Victor Sapitula, and Cedric Angelo Festin. 2018. Connecting communities through mobile networks: The Vbts-CoCoMoNets project. In *Global Information Society Watch 2018: Community Networks*. APC.
- [20] Chiara Bassetti, Mariachristina Sciannamblo, Peter Lyle, Maurizio Teli, Stefano De Paoli, and Antonella De Angeli. 2019. Co-designing for common values: Creating hybrid spaces to nurture autonomous cooperation. *CoDesign* 15, 3 (2019), 256–271. <https://doi.org/10.1080/15710882.2019.1637897>
- [21] BBC Africa 2019. The Village that Built its own WiFi Network. Retrieved from <https://tinyurl.com/y3lenkea>.
- [22] Luca Belli (Ed.). 2017. *Community Networks: The Internet by the People, for the People*. Fundação Getulio Vargas Law School and Internet Society.

- [23] Yochai Benkler and Helen Nissenbaum. 2006. Commons-based peer production and virtue. *Journal of Political Philosophy* 14, 4 (2006), 394–419.
- [24] Yochai Benkler. 2013. Commons and growth: The essential role of open commons in market economies. *The University of Chicago Law Review* 80, 3 (2013), 1499–1555.
- [25] Pravin Bhagwat, Bhaskaran Raman, and Dheeraj Sanghi. 2004. Turning 802.11 inside-out. *ACM SIGCOMM Computer Communication Review* 34, 1 (2004), 33–38.
- [26] Nicola J. Bidwell. 2010. Ubuntu in the network: Humanness in social capital in rural South Africa. *Interactions* 17, 2 (2010), 68–71.
- [27] Nicola J. Bidwell. 2016. Moving the centre to design social media for rural Africa. *AI&Soc: Journal of Culture, Communication & Knowledge* 31, 1 (2016), 51–77.
- [28] Nicola J. Bidwell. 2019. Women and the spatial politics of community networks. In *Proceedings of 31st Australian Conference on Human-Computer-Interaction (OzCHI'19)*. ACM. DOI: <https://doi.org/10.1145/3369457.3369474>
- [29] Nicola J. Bidwell. 2020. Women and the sustainability of rural community networks in the global south. In *Proceedings of International Conference on Information and Communication Technologies and Development (ICTD'20)*. ACM.
- [30] Nicola J. Bidwell. 2020. Wireless in the weather-world and community networks made to last. In *Proceedings of the Biennial Participatory Design Conference (PDC'20)*. ACM.
- [31] Nicola J. Bidwell. 2020. Tragedies in translation: Infrastructuring community networks in the global south. *Journal of Peer Production*. Retrieved from http://peerproduction.net/wp-content/uploads/2020/05/Bidwell_Tragedies-in-Translation-Fostering-Community-Networks-in-the-Global-South.pdf.
- [32] Nicola J. Bidwell. 2021. Decolonising in the gaps: Community networks and the identity of African innovation. In *Media, Culture and Technology in the Global South: Reimagining Communication and Identity in Africa and the Caribbean*. H. Dunn, D. Moyo, W. O. Lesitaokana, and S. B. Barnabas (Eds.), Springer.
- [33] Nicola J. Bidwell, Roberto Cibin, Conor Linehan, Laura Maye, and Sarah Robinson. in press. Being regulated: Licence to imagine new technology for community radio. In *Proceedings of the 24th ACM Conference on Computer-Supported Cooperative Work and Social Computing*.
- [34] Nicola J. Bidwell, Melissa Densmore, Andre van Zyl, Sarbani Banerjee Belur, and S. Nico Pace. 2019. Artful integrations of infrastructures by community-based telecoms. In *Proceedings of the 9th International Conference on Communities & Technologies - Transforming Communities (C&T'19)*.
- [35] Nicola J. Bidwell, Thomas Reitmaier, Gary Marsden, and Susan Hansen. 2010. Designing with mobile digital storytelling in rural Africa. In *Proceedings of 28th International Conference on Human Factors in Computing Systems*. ACM, 1593–1602.
- [36] Nicola J. Bidwell Reitmaier, T. and K. Jampo. 2014. Orality, gender & social audio in rural Africa. In *Proceedings of 11th International Conference on the Design of Cooperative Systems*. Springer.
- [37] Nicola J. Bidwell, Simon Robinson, Elina Vartiainen, Matt Jones, Masbulele Jay Siya, Thomas Reitmaier, Gary Marsden, and Mounia Lalmas. 2014. Designing social media for community information sharing in rural south Africa. In *Proceedings of SAICSIT2014*. ACM.
- [38] Nicola J. Bidwell and Masbule Siya. 2013. Situating asynchronous voice in rural Africa. In *Proceedings of INTER-ACT'13. International Federation for Information Processing IFIP. Lecture Notes in Computer Science*, Springer-Verlag, 36–53.
- [39] Nicola J. Bidwell, Masbule Siya, Gary. Marsden, William D. Tucker, Muvuzo Tshemese, N. Gaven, Senzo Ntlangano, Kirsten Eglinton, and Simon Robinson. 2013. Walking and the social life of solar charging in rural Africa. *ACM Transactions on Computer-Human Interaction* 20, 4 (2013), 1–33.
- [40] Nicola J. Bidwell and Michael Jensen. 2019. *Bottom-up connectivity strategies: Community-led small-scale telecommunication infrastructure networks in the global south*. APC.
- [41] N. J. Bidwell and D. Browning. 2010. Pursuing genius loci: Interaction design and natural places. *Personal and Ubiquitous Computing*. 14, 1 (2010), 15–30.
- [42] David Bollier. 2014. *Think Like a Commoner: A Short Introduction to the Life of the Commons*. New Society Publishers, Gabriola Island.
- [43] David Bollier. 2017. Reinventing law for the commons. In *Law and Policy for a New Economy*. Edward Elgar Publishing.
- [44] Andrea Botero and Sampsa Hyysalo. 2013. Ageing together: Steps towards evolutionary co-design in everyday practices. *CoDesign* 9, 1 (2013), 37–54.
- [45] Bart Braem, Chris Blondia, Chris Barz, Henning Rogge, Felix Freitag, Leandro Navarro, Joseph Bonicioli, S. Papathanasiou, P. Etsch, Roger Vinas Baig, and A. L. Kaplan. 2013. A case for research with and on community networks. *ACM SIGCOMM Computer Communication Review* 43, 3 (2013), 68–73.
- [46] Judith Butler. 2005. *Giving an Account of Oneself*. Oxford University Press, Oxford.
- [47] Greta Byrum. 2015. What are community wireless networks for? *The Journal of Community Informatics* 11, 3 (2015).

- [48] George Caffentzis and Silvia Federici. 2014. Commons against and beyond capitalism. *Community Development Journal* 49, 1 (2014), i92–i105.
- [49] Oona Castro, Carlos Alberto Afonso, and Paulo Duarte. 2018. How community networks in Maranhão are helping quilombolas promote their rights. In *Global Information Society Watch 2018: Community Networks*. APC.
- [50] Ruy Cervantes and Bonnie Nardi. 2010. Innovating from the LMICs: Practices to connect local and global networks of innovation. In *Proceedings of ICIC'10*. 259–262.
- [51] Anita Say Chan. 2007. Retiring the network spokesman: The poly-vocality of free software networks in Peru. *Science Studies* 20, 78–99.
- [52] Anita Say Chan. 2013. *Networking Peripheries. Technological Futures and the Myth of Digital Universalism*. MIT Press, Cambridge, MA.
- [53] Fantu Cheru. 2005. The silent revolution and the weapons of the weak. transformation and innovation from below. In *The Global Resistance Reader*. L. Amoore (Ed.), Routledge, New York, 74–85.
- [54] Han Ei Chew, P. Vigneswara Ilavarasan, and Mark R. Levy. 2013. When there's a will, there might be a way: The economic impact of mobile phones and entrepreneurial motivation on female-owned microenterprises. In *Proceedings of the 6th International Conference on Information and Communication Technologies and Development*. ACM.
- [55] George Hope Chidziwisano, Susan Wyche, and Rellikson Kisya. 2020. SmartChama: Designing collaborative digital financial systems for chama groups in Kenya. In *Proceedings of the 2020 International Conference on Information and Communication Technologies and Development*. 1–12.
- [56] Wallace Chigona, Selina L. Mudavanhu, Adrian Siebritz, and Zaid Amerika. 2016. Domestication of free WiFi amongst people living in disadvantaged communities in the Western Cape Province of South Africa. In *Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists*. ACM.
- [57] Vassilis Chrysos, Aimilia Voulvouli, Alexandros Papageorgiou, Giorgos Klisiaris and Nicholas Kourtzis. 2018. *Global Information Society Watch 2018: Community Networks*. APC. Retrieved from <http://www.sarantaporo.gr>.
- [58] Roberto Cibir, Maurizio Teli, and Sarah Robinson. 2019. Institutioning and community radio. A comparative perspective. In *Proceedings of the 9th International Conference on Communities & Technologies-Transforming Communities*. 143–154.
- [59] Nazli Cila, Gabriele Ferri, Martijn de Waal, Inte Gloerich, and Tara Karpinski. 2020. The blockchain and the commons: Dilemmas in the design of local platforms. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–14.
- [60] Stefano Crabu and Paolo Magaudo. 2018. Bottom-up infrastructures: Aligning politics and technology in building a wireless community network. *Computer Supported Cooperative Work* 27, 2 (2018), 149–176.
- [61] Christopher Csikszentmihalyi, Jude Mukundane, Gemma F. Rodrigues, Daniel Mwesigwa, and Michelle Kasprzak. 2018. The space of possibilities: Political economies of technology innovation in sub-Saharan Africa. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Paper 306.
- [62] John Dada. 2018. The rehabilitation of a rural community network in war-torn northern Nigeria. In *Global Information Society Watch 2018: Community Networks*. APC.
- [63] Massimo De Angelis. 2004. Separating the doing and the deed: Capital and the continuous character of enclosures. *Historical Materialism* 12, 2 (2004), 57–87.
- [64] Primavera De Filippi and Felix Treguer. 2015. Expanding the internet commons: The subversive potential of wireless community networks. *Journal of Peer Production* 6 (2015). DOI : <https://ssrn.com/abstract=2725358>
- [65] Primavera De Filippi and Felix Treguer. 2016. Wireless community networks: Towards a public policy for the network commons? In *Net Neutrality Compendium*. Springer, 261–270.
- [66] Nicola Dell and Neha Kumar. 2016. The ins and outs of HCI for development. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2220–2232.
- [67] Kathleen Diga and Nic Bidwell. 2018. *Gender and Community Networks: Busking in Policy Spaces*. GenderIT.org. Association for Progressive Communications. Retrieved from <http://www.apc.org/en/news/gender-and-community-networks-busking-policy-spaces>.
- [68] Directorate of Census Operations Maharashtra. 2011. District Census Handbook. Thane. Retrieved from http://www.censusindia.gov.in/2011census/dchb/2721_PART_B_DCHB_%20THANE.pdf.
- [69] Nicholas B. Dirks. 2001. *Castes of Mind: Colonialism and the Making of Modern India*. Princeton University Press.
- [70] Marisa Elena Duarte. 2013. *Network Sovereignty: Understanding the Implications of Tribal Broadband Networks*. Ph.D. dissertation. University of Washington.
- [71] Christina Dunbar-Hester. 2008. Geeks, meta-geeks and gender trouble: Activism, identity and low power FM radio. *Social Studies of Science* 38, 2 (2008), 201–232.
- [72] Christina Dunbar-Hester. 2009. 'Free the spectrum!' activist encounters with old and new media technology. *New Media & Society* 11, (1–2), 221–240.

- [73] Christina Dunbar-Hester. 2010. Beyond “dudecore”? Challenging gendered and “raced” technologies through media activism. *Journal of Broadcasting & Electronic Media* 54, 1 (2010), 121–135.
- [74] Christina Dunbar-Hester. 2014. *Low Power to the People: Pirates, Protest and Politics in FM Radio Activism*. MIT.
- [75] Christina Dunbar-Hester. 2016. Frailties at the borders: Stalled activist media projects in east Africa. *International Journal of Communication* 10, 22 (2016).
- [76] Christina Dunbar-Hester. 2019. *Hacking Diversity: The Politics of Inclusion in Open Technology Cultures*. Princeton University Press.
- [77] Michaelanne Dye, David Nemer, Josiah Mangiameli, Amy S. Bruckman, and Neha Kumar. 2018. El Paquete Semanal: The week’s internet in Havana. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*.
- [78] Michaelanne Dye, David Nemer, Neha Kumar, and Amy S. Bruckman. 2019. If it rains, ask grandma to disconnect the nano: Maintenance & care in Havana’s streetnet. In *Proceedings Conference on Computer Supported Cooperative Work and Social Computing*, (CSCW’19). ACM.
- [79] Amanda Elder. 2012. Between Two Worlds: Identity and Community in Oaxaca. Retrieved from <https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1116&context=mcnair>.
- [80] Arturo Escobar. 2018. Autonomous design and the emergent transnational critical design studies field. *Strategic Design Research Journal* 11, 2 (2018), 139–146.
- [81] Gustavo Esteva. 2014. Commoning in the new society. *Community Development Journal* 49, 1 (2014), i144–i159.
- [82] Michael Onyebuchi Eze. 2010. Ubuntu: Toward a new public discourse. In *Intellectual History in Contemporary South Africa*. Palgrave Macmillan, New York, 181–192.
- [83] Jaydon Farao, Monet Burse, Hafeni Mthoko, and Melissa Densmore. 2020. Stakeholder relations and ownership of a community wireless network: The case of iNethi. In *Proceedings of the International Conference on Innovations and Interdisciplinary Solutions for Underserved Areas*. Springer, Cham, 176–191.
- [84] S. Federici. 2014. *Caliban and the Witch: Women, the Body and Primitive Accumulation*. Autonomedia, Brooklyn, NY.
- [85] Silvia Federici. 2011. *Feminism and the Politics of the Commons*. PM Press.
- [86] Silvia Federici. 2018. *Re-enchanting the World: Feminism and the Politics of the Commons (KAIROS)*. PM Press.
- [87] Food and Agriculture Organization of the United Nations. Gender and Land Rights Database. Retrieved from <http://www.fao.org/gender-landrights-database/data-map/statistics/en/>.
- [88] Food and Agriculture Organization of the United Nations. 2011. Rural Women and the Millennium Development Goals 2011. Retrieved from <http://www.fao.org/3/an479e/an479e.pdf>.
- [89] Laura Forlano. 2009. Codespaces: Community wireless networks and the reconfiguration of cities. In *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City*. IGI Global, 292–309.
- [90] Valérie Fournier. 2013. Commoning: On the social organisation of the commons. *M@n@gement* 16, 4 (2013), 433–453. Retrieved from <http://www.cairn.info/revue-management-2013-4-page-433.htm#>.
- [91] Sarah Fox, Amanda Menking, Stephanie Steinhart, Anna Lauren Hoffmann, and Shaowen Bardzell. 2017. Imagining intersectional futures: Feminist approaches in CSCW. In *Proceedings of 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW’17)*, 387–393.
- [92] Sarah Fox, Rachel Rose Ulgado, and Daniela Rosner. 2015. Hacking culture, not devices: Access and recognition in feminist hackerspaces. In *Proceedings of 2015 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW’15)*, 1556–1568.
- [93] Sarah Fox. 2015. Feminist hackerspaces as sites for feminist design. In *Proceedings ACS SIGCHI Conference on Creativity and Cognition*. ACM, 341–342.
- [94] David Franquesa and Leandro Navarro. 2017. Sustainability and participation in the digital commons. *Interactions* 24, 3 (2017), 66–69.
- [95] Christian Fuchs. 2017. Sustainability and community networks. *Telematics and Informatics* 34, 2 (2017), 628–639.
- [96] Ge Gao, Yuling Sun, and Yongle Zhang. Engaging the commons in participatory sensing: Practice, problems, and promise in the context of dockless bike sharing. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI’20)*, 1–14.
- [97] GSMA. 2018. Mobile Industry Impact Report: Sustainable Development Goals. Retrieved from <http://www.gsmaintelligence.com/research/?file=ecf0a523bfb1c9841147a335cac9f6a7&download>.
- [98] GSMA. 2018. GSMA Joins ‘Rural Women’s Alliance’, a Regional Effort to Address the Digital Gender Divide in Rural Areas. Retrieved from <http://www.gsma.com/latinamerica/rural-womens-alliance/>.
- [99] GSMA. 2019. Connected women the mobile gender gap report 2019. Retrieved from <http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/03/GSMA-Connected-Women-The-Mobile-Gender-Gap-Report-2019.pdf>.
- [100] Luca Belli (Ed.). 2016. Community Connectivity: Building the Internet from Scratch. Retrieved from https://guifi.net/https://www.intgovforum.org/multilingual/index.php?q=filedepot_download/4391/1163.

- [101] Robert Hackett and William Carroll. 2006. *Remaking Media: The Struggle to Democratize Public Communication*. Routledge, New York.
- [102] Senka Hadzic, A. Phokeer, and D. David Johnson. 2016. TownshipNet: A localized hybrid TVWS-WiFi and cloud services network. In *Proceedings of the IEEE International Symposium on Technology and Society*. IEEE.
- [103] D. Hakken, M. Teli, and B. Andrews. 2016. *Beyond Capital: Values, Commons, Computing, and the Search for a Viable Future*. Routledge. Retrieved from <https://www.routledge.com/Beyond-Capital-Values-Commons-Computing-and-the-Search-for-a-Viable/Hakken-Teli-Andrews/p/book/9781138924444>.
- [104] Naveed Haq. *Wireless for Communities Pakistan*. GisWatch.
- [105] Donna Haraway. 1988. Situated Knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies* 14, 3 (1988), 575–599.
- [106] Wendy Harcourt and Arturo Escobar. 2005. *Women and the Politics of Place*. Kumarian Press, Bloomfield, CT.
- [107] Garrett Hardin. 1968. The tragedy of the commons. *Science* 162, 3859 (1968), 1243–1248.
- [108] Sandra Harding. 2004. *The Feminist Standpoint Theory Reader: Intellectual and Political Controversies*. Psychology Press.
- [109] Jean Hardy, Dharma Dailey, Susan Wyche, and Norman Makoto Su. 2018. Rural computing: Beyond access and infrastructure. In *Proceedings of the Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing*. 463–470.
- [110] Roger W. Harris. 2018. *Smart Partnerships and Participatory Engagement: A Community Network for Indigenous Borneo*. Giswatch.
- [111] Shaddi Hasan, Mary Claire Barela, Matthew Johnson, Eric Brewer, and Kurtis Heimer. 2019. Scaling community cellular networks with community cellular manager. In *Proceedings of 16th Symposium on Networked Systems Design and Implementation (NSDI'19)*. 735–750.
- [112] Julia Qermezi Huang. 2018. Digital aspirations: 'Wrong-number' mobile-phone relationships and experimental ethics among women entrepreneurs in rural Bangladesh. *Journal of the Royal Anthropological Institute* 24, 1 (2018), 107–125.
- [113] Erick Huerta. 2018. Legal framework for community networks in Latin America. In *Global Information Society Watch: Community Networks*. APC. Retrieved from <http://www.apc.org/en/pubs/global-information-society-watch-2018-community-networks>.
- [114] Tigest Shewarega Hussen, Nicola J. Bidwell, Carlos Rey-Moreno, and William D. Tucker. 2016. Gender and participation: Critical reflection on Zenzeleni networks in Mankosi, South Africa. In *Proceedings of the 1st African Conference on Human Computer Interaction*. ACM, 12–23.
- [115] Samia Ibtasam, Lubna Razaq, Maryam Ayub, Jennifer R. Webster, Syed Ishtiaque Ahmed, and Richard Anderson. 2019. My cousin bought the phone for me. I never go to mobile shops. The role of family in women's technological inclusion in Islamic Culture. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–33.
- [116] Tim Ingold. 2013. *Making: Anthropology, Archaeology, Art and Architecture*. Routledge, London.
- [117] Tim Ingold. 2017. On human correspondence. *Journal of the Royal Anthropological Institute* 23, 1 (2017), 9–27.
- [118] International Development Research Centre. 2019. Understanding Digital Access and Use in the Global South. Retrieved from <https://www.idrc.ca/en/project/understanding-digital-access-and-use-global-south>.
- [119] International Labour Organisation. 2010. *Gender dimensions of agricultural and rural employment: Differentiated pathways out of poverty—Status, trends and gaps*. FAO, Rome.
- [120] International Telecommunications Union. 2015. Broadband Situations in Rural and Remote Areas. Retrieved from https://www.itu.int/en/ITU-D/Technology/Documents/RuralCommunications/Broadband_Situations_in_Rural_and_Remote_Areas_Full.pdf.
- [121] International Telecommunications Union. 2018. Retrieved from <https://www.itu.int/en/action/genderequality/data/Pages/ie.aspx?en/action/gender-equality/data/Pages/default.aspx>.
- [122] International Telecommunications Union. 2019. Digital Inclusion of All. Retrieved from <https://www.itu.int/en/mediacentre/backgrounders/Pages/digital-inclusion-of-all.aspx>.
- [123] International Telecommunications Union. 2019. Retrieved from <http://news.itu.int/why-leaders-need-new-tools-to-connect-rural-citizens/>.
- [124] International Telecommunications Union. 2019. Retrieved from <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf>.
- [125] The Internet Governance Forum (IGF). Outcome document on community connectivity: declaration on community connectivity. Retrieved from http://www.Intgovforum.org/multilingual/index.php?q=filedepot_download/4189/174.
- [126] Internet Governance Forum (IGF). 2019. Berlin towards Equitable and Sustainable Community-Led Networks (Panel). Retrieved from http://www.youtube.com/watch?v=A_h9y9kzj4.

- [127] The Internet Society. 2019. African CN Summit. Retrieved from <http://www.internetsociety.org/events/summit-community-networks-africa/2019>.
- [128] Lilly Irani. 2015. Hackathons and the making of entrepreneurial citizenship. *Science, Technology, & Human Values* 40, 5 (2015), 799–824.
- [129] Esther Jang, Mary Claire Barela, Matt Johnson, Philip Martinez, Cedric Festin, Margaret Lynn, Josephine Dionisio, and Kurtis Heimerl. 2018. Crowdsourcing rural network maintenance and repair via network messaging. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Paper 67.
- [130] Esther Jang, Han Beol, Philip Garrison, Ronel Vincent Vistal, Maria Theresa D. Cunanan, Maria Theresa Perez, Philip Martinez, Matthew William Johnson et al. 2019. Trust and technology repair infrastructures in the remote rural Philippines: Navigating urban-rural seams. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), Article 99.
- [131] David L. Johnson and Korbus Roux. 2008. Building rural wireless networks: lessons learnt and future directions. In *Proceedings of the 2008 ACM Workshop on Wireless Networks and Systems for Developing Regions*.
- [132] Aditya Johri, Cassie Heyman-Schrum, Daniel Ruiz, Aqdas Malik, Habib Karbasian, Rajat Handa, and Hemant Purohit. 2018. More than an engineer: Intersectional self-expressions in a hashtag activism campaign for engineering diversity. In *Proceedings of the 1st ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS'18)*.
- [133] Katrina Jungnickel. 2013. *DIY WiFi: Re-imagining Connectivity*. Springer.
- [134] Kanchana Kanchanasut, Adisorn Lertsinsubtavee, Apinun Tunpan, Nisarath Tansakul, Preechai Mekbungwan, Nuntaphat Weshsuwannarugs, and Parkpoom Tripatana. 2018. Building last-metre community networks in Thailand. In *Global Information Society Watch 2018: Community Networks*. APC.
- [135] Helena Karasti. 2014. Infrastructuring in participatory design. In *Proceedings of the 13th Participatory Design Conference: Research Papers*. Vol. 1, 141–150.
- [136] Lamia Karim. 2011. *Microfinance and its Discontents: Women in Debt in Bangladesh*. University of Minnesota Press.
- [137] Amin M. Khan, Leandro Navarro, Leila Sharifi, and Luis Veiga. 2013. Clouds of small things: Provisioning infrastructure-as-a-service from within CNs. In *Proceedings 2013 IEEE 9th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob'13)*. IEEE, 16–21.
- [138] Vera Khovanskaya, Phoebe Sengers, Melissa Mazmanian, and Charles Darrach. 2017. Reworking the gaps between design and ethnography. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. 5373–5385.
- [139] Faith N. Kibere. 2016. The paradox of mobility in the Kenyan ICT ecosystem: An ethnographic case of how the youth in Kibera slum use and appropriate the mobile phone and the mobile internet. *Information Technology for Development* 22, 1 (2016), 47–67.
- [140] Michel Krieger, Emily Margaret Stark, and Scott R. Klemmer. 2009. Coordinating tasks on the commons: Designing for personal goals, expertise and serendipity. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1485–1494.
- [141] Neha Kumar. 2015. The gender-technology divide or perceptions of non-use? *First Monday* 20, 11 (2015). DOI: <https://journals.uic.edu/ojs/index.php/fm/article/view/6300>
- [142] Neha Kumar and Richard J. Anderson. 2015. Mobile phones for maternal health in rural India. 2015. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, 427–436.
- [143] Neha Kumar, Naveena Karusala, Azra Ismail, Marisol Wong-Villacres, and Aditya Vishwanath. 2019. Engaging feminist solidarity for comparative research, design and practice. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), Article 167.
- [144] Kumar Neha, Naveena Karusala, Azra Ismail, and Anupriya Tuli. 2020. Taking the long, holistic, and intersectional view to women's wellbeing. *ACM Transactions on Computer-Human Interaction* 27, 4 (2020), 1–32.
- [145] Indra de Lanerolle, Marion Walton, and Alette Schoon. 2017. Izolo: Mobile diaries of the less connected. *Making All Voices Count Research Report*. IDS, Brighton. Retrieved from https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/13348/RRReport_LessConnected_FIN AL.pdf.
- [146] Christopher A LeDantec and Carl DiSalvo. 2013. Infrastructuring and the formation of publics in participatory design. *Social Studies of Science* 43, 2 (2013), 241–264.
- [147] Seth C. Lewis and Nikki Usher. 2014. Code, collaboration and the future of journalism: A case study of the hacks/hackers global network. *Digital Journalism* 2, 3 (2014), 383–393.
- [148] Ann Light. 2018. Performing interaction design with Judith Butler. In *Critical Theory and Interaction Design*. J. S. Bardzell and M. Blythe (Eds.), MIT Press, Cambridge, MA, 429–446.
- [149] Ann Light and Clodagh Miskelly. 2015. Sharing economy vs sharing cultures? Designing for social, economic and environmental good. *Interaction Design and Architecture(s)* 24, 49–62.
- [150] Ann Light and Clodagh Miskelly. 2019. Platforms, scales and networks: Meshing a local sustainable sharing economy. *Computer Supported Cooperative Work* 28, 3–4 (2019), 591–626.

- [151] Yu-Wei Lin. 2008. Techno-feminist view on the open-source software development. *Global Information Technologies: Concepts, Methodologies, Tools and Applications*. IGI Global, 3365–3373.
- [152] Yu-Wei Lin and Matthijs den Besten. 2019. Gendered work culture in free/libre open source software development. *Gender, Work & Organization* 26, 7 (2019), 1017–1031.
- [153] Cindy lin kaiying, Silvia Lindtner, and Stefanie Wuschitz. 2019. Hacking difference in Indonesia: The ambivalences of designing for alternative futures. In *Proceedings of the 2019 on Designing Interactive Systems Conference*. 1571–1582.
- [154] Silvia Lindtner and Seyram Avle. 2017. Tinkering with governance: Technopolitics and the economization of citizenship. *Proceedings of the ACM on Human-Computer Interaction* 1, CSCW (2017), Article 70.
- [155] Silvia Lindtner, Shaowen Bardzell, and Jeffrey Bardzell. 2016. Reconstituting the utopian vision of making: HCI after technosolutionism In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 1390–1402.
- [156] Peter Linebaugh. 2008. *The Magna Carta Manifesto*. Berkeley: University of California Press.
- [157] Thomas Lodato and Carl DiSalvo. 2018. Institutional constraints: the forms and limits of participatory design in the public realm. In *Proceedings of the 15th Participatory Design Conference: Full Papers (PDC'18)*. Vol. 1, 1–12, Paper 5.
- [158] Maria Rosa Lorini, Melissa Densmore, David Johnson, Senka Hadzic, Hafeni Mthoko, Ganief Manuel, Marius Waries, and André van Zyl. 2018. Localize-It: Co-designing a community-owned platform. In *International Development Informatics Association Conference*. Springer, Cham, 243–257.
- [159] Quentillian Louw, Jane Coffin, and C. Muller. 2018. *Namibia: The Seed of a Community Network*. Global Information Society Watch 2018: Community Network. APC. Retrieved from <http://www.apc.org/en/pubs/global-information-society-watch-2018-community-networks>.
- [160] Claudia Magallanes-Blanco and Leandro Rodriguez-Medina. 2016. Give me a mobile and I will raise a community: Digital Empowerment: Opportunities and Challenges of Inclusion in Latin America and the Caribbean. In *Communication and Information Technologies Annual*. Emerald Group Publishing Limited, 315–343.
- [161] George E. Marcus 1995. Ethnography in/of the world system: The emergence of multi-sited ethnography. *Annual Review of Anthropology* 24, 1 (1995), 95–117.
- [162] Brandie Lee Martin and Eric Abbott. 2011. Mobile phones and rural livelihoods: Diffusion, uses and perceived impacts among farmers in rural Uganda. *Information Technologies & International Development* 7, 4 (2011), 17.
- [163] Sanna Marttila, Andrea Botero, and Joanna Saad-Sulonen. 2014. Towards commons design in participatory design. In *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium Papers and Keynote Abstracts (PDC'14)*. Vol. 2, ACM.
- [164] Sanna Marttila and Andrea Botero. 2017. Infrastructuring for cultural commons. *Computer Supported Cooperative Work* 26, 1–2 (2017), 97–133. DOI : <https://doi.org/10.1007/s10606-017-9273-1>
- [165] Sanna Marttila, Elisabet M. Nilsson, and Anna Seravalli. 2014. Opening production: Design and commons. In *Making Futures: Marginal Notes on Innovation, Design and Democracy*. P. Ehn, E. M. Nilsson, and R. Topgaard (Eds.), MIT Press, Cambridge, MA, 87–98.
- [166] Achille Mbembe. 2019. *Bodies as borders*. *From the European South* 4, 5–18. DOI : <http://europeansouth.postcolonialitalia.it>
- [167] Janet McIntyre-Mills. 2019. Displacement, loss and enclosure of the commons: The role of the Dutch East India company. In *Mixed Methods and Cross Disciplinary Research*. Springer, Cham, 129–172.
- [168] Rob McMahon, Heather Hudson, and Lyle Fabian. The First Mile Connectivity Consortium FIRST Nations Community Networks. FirstMile.ca
- [169] P. Micholia, M. Karaliopoulos, I. Koutsopoulos, L. Navarro, R. B. Vias, D. Boucas, M. Michalis, and P. Antoniadis. 2018. Community networks and sustainability: A survey of perceptions, practices, and proposed solutions. *IEEE Communications Surveys & Tutorials* 20, 4 (2018), 3581–3606.
- [170] Stefania Milan and Emiliano Treré. 2019. Big data from the south(s): Beyond data universalism. *Television & New Media* 20, 4 (2019), 319–335. <https://doi.org/10.1177/1527476419837739>
- [171] Mark Moberg. 1992. Continuity under colonial rule: The alcalde system and the Garifuna in Belize, 1858–1969. *Ethnohistory* 39, 1 (1992), 1–19.
- [172] Maletsabisa Molapo, Melissa Densmore, and Limpho Morie. 2016. Apps and skits: Enabling new forms of village-to-clinic feedback for rural health education. In *Proceedings of the 7th Annual Symposium on Computing for Development*. ACM, Paper 10.
- [173] Mozilla Foundation. 2019. Retrieved from <https://www.mozillapulse.org/entry/1370>.
- [174] Pretty Mudliar. 2018. Public Wi-Fi is for men and mobile internet is for women: Interrogating Politics of Space and Gender around WiFi Hotspots. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (2018), Article 126.
- [175] Nyamwaya Munthali, Cees Leeuwis, Annemarie van Paassen, Rico Lie, Richard Asare, Ron van Lammeren, and Marc Schut. 2018. Innovation intermediation in a digital age: Comparing public and private new-ICT platforms for agricultural extension in Ghana. *NJAS-Wageningen Journal of Life Sciences* 86, 64–76.

- [176] Laura L. Murphy and Alexandra E. Priebe. 2011. My co-wife can borrow my mobile phone! Gendered geographies of cell phone usage and significance for rural Kenyans. *Gender, Technology and Development* 15, 1 (2011), 1–23.
- [177] Fred Mweetwa and Gertjan Van Stam. 2018. *Global Information Society Watch 2018: Community Networks*. APC.
- [178] Leandro Navarro et al. 2016. A commons-oriented framework for community networks. In *Community Connectivity: Building the Internet from Scratch*. L. Belli (Ed.), Annual Report of the UN IGF Dynamic Coalition on Community Connectivity.
- [179] Andrea J. Nightingale. 2019. Commoning for inclusion? commons, exclusion, property and socio-natural becomings. *International Journal of the Commons* 13, 1 (2019), 19–35.
- [180] Erick Oduor, Carman Neustaedter, Tejinder K. Judge, Kate Hennessy, Carolyn Pang and Serena Hillman. 2014. How technology supports family communication in rural, suburban and urban Kenya. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2705–2714.
- [181] Erick Oduor, Peninah Waweru, Jonathan Lenchner, and Carman Neustaedter. 2018. Practices and technology needs of a network of farmers in Tharaka Nithi, Kenya. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Paper 39.
- [182] Open Technology. Retrieved from <http://www.newamerica.org/oti/about/>.
- [183] Elisa Oreglia and Janaki Srinivasan. 2016. ICT, Intermediaries and the transformation of gendered power structures. *MIS Quarterly* 40, 2 (2016), 501–510.
- [184] Elinor Ostrom. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- [185] Joyojeet Pal, Meera Lakshmanan, and Kentaro Toyama. 2007. My child will be respected: Parental perspectives on computers in rural India. In *Proceedings of the 2007 International Conference on Information and Communication Technologies and Development*. IEEE, 1–9.
- [186] Government of Maharashtra. Retrieved from <https://palghar.gov.in/about-district/>.
- [187] Teresa Palmieri, Liesbeth A. Huybrechts, Oswald Devisch, and Roel De Ridder. 2018. Everyone shares in Hasselt: A perspective on the political potential of spatial communing. In *Proceedings of the 15th Participatory Design Conference (PDC'18)*. Vol. 2, Article 30, 1–3. <https://doi.org/10.1145/3210604.3214359>
- [188] Tapan S. Parikh. 2009. Engineering rural development. *Communications of the ACM* 52, 1 (2009), 54–63.
- [189] Fred Pearce. 2012. *The Land Grabbers: The New Fight Over Who Owns the Earth*. Beacon Press, Harvard.
- [190] Karl Polanyi. 2001. *The Great Transformation: The Political and Economic Origins of Our Time; Foreword by Joseph E. Stiglitz*. Beacon Press, Boston.
- [191] Alison Powell. 2011. Metaphors, models and communicative spaces: Designing local wireless infrastructure. *Canadian Journal of Communication* 36, 1 (2011).
- [192] Re-publica. Retrieved from <https://re-publica.com/en>.
- [193] Joseph Reagle. 2013. Free as in sexist? Free culture and the gender gap. *First Monday* 18, 1 (2013). DOI: <https://doi.org/10.5210/fm.v18i1.4291>
- [194] Arlind Reuter, Tom Bartindale, Kellie Morrissey, Thomas Scharf, and Jennifer Liddle. 2019. Older voices: Supporting community radio production for civic participation in later life. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*. ACM, Paper 434.
- [195] Daniel Revollo-Fernández, Alonso Aguilar-Ibarra, Fiorenza Micheli, and Andrea Sáenz-Arroyo. 2016. Exploring the role of gender in common-pool resource extraction: evidence from laboratory and field experiments in fisheries. *Applied Economics Letters* 23, 13 (2016), 912–920.
- [196] Carlos Rey-Moreno. 2017. Supporting the Creation and Scalability of Affordable Access Solutions: Understanding Community Networks in Africa. Retrieved from <https://www.internetsociety.org/resources/doc/2017/supporting-the-creation-and-scalability-of-affordable-access-solutions-understanding-community-networks-in-africa/>.
- [197] Carlos Rey-Moreno, William D. Tucker, Domonic Cull, and R. Blom. 2015. Making a community network legal within the South African regulatory framework. In *Proceedings of the 7th International Conference on Information and Communication Technologies and Development*. 2015, 1–4.
- [198] Carlos Rey-Moreno, Ines Bebea-Gonzalez, Ignacio Foche-Perez, River Quispe-Tacas, Leopoldo Liñán-Benitez, and Javier Simo-Reigadas. 2011. A telemedicine WiFi network optimized for long distances in the Amazonian jungle of Peru. In *Proceedings of the 3rd Extreme Conference on Communication: The Amazon Expedition*. Vol. 9, ACM.
- [199] Carlos Rey-Moreno, Josephine Miliza, Fred Mweetwa, Gertjan van Stam, and David Johnson. 2016. Community networks in the African context: Opportunities and barriers. In *Proceedings of the 1st African Conference on Human Computer Interaction*. ACM, 12–23.
- [200] Carlos Rey-Moreno, Zukile Roro, William D. Tucker, Masbulele Jay Siya, Nicola J. Bidwell, and Javier Simo-Reigadas. 2013. Experiences, challenges and lessons from rolling out a rural WiFi mesh network. In *Proceedings of the 3rd ACM Symposium on Computing for Development (ACM DEV'13)*.

- [201] Carlos Rey-Moreno, Amalia Sabiescu, Masbulele Jay Siya, and William D. Tucker. 2015. Local ownership, exercise of ownership and moving from passive to active entitlement: A practice-led inquiry on a rural community network. *The Journal of Community Informatics* 11, 2 (2015).
- [202] Sarah Robinson, Nicola J. Bidwell, Roberto Cibin, Conor Linehan, Laura Maye, John McCarthy, N. Pantidi, and M. Maurizio Teli. in press. Islandness and HCI. *Transactions on Computer-Human Interaction*, Special Issue on Rural Computing and HCI.
- [203] Deborah Bird Rose. 1996. *Nourishing Terrains: Australian Aboriginal Views of Landscape & Wilderness*. Commonwealth of Australia. Retrieved from <http://www.ahc.gov.au/publications/generalpubs/>.
- [204] Daniela K. Rosner and Saara Fox. 2016. *Legacies of Craft and the Centrality of Failure in a Mother-Operated Hackerspace*. New Media & Society.
- [205] Nithya Sambasivan Garen Checkley, Amna Batool, Nova Ahmed, David Nemer, Laura Sanely Gaytán-Lugo, Tara Matthews, Sunny Consolvo, and Elizabeth Churchill. 2018. Privacy is not for me, it's for those rich women: Performative Privacy Practices on Mobile Phones by Women in South Asia. In *Proceedings of the 14th Symposium on Usable Privacy and Security (SOUPS'18)*. 127–142.
- [206] Nithya Sambasivan and Thomas Smyth. 2010. The human infrastructure of ICTD. In *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*. ACM, 40.
- [207] Christian Sandvig. 2012. Connection at Ewiiapaayp mountain. In *Race After the Internet*. L. Nakamura and P. Chow-White (Eds.), Routledge, 168–200.
- [208] Fred Saunders. 2014. The promise of common pool resource theory and the reality of commons projects. *International Journal of the Commons* 8, 2 (2014), 636–656. <https://www.thecommonsjournal.org/articles/10.18352/ijc.477/>.
- [209] Selena Savic and Stefanie Wuschitz. 2018. Feminist hackerspace as a place of infrastructure production. *ADA A Journal of Gender, New Media and Technology* 13 (2018). DOI: <https://adanewmedia.org/2018/05/issue13-savic-wuschitz/>.
- [210] Ammari T. Schoenebeck and Silvia Lindtner. 2017. The crafting of DIY fatherhood. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW'17)*. 1109–1122.
- [211] Tim Schütz and Monic Meisel. 2018. From the shelter to the classroom: Two cases of civic participation through Freifunk Berlin. Retrieved from https://giswatch.org/sites/default/files/gw2018_germany_0.pdf.
- [212] Mariacristina Sciannamblo, Marisa Cohn, Maurizio Teli, and Peter Lyle. in press. Caring and commoning as cooperative work: A case study. In *Proceedings of the 2021 ACM Conference on Computer Supported Cooperative Work and Social Computing*.
- [213] Mariacristina Sciannamblo, Peter Lyle, and Maurizio Teli. 2018. Fostering Commonfare. Entanglements between Participatory Design and Feminism. In *Proceedings of DRS Design Research Society Conference*.
- [214] Maria Soledad Segura and Silvio Waisbord. 2019. Between data capitalism and data citizenship. *Television & New Media* 20, 4 (2019), 412–419. DOI: <https://doi.org/10.1177/1527476419834519>
- [215] Vandana Shiva. 2014. *The Vandana Shiva Reader*. University Press of Kentucky.
- [216] Neera M. Singh. 2017. Becoming a Commoner: The commons as sites for affective socio-nature encounters and co-becomings. *Ephemera: Theory and Politics in Organisation* 17, 4 (2017), 751–776.
- [217] Sean Siochrú and Bruce Girard. 2005. *Community-Based Networks and Innovative Technologies*. United Nations Development Programme.
- [218] Sonesh Surana, Rabin K. Patra, Sergiu Nedeveschi, Manuel Ramos, Lakshminarayanan Subramanian, Yahel Ben-David, and Eric A. Brewer. 2008. Beyond pilots: Keeping rural wireless networks alive. In *Beyond Pilots: Keeping Rural Wireless Networks Alive, Networked Systems Design and Implementation*. 119–132.
- [219] Stephen Song, Carlos Rey-Moreno, Anriette Esterhuysen, Mike Jensen, and Leandro. 2018. The rise and fall and rise of community networks. In *Global Information Society Watch 2018: Community Networks*. APC, 7–9.
- [220] Steve Song, Carlos Rey-Moreno, and Mike Jensen. 2019. Innovations in spectrum management. In *Enabling Community Networks and Small Operators to Connect the Unconnected*. The Internet Society. Retrieved from <http://www.internetsociety.org/resources/doc/2019/innovations-in-spectrum-management/>.
- [221] Colin Stanley, Heike Winschiers-Theophilus, Michel Onwordi, and Gereon Kapuire. 2013. Rural communities crowd-source technology development: A Namibian expedition. In *Proceedings of the 6th International Conference on Information and Communications Technologies and Development: Notes*. Vol. 2, ACM, 155–158.
- [222] Rosemary Steup, Arvind Santhanam, Marisa Logan, Lynn Dombrowski, and Norman Makoto Su. 2018. Growing tiny publics: Small farmers' social movement strategies. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (2018), 165:1–165:24. DOI: <https://doi.org/10.1145/3274434>
- [223] Thomas Streeter. 1996. *Selling the Air: A Critique of the Policy of Commercial Broadcasting in the United States*. University of Chicago Press.
- [224] Lucy Suchman. 2002. Located accountabilities in technology production. *Scandinavian Journal of Information Systems* 14, 2 (2002), 91–105.

- [225] Sharifa Sultana, François Guimbretière, Phoebe Sengers, and Nicola Dell. 2018. Design within a patriarchal society: Opportunities and challenges in designing for rural women in Bangladesh. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Paper 536.
- [226] Sharifa Sultana and Syed Ishtiaque Ahmed. 2019. Witchcraft and HCI: Morality, modernity and postcolonial computing in rural Bangladesh. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Paper 356.
- [227] Jo Tacchi, Kathi Kitner, and Kate Crawford. 2012. Meaningful mobility: Gender, development and mobile phones. *Feminist Media Studies* 12, 4 (2012), 528–537.
- [228] Ahmed Tareq. 2017. Inclusive capitalism and bottom of the pyramid approaches to development: The case of information and communication technologies fostering ‘inclusion’ in developing countries. Retrieved from https://ruor.uottawa.ca/bitstream/10393/36599/3/Rashid_Ahmed_Tareq_2017_thesis.pdf#page=89.
- [229] Maurizio Teli. 2015. Computing and the common: Hints of a new utopia in participatory design. In *Proceedings of the 5th Decennial Aarhus Conference on Critical Alternatives (AA’15)*. Aarhus University Press, 17–20.
- [230] Maurizio Teli, Silvia Bordin, Maria Menéndez Blanco, Giusi Orabona, and Antonella De Angeli. 2015. Public design of digital commons in urban places. *International Journal of Human-Computer Studies* 81, C (2015), 17–30.
- [231] Maurizio Teli, Angela Di Fiore, and Vincenzo D’Andrea. 2016. Computing and the common: An empirical case of participatory design today. In *Proceedings of the 14th Participatory Design Conference: Full papers—Volume 1 (PDC’16)*. Claus Bossen, Rachel Charlotte Smith, Anne Marie Kanstrup, Janet McDonnell, Maurizio Teli, and Keld Bødker (Eds.), ACM, New York, NY, 1–10.
- [232] Maurizio Teli, Peter Lyle, and Mariacristina Sciannamblo. 2018. Institutioning the common. The case of Commonfare. In *Proceedings of the 15th Participatory Design Conference (PDC’18)*.
- [233] Josh Terrell, Andrew Kofink, Justin Middleton, Clarissa Rainear, Emerson Murphy-Hill, Chris Parnin, and Jon Stallings. 2017. Gender differences and bias in open source: Pull request acceptance of women versus men. *Peer J Computer Science* 3, e111. DOI : <https://doi.org/10.7717/peerj-cs.111>
- [234] Dimitri Toshkov. 2018. The rise of the global south. *Research Design Matters*. Retrieved from <http://re-design.dimitereu/?p=969>.
- [235] Kentaro Toyama. 2011. Technology as amplifier in international development. In *Proceedings of the 2011 iConference*. ACM, 75–82.
- [236] Uganda Bureau of Statistics. 2017. *National Population and Housing Census 2014*. Area Specific Profiles, Gulu. Retrieved from <https://www.ubos.org/wp-content/uploads/publications/2014CensusProfiles/GULU.pdf>.
- [237] United Nations. Retrieved from <http://www.un.org/en/un-chronicle/new-technologies-and-global-goals>.
- [238] United Nations Development Programme (UNDP). 2009. Retrieved from http://www.undp.org/content/dam/undp/library/development-impact/SS%20Research%20Publications/11960%20-%20Design%20for%20Scaling-up%20South-South%20Cooperation%20for%20Sustainable%20Development%20-%202009-3_Web.pdf.
- [239] United Nations Development Programme (UNDP). 2018. Human Development Reports Gender Inequality Index (GII). Retrieved from <http://hdr.undp.org/en/content/gender-inequality-index-gii>.
- [240] United Nations Statistical Division (UNSD). Population Density and Urbanization. Retrieved from <https://unstats.un.org/unsd/demographic/sconcerns/densurb/densurbmethods.htm>.
- [241] United Nations Women. 2018. Retrieved from <https://www.unwomen.org/en/news/stories/2018/1/announcer-iwd-2018-theme>.
- [242] United Nations Working Group on Aging. 2017. Older Persons in Rural and Remote Areas. Retrieved from https://www.unece.org/fileadmin/DAM/pau/age/Policy_briefs/ECE-WG1-25.pdf.
- [243] Gertjan Van Stam and Darelle van Greunen. 2014. Review of an African rural internet network and related academic interventions. *The Journal of Community Informatics* 10, 2 (2014), 1–16.
- [244] Gertjan Van Stam. 2017. Chapter two the coming-of-age of super-colonialism. In *African Studies in the Academy: The Cornucopia of Theory, Praxis and Transformation in Africa?* Langaa RPCIG, 13–40.
- [245] Irina Velicu and Gustavo García-López. 2018. Thinking the commons through Ostrom and butler: Boundedness and vulnerability. *Theory, Culture & Society* 35, 6 (2018), 55–73. <https://doi.org/10.1177/0263276418757315>
- [246] Evanson N. Wamagatta. 2009. British administration and the chiefs’ tyranny in early colonial Kenya: A case study of the first generation of chiefs from Kiambu district, 1895–1920. *Journal of Asian and African Studies* 44, 4 (2009), 371–388.
- [247] Heike Winschiers-Theophilus, Nicola J. Bidwell, and Edwin Blake. 2012. Community consensus: Design beyond participation. *Design Issues* 28, 3 (2012), 89–100.
- [248] Richmond Y. Wong and Steven J. Jackson. 2015. Wireless visions: Infrastructure, imagination and US spectrum policy. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*. ACM, 105–115.
- [249] Marisol Wong-Villacres, Arkadeep Kumar, Aditya Vishwanath, Naveena Karusala, Betsy DiSalvo, and Neha Kumar. 2018. Designing for intersections. In *Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, 45–58.

- [250] World Wide Web Foundation. 2018. A4AI 2018 Affordability Report. Retrieved from <https://webfoundation.org/2018/10/a4ai-2018-affordability-report>.
- [251] World Wide Web Foundation. 2018. Webfoundation Ghana. Retrieved from <https://webfoundation.org/africasummit/>.
- [252] Worldbank. 2009. *World Development Report 2009: Reshaping Economic Geography*. World Bank, Washington DC.
- [253] Worldbank. 2018. GDP per Capita. Retrieved from <https://data.worldbank.org/indicator/ny.gdp.pcap.cd>.
- [254] Worldbank. 2018. Retrieved from <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?view=map>.
- [255] Susan Wyche, Nightingale Simiyu, and Martha E. Othieno. 2016. Mobile phones as amplifiers of social inequality among rural Kenyan women. *ACM Transactions on Computer-Human Interaction* 23, 3 (2016), 14.
- [256] Bruna Zanolli, Carla Jancz, Cristiana Gonzalez, Daiane Araujo dos Santos, and Debora Prado. 2018. Feminist infrastructure and CNs. In *Global Information Society Watch 2018: Community Networks*. APC, 7–9.

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