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Digital divide and social harm: towards co-designing community-led algorithmic ecologies

by

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Abstract

The digital divide in rural Mexico represents a social harm that manifests through colonial continuities and neoliberal policies. Through qualitative research conducted both in social media and with a rural community in central Mexico, this work demonstrates how the digital divide is seen and lived through the lived experiences of communities harmed by the digital divide. Drawing from decolonial frameworks, the project shows how communities navigate these challenges while maintaining their own cultural practices and knowledge systems.

The research findings demonstrate different and contrasting approaches to the digital divide. While private providers of technology, state actors and NGOs address the digital divide through market driven interventions and control mechanisms, communities actively shape their digital futures by leveraging existing relational practices, communal decision-making structures, open technologies and transnational networks.

This work contributes to scholarship by moving beyond analysis of access, skills, and motivations or further calls for policies, and instead positions how colonial logics have formed and give continuation to what we call the digital divide. By centring community experiences and practices, this work establishes pathways towards co-designing algorithmic ecologies that grow from and strengthen existing forms of collective organisation.

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Chapter 1. Introduction

The digital divide has evolved significantly since its emergence in the 1990s, as a concept highlighting disparities in access to and use of digital technologies. Initially characterised by simple access metrics, the phenomenon has revealed itself to be increasingly complex, manifesting through multiple intersecting factors that particularly affect rural and other marginalised communities. A complexity that demands a more nuanced understanding that goes beyond mere theorisations from western spaces and measurement frameworks to more situated community-led theorisations and approaches.

This work examines how the digital divide both constitutes a form of social harm, and it produces social harm. This distinction is critical because the digital divide itself represents social harm by systematically excluding certain populations from not only designing technology but also from essential services and opportunities, while simultaneously generating cascading harmful consequences through this exclusion.

Based on zemiological approaches (Hillyrad et al., 2004), social harm is understood not only as a result of criminal acts or isolated events but as the product of systemic social relations that disadvantage specific groups. Pemberton's (2015) framework extends this by identifying three core dimensions of harm, physical well-being, autonomy and relational ties that are systematically damaged under the social systems we live in, a capitalist structure that relies on neoliberal logics and processes. Within this framework, the digital divide constitutes harm by directly undermining these three dimensions when digital access becomes prerequisite for essential services, as it is becoming more and more evident in the push to digitalise public services.

Thus, the structural forces that generate this social harm are not accidental but systematic, and the current research demonstrates how the digital divide is fuelled by neoliberal economic models and political frameworks which perpetuate colonial power relations. These neoliberal approaches weaponize the three dimensions of harm by transforming access to digital resources and their design from a shared responsibility into a market commodity, disproportionally affecting communities already marginalised by colonial legacies.
While the broader logics of capitalism create the conditions necessary for various forms of exclusion and exploitation (Fraser and Jaeggi, 2018; Fraser, 2022), neoliberal policies specifically intensify these dynamics through market driven approaches that not only create but

actively reproduce the digital divide, particularly for historically marginalised communities. Through a decolonial lens, this project posits these structural conditions as constituting forms of social harm in themselves, challenging the assumption that policy driven solutions emerging from colonial and market-based logics can effectively address the digital divide when they are fundamentally embedded in the same systems that produce and fuel the digital divide and thus the exclusions and inequalities to technologies.

While extensive research demonstrates how the digital divide needs to be studied and understood as an inequality that expands from other socioeconomic and sociopolitical inequalities (Berrío-Zapata, 2020; Dijk, 2020; DiMaggio & Hargittai, 2023; Hargittai & Hinnant, 2008; Ragnedda, 2016, 2018; Van Deursen & Van Dijk, 2014; van Dijk, 2006), scholarship has not critically engaged with the systemic structures that fuel these inequalities.

Thus, the present research aims to reframe the discourse around the digital divide by positioning Mexican communities in rural geographies as critical sites of knowledge production and technological agency. In the context of Mexico, official state data continuously positions and finds persistent disparities between urban and rural regions (*Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares 2023. ENDUTIH. Síntesis metodológica. 2024.*, 2024). However, these statistics, while initially important, fail to capture the complex social, political and historical dimensions of the digital divide.

What is more and despite extensive research on access disparities and socioeconomic barriers, there remains a critical gap in understanding how communities conceptualise and engage with technologies and how current research lacks critical insights from those most impacted by the digital divide. Thus, this project moves beyond the perpetuation of universal deficit-based approaches that measure the digital divide and conceptualise it without any deep critique on the structures that fuel it. For example, it takes on the work by Escobar (2008; 2018) to help explain and recognise that the very framing of technology use as necessary progress constitutes a structural harm by imposing Western technological frameworks on communities with different values, context and needs.

This work further argues that the current social systems embed harm directly into their design when they deny historically marginalised communities the inherent belonging to technological practices, including defining technology, designing it and developing it. Thus, the project aims to recognise and centre communities' experiences, practices and understandings as critical

epistemic contributions to our understanding of the digital divide and doing so by carrying out interviews and focus groups with a rural community in Mexico.

Through qualitative research and qualitative content analysis of social media data, interviews and focus groups, this project aims to examine how communities impacted by the digital divide navigate the digital divide and how relevant actors to how the digital divide operates in Mexico respond and navigate it.

This positioning shifts the focus away from more quantitative measurements of digital divide and moves towards recognising how communities in rural Mexico generate and enact knowledge and practices on their own terms. So, instead of reinforcing Western frameworks of technological development, this project aims to document how these communities create their own meaningful engagements with technologies, serving as a framework for developing digital technologies.

Through extensive qualitative analysis, this project reveals both established patterns in how the digital divide manifests and novel insights into community dynamics. Thus, the significance of this research lies in its revelation of deeper patterns and complex dynamics that extend beyond established digital divide conceptualisations and the many ways communities are already conceptualising, designing and developing technologies.

The findings are organised into three main themes, each addressing different and unique aspects of the digital divide and community's responses to it. "*Chapter 5 Commercialised empowerment: the digital divide as a market opportunity"* shows how private providers, state actors, and NGOs approach the digital divide through market driven and control-oriented interventions. "*Chapter 6 Algorithmic agroecologies: nurturing community digital futures"* highlights how communities actively nurture their digital futures through long established relational practices. *"Chapter 7 Communal roots, network routes: materialising digital futures"* reveals how established community decision making mechanisms serve as organisational structures that operate along open technologies and transnational relationships.

The research questions of this project are:

1. *How can the digital divide constitute a form of social harm?*
2. *How can insights from social media research, interviews and focus groups inform the need to move towards co-designing community-centred algorithmic ecologies?*

3. *How does working towards co-designing community-centred algorithmic ecologies support community life and care in historically left out communities?*

Chapter 2. Literature review

What is the digital divide?

The digital divide is a concept that can be traced back to the 1990s. It was initially used to highlight disparities in access to and use of digital technologies. Since then, it has been approached through multiple perspectives, each offering important insights about its complexity. This section will lay out three main perspectives. While these are not exclusive, they help to explain the wide array of perspectives that shaped the understandings of the digital divide over the last decades.

Initially used to describe disparities in access to Information and Communication Technologies (ICTs), according to Compaine (2001) the digital divide as term was framed as a binary matter of whether individuals have access to ICTs or not. Throughout the 1990s and early 2000s, the term digital divide was initially used by some scholars and policymakers to refer to a simple binary distinction between those who had access to ICTs and those who did not, with a focus on computer hardware and the internet (Hoffman and Novak, 1998; Besser, 2004).

The concept was first widely discussed in the United States, especially after a 1999 report by the National Telecommunications and Information Administration (NTIA) titled Falling through the net: defining the digital divide. This report highlighted the significant differences in access to telecommunications services, and later on, the internet, across different communities in the US.

However, in 2001, the definition of the digital divide proposed by the Organisation for Economic Cooperation and Development (OECD) was referred to as the gap between individuals, households, businesses, and geographic areas of different socioeconomic levels, in relation both to their opportunities to access information and communication technologies, and to the use of the internet for a wide variety of activities (OECD, 2001; 5).

As research evolved, the focus shifted from access to more varied considerations of digital skills, use patterns and the broader social implications of digital exclusion. For instance, van Dijk and Hacker (2003) were among the first scholars to define the digital divide as a complex and dynamic phenomenon that goes beyond only access to technology. They argue that the

digital divide persists in the form of relative differences in skills, use and opportunities, even as access to computers and the internet become more widespread and critiqued simplistic views that assume the divide will disappear as technology becomes cheaper and more accessible.

However, a number of scholars started analysing the digital divide from its first use, and there are a number of policy perspectives which focus mainly on how policy-led initiatives can and should tackle the digital divide with other more critical perspectives that introduce more situated, contextual and decolonial insights. Foundational analyses, as established by Norris (2001), Warschauer (2002, 2003), van Dijk 2006) and Hargittai and Hinnant (2008) provide a basis for understanding the digital divide and frame it as encompassing disparities in access, skills, and usage patterns, positioning it within a socio-economic and infrastructural context.

For example, Norris (2001) categorised the digital divide into layers of access and civic engagement. Warschauer (2003) highlighted the importance of combining technology into broader systems of social inclusion. van Dijk (2005) extended these perspectives by identifying four different divides: motivational, material, skills-based and use-related. Meanwhile, Hargitai and Hinnant (2008) introduced the second level digital divide which focuses on disparities in online skills and effective technology use. Altogether expanding the scope beyond physical access.

While these foundational perspectives are crucial in establishing the nuanced nature of the digital divide, they are predominantly Western focused which has some limitations. First, their categorisation assumes universal patterns of technology adoption and use, overlooking how different cultural contexts might reshapes these patterns. Second, they focus primarily on measurable aspects such as skills which often overlook the role of power dynamics and cultural values in shaping digital participation.

As the scholarship above demonstrates, the digital divide is linked to broader social inequalities, including income, education and cultural capital. Scholars also anticipated that it would evolve alongside societal and technological changes. This conceptualisation positions digital inequalities as dynamic phenomena that change in tandem with technological advancement and societal transformation. Building on this understanding, researchers developed more comprehensive theoretical approaches, specifically through the concepts of digital exclusion and digital inequalities. This evolution represents a significant shift from viewing digital

disparities as primarily infrastructural to understanding them as deeply embedded in broader social processes.

As already seen, early conceptualisations of the digital divide primarily focused on binary disparities in access to digital technologies, specifically computers and internet connectivity. However, scholars Norris (2001), Warschauer (2003), van Dijk (2005) and Hargittai and Hinnant (2008) began to demonstrate how technological disparities persisted even when access barriers were overcome. This insight expanded the understanding of the digital divide to encompass variation in digital competencies and use patterns, recognising that access alone cannot ensure equitable opportunities.

Building on these theoretical foundations, the concept of digital exclusion emerged to capture the broader societal implications of digital marginalisation as noted by Selwyn (2002) and Helsper (2012) who established that digital exclusion encompasses not only access limitations but extends to the complex interplay of skills, resources and opportunities necessary for meaningful digital participation.

As digital technologies became increasingly ubiquitous, scholars' attention shifted toward examining digital inequalities, particularly focusing on disparities in technological use and the outcomes of these uses (van Dijk and Hacker, 2003; Warschauer, 2003). Research by van Dijk (2020) and Selwyn (2022) shows that digital inequalities are multifaceted and encompass access to devices, internet connectivity and the skills necessary for meaningful engagement with digital technologies. It has also been demonstrated by Ragnedda and Muschert (2013) that these inequalities contribute to broader societal disparities and reinforce existing socio-economic divides.

However, while this scholarship is valuable in recognising multiple dimensions of digital inequality, it operates within what decolonial scholars (Mignolo; 2000, 2002, 2007, 2011) identify as Western epistemological frameworks that subordinate alternative ways of understanding technology and the emphasis on meaningful engagement reflects what Escobar (2008) critiques as development discourse, where communities most impacted by the digital divide are positioned as lacking against such technological standards.

Recent studies argue that disparities in digital use are particularly pronounced in marginalised communities, where barriers to technology access are exacerbated by systemic socio-economic

and cultural factors (Eubanks, 2018; Robinson et al., 2015) Furthermore, Deursen and Helsper (2008) suggest that while some progresses have been made in addressing access related inequalities, significant gaps remain in the space of digital literacy and its impact on social mobility.

While this scholarship acknowledges systemic barriers in marginalised communities, the focus on social mobility and beneficial outcomes suggests what Escobar (2008, 2018) critique as development discourses. These discourses position communities within expectations of Western frameworks of progress rather than recognising their autonomy to define technology and technological engagement on their own terms.

What is more, the concept of the second level digital divide has received considerable attention in recent years which highlights the disparities in how individuals use technology, focusing on differences in skills, use patterns and the ability to achieve beneficial outcomes (Deursen and Helsper, 2015; Scheerder et al., 2017; Van Deursen and Van Dijk, 2014) suggest that these divides are not only technological but deeply intertwined with broader systemic issues, including education, employment opportunities and access to social services.

For example, in the context of education, scholarship (DiMaggio & Hargittai, 2023; Scheerder et al., 2017) shows that digital inequalities significantly impact students' ability to engage with online learning environment. Selwyn (2021) further emphasises that addressing these challenges requires a multidimensional approach thar considers not only technological solutions but socio-economic interventions too.

Furthermore, and previous to Mertala (2020) and Selwyn (2021), Warschauer (2004) and Castells (2002) who were some of the first scholars to argue that to bridge the digital divide requires more than just providing physical access to technology, it also involves addressing the underlying socioeconomic and political structures that mediate access and use. Warschauer (2004) stresses that social inclusion through technology depends on multiple factors, such as education and literacy, and calls for comprehensive policy interventions that would go beyond more provision of devices or internet access.

From a policy focused perspective, Howard (2010) examines the digital divide's impact on political participation and governance, and whose work shows how digital inequalities diminish citizen's ability to participate fully in modern governance systems. In a similar policy focused

perspective, Manyika et al. (2015) demonstrates the economic implications of the digital divide, focusing mainly on how technological disparities affect workforce productivity and skills development in an increasingly digitised economy. Both, Howard (2010) and Manyika et al. (2015) research suggests that unequal access to digital resources creates significant barriers to economic mobility and professional development.

Furthermore, Helbig et al (2009) emphasises the need for carefully designed policy frameworks in the context of the United States, arguing that poorly conceived e-government initiatives can inadvertently exacerbate inequalities. While their work discusses policy outcomes as potentially exacerbating disparities, their analysis centres on the design and implementation of policy initiatives rather than deeply exploring systemic oppression.

Peters' (2016) work carries out a historical analysis of digital policies with a focus on state driven initiatives, mainly in the context of the United States and through this analysis. Peters traces the evolution of digital initiatives and highlights the unintended consequences of well-meaning policies. Although the study acknowledges the failures of policies to account for inequalities, it does not deeply interrogate structural factors such as poverty, or gender discrimination.

Nevertheless, these policy-based perspective effectively help us see how the economic and governance implications of digital divides, their methodical approach presents some constraints. For instance, the emphasis on quantitative measures and institutional solutions, while valuable for policy implementation, often fail to capture the nuanced ways in which communities may resist or may have historical and political grounds for dismissing them. Furthermore, their focus on state led governance structures overlook structures outside these frameworks, assuming that policy interventions will have similar outputs.

What is more, Helsper (2012) and Robinson (2009) highlight that digital exclusion is intrinsically connected to social exclusion where inequalities in digital access and use mirror broader social inequalities. Helsper (2012) argues that these inequalities are connected to policy frameworks, stressing that effective solutions must go beyond access and incorporate efforts to build social, cultural and educational capital.

Helsper's (2012) framework marked a significant advancement in conceptualising the relationship between social and digital exclusion as it outlined four key areas: economic,

cultural, social and psychological, along with their digital counterparts, thereby establishing a comprehensive model for understanding the complex interplay between offline and online inequalities. Helsper added that understanding how digital and social exclusion connected requires examining macro-economic, meso-social and micro psychological factors and that only by studying this together, research can recognise the separate and combined influences of different types of social exclusion on different types of digital inclusion (Helsper, 2012: 3).

Expanding this approach, Ragnedda and Muschert (2013) argue that digital inequalities are a global issue and are shaped by global structural factors such as socio-economic issue and global policies, and not one attached to a certain nation state, and that these inequalities carry significant social, political and economic impacts across countries. Similarly, Graham and Dutton (2014) argue that access to digital technologies is influenced by broader global economic forces, including international trade agreements and the interest of corporations.

While Helsper (2012), Ragnedda and Muschert (2013) and Graham and Dutton (2014) identify digital inequalities as global phenomena shaped by structural factors, their analysis still operates within a problematic framework that obscures crucial power dynamics. Firstly, they all speak broadly of macro-economic, global structures, and global policies as factors fuelling digital inequalities without explicitly naming neoliberal capitalism. However, the issues they mention as the social exclusion that results from these inequalities, socioeconomic factors based on global policies are principles and mechanisms of neoliberal capitalism.

Neoliberal capitalism is an economic and political system and model that prioritises market driven policies, advocating for free markets under the premise that when left unregulated lead to more efficient resource allocation and promote economic growth (Harvey, 2015; Brown, 2015) but which lead to increasing global inequality (Harvey, 2015; Peck, 2015; Bourdieu, 2016; Chomsky, 1999; 2017). According to scholars (Ndlovu-Gatsheni, 2020; Sambuli, 2019) these global inequalities are deeply embedded in colonial histories of extraction.

So far, we can see few patterns across all scholarship presented, one being they all speak of digital inequalities, digital exclusion, and the recognition that these are driven by broader socioeconomic mechanisms. Drawing from decolonial scholars (Quijano, 2000; Maldonado Torres (2007) it becomes evident that while all the scholars presented so far recognise digital inequalities as globally structured phenomena, their analytical frameworks remain contained within Western boundaries.

Furthermore, this limitation reflects what Rivera Cusicanqui (2012: 98) identifies as academic theorisation, disconnected from the lived experiences of those most affected by digital marginalisation. According to Mignolo's (2011) concept of epistemic decolonisation, the analysis presented by scholars so far, perpetuates a form of knowledge production that, while acknowledging structural inequalities, fail to challenge the fundamental ideologies, systems that underpin what is driving these global structures and these socio-economic factors.

This disconnect between academic theorisation and lived experiences becomes particularly evident when examining how digital inequalities manifest in specific contexts. While Mignolo's (2011) framework may also help situate knowledge production and its problematisations of main digital divide scholarship, Nakamura (2012) provides concrete examples of how these theoretical gaps translate into real world consequences.

Nakamura (2002) argues that digital technologies often perpetuate racial and cultural biases. Nakamura's work is primarily rooted in the context of the United States, focusing on how online spaces and digital platforms reflect and reinforce societal hierarchies while also challenging the idea that the internet inherently democratises information and empowers marginalised communities, showing instead that digital inequalities often mirror and exacerbate offline inequalities.

From another US perspective, Eubanks (2011) argues that the digital divide is deeply rooted in structural inequalities, and emphasises how systemic issues such as poverty, racism and gender discrimination shape the experiences of marginalised groups. By using the YWCA community in Troy, New York, as a case study, Eubanks shows how high-tech development often benefits privileged groups while deepening marginalisation for others.

As we can see, these critical perspectives go beyond theoretical understandings, and policy driven initiatives with more engagements outside the West. The works of Eubanks (2011) and Nakamura (2002) show how technological systems cannot be separated from broader patterns of systemic inequality. However, these critical perspectives remain focused in a US context which may limit their applicability to understanding how the digital divide unfolds and means in other global contexts.

Although these works recognise structural inequalities, as decolonial scholars (Escobar, 2018; Quijano, 2000) argue, US context overlook how communities outside this context might resists and respond to a more global perspective. Goggin and McLelland (2009) work focuses mainly on the Asia-Pacific contexts of Japan, China and Australia by showing how digital technologies are localised and adapted across cultural contexts, highlighting the intricate ways global and regional power dynamics shape digital inclusion and exclusion. Through a comparative lens, they critique how international technological standards privilege Western, Anglophone models of access by showing how four different marginalised communities' resist.

For instance, they show how disabled communities in Japan and Australia advocate for accessible technologies. In the contexts of Japan and South Korea, they show how LGBTQ+ communities use digital platforms to create networks and visibility. In China, they explore how rural users navigate limitations of state-controlled internet infrastructure by using alternative networks. While not a central focus of their work, they give an overview of how Indigenous communities in Australia use digital platforms to preserve cultural heritage and advocate for their rights, by adapting to local languages and traditions.

More recently, Arora's work (2019) shifts the focus to what is known as the Global South and explores how digital inequalities intersect with aspirations and everyday practices among underrepresented populations. By using ethnographic methods through interviews and fieldwork, Arora's work gives insight into different communities across the world, spanning from rural India, Hyderabad and Nairobi, and the favelas in Brazil.

However, while Arora highlights how communities across the world overcome technological challenges which provides a different perspective to the previous ones in that it offers a counterpoint to narratives of deficiency through adaptations; the critique does not deeply engage with the structural forces such as neoliberalism, systemic inequality or historical patterns of exclusion which I argue are crucial in understanding and shaping the root constrains of the digital divide.

On the other hand, Venegas (2010) work on Cuba's context, reveals how state structures and political ideologies shape the conditions within which such adaptions occur. Venegas (2010) argues how geopolitical and cultural contexts influence digital inclusion, using Cuba as a case study to explore the complexities of access and state driven technological adoption. Venegas' analysis shows that access to digital technologies in Cuba is intertwined with the country's

political ideologies of socialist values and highlights how state-controlled initiatives prioritise access to education and public institutions over individual consumption or interests while also documenting the creative and informal practices developed by Cubans to navigate these constraints.

What is more, Venega's work shows how people in Cuba have developed informal networks and practices such as "el Paquete semanal" (the weekly package). The Package is one tera (or a thousand gigabytes) worth of material that is downloaded weekly by people with access to high-speed Internet and while it is not known who they are or where they get this access, with speculation that it is be under government radar or the whole production would have been shut down (Fernandes and Halkin, 2014).

While all these perspectives give a more nuanced understanding of how the digital divide is conceived in various contexts, most of them fail to acknowledge the role of current economic models in driving these inequalities with the exception of Venegas' (2010) work but which is focused in a communist economic and political model.

Ancheta-Arrabal et al. (2021) systematic secondary analysis study provides a critique of neoliberalism and highlights the importance of addressing the gender digital divide in Latin America. However, their work does not fully explore alternative frameworks and methodologically, their study does not carry out empirical research, such as fieldwork or interviews which limits its ability to offer new, context specific insights.

From a Mexican perspective, Trejo Delarbre (2001) highlights how while the digital divide is a global issue as it manifests differently across regions, with developing countries facing more significant challenges due to lack of infrastructure and resources. Furthermore, Herrera Ramos (2001) highlights the significant disparities in access to ICTs not only between Mexico and more developed OECD countries but also within Mexico itself.

The work of Coria and Garcia-Garcia (2022) examines disparities in access to information and communication technologies (ICTs) across all Mexican states between 2010 and 2020 and highlights persistent inequalities in ICT access between southern states and central with northern states where southern regions lag in ICT availability. However, some of the limitations of their study is that it relies on census data from 2010 and 2020 and overfocuses on the need for targeted policies to address regional disparities.

Another important scholarship in the early 2000s was the work of Gomez and Martinez (2001) from a Central American perspective, more specifically, Costa Rica. Their work addressed an urgent need at the time: to pause and reflect on the complex path of using information and communication technologies (ICTs) as tool for development in Latin America and the Caribbean.

While Coria and Garcia-Garcia (2022) work identifies important regional disparities in Mexico, their reliance on state level census data and policy recommendations reflects what Rivera Cusicanqui (2012) critiques as the colonising tendencies of academic research that reduce complex lived realities to quantifiable metrics. For instance, the study's methodological approach, centred on indicators of development and access, fails to engage with other conceptualisations of technology and access to it.

In a similar vein, Gomez and Martinez (2001) work from Costa Rica attempts to critically examine ICTs in development, their framing of technology as a tool for development requires to be considered carefully. As decolonial scholars (Mignolo 2012; Rivera Cusicanqui, 2012) point out, frameworks that position an understanding or process as purely developmental tool can mask and overlook deeper power dynamics at play. This project argues that technology, its development, its use is not different and thus should be challenged.

However, Srinivasan (2018) work adds to these decolonial critiques by highlighting the resistance of Indigenous communities to digital colonialism, a process through which digital technologies impose Western centric values, norms and infrastructures into these communities. Srinivasan's work challenges the assumption that digital inclusion is universally good arguing instead for approaches that respect Indigenous epistemologies.

The literature so far has highlighted some competing conceptualisations, with much of the literature paying attention to Western frameworks of development, use and policy initiatives while failing to address underlying structures. What we know of the digital divide is largely based upon research investigating access patterns, motivations, use metrics rather than examining structural causes, particularly the role of neoliberal policies in producing these inequalities.

Drawing on the range of sources presented here so far, decolonial scholars such as Rivera Cusicanqui (2012) and others (Mignolo, 2012, Quijano, 2000, Maldonado Torres, 2007) help challenge the conventional frameworks that perpetuate colonial thinking in digital divide discourse. As Rivera Cuscanqui (2012: 98) argues, most of the academic theorisation remains disconnected from lived experiences, especially in how it sanitises the nature of technological exclusion through using neutral sociotechnical language. Ugwudike's (2020) concept of bias elimination fallacy exemplifies this by showing how modern predictive policing algorithms falsely appear neutral by removing explicit racial markers while perpetuating structural inequalities though biased data.

Unlike most of the conceptualisations presented here so far and which see digital divide primarily through access metrics, this project proposes understanding the digital divide as a multidimensional and continuing phenomenon and process fuelled by neoliberal policies and systemic structures which encompasses much more than socioeconomic and sociopolitical factors fuelling them, but it is a phenomenon that has been defined with lack of critical insights from the point of view and experience of those most impacted. Thus, it is a concept in contestation.

This view is supported by a body of decolonial scholarship that can help show how technological disparities cannot be separated from the structures that fuel them and how these are colonial continuities that have materialised through neoliberal policies. To tackle them, this project proposes moving beyond what the overwhelming body of literature presented here argues and move towards co-designing community led algorithmic ecologies.

The next section will examine how the digital divide is rooted in and shaped by neoliberal economic frameworks and through analysis it will outline key political and economic definitions, events and processes that have led to the digital divide being what it is today, a colonial continuity.

Digital divide: a neoliberal legacy

The digital divide, characterised by unequal access to digital resources and internet infrastructure, is deeply rooted in the principles of neoliberalism that prioritise market efficiency, privatisation and deregulation. These principles are the backbone of policies that

have favoured the concentration of internet infrastructure development in the hands of a few private entities.

Neoliberalism, described as the "defining political economic paradigm of our time" (McChesney, 1999; 40) is complex and has many layers (McCarthy and Prudham, 2004), encompassing ideology, policy, state form and governmentality. As an ideology, it emphasises individual freedom, self-interest and competition (Harvey, 2005; Beattie, 2019; Coburn, 2000). As a policy, it advocates for economic and market liberalisation, privatisation, and deregulation (Ward and England, 2007; Winston, 2018). In state form, it favours minimal state intervention (Ward and England, 2007) and privileges the role of the neutral market to make decisions instead of politicians (Mirowski, 2014).

As governmentality, it promotes self-governance through values such as efficiency and autonomy by encouraging people to take responsibility for their own well-being and opportunities in life (Ward and England, 2007) emphasising individualistic over collective solutions (Coburn, 2000). This has led to unequal investment in digital infrastructure, favouring profitable, densely populated areas while neglecting marginalised and rural communities (Mansell, 2017).

According to Pickard (2015) and Fuchs (2019) the digital divide reflects the framework of neoliberalism based on market driven solutions and reduced state intervention, especially since neoliberalism prioritises the privatisation of infrastructure and the belief that market competition will naturally lead to innovation and access. Therefore, by reducing state involvement in building equitable digital access and relying on private entities driven by profit, neoliberalism has worsened disparities in who can access digital technologies and who cannot, thus laying the foundations for the digital divide.

It is widely acknowledged that the neoliberal model first took hold not in Margaret Thatcher's Britain or Ronald Reagan's United States, but in Pinochet's Chile (Valdés, 1997; Porion and Mort 2022; , 2022) which policies, initially implemented under a dictatorship regime, were later embraced and promoted by western powers, transforming them into a global economic model that prioritised market efficiency and competition (Valdés, 1997, Cooper, 2012; Mathieu, 2022).

While the birth of neoliberalism can be traced back to Chile, under a dictatorship; it was made dominant and institutionalised by Western, Anglophone countries and later spread worldwide. Harvey (2005) and Albo (2008) argue that neoliberalism has particularly negatively impacted the Global South or what is sometimes referred as developing countries, by intensifying inequality and poverty through new forms of accumulation by dispossession, such as the privatisation of the commons.

As Quijano (2000) argues through the coloniality of power theory, this global spread of neoliberalism represents a continuation of colonial power structures through modern economic systems. This is a perspective that is further strengthened by Maldonado Torres's (2007) analysis of how neoliberal policies perpetuate a "non-ethics of war" where certain populations, particularly developing countries, are systematically denied protections and rights under market logics. Escobar's (1994, 2007) critique of development as a colonial project is particular significant here as it shows how neoliberal policies are often imposed on communities in the Global South under the guide if development and progress.

The influence of neoliberal dynamics on technological development can be traced back to the adoption of TCP/IP protocols for internet infrastructure. As Galloway (2004) argues, internet protocols embed control mechanisms, serving as regulatory structures within decentralised networks and which according to Galloway, serve neoliberal interests as market priorities for efficiency and standardisation led to TCP/IP's dominance over other more democratic approaches such as the OSI model (Russel, 2013).

The internet roots in American liberalism, starting with ARPANET and its design as an open, decentralised network (Abbate, 1999; Arkko, 2020; Masnick, 2019), were initially designed for its protocols to ensure compatibility and connectivity. ARPANET, funded by the US Department of Defence in the late 1960s, embodied ideals of robust communication and information sharing and emphasised decentralisation to prevent single points of failure (Abbate, 1999). However, this decentralisation coexists with a somehow centralised but supposedly distributed model Domain Name System (DNS) that oversees the global system with thousands of servers working together to make sure people can access websites from anywhere (Akanho, 2023).

At the heart of the DNS is the root server system, managed by 12 root server operators (RSOs) and which oversee 13 root server identifiers forming the backbone of DNS operations. These

RSOs are predominantly headquartered in the US and Europe with Japan having one (Mueller, 2010; DeNardis, 2014). This concentration of control, particularly in the US, exemplifies how technical protocols can embed mechanism of centralised authority within. Supposedly decentralised systems.

In the 1990s, the Clinton administration's policies accelerated the internet privations and commercialisation which marked a shifting what was somehow believed to be public (Abbate, 1999, Radu, 2019). This adoption exemplifies neoliberal values that favours market mechanisms over public institutions, resulting in the concentration of internet infrastructure in the hands of a few US based companies (Chenou, 2014) which has also happened in Mexico (Barry, 2012). This emphasis on privatisation and commercialisation reflected neoliberal ideas of market supremacy and deregulation (Radu, 2019; Chenou, 2014).

Additionally, the creation of the *Internet* Corporation for Assigned Names and Numbers (ICANN) in 1998 and the Internet Governance Forum (IGF) in 2006 institutionalised a liberal, multi-stake holder model, apparently promoting cooperative rather than hierarchical decision-making (Hofmann, 2016). However, ICANN ties to the US Department of Commerce and the broader origins of the internet in the US government initiatives ensured that significant US influence persisted within these frameworks, reflecting what Mueller (2013) and DeNardis (2014) argue as a strategic fusion of liberal governance principles with underlying political control.

Building on this historical context, a decolonial analysis reveal deeper patterns of power embedded within internet governance structures. For instance, the supposedly decentralised nature of the DNS must be demystified, while thousands of servers operate somehow collaboratively worldwide, the system maintains still a centralised control model hosted in mainly Western geographies. As Mignolo (2011) argues, such Western institutional models represent a form of epistemic violence, privileging Euro-American conceptualisation of order and control.

This shows how internet governance mechanisms, while presented as distributed but driven from market priorities for efficiency and standardisation led to TCP/IP's, function as what Grosfoguel (2011) terms "global coloniality", whereby systematic arrangements maintain Euro-American hegemony through apparently neutral institutional and technically distributed systems.

Together, this analysis demonstrates how internet governance mechanisms reflect and reproduce colonial power relations through technical protocols and institutional arrangements. The intersection of neoliberal principles of efficiency and standardisation with privatisation as colonial patterns of control shows how governance structures that while claiming neutrality or distribution, still concentrate power in Western, Anglophone institutions.

Furthermore, the privatisation and commercialisation of the internet gave rise to what is known as digital capitalism. The concept of *digital capitalism* was introduced in the late 1990s to emphasize the role of digital technologies in the success of economic globalization (Rivera, 2020). Schiller (2000) describes it as a "new epoch" in which "cyberspace not only exemplifies but today actually shapes the greater political economy" and "networks generalize the social and cultural range of the capitalist economy".

According to Rivera (2020) digital capitalism represents a new stage of capitalism because digital markets have renewed the strategies of capital reproduction, temporarily overcoming the tendency of the rate of profit to fall by strengthening the regulatory power of capital over society. In this case, digital platforms operate as key agents of capitalist development, not necessarily regarding the value of the assets they actually manage or the profits they make, but because of how they mobilize market forces, creating new habits and shaping a new type of society.

This understanding provides a critical foundation for examining how these global governance patterns become visible in specific contexts and how it can directly influence the accumulation and transfer of digital capital, which has been defined as the accumulation of digital competencies and digital technologies that can be historically accumulated and transferred from one arena to another (Ragnedda 2018; Ragnedda and Ruiu, 2020). Such connection becomes clearer when we consider how the colonial and neoliberal aspects of internet governance are likely to shape who can accumulate digital capital and how it can be deployed.

The role of digital capital

Within the space of digital divide academic research, there is a widely used term that has helped researchers in the West to further analyse the digital divide through the lens of digital capital. Digital capital is defined as skills and knowledge in digital products and technologies, and its

role in social status acquisition (Ragnedda, 2018; Ragnedda and Ruiu, 2020). This concept attempts to extend Bourdieu's theory of capitals (1996, 1986) such as social (Bourdieu, 1983, Putnam, 1995), political (Syed and Whiteley, 1997), economic (Bourdieu, 1983), personal (Becker, 1996) and cultural capitals (Bourdieu, 1983) to the digital space, now known as the 5Cs. Ragnedda (2018) states that "this interaction helps individuals to transform the digital resources into social resources and to exploit the full advantages offered by the Internet (2018: 2366)."

While Bourdieu did not specifically refers to capital in the same sense of economic capital that Marx does, it stems from a Eurocentric view of how the world operates. While the capitals from Bourdieu are useful to understanding the interconnected ways in which one or the other are amplified, current digital capital concepts fail to integrate a critique of the systems that perpetuate who has digital capital or not. According to decolonial scholars (Quijano, 2000; Mignolo, 2011), these western notions of digital divides, as previously seen, and digital capital fail to even mention the role that colonial power dynamics play, let alone centre and try to dismantle, even through theorisation.

What is more, digital capital (Ragnedda, 2018, Rodriguez-Camacho et al., 2024), as a concept or theory fails to adequately contextualise the digital divide within the historical processes of colonisation and ongoing power imbalances that shape resource distribution globally. These frameworks may perpetuate the coloniality of power (Mignolo and Walsh, 2018) as already mentioned before and which occurs by not challenging the Eurocentric assumptions about resources, where they came from, and thus technology and the ways this can be accumulated and transferred.

As Ugwudike (2020) argues, state and non-state creators of technologies possess digital capital and with their empowering digital capital, they are able to exert "digitised epistemic domination (Ugwudike, 2020: 488)". While this analysis was made on the grounds of digital prediction technologies, the underlying principles applies more broadly, as organisations and institutions with substantial digital capital, more advanced technological capabilities and expertise, can

maintain power over marginalised communities how lack equivalent access to these digital resources and competencies.

Access to digital capital has been noted to influence or even dominate knowledge production in digital spaces which can be linked to intersecting social categories of race, gender and socio-economic status (Ugwudike & Fleming, 2021; Benjamin, 2019; Ugwudike, 2020; van Dijk, 2005). I argue that digital capital cannot be separated from the systems that shape who gets to have it or not. Thus, the use of digital capital as way to speak of community-led technological development risks reinforcing Eurocentric assumptions by treating access and accumulation as neutral or merit-based, rather than recognising how digital capital is shaped by colonial histories and ongoing structural inequalities.

But perhaps, even more relevant to the focus of this project is from Bolivian Aymara sociologist Silvia Rivera-Cusicanqui's (2012) notion of ch'ixi which offers a more situated understanding of rural and Indigenous communities navigating and resisting colonial structures while maintaining their own epistemologies. Rivera Cusicanqui's ch'ixi epistemology comes from daily life experiences and points out that life is constructed through acts, remembrances and deep feelings; an approach that challenges traditional linear historicism and binary thinking in social sciences.

Rivera Cusicanqui and other phenomenological social scientist such as Schutz (1993) advocate for paying attention to conversations with people who are not typically considered to have social theories as they argue that these micro sociological interactions are the ones that reveal the foundations of societal community. Using concept metaphors to describe and interpret complex social mediations can offer a more nuanced understanding of heterogenous societies as it values everyday experiences and interactions as key to understanding social realities. Thus, challenging conventional western frameworks while also affirming the importance of diverse perspectives in building social knowledge, and hence technological knowledge too.

When applied to digital technologies and inclusion policies, the perspectives from Rivera Cusicanqui encourage us to look beyond conventional metrics and binary centric frameworks and capitals which may overlook deeper systemic structures fuelling these inequalities. Instead, they prompt us to consider how digital capital might be challenged and changed to instead speak of having the necessary resources our communities need for technological co-creation. This

also reveals that barriers to digital inclusion are not only technical or economic but strongly intertwined with social, cultural and ways of knowing, doing and being.

The following section analysis through literature and decolonial theory how neoliberal principles, play out in rural Mexico, providing some context of how the neoliberal model has affected communities in Mexico.

Rural Mexico: from revolution to neoliberal reforms

Neoliberal principles have significantly shaped the digital landscape, particularly in rural Mexico. A neoliberal framework that shifted Mexico from a developmental state to one that favoured privatisation, reduced state intervention and openness to global markets (Schneider, 1990; Icaza, 2004). While this shift was intended to stimulate economic growth by promoting efficiency, and competition, and attracting foreign investment (Schwartzman, 2019) it has instead contributed to widening economic divides, particularly in rural areas.

It has already been covered earlier in this work through the research on the digital divide that socio-economic divide and the digital divide are deeply intertwined (van Dijk, 2005, 2015, 2020; Castells, 2002) with socio-economic disparities often leading to unequal access to digital technologies. This connection is further demonstrated by the implementation of neoliberal policies in Mexico, which, while contributing to the integration of the country into the global economy, mostly through the North American Free Trade Agreement (NAFTA) (Trubetskaya, 2022) which amplified social and economic disparities.

These disparities not only increased inequality (Sanchez, 2021) but also, in many cases, undermined public services (Juarez et al. 2022) and labour rights (Demeter, 2019). As a result, the socio-economic divide in Mexico was reproduced in the digital divide, where those with fewer resources were less able to benefit from the technological advancements that came with globalisation. This outcome is representative of a broader critique of neoliberalism's impact on Mexican society, highlighting the state's transition from being a provider of public goods to an advocate of free market policies and characterised by both democratisation and authoritarian trends (Olvera, 2002; Icaza, 2004).

While scholarship was critical of the neoliberal turn in Mexico's political economy often operated under the uncontested assumption that Mexico was, and is, a unified nation (Icaza, 2021). However, Aguilar's work *'Nunca más un Mexico sin nostros - Never again a Mexico without us'* (2018), challenges the notion of Mexico as a unified and singular nation. Aguilar

argues that Mexico is, in fact, a state that has encapsulated and denied the existence of many first nations. This critique exposes Mexico's nationhood as not just a political project but one of ethnocide (Icaza, 2021).

This contested national identity provides context for understanding Mexico's adoption of neoliberal policies, which Greenberg et al (2012) identify as all-encompassing and impactful by quoting that "nowhere has neoliberalism been more widely implemented or its impacts been deeper than in Mexico (p.2)" which is grounded in the significant economic and political shifts that Mexico underwent, particularly from the 1980s onwards. A transformation that began after Mexico's prolonged period of state led development following the 1920 Revolution.

However, under the PRI political party seven-decade rule, often characterised as the perfect dictatorship, the state-maintained control over key industries and economic sectors (López Guzmán, 2017; Ruiz Lagier, 2019) which began to shift in the 1980s as Mexico moved toward neoliberalism, restructuring Mexico's political economy (Browning-Aiken et al, 2012; Moreno, 2021).

The Mexican Revolution itself was a reaction against 19th century liberal policies that had concentrated wealth and power in a small elite, reducing much of the population to poverty (Gilly, 2005; Salinas, 2014). The revolution was characterised by being a peasant uprising which was led by Emiliano Zapata in southern Morelos in 1909 and was a direct response to these centuries-long practices of exploitation and which according to Ulloa and González y González (1979) was driven by a community-centric approach rooted in the pre-Hispanic calpulli tradition.

Scholars of the Mexican Revolution highlight that these struggles were not only economic but also cultural and epistemic, challenging the erasure of Indigenous ways of life. This, as Vaughan (1999) shows how Indigenous and peasant communities used local customs and collective identities to negotiate their roles in revolutionary politics. This process of participation extended beyond material demands, such as land reform, to include defence and revitalisation of cultural practices and Indigenous knowledge systems, often in opposition to homogenic state policies. A pattern that provides context for understanding why later neoliberal policies encountered and continue to encounter impacts across Mexico and diverse responses too.

However, despite some land redistribution, by 1923, haciendas still controlled 58.2 percent of Mexico's territory with 50 percent of the rural population clustered in 82 percent of all rural communities (Gruening, 1928). As haciendas monopolised land, coercing local workers and

Indigenous communities into sugarcane production, this also disrupted the traditional milpa system. This polyculture, a symbol of food sovereignty is essential for diverse diets and sustainable agriculture, was compromised, undermining ecological balance and community sustenance.

In the wider historical context, maize cultivation has played a central role in the self-organisation of peasant, rural and Indigenous communities in Mexico, supporting cultural and communal forces (Pineda, 2012). An important feature of the milpa system, is that its productivity increases when grown alongside other crops such as beans, squash, and chillies, to mention some; promoting self-sufficiency and resisting the commercial pressures of neoliberal policies. However, Cardoso-Hernández and Gouttefanjat (2023) study has found that the milpa and its main component, maize, have experienced decline over 40 years of capitalism and neoliberalism in Mexico.

The historical trajectory of land exploitation and communal land reforms in Mexico, from the post-independence era through the development of neoliberal policies, reflects deep-seated issues of economic and social inequity that remain intertwined and inseparable. Article 27 of the Mexican Constitution, enacted in 1917, as the Mexican Revolution was ending, aimed to redistribute land back to peasants and Indigenous communities, establishing the ejido system for communal farming. Today, the ejidos and agrarian communities are the form of land tenure that covers most of the surface in rural Mexico (Barnes, 2014; Morett-Sanchez, 2020).

As land redistribution policies unfolded, the state determined that to restore the lands to the communities, they would have to prove their right to them with documents, which were generally royal decrees granted by the Spanish Crown (whose authenticity had to be determined by a government expert in palaeography) (Assies, 2008); Another option was to prove that the lands belonged to them and they were dispossessed of them before June 25, 1856 or between December 10, 1876 and November 20, 1910; that is, before the first reform or during the dictatorship of Porfirio Diaz. Many peasant groups were not able to demonstrate their dispossession, much less with colonial titles; for them, the possibility of endowing property and becoming ejidos was opened (Morett-Sánchez and Cosío-Ruiz, 2017).

The community where this research is taking place is considered an ejido. However, many traditional Indigenous practices remain such as decision making about land use which is often conducted through assemblies, involving all community members through family or household representatives. Another example of common principles distinct from state-imposed systems

such as the ejido is sustainable agriculture, such as the milpa system and rotational farming and other techniques to avoid overexploitation of natural resources.

What is more, offerings to honour the land and natural resources where agrarian activities happen are common in the community. The presence of collective labour systems is another characteristic of this community, known as tequio[1], such as building infrastructure or maintaining communal lands. In the rural community where the research is taking place like many other communities retain elements of Indigenous systems and practices, tensions that manifest as efforts to adapt the ejido system to align with the cultural and ecological values of the community.

However, the 1992 neoliberal reforms to this article and the implementation of NAFTA (North American Free Trade Agreement) in 1994 facilitated the privatisation and sale of communal lands, aligning agricultural practices with global market demands at the expense of local systems (Ortega Hernandez and Leon Andrade, 2021). This further worsened the impact of these reforms, as the removal of free trade barriers increased competition and market integration (Neubauer, 2011) that rural and Indigenous communities were left with severe negative impacts through increased forced migration, threatened biodiversity, exacerbating challenges already faced by rural and Indigenous populations (Gonzalez, 2011).

These changes not only disrupted the livelihoods of ejidatarios and fuelled migration (Delgado-Wise and Covarrubias, 2007) as traditional agricultural systems were dismantled in favour of export-oriented economies. This migration trend highlights the interconnectedness of neoliberal policies fuelling international trade agreements and internal economic policies, shaping a narrative of displacement and forced adaptation (Wilson, 2020) for many rural communities.

However, traditional agricultural methods and community organisation offer a foundation for building and re-building living models that counteract dominant industrial and capitalist systems (Alcantara, 2023). This project argues that these systems and the communities that practice them should be centred in discussions around how to tackle the digital divide which should include centring their voices, concerns and experiences rather than simply attempting to bridge inequalities on external terms, such as those widely covered so far, through policy initiatives or academic theorisations.

[1] Tequio has its roots in the Nahuatl language from tequi or tequiotl means work or tribute, now used as community or collective work for the community.

This tension between local autonomy and centralised control has deep historical roots. As Aguilar Gil (2023) demonstrates how the post-revolutionary Mexican state kept pursuing policies of assimilation and ethnocide under the guise of building and indivisible Mexican identity at the expense of Indigenous ways of life and political systems. A process that extended from colonial practices, as decolonial and Indigenous scholars argue (Rivera Cusicanqui, 2012; Aguilar, 2023) and which allows elite classes to consolidate power while marginalising communities that do not ascribe to these neoliberal practices. Understanding this historical context is crucial for setting the scene and analysing contemporary struggles over development models and communities' politics.

What is more, the implementation of neoliberal policies, through pushing globalised free markets, as it has been established, led to the displacement of rural communities and the erosion of traditional land use and community-led practices (Ortega Hernandez and Leon Andrade, 2021), a process that can be further analysed through theoretical frameworks in decolonial globalisation studies.

Scholars such as Fúnez-Flores (2023) and Mignolo (2021) have made significant contributions to reconceptualising globalisation as a form of global coloniality, highlighting how local projects are co-opted into universal schemes that perpetuate appropriation, destitution and destruction (Dale and Robertson, 2004), a process that often results in the destruction of local systems of knowledge and practice, even when they operate under the rhetoric of development and modernisation.

Therefore, this project argues that decolonial theories and decolonial globalisation studies provide a critical framework for examining how neoliberal policies worsen technological and digital divides. Scholars such as Bhambra et al (2018), Connell (2007), Davis (2018), Grosfoguel et al (2016), Mignolo (2021), Richards (2014), Shahjahan et al (2017) and Stein (2019) challenge the notion that neoliberal policies, such as market liberalisation and privatisation, are universally beneficial, arguing that these policies, driven by geopolitical agendas, systematically disadvantage developing countries by favouring private investment over public good, particularly in crucial areas such as technological infrastructure.

This critique is essential in understanding how neoliberalism, while touted as progress, deepens socio-economic disparities and reinforces historical patterns of exploitation. Insights from decolonial globalisation studies into the analysis of neoliberalism in rural Mexico help this project to highlight how neoliberal policies not only worsen existing inequalities but also mirror

historical patterns of disenfranchisement that continue to undermine Indigenous and rural communities.

The critique of global coloniality provides a vital lens through which to examine the narrative surrounding technology development and the digital divide, making it clear that these contemporary challenges are deeply rooted in historical injustices. Thus, highlighting the importance of recognising how the legacies of colonialism and state-led assimilation, destitution and destruction (Fúnez-Flores, 2023) are perpetuated under neoliberalism, particularly through policies that privilege global market demands over local, community cantered practices. Understanding these dynamics is essential for framing the ongoing struggles of Indigenous and many rural communities in Mexico, especially in relation to technological exclusion and the broader digital divide.

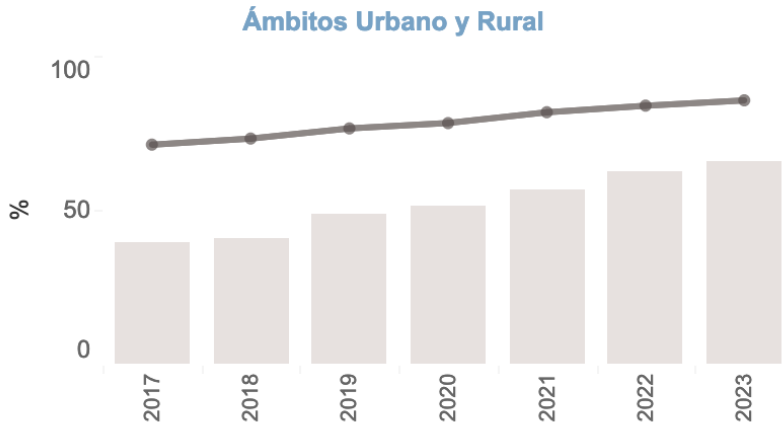
The context offered in this section is essential for framing the discussion around technology in rural communities and it is significant in that challenges the narratives of progress, often rooted in neoliberal ideology, Western centric notions of modernity and industrialisation, mirroring the same colonial patterns of dominance and exclusion that have historically oppressed marginalised communities.

The first section on conceptualisations of the digital divide gave us an overview of the predominant ways in which scholarships refers to the digital divide, though digital inequalities, exclusions driven by what was called global structures that fuelled these inequalities with the section on the roots of the digital divide in neoliberalism set the stage for this section on a historical and critical overview of neoliberalism in Mexico. The following section will give a literature review on the digital divide in rural Mexico using decolonial theories to critique the ways in which the digital divide has been predominantly approached by state and academia.

The digital divide in rural Mexico

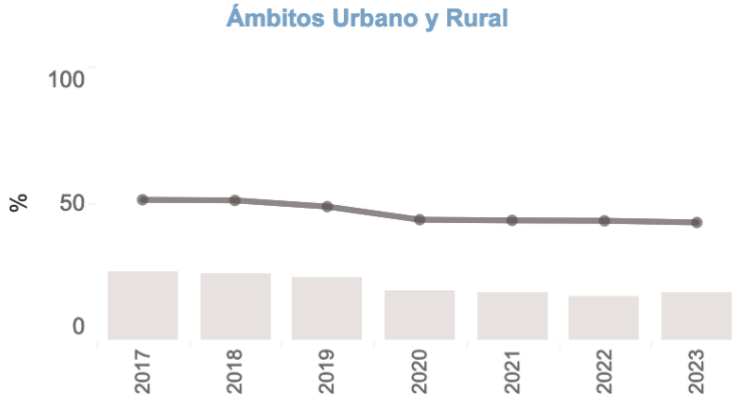
In Mexico, according to the 2023 National Survey on Availability and Use of Information Technologies in Households (ENDUTIH), there seems to be an increase in internet users in both rural and urban areas since 2017, with urban areas reaching 85.5 percent people internet users and rural areas 66 percent of people as users (INEGI, 2020). The following graphs show the survey results from 2017 to 2023. The line graph represents the urban areas, and the bar

graph represent the rural areas. This reveals there has been a significant divide since 2017, with urban areas consistently showing higher internet use.



ENDUTIH 2023 survey ITCs Users of Internet (2024)

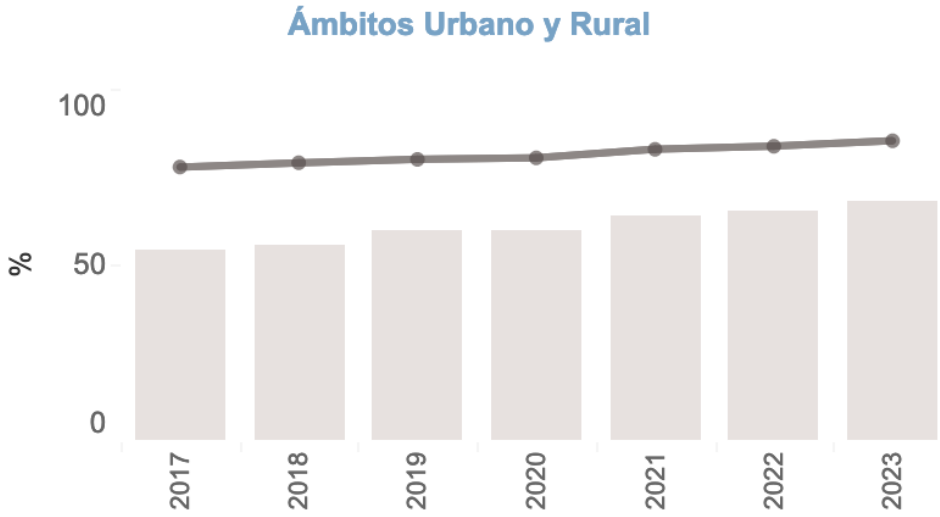
The following graph shows use trends of computers in urban and rural areas. Computer use in urban areas has remained relatively stable over the years, at around 50 percent, slightly going down to 41 percent in 2023. In rural areas, there has been a significantly lower use rates compared to urban areas at 25 percent in 2017, going downwards each year to its lowest in 2022 with 16 percent and going slightly up in 2023 to 17 percent.



ENDUTIH 2023 survey ITCs Users of Computers (2024)

The following graph represents the adoption of mobile usage. Once again, in urban areas starts high at 77.7 percent and goes steadily upward to 85.2 percent, indicating almost

complete coverage. However, in rural areas, started at 53.8 percent in 2017 and has reached 68 percent, marking a more significant closure in gap use.



ENDUTIH 2023 survey ITCs Users of Mobiles (2024)

Further analysis from the latest ENDUTIH survey in 2023, which comprises of 58922 respondents, I analysed the data to obtain more recent up to data information on reasons for not having an ITC, in this case, the survey had access for computers, mobiles and the internet.
In the following tables, we will be able to see rural responses for why they do not having computer **(Table 1)** and internet at home **(Table 2)** , and it is relevant to this project since it let us see that government led census on statistics with already small samples, get almost half respondents to not responding.

Table 1.

Rural respondents reply to – Why don't you have a computer at home?			
Reason	**Number of answers**	**Percentage from rural sample**	**Percentage from whole survey sample**
Economic	5756	40.5 %	9.8 %
Not interested or do not need it	2680	18.9 %	4.5 %
Do not know how to use it	1884	13.2 %	3.2 %
Use a smartphone or other device	541	3.8 %	0.9 %

It's broken	90	0.6 %	0.15 %
Privacy or security	8	0.05 %	0.01 %
Other reasons	97	0.7 %	0.16 %
No response	3122	22 %	5.2 %
Total asked	14178	100 %	24 %

Table 2.

Rural respondents reply to – Why don't you have internet at home?			
Reason	**Number of answers**	**Percentage from rural sample**	**Percentage from whole survey sample**
Economic	4251	30 %	7.2 %
Not interested or do not need it	1329	9.3 %	2.2 %
Do not know how to use it	848	6 %	1.4 %
Do not know its utility	77	0.5 %	0.1 %
Insufficient or incapable equipment	48	0.3 %	0.08 %
No provider of infrastructure	550	3.9 %	0.9 %
Have access elsewhere	96	0.6 %	0.16 %
Privacy or security reasons	15	0.1 %	0.02 %
Other reasons	44	0.3 %	0.07 %
No response	6920	48. 8 %	11.7 %
Total	14178	100 %	24 %

These statistics offer an overview of how the digital divide manifests in Mexico and while the emphasis remains between urban and rural, it lacks situating the many types of lacks that affect most communities in accessing internet which can be useful, especially in revealing the layers in which these lacks manifests and how they interconnect. From this, we can see how the lack of financial resources is the most significant barrier in both rural and urban areas highlighting the socioeconomic inequalities in Mexico, which have been documented in detail by many authors (Tello, 2012; Castaneda Garza, 2024; Rios, 2021; Rios, 2024).

However, as scholars (Tuhiwai Smith, 2012; Mignolo, 2012) note, such statistical approaches often reproduce colonial power structures and knowledge systems and while they are helpful in having a quick overview of the challenges in the digital divide, they lack context and has critical limitations that at the end of the day, originate from state produced statistical analyses. Tuhiwai Smith (2012) emphasises the need for Indigenous and marginalised communities to be centred to challenged narratives, which this project argues should be applied to the digital divide.

However, the difference in the lack of infrastructure between rural and urban areas further shows a divide which is exemplified in Galperin et al.'s (2018) findings that there are geographical challenges to digital inclusion in Latin America and points out to the need to develop targeted infrastructure in rural areas. These socio-economic and geographical reflect historical patterns of marginalisation and systematic discrimination as already covered in the section before. Socioeconomically, rural areas in Mexico have historically experienced higher rates of poverty and lower levels of economic development (Appendini, 2014). However, as I have covered before, this is fuelled by government policies, more specifically neoliberalism, in the last decades.

Geographically, the open and disperse nature of rural communities poses significant challenges for digital infrastructure development (Hollman et al., 2021). However, the framing of rural communities as disperse and therefore challenging for infrastructure deployment reflects what Rivera Cusicanqui (2012) identifies as colonial categories that render Indigenous and communal spatial organisation ad inherently problematic or deficient.

After checking Telmex' website (TELMEX, nd) (the first ever and still most widely used service in the community where the second stage of this project is being carried out) I examined the geographical coverage of the community. The webpage indicates that the community has access to copper infrastructure (1) and fibre infrastructure (2) but no wireless coverage (3); with copper infrastructure is the most widely available in the community.

However, this official coverage map reflects the service provider's perspective, which omits local knowledge of actual connectivity and the experiences with it as well as infrastructure gaps. In this context, mapping becomes a contested practice. According to Boatca (2021), counter mapping is presented as a decolonial tool used to challenge and resist the dominant cartographic and knowledge systems, a method that allows marginalised communities to reposition

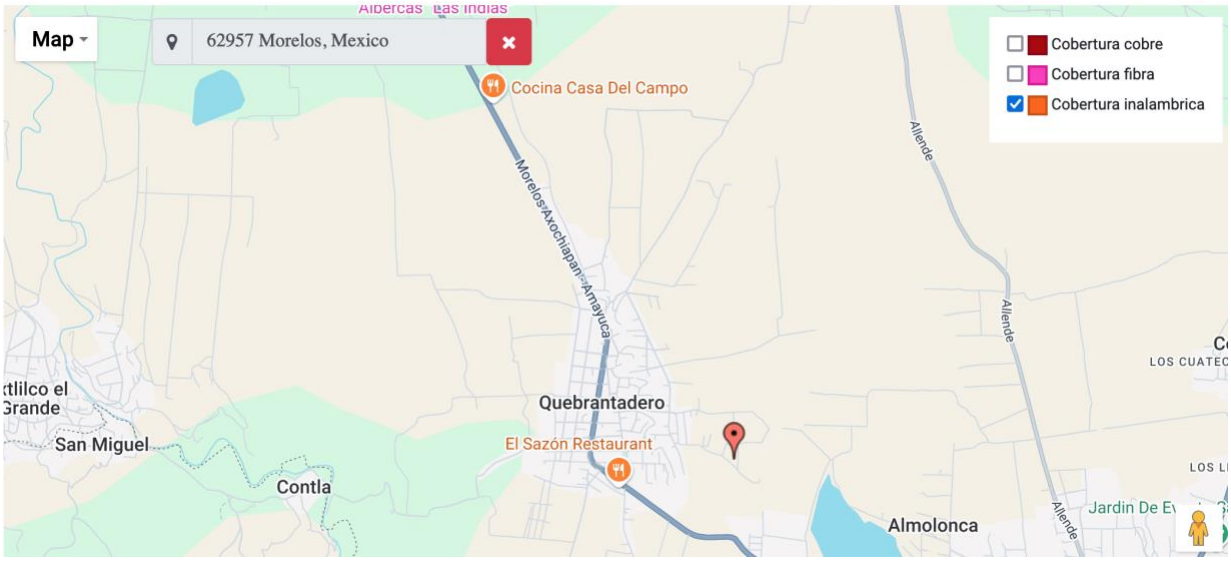
themselves and uncover absences in mainstream knowledge, especially the silences produced by colonial perspectives.

Please see images below.

(1)

(2)

(3)



As it can be seen from the images, copper coverage is the most widely spread and this also connects to literature that shows that copper networks, especially through Digital Subscriber Line (DSL) technology are one of the primaries means of internet access in rural Mexico. However, the limitations of copper infrastructure have been documented. According to Alotaibi et al. (2016) copper infrastructure, while affordable and easily available option due to its reliance on already established telephony infrastructure, is not suitable to meet high speed broadband. What is more, as DSL signals travel over copper, they deteriorate in performance from what is known as high attenuation rates and signal degradation, leading to lower bandwidth and increased latency (Mukherjee, 2006).

Furthermore, attenuation is when the signal loses its strength over distance, in a similar way of how sound gets quitter as you move further away from its source, and in the case of DSL, the further the data has to travel through these copper wires, the weaker and slower the signal becomes. Signal degradation happens because copper is very sensitive to interference from electromagnetic fields (Toy et al., 2021) or weather conditions which may disrupt the data being transmitted; leading to lower bandwidth or amount of data to download or upload, and increased latency as the delay that happens before internet responds.

When examining Telmex's coverage maps of the community, what becomes visible is not only the technical limitations of fibre infrastructure and wireless coverage but through the previous analysis, the systematic ways in which certain territories and populations are rendered deficient in dominant technical and cartographic representations. What is more, the focus on technical

metrics such as bandwidth and latency to describe access to internet infrastructure overshadow deeper concerns about how communities conceptualise and experience this on their own terms.

As mentioned in the first section, this technical framing reflects categories that normalise patterns of exclusion under the guise of neutral infrastructure challenges. The corporate mapping by Telmex reproduces erasure and visibility through colonial systems that simultaneously erase and exploit the histories and identities of communities, creating a paradoxical visibility and invisibility. This could be further critiqued through what Spivak (1988) terms epistemic violence whereby corporations and the state systematically exclude local knowledge systems by prioritising statistical representations and technical mappings.

By using decolonial and countermapping practices, the above could be analysed as reinforcement of patterns of state and corporate disinvestment which need communities' experiences and knowledge centred to counteract these narratives and make real and visible what scholars tend to refer to as inequalities, exclusions. Patterns of exclusion that reflect broader systemic discriminations and which are documented throughout.

According to various studies in Mexico examining discrimination (CONAPRED, 2004a, 2004b; Raphael, 2012; Székely and Fuentes, 2010) have documented a pervasive pattern of social exclusion that can be seen across different aspects of life in Mexico which demonstrated that discriminatory practices are not confined to isolated incidents or specific sectors but rather permeate multiple settings and relationships throughout Mexican society. According to FLACSO (2006) and Ronquillo (2011) these practices arise from deeply embedded prejudices that create obstacles across everyday experiences, such as social interactions, political participation, economic opportunities, and cultural expression, which manifest as poverty.

Chiramba and Motala (2023) offer a comprehensive definition of poverty as a multidimensional concept that encompasses three main types of poverty: material, economic and epistemological. Material deprivation (Makomane, 2011) represents a fundamental denial of human dignity and opportunities in the form of inability to provide food, clothing, lack of access to essential services such as education and experiences of insecurity and powerlessness, to mention some. Income poverty refers to a situation of low or no income in a household (Chiramba and Motala, 2023: 518). Epistemological poverty means “being excluded, either intentionally or otherwise, from life empowering processes and those processes which increase human dignity, knowledge and understanding (Maringe and Moletnase, 2015: 354).

Reports and studies on how poverty manifests in Mexico (CONEVAL, 2024; Suarez, 2024; Rios, 2023) have made the connection between poverty and neoliberal policies. In her book 'No es normal' (It is not normal), Rios explains how neoliberalism in Mexico has worsened economic disparities by implementing policies that favour the wealthy. This project proposes the obvious, that the digital divide should be considered a form of impoverishment and thus should be critiqued from the lens of how neoliberalism operates.

From a decolonial perspective, these three forms of poverty intersect and reinforce each other within the systems we currently live in, neoliberal economic models through which the resulting cycle of poverty is maintained through what Mignolo (2011) terms "coloniality of power", the persistence of colonial hierarchies and relations in our social, economic and knowledge systems. In the words of Amartya Sen (2000), "poverty must be conceived as the deprivation of basic capacities and not only as the lack of income, which is the usual criterion with which poverty is identified (p. 114)".

Few authors discuss the nature of the discrimination-poverty link in Mexico, but Horbath (2008), who analyses the effect of labour discrimination against Indigenous people in urban labour markets in Mexico and defends the hypothesis that discriminatory practices against the Indigenous population limit their access to well-paid jobs and quality education and condemns them to a situation of marginalisation and poverty. However, Indigenous academic and activist Gladys Tzul Tzul (2020a; 2020b; 2018) describes how Indigenous women resist domination and exploitation through communal democracy in the regions of the Andes (in South America) and Mesoamerica (current central and southern Mexico and Central America). This study proposes that similar communal practices can help move towards co-designing community led algorithmic ecologies.

In general, studies (Horbarth and Gracia, 2012) on discrimination-poverty link assume that the former is the cause of the latter; but the opposite is also true. Lahoz et al.'s study (2011) points out that Indigenous women from a small rural community in the state of Veracruz, Mexico are victims of segregation and discrimination because they are poor. As stated earlier, social exclusion and the related problem of digital exclusion are forms of social harm. A study by Ordóez Barba (2018) found that social discrimination against existing vulnerable groups in

Mexico (based on race, religion, gender, and disability) is worsened in circumstances of poverty and is twice as likely to occur when an application for social programme benefits is denied.

This compartmentalised view further obscures what Espinosa-Miñoso (2019) describes as the co-constitution of multiple forms of oppression under coloniality and emphasises that coloniality operates not as isolated or singular form of domination but through intersecting systems of oppression such as racism, sexism and epistemic violence. Furthermore, Tucker (2018) warns against portraying coloniality as a uniform system and emphasises the importance of recognising that coloniality can take many forms of oppression.

This project proposes to conceptualise the digital divide as a perpetuation and extension of colonial relationships through multiple and overlapping forms of dominations that occur through socio-economic models such as neoliberalism which in turn fuel unequal distribution of resources, mirroring colonial patterns, such as epistemic violence through the privileging of Western knowledge but also through omission from theorising of the digital divide that fails to position it as harmful extension of system structures.

The next section gives a critical overview of how the digital divide is a social harm, utilising criminological and more specifically zemiology to help this project position the digital divide within this framework.

The digital divide as a social harm

As established earlier, the digital divide is a multidimensional and continuing phenomenon and process fuelled by neoliberal policies and systemic structures which as examined throughout the last sections, encompasses much more than socioeconomic and sociopolitical factors fuelling them, but it is a phenomenon that has been defined with lack of critical insights from the point of view and experience of those most impacted. Thus, it is a concept in contestation.

However, this project argues that the digital divide not only reflects and reinforces existing structural inequalities in society but it is an organic manifestation of how it was set out to be since the beginning, one which is perpetuated by power imbalances and perpetuates power imbalances through unequal access to digital resources, knowledge and opportunities.

Building on these, the project will examine the digital divide through the lens of social harm theory, an approach rooted in Zemiology (Hillyard and Tombs, 2007). This framework offers

valuable insights into how the structures and institutions shaped by neoliberal policies can produce harmful effects comparable to other already recognised social inequalities (Yar, 2012; Powell and Henry, 2016).

As White (2013) argues, one of the main hallmarks of the development of social harm as a concept is that it directs writers critically to consider wider social contexts and the limitations of conventional approaches, particularly criminological, to harm (Hillyard and Tombs, 2007; Hylliard et al., 2004; Hillyard and Tombs, 2007).

This has come with criticisms that a criminological approach can be limiting and should move towards an alternative discipline called zemiology (Hillyard and Tombs, 2007). However, criminology, especially critical criminology can be relevant in that it challenges legalistic, narrow definitions of crime and harm (Matthews and Kauzlarich, 2007; Friedrichs and Scwartz, 2007).

Nevertheless, a social harm approach is very useful to the study of the digital divide as a social harm. Pemberton (2015) states that social harm highlights three relevant issues. Firstly, that social harms are everywhere mainly because they originate and are rooted in the structures of today's society. The second one is that social harms are commonly a result of omission to act or societal indifference to exploitation. The third one is that these harms are preventable since the consequences of certain social actions or inactions are mostly foreseeable.

By reframing the digital divide as a form of social harm, we can begin to unpack its less visible causes and consequences which has already been established, and which are rooted in neoliberal policies. These policies have negative impact in communities in the forms of educational opportunities, lack of access to economic participation, and limited access to services (van Dijk, 2020; Robinson et al., 2015).

This work emphasises a critical, often overlooked aspect, which is the lack of access due to structural, neoliberal policies does not only limit consumption of technology but fundamentally restricts communities from participating in the design of technologies that affect them, often negatively. This exclusion from the design process also represents a significant form of social harm, perpetuating cycles of technological dependency and alienation.

In that vein, this project introduces the work within criminology to firstly, try and re-define crime, then to situate the digital divide as a social harm, which is driven by state sponsored neoliberalism and digital capitalism driven by big tech giants or as this project sets out to refer to them as digital capitalist giants by highlighting the role of the powerful in perpetuating the digital divide and also stresses the importance of addressing these systemic issues from a criminological perspective.

Criminology, as the study of crime, its causes, and social impact (Newburn, 2017; Reid, 2017) offers tools that can help in analysing power dynamics and addressing complex social issues like the digital divide. By bringing in and applying criminological theories, more specifically critical criminology, this section aims to explain what the broader implications of the digital divide are, for example, its role in reinforcing inequalities but also its roots in neoliberal state policies and the practices of digital capitalist giants. While critical criminology has no standard definition, it presents perspectives and narratives that challenge state defined concepts of crime, oppose official crime statistics and question the authority and universality of traditional or positivist analyses of criminality (Ugwudike, 2015).

Rothe and Kauzlarick (2016), in Crimes of the Powerful, argue that expanding criminological inquiry to include crimes of the powerful would require defining crime beyond acts deemed illegal by law, or in this case, the state. However, as Michalowski (2015) notes, zemiology, the study of harm - zemos, in Greek (Hillyard et al., 2004; Presser, 2013) was born out of critical criminologists wanting to separate criminology due to its inherent connection to law.

Zemiology can be defined as the study of social harms which expand the focus in criminology to include actions that cause significant social harm, even if these are not legally defined as crimes (Hillyard et al., 2004). Zemiologists propose that the label of crime should be discarded because it does not sufficiently accommodate the harmful activities of the powerful in society (Ugwudike, 2015: 11). Furthermore, Tift and Sullivan's (2001: 198) definition of a social harm as, '*actions or arrangements that physically and spiritually injure and/or thwart the needs, development, potentiality, health, and dignity of others*'; offers a good overview of how I also see social harm.

Zemiologists and criminologists have worked on developing the concept of social harm which opens up the possibility of critically engaging in the study of social harms (Hillyard and Tombs 2007; Cain and Howe 2008; Pemberton 2015; Canning 2017). For Zemiologists Hillyard and

Tombs (2007), a social harm approach within criminology and criminal justice policy should ensure that harms such as structural inequalities come under criminological scrutiny. This would include unequal access to digital capital and the related problem of the digital divide.

From a social harm analysis, it is important to bring forward suitable indicators and audit processes that allow for evaluation and quantification of harm (Pantazis and Pemberton, 2009; Pemberton, 2015). Here would be relevant to make evident that there is a top-down hierarchical relationship globally which has been possible through colonial processes and events which in turn have been possible and maintained through a capitalist system that has allowed Global North countries to get resources from the Global South and maintain a certain privilege from this dynamic.

As mentioned earlier, the digital divide is being driven by digital capitalist giants as well as governments who incentivise so-called technological innovation in the name of digital revolution and progress. This project proposes that the digital divide is a social harm, as unequal access to digital capital is to some extent controlled by governmental policies. Policies that tend prioritise digital inclusion policies without regard for many communities' needs but the needs of digital capitalist giants through neoliberal policies that privilege the market.

This phenomenon can be understood through the concept of state-corporate crime which was first conceptualised by Karmer and Michalowski in 1990 (in Rothe and Kauzlarich, 2016) where they define state-corporate crime as 'illegal or socially harmful actions that occur when one or more institutions of political governance pursue a goal in direct cooperation with one or more institutions of economic production and distribution (Karmer and Michalowski, 1990: 4)'. This concept helps explaining how the intersection between state policies such as neoliberalism and corporate digital capitalist giants' interests produces social harms like the digital divide.

According to Lupton (2014) the term 'digital divide' has become commonly used in discussions of the diversity of digital technology use among different social, cultural and geographical groups. In going back to previous critiques on the term digital divide, I want to expand further and argue how the digital divide as a concept is also a social harm. Halford and Savage (2010) argue that this term oversimplifies by separating social issues from technological ones and suggest the idea of 'digital social inequality' to capture the intertwined nature of social disadvantage and digital access.

Furthermore, the digital divide, as a manifestation of social harm, is not only a byproduct of technological advancements or policy failures but is deeply rooted in the capitalist system's foundational dynamics, more specifically, neoliberalism. This perspective responds to the concept of coloniality of power as articulated by Quijano (2000) and further developed by Mignolo (2011) in which coloniality of power is the persistence of colonial era power structures in our supposedly post-colonial world, including in spaces of knowledge production and technological development.

In this context, approaches to the digital divide that do not centre diverse ways of knowing and doing inadvertently reinforce these colonial power structures. As Grosfoguel (2007) argues, the dominance of Western epistemologies in technological development often leads to marginalisation of other forms of knowledge and practice. This is particularly relevant in the context of the digital divide, where solutions are frequently imposed from the Global North onto Global South without consideration of local knowledge systems and needs.

Drawing from the critical insights of Garside (2013), we can demystify how the capitalist system, through its various forms, including neoliberalism, perpetuates social harms, including through the last decades of discourse on the digital divide. Capitalist systems, celebrated for driving human progress and producing essential goods and services, conceal a darker reality marked by the production and perpetuation of social harms (Harvey, 2005; Qureshi, 2023).

As Garside (2013: 251) articulates further, focusing solely on neoliberalism as the latest phase of capitalism limits our understanding of the structural dynamics that generate social harm. The neoliberal capitalist agenda, prioritising profit and economic growth, often overlooks or exacerbates these disparities, marginalising communities and individuals from the socio-economic, cross-cultural benefits of digital inclusion (Harvey, 2005; Qureshi, 2023).

Furthermore, the inherent harms found in neoliberal policies and their perpetuation of inequalities, as outlined by Hillyard and Tombs (2004), can be used to describe the digital divide as a social harm, whereby the production and distribution of digital technologies are guided by profit motives rather than the universal provision of access and opportunity. This approach not only widens existing social and economic divides but also creates new forms of exclusion and marginalisation and what some scholars call digital poverty (Jin and Lingyu, 2021).

The term digital poverty is seen in two different ways, one in the material level where an individual does not own all kinds of digital facilities and cannot afford the cost of information

access; and at the cognitive level, where a person feels it lacks the knowledge, skills and digital knowledge to engage with and access information (Yan and Liu, 2016; Luan et al., 2023; Fan et al., 2023; Zhou et al., 2024).

While the term digital poverty has gained traction in academic research, its applicability and conceptual clarity remain contested (Wang et al., 2021). When applied to Latin American settings, the term often conflates with broader socioeconomic issues which may capture the nuanced realities of the region and continue what other Latin American researchers have been talking about for decades: that digital divide is an extension of the social realities of the region.

In Galperin and Mariscal's book (2007) a contradiction becomes quickly apparent in their argument for creating an information society (ICTs) in Latin America, as the authors argue that the expansion of ICTs, a hallmark of neoliberal development policies needs to simultaneously call for a pro-poor approach to avoid the increase of inequalities and social exclusion.

However, this stance overlooks the inherent tension and contradiction between neoliberal market driven ICT expansion and what they call pro-poor development strategies. It can also be argued that the use of this terminology and its contradiction also reflects a larger issue in digital inequality. For instance, the imposition of Western terminologies on diverse global contexts (Unwin, 2019) including the use of terms such as poverty, or the poor since the imply a static, unavoidable and natural states.

According to decolonial researchers, such framing can perpetuate colonial power structures whereby defining digital divide, digital poverty trough a Western lens overlooks Indigenous and situated forms of digital engagement (Milan and Trere, 2019). Moreover, there is a static nature imposed by the term poverty which fails to capture the dynamic, often deliberate process creating digital inequalities. Therefore, I suggest different framings, such as digital impoverishment or the already suggested by Oyedemi (2020), digital coloniality. These framings may better highlight the systemic nature of these inequalities and align more closely with decolonial perspectives (Kwet, 2019).

The concept of digital impoverishment aims to capture the dynamic and systemic nature of digital inequalities more accurately than digital poverty or digital divide or digital inequalities; notions that imply a static condition of something that has already occurred, while digital impoverishment emphasises an active process of deprivation, marginalisation, dividing and discrimination.

The framing of digital impoverishment deliberately shifts focus from describing outcomes to identifying causes, thereby helping to name the culprits responsible for creating such divides. Thus, by employing the term impoverishment, this framing draws attention to the deliberate policies, economic structures and power dynamics that are actively excluding populations from digital resources and opportunities.

What is more, by naming the process more directly, digital impoverishment encourages a deeper examination of why these disparities exist, who benefits from them, and how they relate to broader geopolitical patterns of exploitation and exclusion; instead of centring those who lack access or skills. Digital impoverishment and digital coloniality cannot be separated. As Oyedemi (2020) states, understanding coloniality as an ongoing process of economic and cultural domination provides a critical explication of digital capitalism. Coloniality, as Quijano (2007) argues, is the recognition that the relationship between the Western culture and others continues to be of colonial domination often shaped by capitalism and culture.

Oyedemi (2020) expands how communication as an innate aspect of culture, has been crucial in establishing and maintaining colonial power structures, where Western cultural aspects have been strengthened by two key factors, capital through economic power and technology (e.g., telegraphy and broadcasting) where ICTs represent the backbone of a current form of coloniality – digital coloniality. This emphasises how technology and capital reinforce cultural domination in the digital age. It manifests in the dominance of what I called before, tech capitalist giants over the digital landscape, shaping it in ways that benefit them at the expense of less powerful nation states and communities.

The relationship between digital coloniality and digital impoverishment is fundamentally causal as the mechanisms enabling digital colonialism directly to contribute to the impoverishment of communities, both in the physical and digital spheres. A process that begins in the material world with the extraction of resources necessary for digital infrastructure but also expands to the human component of labour exploitation, which is needed to keep the colonial powers producing. As Carr (2023) argues, the tech industry's material base is deeply embedded in extractive industries, for instance, mining of earth minerals, crucial for manufacturing digital devices which occurs predominantly in Global South geographies, under exploitative conditions and echoing historical colonial resource extraction.

What is more, digital impoverishment further highlights why the digital divide functions as a social harm that generates additional social harms since digital impoverishments represent not

only a lack of technological resources but a systematic process of deprivation resulting from digital coloniality, where Global North technological frameworks are imposed as universal standards.

This causal relationship between digital coloniality and digital impoverishment reveals that digital inequalities are not simply technological gaps to be bridged, but manifestations of deeper, systemic inequities rooted in colonial legacies and capitalist structures manifested through neoliberal policies. Thus, when neoliberal policies favour market driven solutions over equitable access, they directly produce digital impoverishment as a form of social harm that erodes Pemberton's three dimensions of physical wellbeing, autonomy and relational ties.

To counteract digital coloniality and digital impoverishment demands a reimagining of our digital ecosystems by centring geographies and communities, their stories, their desires, that have been harmed and continue to be harmed by coloniality. This work does this by centring rural Mexico, a context where the interconnections between historical colonialism, contemporary neoliberal policies and digital impoverishment come into play.

It has already been covered how neoliberalism operates in Mexico before. However, this new line of inquiry into digital impoverishment offers few pathways to further emphasise the digital divide as a social harm, since neoliberal policies favour market driven solutions over equitable access, they lead to digital impoverishment. This means people are denied access to digital technologies, preventing them from participating and getting any benefits people might receive from participating in the digital economy, which has become crucial in today's world.

In bringing these critiques, it becomes clear that addressing the digital divide requires a deep re-evaluation of the capitalist system's role in shaping our digital landscape. This project proposes that the quest for digital inclusion must go beyond accepted definitions of the digital divide (one which is lack of access but also skills and access to other resources) and shift towards one that includes a dismantling of current neoliberal dynamics. It should aim at restructuring the socio-economic frameworks that dictate the production, distribution, and use of technologies. This needs a shift towards models that prioritise community empowerment, equitable access, and the democratisation of digital spaces as central to combating the structural harms perpetuated by capitalist agendas.

While it is undeniable that the state and digital capitalist giants are at the core of the digital divide as it has been accepted in media, academia and the technology sectors; there is another angle in which the digital divide becomes harmful. A commonly accepted perception is that connection to the internet, for example, habilitates other rights such as access to government digital services as can be clearly stated by most governmental policies (Gob, 2019); replacing education with online platforms which intensified during the COVID-19 pandemic (Teräs et al, 2020).

By concentrating on this, the likelihood of not accessing rights non-digitally is reduced, and the risk is that face-to-face services will be permanently replaced by virtual services, which will make connectivity a crucial component of the services supply for accessing rights (Bloom, 2021). A good example is the online booking for COVID vaccinations in Mexico, as elders did not feel comfortable navigating online booking processes (Shepherd, 2021; OECD, 2021). This structural transformation creates what Pemberton (2015) would recognise as direct harm to physical well-being, autonomy and relational connection, especially for vulnerable populations.

According to a conversation held by REDES AC, a communitarian technology providers in Mexico, connectivity is commonly seen as an end in itself, as the goal (REDESAC, 2020) when in reality accessing rights and services should be the goal. This is usually what governments, internet providers and social media companies and civil society accept where the concept lies in advancing the frontier of connectivity and to have more people 'connected', making somehow the world before 'connectivity' disappear.

However, to see connectivity as an enabler of other things (as long as there are other viable options to access services and rights that are not exclusively digital) allows for the non-conditional access to certain rights and services (Bloom, 2021). This perspective advocates for maintaining multiple pathways to access services, rather than making digital access the only option. Thus, the binary conception of 'connected vs non connected' fails to capture the nuanced reality of digital access and usage, since as already covered in section one, having the means to connect to the internet does not automatically translate into meaningful digital participation.

Conversely, those who are disconnected may find themselves in this position due to a myriad of factors, including structural decisions regarding the allocation of digital infrastructure based on socioeconomic status (Benjamin, 2020; Ugwudike, 2020) and, to some extent, geographical

location (Martínez Domínguez, 2020). Moreover, individuals may choose not to participate in mainstream digital inclusion initiatives, reflecting a certain level of resistance or scepticism towards digital integration (Binder & Garcia Gago, 2020; Gómez Menjívar & Chacón, 2019).

The discourse surrounding digital technology use often centres on assumptions rooted in a specific social group and cultural context, typically from a standpoint of the global North. Philip et al. (2012) introduces the concept of 'postcolonial computing' to critique this perspective, highlighting the oversight of diverse cultural, social, and geographical contexts in which digital technologies operate and highlight that is within this space of unravelling the various ways in which the internet is used within specific geographical and cultural settings that digital anthropologists play a pivotal role.

Through ethnographic fieldwork Bell's (2006a, 2006b) in South Asian countries, they generated rich, and contextually intricate data that shed light on the integration of digital technologies into everyday life, showing the exploration of digital engagement practices within diverse household settings. Outside anglophone countries, significant disparities exist in digital access and usage patterns, shaped by infrastructure, education levels, and cultural lifestyles. For example, Goggin and McLelland (2009) show these differences through a comparative analysis of adolescent girls' experiences in contrasting cultural contexts, highlighting the complexity between technological infrastructure, literacy levels, and cultural norms which further emphasises the need for contextually sensitive approaches to digital inclusion efforts.

What is more, the discourse surrounding digital inclusion needs a critical interrogation of existing categorisations and assumptions and instead acknowledge the multifaceted nature of digital access barriers and the diverse socio-cultural contexts in which they manifest. Through social media data and empirical investigations, and as part of a rural community, this project strives to unravel the logics that have led to digital impoverishment and advocate for approaches to technology adoption that centre lived experiences.

Lupton (2014) highlights the diverse narratives surrounding technology use and the digital divide, emphasising the complex interaction between technology, culture, and power dynamics, further emphasising that the internet is not a monolithic entity but rather manifests differently across regions and cultures, shaped by unique historical and socio-political contexts. What is more, Lupton (2014) argues is that material infrastructures, such as download speeds, access types, and government regulations, vary significantly between countries, influencing the adoption and meaning of digital technologies.

For instance, in several Asian countries, personal computers found their place in middle-class homes before workplaces, serving primarily as domestic devices intertwined with internet access, particularly for educational purposes (Bell, 2006a). Goggin and McLelland (2009) further illustrate this diversity, noting variations in technology adoption across geographical regions. While personal computers may not have been as prevalent in Japan, locally made internet-enabled phones gained traction earlier, reflecting unique technological trajectories. Similarly, South Korea's early embrace of mobile internet and broadband stemmed from its high population density and topography, facilitating extensive network coverage (Bell and Dourish, 2007, 2011; Dourish and Bell, 2007).

Moreover, the geographical features and socio-political landscape of nations such as Singapore have supported a conducive environment for fast technology adoption and with a highly urbanised population and a government inclined towards extensive regulation, Singapore has emerged as a leader in ubiquitous computing technologies (Bell and Dourish, 2007). However, in Mignolo's Coloniality: The Darker Side of Modernity (2009) work provides a critical lens through which to examine these technological advancements, revealing how they are intertwined with the global spread of modernity and its inseparable counterpart, coloniality.

This relationship highlights a form of domination that extends beyond the physical to include global knowledge production, economic systems, and cultural norms, challenging the narrative of modernity as progress by exposing its role in perpetuating inequalities and erasing Indigenous knowledge systems. Thus, the global adoption of technology, while diverse in its manifestations, is also a reflection of the broader dynamics of modernity and coloniality, highlighting the need for a critical understanding of technological progress within the context of global power structures.

Central to Mignolo's thesis (2011) is the assertion that there is no modernity without coloniality and thus there is no capitalism nor neoliberalism without coloniality as well as what other decolonial authors argue (Quijano, 2000; Maldonado Torres, 2016). This relationship suggests that the global spread of modernity also exemplifies the proliferation of colonial structures and logics which are manifested not only in the physical occupation and exploitation of lands but also in the global spaces of knowledge production, economic systems, and cultural impositions where technology plays a crucial role.

Thus, the narrative of modernity as a beacon of progress is critically challenged by recognising its role in perpetuating inequalities, erasing Indigenous knowledge systems, and enforcing

Eurocentric standards of civilisation and rationality. By connecting this premise to the reflections on technology narratives and the digital divide, it becomes evident that the digital divide is another frontier where the dynamics of modernity and coloniality play out.

What is more, the push for a universal model of "*bridging the digital divide"* mirrors the colonial drive for global modernisation, often disregarding the unique socio-political contexts and needs of diverse communities (Kwet, 2019; Berrio-Zapata, 2020; Bon et al., 2023). This approach not only oversimplifies the complexities of digital exclusion but also perpetuates a form of digital coloniality, where technology and digital resources are deployed in ways that reinforce existing power imbalances rather than democratise access and opportunity.

This project proposes the terminology of "progressive digitalism" as a concept that reveals how technology's promise of inclusivity and progress often masks a continuation of colonial practices, by imposing homogenised, top-down solutions on diverse communities, privileging certain forms of knowledge and communication over others, and prioritising economic gains over genuine empowerment and self-determination.

Drawing from decolonial insights (Funez-Flores, 2022; Mignolo, 2011; Rivera Cusicanqui, 2012), the path towards addressing the digital divide necessitates a decolonial approach, one that recognizes the diverse realities of communities, especially those most affected by the digital divide and which seeks to empower them through technologies that are respectful of their cultures, responsive to their needs, and reflective of their aspirations for autonomy and development. This project proposes that this entails challenging the dominant models of technology conceptualisations, use and development and embracing a multiplicity of digital realities that are shaped by the values, knowledge, and priorities of local communities themselves.

As zemiologist speak vastly about social harms from the powerful and while their contributions have helped in developing and using the language to include the crimes of the powerful; they seldom talk about how that power came to be. Wright (2023) identifies the obvious, that zemiology has a disciplinary blindness to colonialism and argues that zemiology works within a standard narrative of modernity characterised by capitalist nation-states, not recognising the colonial foundations of these.

And indeed, recognising this allows for a better understanding for a wide range of harms done to diverse communities, contexts and histories. The work of Agozino (2018) brings to the centre the role of imperialism and how corporate profits are linked to social harms (p. 356) and argues

that imperialism is the root of all criminality, including structural wrongs not criminalised but institutionally orchestrated (Agozino, 2010).

Thus, embracing the digital divide as a social harm shows a complex landscape that intertwines historical, social, geographic, economic, and crucially, cultural dimensions, a complexity that is especially pronounced in environments such rural Mexico, where, as we have seen in the section on manifestations of neoliberal policies in rural Mexico and how the digital divide unfolds, it requires equally, a grounded approach that has not been proposed by most digital divide literature: to centre lived experiences of those affected by the digital divide.

What is more, the prevailing narrative of progressive digitalism, with its focus on capitalising on advancements in science, technology, and neoliberal economic ideologies for digital and social reform, often fails to account for the situated ways in which culture intersects with technology (Eubanks, 2011; Nakamura, 2008; Benjamin, 2019). This oversight risks creating digital ecosystems that do not fully embrace or respect the rich diversities of local cultural values and practices, thus limiting their inclusivity and effectiveness.

Therefore, by applying the lens of decolonisation and zemiology with counter-colonial criminology, it can be recognised that the digital divide is a social harm rooted in imperial histories that continue to erase cultures. This harm is clear in many rural and Indigenous communities in Mexico, where technological disparities have not only perpetuated inequalities but have denied cultural and social development.

While the literature review so far has covered ground for how the digital divide is conceptualised through various angles and contexts, it has also laid out the ways in which this work argues for the digital divide as a concept and a process borne out of neoliberal policies which as decolonial scholars have argued, is a continuation of coloniality. The previous sections have also discussed how the digital divide through being a concept emerging from neoliberal policies and which fuels inequalities, it is a social harm.

However, this project has already proposed that to truly tackle the digital divide, we must reimagine ways in which we move towards co-designing community led algorithmic ecologies, which this project argues can happen when we centre lived experiences and visions of those impacted by the digital divide. The next section gives a critical overview of how creating technologies is possible and this project uses the term *tequiologies* to help situate current

community-led organising and building communal sites, particularly in the context of technologies.

Tequiologies

While the digital divide literature predominantly focuses on technology through functional definitions centred around digital tools, infrastructure and access barriers, there are alternative frameworks that offer different conceptualisation of community technological engagement. A significant concept is that of *tequiologies*, introduced by Aguilar Gil (2020) as a framework for understanding how rural and Indigenous communities have historically developed and continue to implement technological solutions through collaborative practices.

Thus, tequiologies is used here as a counter to what Aguilar Gil identifies as Western myth of perpetual growth, where the world has become overrun with their products, where ecosystems have become goods, and people are only consumers. This frameworks challenges digital divide and technological narratives that have long dismissed Latin America as a passive receptor for technology, instead highlighting how communities repurpose technologies for resistance, resilience and collective care.

Aguilar Gil (2020) adds that by repurposing imported technologies, Latin America, is far ahead of the west in understanding how digital technology can burst out from the scope of the intangible into the real world (e.g. fake news, deep fakes, misinformation, online interferences that have translated into real physical issues such as political and democratic processes). This is because Latin America has spent decades waging its struggles in digital spaces, exemplified by the defence of native languages or the vindication of technological material sovereignty through Community Cellular Technology (mobile systems that are locally owned, administered and operated) (REDESAC, 2021).

However, while tequiologies offers valuable insights, it has remained primarily conceptual, with limited empirical investigation of how it manifests in community practices. Thus, this project aims to bring and centre how tequiologies may operate in practice by centring a rural community in Mexico that already has deep communal and collective practices. The project will do this by documenting their conceptualisations, ideas and visions around technology, how they experience the digital divide and how they envision building their own technologies.

Tequiologies suggests that minoritised and marginalised communities can solve their own technological challenges, so this research aims to extend by investigating how this is harmed and how it is lived as there is a digital divide. The term tequiologies can also be used as a theoretical framework for understanding how communities have historically developed and implemented technological solutions through collaborative practices and which by doing tequiology and countering the notion that minoritised communities are incapable of solving our own problems or are passive consumers of technology.

While tequiologies demonstrate how marginalised communities actively create technological approaches through collaborative practices, these practices face obstacles that further perpetuate the digital divide. Despite the agency and self-determination exercised within communities, structural barriers continue to undermine the effectiveness of digital inclusion efforts, creating a disconnect between community-led innovation and policy implementation. The following section examines some of the barriers that prevent digital inclusion policies from recognising and supporting community-led technological solutions.

Barriers undermining digital inclusion policies

The disconnection between policy frameworks and community needs help explain why many digital initiatives and programmes across the world have been and will continue to be unsuccessful as they are rolled out from a top-down approach with lack of involvement of concerned parties. One example is the UK government Mobile Infrastructure Project (MIP) (GOV, 2017) which was originally set up in 2011/12 to improve mobile network coverage in rural "not spot" areas, building only 75 of the promised 575 masts. According to Jackson (2017), one of the problems with the project was getting planning permissions s some communities were unhappy and protested.

For example, in the context of Mexico, while previous attempts by the initiative *Mexico Conectado* from 2013-2018 have been made to provide internet in public spaces across the country, including rural areas and while it connected many public spaces, it failed significantly to increase access and adoption in rural areas (OECD, 2017), reporting lack of involvement from interested parties: education ministries, private sector, etc. Such examples show the importance of involving interested parties in digital inclusion policies, with special attention to the communities which is what this project is aiming to contribute to.

What is more, within Mexico, the rush to fix the digital divide focuses heavily on the progressive agenda (e.g. Mexico's AI Strategy in 2018) fails to critically engage in the historical and social structures of the country, leaving the most affected communities out of the conversation. Meanwhile, despite growing internet penetration in Mexico, the digital divide between urban and rural regions in Mexico has remained a significant problem: in 2018, 73.1 percent out of 74.3 million internet users were in urban areas and only 40.6 percent in rural areas (INEGI, 2018). According to recent figures, 14 million Indigenous people and people living in rural communities were disconnected (Martínez Domínguez, 2020), making ethnic and linguistic divides visible and extremely significant.

However, it is necessary to analyse these frames between the rural and the urban, between the ethnic and linguistic divides and further explore why these divides exist in the first place. By now, it has been well established that factors indicating digital inequalities mirror offline inequalities, for example, socioeconomic resources, knowledge and physical abilities (Vassilakopoulou & Hustad, 2021).

A study conducted among governmental participants representing rural communities in Australia suggests that rural digital exclusion can result from three intertwined layers: availability (elements of infrastructure and connectivity), adoption, and digital engagement (Park et al. 2015). Similarly, one large household study conducted across the US found that the availability of Internet Supply Providers (ISP) had little impact on Internet adoption, and that Internet adoption can almost exclusively be attached to differences in household attributes and not to ISP availability (Vassilakopoulou and Hustad, 2023).

The above heightens doubts about the current Mexican program *Internet for all* which has as one of its primary aims, the inclusion of those in situations of poverty, in financial and social programs. But in reality, ongoing social discrimination has not been remediated, pointing us to the so called '*technological solutionism'*, an ideology that positions complex social phenomena like politics, public health, education, and law enforcement as "neatly defined problems with definite, computable solutions or as transparent and self-evident processes that can be easily optimised, if only the right algorithms are in place! (Morozov, 2013)".

These current technological narratives are harmful because they continue to socially exclude groups and communities and continue to fail to remediate social harms caused by structural policies. Thus, to critically and actively dismantle current narratives, efforts should be made to,

not only point out the institutional, power structural harms that have contributed to the social exclusion and poverty of certain groups, but also to actively engage in centring alternative narratives.

Efforts should also be made to work with alternatives based on the actual needs, wants and desires of the same communities that have been historically excluded. Digital exclusion is only another form of social exclusion and should not be considered more important than any other form of social exclusion or a solution to other forms of exclusion (as the current narratives present us). As noted before, the aim of this project is to work towards co-designing community-led algorithmic ecologies, departing from the wants and needs of excluded communities. This approach is also grounded in the recognition of digital access as a fundamental right in today's digital world.

According to the UN General Assembly (2012) affordable internet access is a human right, critical to participation in democratic governments, yet the divide has not changed much for many rural communities and the UN bodies providing suggestions to countries on the digital divide for addressing global digital disparities could do more in this regard, considering the reach and power they hold.

For example, the UN specialised agency for digital technology, the ITU, released a solutions guide in 2020. In this guide, it outlines a four-step approach: 1) identify digitally unconnected (and underserved) geographies; 2) review options from existing solutions; 3) select sustainable solutions by matching viability subject to constraints; 4) implement interventions to extend sustainable connectivity service. While the approach appears logical, it fails to adequately centre community needs and perspectives throughout the process. In fact, part of the guide suggests choosing from either a top-down approach or bottom-up approach which is made obvious through their four-step approach that they chose a top-down approach as a suggestion.

While well intentioned, the guide falls short in its comprehensive understanding of the nature of connectivity challenges. Their process lacks explicit consideration of: 1) community participation or any kind of direct involvement with communities affected; 2) a critical analysis or at least some acknowledgment of the existing power structures in the digital space, including the role of tech giants; 3) acknowledgment of historical and ongoing structural inequalities that have led to digital divides and 4) integration of local knowledge which could complement how fitting and sustainable solutions are.

Therefore, by neglecting those crucial aspects, the UN perpetuates a technocratic, top-down model of development that has long been critiqued for its ineffectiveness and potential harm (Ferguson, 1994; Cornwall and Brick, 2006; Rist, 2014); making it obsolete for future proofed sustainable solutions that benefit communities currently in the margins. This is why community-based approaches are important as they help us move past the development trap (Rist, 2014) that relies on top-down approaches.

It can be said that systematic discrimination and social exclusion are undermining the Mexican government's digital inclusion policies which makes it a social harm, as described in previous sections. This can be exemplified through the divides between access to digital resources between urban and rural areas, but also from the historical and socio-economic points of view of class, gender and ethnicity.

Chapter 3: Theoretical framework

In order to understand how the digital divide is a social harm in rural communities, a theoretical framework is important to help me position and uncover the systemic patterns and to highlight the urgency of moving the conversation in the digital divide scholarships and broader work towards co-designing community based algorithmic ecologies. As a member of the rural community where the interviews and focus groups were carried out, this work shows how the digital divide is a social harm as a manifestation of colonial continuities through neoliberal policies.

Thus, this project uses decolonial theories to interpret, explain and where possible generalise my findings. These theories offer crucial insights into the ongoing colonial patterns in technological development through neoliberalism which decolonial theorists have characterised as a continued form of colonialism. Through using these theories, we can see how these colonial structures are ingrained not only in the digital divide itself but also in many interventions aimed at addressing it.

Drawing from the foundational theories of Fanon (1961), Quijano (2000; 2007), Mignolo (2002; 2007), Lugones (2007; 2010), Maldonado Torres (2007), Escobar (1994; 2000; 2008; 2018), Tuhiwai Smith (2012), TallBear (2002; 2020; 2022), Rivera Cusicanqui (2010; 2012; 2015), Espinosa Minoso (2011), Curiel (2013), Tzul Tzul (2024; 2020a; 2020b; 2018) and

Cumes (2012) this research highlights the need for community centred algorithmic ecologies while also acknowledging that these theories have limitations to how they are applied and the contexts in which they are being applied.

Decolonial thinking consist of two main foundational elements; the first one is that colonialism is a fundamental problem and the second one, outlined by Fanon (1961) is that decolonisation is a project. Colonialism, Fanon argued, is not only about exploiting land and labour but fundamentally reshaping how colonised peoples and communities understand themselves and their place in the world and their subjectivities, their inner experiences, emotions, and perspectives.

Fanon further argued that coloniality sustains itself by avoiding acknowledgment as a problem, leaving colonised communities to navigate shifting definitions of reason imposed by colonial powers. In Fanon's view, decoloniality is to be pursued because there is no other way in which one can imagine living in a context marked by coloniality and this process of decolonisation has nothing automatic about it as it is continually challenged from the outside and the inside.

Quijano's (2000) concept of coloniality of power builds on this view, offering a point of view for understanding how colonial power structures persist. According to Quijano, the impact of colonialism did not end with the formal dismantling of colonies, instead, its structures and hierarchies persist through modern systems of power, economy and knowledge. The coloniality of power describes how colonial control over labour, resources and knowledge has been institutionalised and affects all aspects of society which makes it an essential concept for analysing and interpreting the digital divide. This allows us to see it not only as a structural divide, as many scholars have agreed (e.g. Van Dijk, 2000, 2005, 2020; Ragnneda, 2017 but it perpetuates a structural system that follows colonial forms of control, which has been largely overlooked in the most prominent digital divide literature.

The importance of recognising this cannot be left untouched, especially since in many rural communities in Mexico, the digital divide such as many other divides mirrors colonial hierarchies where access to resources is systematically denied. Quijano's theory helps explain how these disparities are entrenched within neoliberalism which is today's global economic model, as technological infrastructure, education, and economic opportunities are concentrated in urban spaces. This distribution of resources replicates colonial spatial hierarchies which has been thoroughly document in historical documents (Seijas, 2018; Joaquín García Icazbalceta

Manuscript Collection) as rural communities are positioned as peripheral or backward in relation to the cities which continues to this date.

Quijano's understanding of the coloniality of power has resonated extensively within academic debates. For example, Lugones (2007) provides a critical interpretation of the coloniality of power in the context of making an argument for decolonial feminism by introducing the concept of coloniality of gender. For Lugones, the coloniality of gender is essential to the broader coloniality of power, as colonial regimes not only imposed economic and political control but also reshaped social structures, including gender relations.

By applying this concept, we can see the persistence of gendered inequalities that have become part of the sociocultural dynamics in rural communities too. Thus, by incorporating Lugones's insights, I can highlight the intersectional nature of the digital divide and the responses to it, especially since these gender impositions translate into barriers for women to not only digital access and use but economic opportunities too and decision-making roles within the community itself.

Since this project's aim is to untangle the digital divide from the views, experiences and needs shared by members of a rural community, many of whom identify as women, it becomes imperative to bring in the perspectives of decolonial feminists who can provide further insights into the intersectional nature of the digital divide and its possible solutions. In applying decolonial feminist critique, such as that of Espinosa Miñoso (2021) we can gain a more complete perspective on the deeply interconnected structures of oppression that shape the digital divide.

Espinosa Miñoso et al. (2021) work builds on Lugones' (2012) work on the matrix of oppression and domination which can help in showing how the digital divide in a rural community and other underserved communities reflects systemic exclusions tied not only to colonial and capitalist logics but patriarchal ones too. Espinosa Miñoso (2014, 2021) and Curiel (2013, 2020) argue for a decolonial and antiracist feminism that not only challenges patriarchal capitalism but also confronts western hegemonic ideas within feminist theory. This perspective is critical for this project, as it encourages solidarity across racialised movements, further grounding this project in a framework of collaborative, community-centred approaches towards co-designing algorithmic ecologies; ecologies are envisioned as solidarity network across historically underserved communities.

Maldonado Torres (2007) extends Quijano's work through his concept of coloniality of being which critiques how colonialism legacy persists in modern structures, particularly through neoliberal policies that perpetuate exclusion and dehumanisation. Maldonado Torres (2007) argues that these policies sustain a "non-ethics of war" where certain populations are systematically denied protections and rights, rendering them disposable, thus challenging the narrative of modernity as a democratic project and giving way to an unfinished project of decolonialisation (p. 263).

In the context of the digital divide, this concept shows how neoliberal approaches to digital challenges often commodify technology and the processes in between, leading to further marginalisation of underserved communities, a process that happens through prioritising profitability over equitable access, reinforcing existing inequalities. This makes this contribution essential for understanding how neoliberal policies deepen the digital divide and all the other divides but also through western scholarship, which often endorses these policies uncritically, failing to examine how they reinforce colonial tactics.

Another decolonial scholar used in my work is that of Mignolo (2000; 2011), starting with epistemic decolonisation which is the undoing of the epistemic dominance embedded in modernity, by arguing that colonial frameworks have subordinated specific knowledge systems by presenting modernity as a universal framework. Thus, advocating for decolonising knowledge which requires recognising the geopolitical sources of knowledge and affirming those modes of knowing that modernity/coloniality has marginalised (Mignolo, 2000).

Mignolo's (2011) concept of border thinking is another useful approach to interpret the digital divide in the context of this project. This concept advocates for an epistemology that is both historical and geographically rooted and rather than a simple focus on place, border thinking considers how specific locations and histories shape what can be known and how it is known. This concept can be extended into the digital divide where technological development imposes a singular model of progress and development on underserved communities, framing them as backward or resistant to change and disregarding local epistemologies and practices while also reinforcing colonial hierarchies within digital inclusion efforts.

Escobar's (1994; 2008; 2018) works add another layer to this framework by critiquing development as a colonial project. Escobar (1994) argues that development discourses make

non-western societies as underdeveloped or lacking, thus justifying interventions that impose western models of progress. This is directly relevant to the digital divide and the policies deigned to address it, which often frame it as a development problem rather than as a consequence of ongoing oppression and marginalisation driven by the same policies.

Furthermore, this analysis helps in challenging the assumption of the digital divide as a developmental problem by showing how development policies, including digital inclusion programmes can undermine local knowledge systems and reinforce dependence on external sources. This suggests that solutions rooted in western ideas of progress may overlook or even harm the social and cultural fabrics of rural communities which helps in repositioning the digital divide not as underdevelopment but as an issue of epistemic injustice where imposed digital interventions often fail because they do not respect the distinct worldviews and priorities of underserved communities.

Another helpful concept in this project is Escobar's (2018) concept of pluriversality which advocates for localised knowledge and community agency, something that strongly resonates with one of the goals of this work, a call towards co-designing community-centred technological solutions. In Designs for the Pluriverse, Escobar (2018) argues that communities should be able to design their futures based on their own philosophies.

A more familiar and perhaps accurate is the Zapatista Movement from Chiapas, Mexico which emphasises the vision of a *world where many worlds fit*, prioritising autonomy, communal self-determination, and the right to create alternative social, cultural and political spaces beyond colonial modernity. Maldonado-Villalpando et al. (2022) work explain how Zapatista grassroots innovations, especially through autonomous education, empower local communities by generating own knowledge and practices, initiatives that are essential for countering transformative alternatives to development and highlighting the need for frameworks that support grassroots innovation.

Another strong reference used in this project is the work of Tuhiwai-Smith (2012) *Decolonising Methodologies*, fundamental for understanding how research on the digital divide should be conducted with rather than on underserved communities. Tuhiwai-Smith argues that colonial research practices have long dehumanised Indigenous populations, treating them as subjects rather that partners; emphasising that decolonial research methodologies must engage with communities on their own terms, respecting their autonomy and knowledge systems.

For interpreting the digital divide from the standpoint of my community, Tuhiwai-Smith's work is crucial in challenging the digital divide and the research around it and to centre underserved communities' perspectives, experiences and priorities in navigating and addressing the digital divide.

This project engages with the scholarship of TallBear (2002; 2013; 2022) and Aguilar Gil (2022) to provide further critical insights into the digital divide from perspective that resonate with, yet differ from, my own positionality. While I am not considered Indigenous within contemporary Mexican identity due to loss of native language, my community's way of life converges from and practices that under this system of categorisation are Indigenous in many respects. This recognition informs my approach to Indigenous scholarship, where I aim to engage respectfully with these ideas without claiming an Indigenous identity yet being aware that this is more of a historical process that failed to strip my community of what are considered Indigenous philosophies and ways of organising.

TallBear's (2013, 2022) work on Indigenous science and technology sovereignty is key in critiquing the imposition of Western technological models on communities. TallBear (2013) argues that Indigenous technological sovereignty is fundamental as Indigenous communities maintain unique relationships with technology, land and resources that do not align with western ideals.

As a community member of where this research was carried out and as a researcher examining the intersections of the digital divide through decolonial lenses, Indigenous scholarship provides critical insights that decolonial theory alone cannot take on. For example, I draw on TallBear's (2002) critical insights to challenge simplistic narratives about tradition and modernity. TallBear's critique of rigid traditionalism provides a significant framework for understanding how systems such as Milpa agriculture and ejidos (mentioned in the literature review) represent sophisticated technological innovations that have preserved, rather than diminished, Indigenous agricultural and community knowledge.

This project works within the context of my rural community, while not officially recognised or categorised as Indigenous within contemporary Mexican identity frameworks due to language loss, maintains deep connections to Indigenous agricultural practices and communal organisation and decision making. This corresponds with TallBear's (2002) critique of

oversimplified categorisations of indigeneity and puts an emphasis on understanding how communities maintain meaningful cultural practices while engaging with changing institutional contexts.

Therefore, TallBear (2002, 2013) works contribute and helps in interpreting broader discussions about technological sovereignty and cultural preservation, by showing how communities can maintain Indigenous practices despite institutional and technological innovation. As TallBear argues, the key is not rejecting modernity in its entirety, but rather understanding how communities can apply culturally specific values and decision-making processes as we face technological innovations and at the same time co-create our own. TallBear's work thus supports and encourages a shift toward Indigenous-led technological frameworks, where communities can create the digital tools through their relational culture, they knowledges they share and the ways they protect their cultures.

Rivera Cusicanqui (2012) adds another core perspective in this project which also offers an important critique of the broader decolonial discourse, particularly pointing to how some decolonial theorists have, perhaps unintentionally, replicated hierarchical structures in their work. Rivera Cusicanqui (2012: 98) argues that the North American and European adoption of decolonial language and concepts – especially figures such as Mignolo – often isolates theory from its practical and political roots, leading to academicised version of decoloniality that lacks meaningful engagement with social movements and Indigenous struggles on the ground.

Rivera Cusicanqui also notes how Mignolo, Quijano, and others have appropriated and reshaped decolonial frameworks from Latin America and built a sort of mini empire within an empire that is disconnected from the lived experiences and struggles of Indigenous and so-called mestizo populations. Rivera Cusicanqui also argues that while decolonial scholars have brought in concepts such as colonial difference and geopolitics of knowledge which have gained prominence, it often does so in ways that obscure the local histories, conflicts and grassroots actions that constitute genuine decolonial practice.

However, for Rivera Cusicanqui (2012), decolonisation is not simply a set of ideas or a discourse but requires tangible, community-centred practices that resist colonial legacies and allow communities' knowledge to thrive in its full complexity (p. 107). Through Rivera Cusicanqui's concept of ch'ixi which describes the coexistence of cultural differences without falling in what is called inclusion or integration, provides a crucial lens for understanding how

rural communities might not only adopt digital technologies but to co-design and build our own in ways that align with our cultural values without conforming to Western technological norms.

By building from all the decolonial concepts so far, I seek to also critique and expand upon the limitations of mainstream decolonial discourse and the ch'ixi philosophy allows this. For my community and other communities, Rivera Cusicanqui's work provides a model for engaging with technology co-design in a way that values cultural identities and resists the homogenising pressures of the state, big digital giants and of course, neoliberal agendas.

Chapter 4: Methodology

This section details the methodology and outlines the theoretical and conceptual basis for the two-stage research design, as the primary aim is to understand how the digital divide is not only conceptualised in mainstream narratives but how it is experienced and lived in rural communities. Thus, the methodology is designed to bring together the decolonial theories and structural discussions of the digital divide that tend to be more abstract, with tangible, everyday experiences of those affected by it.

This project uses a qualitative research approach to centre the experiences of communities that have been historically underserved and marginalised in the digital divide space and to critically analyse dominant narratives about the digital divide. As established in the literature review, the digital divide is a social harm, a term that addresses the unequal distribution of technological resources and also highlights the neoliberal principles that drive these disparities through market-driven policies that centre market driven solutions. To examine this structural and complex process, this project employs a two-stage methodology whereby the first one carries out social media research, and the second stage engages with members of my rural community through interviews and focus groups.

The first stage seeks to investigate narratives by analysing social media discourses, allowing the project to identify how the digital divide is framed by institutional and communitarian spaces, focusing on the key narratives, actors, and structural assumptions that inform these discourses. The second stage engages directly with a rural community through interviews and focus groups to explore and situate how technology and the digital divide is conceptualised and lived from their perspective.

In order to have consistency in the analysis of the data from both stages, the project uses a qualitative content analysis to allow for a more comprehensive and systematic analysis of meaning across different data types, as well as allowing the project to remain grounded in context and respect of the discourses and answers.

Methodological foundations

This research methodological framework emerges from a critical engagement with both decolonial theories, as seen in the previous chapter and throughout the literature review and with decolonising approaches to research practice. As Tuhiwai-Smith (2012) argues, research methodologies can perpetuate colonial relationships which requires careful attention to how research practices either challenge or reinforce colonial approaches to knowledge production, and it is this understanding that shapes how data is collected and analysed across both stages.

This project is about centring the perspectives and lived experiences of communities that have been historically marginalised in the making of knowledge and therefore this already grounds the project in a practice that actively works to decolonise the research process itself. As Lenette (2022: 21) argues, this methodological approach requires exploring emancipatory and transgressive research possibilities, even when they challenge Western academic conventions about legitimate knowledge production. What is more, drawing from Tuhiwai Smith's (2012) work, this research moves beyond theoretical frameworks to implement specific methodological practices that embody decolonial principles throughout the research process.

These practices inform both stages, positioning communities not as subjects of damage but as holders and creators of knowledge by recognising and making clear the community values, agency and expertise, moving away from practices that position communities as singularly defective and powerless to make change (Tuck, 2010). Instead, it creates space for communities to articulate their own concepts, experiences and visions regarding the digital divide.

The methodological principles guiding this research move beyond what Tuck (2009) terms damaged-centred narratives to centre how communities actively conceptualise and engage with the digital divide. While damage centred approaches often seek to document harm to justify reparative interventions to external authorities, this research focuses instead on amplifying community knowledge and visions.

Thus, a key principle is reimagining what counts as valid knowledge by examining both institutional discourses and community perspectives about the digital divide. As Gegeo and Watson-Gegeo (2001) argue, this means understanding how knowledge is theorised and constructed, encoded and passed on while remaining attentive to power relations in knowledge production. Furthermore, as Zanotti et al (2020) mention, decolonial research is not just about giving communities equal decision-making and power-sharing roles as researchers, it is also about using the research project to change dominant rationalities and practices, especially Western scientific paradigms and institutions, including the home institutions of researchers.

Methodological choices in practice

This research employs qualitative methods across two stages to develop a comprehensive understanding of how different actors conceptualise and engage with digital divide issues. Qualitative approaches are methods that can allow for the emergence of meaning from participants' own frameworks rather than imposing predetermined categories, which aligns with principles discussed earlier, as shared by Tuhiwai-Smith (2012). For example, the first stage analyses social media content while the second stage involves interviews and focus groups, with both stages using qualitative content analysis to examine the data systematically while preserving meaning and context.

Qualitative content analysis fits within some principles of decolonial research by preserving the context and meaning in how different actors frame the digital divide. As Gegeo and Watson-Gegeo (2001) emphasise, this attention to context is crucial for understanding community ways of theorising knowledge. Thus, the analysis steps make sure that institutional and community perspectives are understood within their contextual framework rather than being reduced to isolated data points.

Building on Tuck's (2009) critique of damage centred research, the interview questions and the focus groups create space for community members to articulate their own conceptualisation around technology and digital access which positions community members as knowledge holders and visionaries rather than research subjects. This further reflects what Tuhiwai-Smith (2012) terms as researching back, whereby communities and so members of these communities disrupt the rules of the research game toward practices that are more respectful, ethical, sympathetic and useful to communities.

These methodological choices of a two-stage design embody decolonial principles by first positioning institutional but also communitarian perspectives through social media analysis, then making sure these are grounded and contextualised in the next stage with direct community engagement. This choice in structure emphasises what scholars such as Tuhiwai-Smith (2012), Tuck (2001), Simpson (2007) emphasise on centring Indigenous and community knowledge while remaining attentive to broader power relations that shape how digital divide is not only understood but lived and challenged and addressed from the communities' perspectives.

The analytical framework brings these methodological choices and principles together by maintaining the integrity of different perspectives while making interconnections in order to co-build new knowledge around the digital divide.

Having established the methodological foundations and research design choices that guide this project, it is important to detail how these principles and choices are implemented throughout the two stage research process with the following sections outlining the approach used in each stage, both including their inclusion criteria (otherwise known as sampling), then gathering data with some preliminary analysis in the first stage and finalising with a more comprehensive analytical framework bringing both stages together.

Stage one: Social media research

The first stage employs social media research to address a gap in the current understanding of how the digital divide operates in Mexico. This stage addresses two key questions:

- *Who is driving the conversations around change, policies and projects with communities in the social media sphere?*
- *How can conversations around digital divide on social media platforms offer insight on the digital divide in the country and relevant remedies?*

and it does so by gathering information from different groups, institutions and individuals present in Twitter. While Mexico sees ongoing changes in technology access and use, there is limited research investigating how different groups directly connected and impacted to and by

the digital divide are working to address it (Galperin, 2017; Mariscal et al., 2019), especially in terms of how they describe these issues and suggest ways forward.

Social media research has been widely used as a valuable methodological approach for examining how diverse groups engage with and shape public discourse around critical social issues. Therefore, social media research offers a space for engaging with the different discussions around the digital divide.

Digital platforms such as Twitter provide dynamic spaces where organisations, communities and individuals articulate their perspectives and experiences, which allows researchers to engage with real time discussions and patterns of engagement while remaining attentive to power dynamics that may influence these conversations (Highfield, 2016; Rambukkana, 2015).

Research on social movements such as #BlackLivesMatter (Carney, 2016) and #MeToo (Clark-Parsons, 2021) demonstrates how social media platforms amplify marginalised voices and facilitate global dialogues that go beyond geographical and institutional boundaries while also challenging dominant narratives.

In the context of digital divide research, social media offers crucial insights into how different interested and impacted groups conceptualise and address the digital divide as well as themes pertinent to it such as technology access, digital inequalities, and initiatives to tackle it. It is the multiplicity of perspectives that can enrich the understanding of the digital divide and demystification of it as well. As Tufekci (2017) argues, social media's interactive nature allows researchers to observe and engage with these different perspectives and narratives.

Twitter was selected as the platform for this stage and while it is not Mexico's most popular social media platform (Statista, 2022), it was chosen for the way in which its open access nature and real time communication features allow researchers to gather direct, user generated content and engage with diverse perspectives. What is more, Twitter's academic research product track, introduced in 2021, when this stage was carried out, granted unrestricted access to historically published tweets, allowing systematic analysis of discussions over a certain period of time.

Inclusion criteria

The inclusion strategy was developed to capture discourse from key groups and actors involved in Mexico's digital divide discourse. To make sure that the data gathered from Twitter was

relevant to this project focus and was able to answer the research questions, specific inclusion criteria, otherwise known as sampling, was developed to identify Twitter users and their content.

The sampling methodology began by identifying Twitter users already known to be active in Mexico's digital divide space and which were already known to the researcher. Following a snowballing technique, I went through these initial account's bios and tweets, and retweets, and new accounts were identified. Snowballing techniques are useful for identifying further participants through existing networks (Marcus et al., 2017; Naderifar et al., 2017) and allows researchers to build comprehensive datasets through existing networks rather than direct recruitment (Parker et al., 2019).

The selection criteria focus on selecting users who:

1. Are directly involved in the provision and/or development of technology, or
2. Produce materials or engage in activities related to access to technology in one way or another

After this iteration and based on the literature review which shows how the digital divide operates, certain characteristics became useful for further identifying potential users on Twitter and grouping them into categories, for example, and as mentioned in the literature review, communitarian technology providers and private providers are groups that are heavily involved in the subject, and thus relevant to see how they engage with the digital divide.

Furthermore, communities and at a more micro level, individuals who are involved in some way or another in themes around the digital divide would bring more situated perspectives. However, rural communities per se are not present in Twitter, but collectives or groups that centre their work on communitarian or communal practices are and who are also involved in digital divide initiatives. Therefore, looking for communitarian groups or collectives that work at the crossroads of communal values and digital technologies initiatives on Twitter was an organic and obvious choice.

There was another group that while not obvious at first, it represents institutional work and who would be relevant to bring into the research to have broader perspectives, Non-Governmental Organisations (NGOs). Thus, ending up with five different groups:

1. Communitarian organisations or collectives
2. Communitarian providers of ICTs
3. Private providers of ICTs
4. Individuals
5. NGOs

Based on the users or account twitter bio I was able to see which kind of group sample they could fit in; ending up with each group made up of approximately 10 users.

Twitter data collection

Data was collected from using Twitter's Application Programming Interface API which allows researchers to access what is known as public data from all public accounts active in Twitter. In order to collect the data, I used the Python Tweepy library, which provides structured access to Twitter's API, collecting 3, 000 tweets per user/account.

The data collection process used a script to gather specific information fields chosen for their relevance to understanding digital divide discourse, including user metadata which is made up of profile descriptions and follower information; tweet content which includes text, timestamps, and hashtags; and interaction markers (retweets and reply status). The script then processes this information through Cursor pagination, helping in the initial organisation of the data systematically while maintaining Twitter's rate limit requirements.

Data pre-processing and organisation

The raw twitter data underwent systematic pre-processing or what is also known as data cleaning, a process which includes cleaning, transforming and structuring raw data to make it suitable for analysis. As Stieglitz et al. (2018) note, pre-processing is essential, especially due to the unstructured nature of social media user generated content. This pre-processing phase included decoding special characters to properly present Spanish language content, processing tweet entities such as hashtags and URLs, and standardising text formats.

Such pre-processing is used in Twitter data analysis preparation, (Alaimo and Kalliniko, 2017) focusing on creating consistent, analysis ready datasets while preserving the original meaning and context of the tweets. Once I had all users with their allocated tweets, the volume of up to 50, 000 tweets per group proved unsustainable for qualitative analysis. To maintain analytical

depth and make sure of the feasibility of qualitative content analysis, I reduced each dataset to 10, 000 tweets per group. I did so by selecting the latest 10, 000 aiming to capture the most current patterns of discourse. Reducing the dataset was necessary to prevent the scale of data from overwhelming the analysis and to allow for detailed contextual reading that qualitative methods require.

As Andreotta et al. (2019) explain, when working with large social media datasets, it is often more practical to focus on a subsample of data rather than analysing the entire corpus of data collected. Furthermore, Kim et al. (2018) describe their methodological approach to dataset size and note that in their study of collected tweets, they made sure the population size should be manageable to the extent that human coders conduct manual coding for the tweets.

While Twitter (now X) API access has changed, this did not affect the sample because the data collection happened prior to the major restrictions. However, the evolving limitations on data access highlight the challenges researchers now face in replicating similar studies.

The pre-processed data was then finally organised into five separate CSV (Comma-Separated Values) files, one for each group: communitarian organisations, communitarian providers, individuals, private providers and NGOs. Following ERGO ethical guidelines, these files contained on tweet content, with all other identifying information removed to maintain user anonymity.

Each CSV file ended up being structured with a single column containing the pre-processed tweet text, creating a focused corpus for qualitative analysis while making sure the research followed data privacy and analytical clarity. To make storage easier and more manageable, the CSV files were exported into excel sheets without losing its structure and are stored in my university drive and private drive.

Below we can see examples of tweets content belonging to communitarian organisations. The content has been rephrased according to my ERGO ethical procedure.

Spanish original data:

Una charla sobre los proyectos productivos agropecuarios y tecnológicos que se desarrollan en una comunidad. Invitando a sumarse a la #SoberaníaAlimentaria y #SoberaníaTecnológica 💪
Invitacio al Festival de #softwarelibre #FLISoL o seguilo #online desde tu casa pero no te lo pierdas! Vamos a mostrar el #LibreRouter y contar experiencias de #RedesComunitarias de #internet
📝 Fechas
Día de la Diversidad, Radios Indígenas Informacion
Dando los últimos ajustes a servidor abierto #Erudi para ser instalado en una escuela primaria

Translated to English:

A talk about the productive agricultural and technological projects that are developed in a community. Inviting you to join the #Food Sovereignty and #Technological Sovereignty
Invitation to the #FLISoL #softwarelibre Festival or follow it #online from your home but don't miss it! We are going to show the #LibreRouter and share experiences of #Internet #CommunityNetworks
📝 Dates
Diversity Day, Indigenous Radios Information
Giving the last adjustments to open server #Erudi to be installed in an elementary school

Preliminary social media data analysis

While all the analysis of this research is integrated in the analytical framework, a preliminary analysis of the tweets was carried at the time which helped informing some of the details in stage two, mainly around initial findings and the way different groups engaged with topics and initiatives around the digital divide. This was one of the intentions of carrying out an initial exploration into discourse which helped design the interview questions and focus groups to an extent.

Stage two: community- based research in rural Mexico

The second stage of this project aims to examine and demystify the digital divide through direct community engagement in a rural community in Mexico, addressing a significant methodological gap in current digital divide literature. While the first stage provides valuable insights into how different groups speak about digital divide themes and how they tackle them

in social media, it is also limited by the lack of direct engagement and deeper understanding of how communities may conceptualise different themes that pertain the digital divide.

For example, and as developed throughout the literature review, a critique that appeared from applying decolonial frameworks in regard to how the digital divide is conceptualised and continually tackled globally and within Mexico, the artificial separation of technology as a whole from digital technologies provides excuse for further challenging this artificial disconnection that may do more harm than good. Therefore, this stage moves beyond mediated representations on social media and engages directly with a rural community affected by the so-called digital divide.

By creating space for community members of a rural community to articulate their experiences, challenges, and aspirations regarding technology and the digital divide, this project recognises that understanding the digital divide requires moving beyond statistical measures such as those widely presented by many studies in Mexico using survey data from governmental sources. At the same time, this project recognises that the need to move beyond further analysing and proposing policy interventions which as we saw throughout the literature review, have failed majorly.

This approach positions community members as knowledge holders and visionaries rather than research subjects, reflecting what Tuhiwai-Smith (2012) terms researching back, where communities or members of these communities disrupt conventional research methodologies towards approaches that centre, respect and serve community needs.

Inclusion criteria

This stage engaged with 40 community members of my rural community in central Mexico, ranging in age from 18 to 80 years old. All participants took part in individual interviews while nine participants also contributed to three focus groups of three members each. This structure provided opportunities for both individual reflection and collective dialogue about themes pertaining the digital divide.

The selection of participants from diverse age groups supported a broader knowledge of how digital divide is experienced in the community, however, age is not a unit of investigation here, it was important that the data collection design included as many different experiences as

possible, to provide a more comprehensive overview and insights into how the digital divide can be demystified and reimagined.

Furthermore, the combination of interviews and focus groups create multiple spaces for community members to share their experiences and further challenge digital divide themes, allowing different forms of knowledge sharing to emerge. This combination reflects the project's commitment to centring marginalised communities in the making of knowledge and disruption of conventional concepts and processes as it is the digital divide.

As a member of the community, I approached a few people from my town who also helped me reach out to other people. In research, this is what is known as a snowball sampling, a method helps in accessing a diverse and a more representative sample. From an academic point of view, the snowball sampling technique, the first participants lead to new participants, who also indicate others, and so on, helps to reach a proposed goal (Parker, 2019).

Interviews and focus groups design

The interviews were designed to tackle these two main research questions:

How do we move towards co-designing community based algorithmic ecologies?

Interview questions in Spanish	Translation
1. ¿Qué significa la tecnología para ti en tu vida diaria? 2. ¿Puedes compartir cómo la tecnología ha influido en tu día a día? ¿En qué aspectos ha sido útil y en cuáles ha presentado desafíos? 3. ¿Cómo ha sido tu experiencia al acceso o no acceso a alguna tecnología? Por ejemplo, aplicaciones en tu teléfono o computadora, electrodomésticos, computadoras, transporte colectivo, buena infraestructura de electricidad, agua, buen internet; ciertas tecnologías agrícolas (puedes mencionar	1. What does technology mean to you in your daily life? 2. Can you share how technology has influenced your day-to-day life? In what ways has it been useful and in which have it presented challenges? 3. How has your experience been with access or non-access to any technology? For example, applications on your phone or computer, appliances, computers, public transportation, good electricity infrastructure, water, good internet; certain agricultural technologies

cualquier otra y se lo mas especifico(a) que puedas).	(you can mention any others and be as specific as you can).
4. ¿Qué piensas que podría estar causando que algunas comunidades (como la nuestra) no tengan (buen) acceso a ciertas tecnologías (¿por ejemplo, las mencionadas en la pregunta anterior? Puedes mencionar otras tecnologías.	4. What do you think might be causing some communities (like ours) to not have (good) access to certain technologies (e.g., those mentioned in the previous question? You can mention other technologies.
5. ¿Cuáles crees que podrían ser acciones efectivas que puedan contribuir a abordar la falta de acceso a ciertas tecnologías en la comunidad?	5. What do you think could be effective actions that can contribute to addressing the lack of access to certain technologies in the community?
6. ¿Crees que las empresas tecnológicas, instituciones académicas y/o de investigación, y los gobiernos tienen algún papel que desempeñar en proporcionar a que más comunidades tengan acceso a la tecnología y su creación? ¿Por qué?	6. Do you think tech companies, academic and/or research institutions, and governments have any role to play in providing more communities with access to technology and its creation? Why?
7. ¿Qué crees que la comunidad y sus miembros puedan hacer para abordar el acceso a la tecnología o tecnologías? Aquí puedes hablar de como lo abordarias tu desde tu experiencia.	7. What do you think the community and its members can do to address access to the technology or technologies? Here you can talk about how you would approach it from your experience.
8. ¿Qué tipos de tecnologías consideras importantes para la comunidad y/o para ti? ¿Hay algo que hayas visto o experimentado que podría ser de impacto positivo en tu vida diaria o en el de la comunidad? Puedes compartir sentires y pensares personales.	8. What types of technologies do you consider important to the community and/or to you? Is there anything you've seen or experienced that could have a positive impact on your daily life or that of the community? Feel free to share personal feelings and thoughts.
9. ¿Puedes pensar en situaciones donde la tecnología podría tener buena relación con el medio ambiente rural y también sea de beneficio a la comunidad?	9. Can you think of situations where technology could have a good relationship with the rural environment and also be of benefit to the community?
10. Desde tu experiencia, ¿Cómo imaginas un futuro en el que la tecnología se utilice de una manera que beneficie a toda la comunidad?	10. From your experience, how do you envision a future where technology is used in a way that benefits the entire community?

This methodological approach represents a novel contribution to digital divide literature by directly addressing a significant limitation which is the artificial separation of digital technologies from broader socio-technological systems. While scholars have critiqued the reductionist nature of digital divide conceptualisations and frameworks (Selwyn, 2004; van Dijk, 2020); these critiques have largely remained theoretical. More specifically, there has been a lack of practical application in field research that engages impacted communities directly in defining what technology means to them within their lived realities.

By beginning with the open-ended question, "*¿Qué significa la tecnología para ti en tu vida diaria? - What does technology mean to you in your daily life?"* this approach provides participants the space to define technology on their own terms, free from imposed assumptions about digital access or skills. This methodological decision intentionally avoids privileging digital technologies and instead situates the discussion in a broader framing of technology which allows participants space for reflection on a wide range of technologies, whether digital, analog, infrastructural, or agricultural, that shape their daily lives.

Therefore, the follow-up questions build on this foundation which encourages participants to expand and articulate their technological landscapes. For example, the third question broadens the technological scope by mentioning diverse examples: *"How has your experience been with access or non-access to any technology? For example, applications on your phone or computer, appliances, computers, public transportation, good electricity infrastructure, water, good internet; certain agricultural technologies (you can mention any others and be as specific as you can)"* which deliberately introduces examples that cover diverse forms of technology. This prevents the interview from defaulting to digital tools alone and acknowledges the interdependence of technologies within lived experiences and allows participants to situate digital technologies alongside other technologies and infrastructures that are critical parts of their everyday lives.

The progression of the methodology allows participants to organically situate digital technologies within their broader technological understanding, rather than imposing predetermined frameworks of digital access and skills; an approach that can help revealing how communities themselves understand and experience the digital divide without falling into narrowness that focusing on digital technologies would bring.

This is particularly significant given how digital divide research has developed from moving beyond simplistic binaries of haves and have-nots to acknowledging broader structural barriers – economic, cultural, political, social and personal. However, digital divide research has fallen short of centring communities where the fundamental infrastructure needed for digital technologies is absent or dysfunctional or simply has not broaden its scope to consider that the digital divide emanates from its very western inception.

Moreover, the continued focus on ICTs reinforces a narrow understanding of the digital divide which has already been explored in the literature review and thus presents an incomplete picture of how the digital divide manifests in lived experiences in rural communities. This narrow framing is problematic because it fails to capture lived realities of rural communities where digital technologies may not be experienced in isolation but are deeply intertwined with other material and technological systems.

Therefore, by limiting the scope of inquiry to ICTs, digital divide research risks reinforcing external assumptions about what constitutes relevant and/or valuable technology, overlooking the technologies that communities themselves prioritise and rely upon in their daily lives. Demystifying this narrow conceptualisation of the digital divide is critical for affected communities because it allows for a more situated understanding of technological access and thus digital technologies access, use and significance which makes this project novel and relevant, as it centres community defined perspectives. At the same time this work seeks explore how can the digital divide be tackled from the perspectives of communities impacted.

This methodological reframing answers to few critical dimensions in addressing the digital divide. First, it acknowledges community agency by allowing participants to articulate their own understanding of technology rather than imposing predetermined priorities and conceptualisations in current digital divide literature; thus, reinforcing the communities' conceptualisations of technology based on their context.

Second, this approach allows for a deeper examination of structural inequalities by situating technology within broader socio-economic and material systems, moving beyond a narrow focus on ICTs and instead exploring how various forms of technological exclusion intersect with other barriers. In doing so, the questions are formulated to tell us a bigger story of the digital divide by asking for diverse technological systems.

Third, this part of the methodology actively challenges conventional imposed frameworks that often reflect external priorities rather that community needs. Thus, by allowing the community to define technology on their own terms and the space to build on from this, it counters top-down approaches that risk navigating solutions disconnected from local realities. This can be seen in the way the questions progress through community experiences, challenges and aspirations, showing the project's commitment to centring local experiences in understanding and addressing the digital divide, as well as demystifying it.

Fourth, this holistic approach allows for the examination of how different forms of technological access and engagement interconnect in daily life for the community. Thus, by considering technologies rather than digital technologies only, the methodology creates space for understanding how certain aspects of technological exclusion may influence and reinforce each other into what we know as the digital divide.

Following the individual interviews, the research incorporated three focus groups of three participants each to deepen collective understandings and demystifications and reimaginations of the digital divide in the community, allowing for a more relaxed and dynamic exchange of ideas, where insights from individual interviews could be collectively analysed and connected upon.

The focus groups explored five interconnected themes central to understanding technology access, building and visions in the community context. These themes examined the intersections of gender and cultural factors in technology use, historical influences on rural digital exclusion, specific forms of digital exclusion, lived experiences of connectivity challenges and potential collaborative approaches to addressing identified issues.

This thematic approach supports a structured yet flexible discussion that could respond to emergent community perspectives and reflected both practical research considerations and decolonial principles. The progression from individual interviews to small group discussion allowed participants to reflect in a collective meaning making about digital divide challenges and possibilities.

Data collection

The data collection involved two stages, initially beginning in the summer months of June to August 2023 and concluding in January 2024. The idea was to carry out all interviews and focus

groups during June and August 2023 but there were many community events, which presented logistical challenges in organising focus groups and the one-to-one interviews. As a result, most of the interviews and the group discussions were deferred to a later date.

In the initial phase, 10 interviews were conducted. As a member of the community and being known by the members and participants, I felt at the time that the process of interviews and focus groups had to happen in a more organic way, I personally was happy to allow room for deferring the interviews and group conversations but I was aware of the funding coming to an end at the beginning of 2024. To facilitate and to try to speed up the knowledge-gathering process amongst the community events and lack of availability from many participants, 5 of these initial interviews were conducted face-to-face, while the remaining 5 used WhatsApp to communicate between each other, demonstrating adaptability in data collection methods to suit the participants' availability and the project's timelines.

The next stage, conducted in January 2024, saw the completion of 30 additional interviews, all carried out on a one-on-one basis. As per the participants' desires, the interviews were only recorded in writing and no voice was recorded. These were written in Spanish and no translations to English exist, apart from some of the excerpts in this project findings. As the researcher who has domain in both languages, I decided to keep the original responses in Spanish and only use English to show the findings in this work.

Data organisation

After finalising interviews and focus groups, I ended up with two different datasets.

In processing the knowledge gathered from both the interviews and focus groups, I prioritised ethical considerations and participant consent, engaging in discussions with participants about their comfort levels regarding the public sharing of information. While there were no explicit reservations about public dissemination, a common sentiment among participants was the desire for the research to transcend academic discourse and catalyse actionable initiatives that address the issues identified. This feedback shows the project's potential impact beyond the academic space, and highlights the participants' aspirations for tangible, positive change from their contributions.

The datasets from the interviews and focus groups are maintained separately to facilitate a structured analysis, ensuring that each set of data can be analysed in a manner that respects the context in which it was collected. This careful segmentation of data supports a subtle

understanding of the community's experiences and perspectives, laying the groundwork for a research output that not only advances academic knowledge but also fits with the community's expressed desire for actionable outcomes.

Qualitative content analysis

This project employed qualitative content analysis to analyse data collected across the two different stages. Qualitative content analysis is a systematic approach for interpreting textual data by coding and identifying patterns or themes (Hsieh and Shannon, 2005). What makes qualitative content analysis a suitable method of analysis for this project is its flexibility as it allows researchers to explore content that is either directly observable or more subtle, hidden meanings (Schreier, 2012).

This section details how qualitative content analysis was applied, including the initial coding frameworks from social media analysis and the consistency maintained across data types, the adaptations for different data sources and how identified themes across the two stages were incorporated.

Qualitative content analysis was used to analyse seven datasets, five from social media data containing data from the five different groups: communitarian organisations, communitarian technology providers, private providers, NGOs and individuals; and two datasets from the interviews and focus groups accordingly.

The analysis began with an inductive approach which is suitable for exploring phenomena with limited prior knowledge (Elo and Kyngas, 2008). An inductive approach involves building understanding or theory from the ground up, starting with data collection and moving towards identifying patterns, themes or concepts. What makes this method relevant and the chosen method for this research is that rather than testing a pre-existing hypothesis, researchers allow the data to guide the development of new insights. This method that is commonly used in exploratory research to uncover novel patterns and explanations (Thomas, 2006).

In social sciences, phenomena refer to observable events, behaviours or patterns within societies and cultures and these can include social interactions, institutional practices or larger systemic issues (Kluver et al., 2003). In the content of this work, the digital divide is considered a phenomenon since it encompasses both structural inequalities and their lived effects which are

social phenomena (van Dijk, 2005; Warschauer, 2004; Selwyn, 2004; Helsper, 2012) that can be analysed, explored further to understand their underlying causes, implications and dynamics.

I used an inductive approach, and when knowledge about the phenomenon being studied is sparse or incomplete, an inductive technique is appropriate (Elo & Kyngäs, 2008). Codes, categories, or themes are directly derived from the data in the inductive technique (Cavanagh, 1997; Kondracki, Wellman, & Amundson, 2002). Coding in qualitative content analysis can take into account both the explicit and implicit meaning of communications. This inductive approach allowed me to identify needs, preferences, and levels of active engagement in the provision of some form of technological access.

The inductive approach used in this research, allows categories and themes to emerge directly from the data rather than being constrained by pre-existing theoretical frameworks. In the first stage which involved coding tweets to identify how various groups addressed the digital divide, each tweet served as a unit of analysis.

By using an inductive approach, the project allowed for categories and themes to arise directly from the data, making sure that these would reflect the participants' lived experiences and the nuances too as well as (Elo and Kyngas, 2008; Kondracki et al 2002). For the social media data, by analysing tweets inductively, the project identifies patterns in language, discourse and sentiment that would reflect either language, discourse, sentiment and lived experiences of digital divide. Murthy (2013) argues that Twitter as a platform for public discourse, tweets provide insights into societal phenomena such as inequality and exclusion.

In order to manage the large volume of data, this project initially used Voyant Tools for textual analysis, which allowed for a quick overview of the most recurring themes. For example, it was used to search specific terms relevant to communitarian providers which gave me a better sense of the data and allowed me to familiarise myself with some main terms.

Term	Count	Relative	Trend
indígenas	401	1,858	
redescomunitarias	272	1,260	
comunidad	245	1,135	
redes	241	1,117	
comunidades	225	1,042	
pueblos	221	1,024	
comunitaria	174	806	
comunitarias	162	751	
librerouter	138	639	
indigenous	135	625	
historias	131	607	
softwarelibre	111	514	

Following this step, I started searching for these terms in the dataset, in this case the communitarian providers tweets which I reviewed manually to start getting a better sense of the tweet context in which those terms being used. After this, I did the same for the other datasets and once I had a better overview of each dataset, I started coding some initial themes. These initial themes with codes include can be seen in the following table for the first stage.

Community technology infrastructure	References to free routing, community networks, internet deployment and access, network nodes installation
Community empowerment and sovereignty	Technological sovereignty; food sovereignty; community autonomy; local development
Educational and knowledge sharing	Seedbeds, trainings programmes, workshops and panels; documentary screenings;
Territorial development	Community spaces; rural areas; local projects; infrastructure development
Collective action and organisation	Community meetings; collaborative projects; network building; community participation
Basic rights and access	Land; housing; work; connectivity
Indigenous language and culture	

Cultural knowledge transmission	Cultural explanations; daily life sharing; traditional knowledge
Regional identities and culture	Local communities; territory and places
Community communication	Language sharing; community connections; cultural exchange
Identity and belonging	Cultural meanings; community roots; traditional values; collective identity
Customer service communication	Direct user responses; problem resolution; service enquiries; contact channel referrals
Technical support	Services issues; troubleshooting; problem verification
Corporate communication style	Formal responses; standardised messages; privacy policy references
Marketing and engagement	Promotional content; campaign hashtags; user engagement
Customer management	Services verifications; personal attention promises; multiple communication platforms
Digital transformation and education	Digital skills development; bridging digital divides
Institutional collaboration	Public-private partnerships; government cooperations; cross sector alliances
Capacity building	Future skills, digital competencies trainings
Impact measurement	Social impact; programmes outcomes; digital inclusion effots

I decided to explore the views of different groups about the digital divide and how they were responding to the problem. Their response to the problem also gives us some insight on how they view the digital divide. Overall, my aim in this component two of my research is to reimagine the concept of the digital divide by taking into account how the most affected groups define the concept and how their definitions of the problem and solutions differ from those offered by other groups.

For stage two, preparing the data prior to analysis involved writing the interviews responses in writing and the notes from the focus groups into an excel digital dataset. After this, the data were uploaded to Taguette, an open-source qualitative analysis tool, to facilitate systematic coding. Taguette allows its users to make the coding directly on the platform. A process that included reading the transcripts line by line, generating codes and grouping related codes into categories. This iterative approach made sure that these initial categories informed but did not constrain the next step of the analysis.

For the interviews and focus groups, these were the initial themes with codes.

Educational impact	Educational opportunities; student mobility issues; access to study materials; online learning challenges
Infrastructure barriers	Limited electricity access; clear rural urban divide seen
Generational technology experiences	Learning curves; elder challenges
Community solutions and solidarity	Resource sharing; collective organisation; local initiatives
Social connectivity	Community relationships; migration connections
Institutional responsibility	Government role; corporate accountability; infrastructure investment; public private partnerships
Digital inequalities	Economic barriers, geographic disparities; access variations; technology literacy gaps
Daily life impact	Work limitations; study disruptions; communication challenges; access to services
Cultural and historical contexts	Rural lifestyle impact; community adaptation history; migration influence; cultural adaptation
Community knowledge support	Local support networks; knowledge sharing practices; collective organising; community workshops

Agricultural technology	Knowledge gaps; modern farming needs; traditional knowledge

In contrast to other methods of qualitative analysis, Sandelowski (2000) argues that qualitative content analysis involves analysing qualitative descriptive studies that are data-derived and the least interpretative. This is because "there is no mandate to represent the data in any other terms but their own" (Sandelowski, 2000, p. 338). Additionally, Sandelowski asserts that qualitative descriptive investigations necessitated staying "closer to their data and to the surface of words and actions" than other qualitative methods, like grounded theory for example (p. 336).

Inductive and deductive category development are the two separate methods that Mayring (2000) offered for qualitative content analysis based on the methodologies used by researchers. The idea of a theme can be interpreted in various ways: in order to communicate qualitative data, it serves as a means of describing a structural unit of meaning (Streubert & Carpenter, 1995); a persistent regularity within or spanning categories (Polit & Hungler, 1999); and "a manifestation of the text's latent content" (Graneheim & Lundman, 2004, p. 107).

As mentioned before, I used an inductive approach to qualitative content analysis and started by selecting units of analysis, which included a whole public dataset of tweets. I then summarised the text in order to establish the analytical units which were the tweets. By reading each transcript line by line and word by word, I began open coding. I identified the initial codes that appeared from the text after completing the open coding, and I then used those codes to code the remaining transcripts. I created new codes when I came across data that did not correspond to an existing one.

The following phases involved grouping related codes and classifying them. In order to assess whether the categories were mutually exclusive, I restructured the original categories into broader, higher order categories, then aggregated, updated, and improved them. Three main themes were found across the groups with different sub themes which represent the activities and ways of manifesting their main views. I then compared each groups' contents across all groups to see what each group focused on the most when tackling the digital divide and access to technology.

As Neuendorf (2017) notes, the aim of qualitative content analysis is to unravel patterns in the data (interviews and focus groups) by using codes to label segments of the data, and group

codes that referred to the same theme categories. The following tables show some of the initial codes from the interviews and the focus groups, respectively.

Strengths and Limitations

Stage one: social media research

Social media can be any form of computer mediated communication where individuals not only set up profiles to present who they are but also generate content of their own, see, and interact with content of their friends or other users online (Carr and Hayes, 2015; Alhabash et al., 2017). Social networking sites (SNSs) such as Twitter, are a subdomain of social media that and have been defined as a networked communication platform where users can create profiles, form visible networks of connections with other and actively engage with user generated content within their network (Ellison and boyd, 2013: 157).

Since SNSs generally entail the creation of online relationships, both personal and professional, via various platforms (Schauer, 2015), makes them a key consideration in investigating how digital divide discourse and narratives unfolds from different groups involved in themes around the digital divide in Mexico. The use of Twitter data for social media research, especially in exploring how groups and actors concerned or involved around digital divide themes in Mexico presents both opportunities and methodological challenges that require careful consideration. Unlike traditional methods relying on static or retrospective data, Twitter captures, immediate responses and evolving narratives.

One of the key strengths of using Twitter data is accessibility and potential for providing real time insights. For example, Twitter's public facing nature and its Application Programming Interface (API) allows researchers to collect vast amounts of data in a quick and efficient way (Vicente, 2023). For instance, the project gathered thousands of tweets, offering an overview of ongoing conversations about themes pertaining the digital divide in Mexico. Such data can reveal patterns, highlight key actors and trace how issues are framed and discusses within digital spaces, as covered throughout Weller's et al. (2014).

Furthermore, the large and diverse data pool that can be gathered from Twitter is a key strength through which Twitter can provide a snapshot of various demographics and interests groups discussing specific topics, such as the digital divide and subjects pertaining in Mexico. This is

a significant strength compared to other qualitative methods which often require extensive fieldwork and may be limited in scale with a narrower lens, particularly relevant in the context of the digital divide where public narratives and institutional actors play a critical role in shaping discourse.

What is more, in the last decades, social media platforms have emerged as spaces of civic organisation and acts of resistance (Metaxas and Mustafaraj, 2012; Shirky, 2012) with more recent research by de la Garza Montemayor and Riera Robles (2020) that examined two cases in Latin America where social media played a pivotal role in resisting neoliberal policies, highlighting the importance of virtual public spaces as sites of articulation and opposition to neoliberalism.

Thus, this demonstrates a key methodological strength of incorporating social media analysis in this project. Their research shows how social media platforms can operate as critical spaces where communities, or in the case of this project, communitarian technology providers and organisations, articulate opposition to dominant economic and technological narratives.

What is more, digital platforms such as Twitter can serve as sites of contestation, social activism and resistance, allowing this research to examine how power dynamics are reflected in digital narratives about digital divide themes. In recent years for example, social media platforms have emerged as crucial spaces for civic organisation and acts of resistance.

Therefore, and building from this insight, choosing social media analysis provides this project with direct access to how communities, through communitarian technology providers and organisations who are working directly with the communities or form part of the communities, frame and challenge subjects around the digital divide, thus challenging market-led narratives. The work of Schoder et al. (2013) argues that social media has a significant role in strengthening collective intelligence and facilitating diverse actors to tackle shared societal challenges.

Furthermore, research by Nguyen (2008) shows social media's capacity for facilitating collaborative knowledge creation and collective action around complex social issues, providing further grounding for this methodological approach in this project. Likewise, Smyth et al. (2020) highlight that social media functions as an emergent collective intelligent system, dynamically processing information and facilitating mass mobilisation through the propagation of ideas and content.

However, recent studies underscore the potential of these platforms to drive systemic change while also highlighting the risks of perpetuating inequalities without community centred approaches (Levy, 2010; Centola, 2018).

While social media research offers unique strengths and advantages to accessing information around digital divide narratives, it also has some limitations. For example, Twitter's platform architecture, with its emphasis on individual profiles, and personal timelines, structurally privileges individual voices (Gonzalez-Bailon and Wang, 2016). As such, this platform design creates particular challenges when attempting to centre marginalised communities, who often organise and express themselves collectively rather than individually (Trere and Milan, 2020).

To address this structural constraint, this project deliberately focused on sampling communitarian organisations and communitarian providers of technology as well as individuals. While not all individuals belong to a marginalised community, the sampled individuals were activists, technologists who may have been or not part of a marginalised community but how whose bio included words surrounding digital divide subjects.

Therefore, what initially appears as a limitation from the inability to address and connect with individual community voices directly, it was methodologically reframed through strategic sampling choices. This way, by focusing on communitarian organisations, which are directly involved or as part of a marginalised community, they functioned as digital mediators and amplifiers of collective community experiences, and the project is able to document instances of community engagement with digital divide issues while acknowledging both Twitter's structural limitations and social media analysis limitations.

Firstly, the representational validity of Twitter data in the Mexican context must be taken into consideration, as Twitter's user base in Mexico, while significant, shows clear demographic skews toward urban, more affluent populations too. According to Global Web Index (2018) and scholarship around the digital divide in Mexico (Dominguez et al, 2019; Djamel, 2019) internet users in Mexico are predominantly young, urban, access to some kind of affluence, further suggesting that Twitter's user base in Mexico is not fully representative of the broader population.

This poses a challenge when studying the digital divide, a phenomenon that disproportionately affects rural and lower income communities, creating a paradox whereby using a platform less accessible to those most impacted by the digital divide to explore the very disparities it carries. Such demographic bias brings in a paradox whereby using a platform to study the digital divide that is itself less accessible to those most affected.

To address this limitation, the second stage of this project, which involved interviews and focus groups, centred the lived experiences of people in rural Mexico who may or, may not have access to technologies, specifically digital ones. Through this two-stage approach, the research design seeks to bridge the representational gap in stage one, thereby offering insights into both the digital divide discourse and the perspectives of communities who remain partially or completely excluded from digital spaces.

The real time nature of Twitter data represents another methodological strength as it offers researchers unprecedented access to current public discourse around the digital divide. However, this real time capability introduces some methodological tensions that should be carefully examined. For example, the way Twitter often prioritises reactive, emotional responses over considered reflection might represent a challenge when it comes to gain more understanding and knowledge around topics around the digital divide. What is more, when studying social phenomena, this reactiveness can lead to overemphasis on immediate reactions rather than deeper structural issues.

Stage two: interview and focus groups

Conducting qualitative research through interviews and focus groups has been increasingly recognised as a powerful means to gather in-depth insights and narratives from communities experiencing digital exclusion (Toombs, 2022; Hernandez and Faith, 2022; Correa and Pavez, 2016). Qualitative research is well known for its ability to capture the complexities and detailed understandings of individuals and groups directly impacted by phenomena, and the digital divide is one, which provides a depth of context and meaning that quantitative methods may not fully capture.

For example, interviews offer a platform for detailed, personal narratives, allowing to have an engagement with the lived experiences, perceptions, and feelings of individuals facing technological barriers (Aviles et al, 2016; Schou and Svejgaard Pors, 2018). This one-on-one engagement can also facilitate a deep exploration of the personal impact of digital exclusion in

rural areas (Correa and Pavez, 2016; Ferrari et al, 2022) which helps reveal the intricate ways in which the digital divide affects daily life, opportunities, but also future prospects.

Focus groups, on the other hand, bring to the centre the power of collective conversation and interaction, by also bringing to light more communal perspectives and shared experiences (Ayrton, 2018; Robinson, 2009; Arrieta-Canales et al, 2023). Bucelli and McKight (2022) argue that these are particularly effective in uncovering the social and cultural dimensions of digital exclusion.

Using interviews and focus groups as methodologies, as emphasised by Israel et al. (1998) and Zanotti et al. (2020), can facilitate a situated approach that can help in the first steps towards co-designing tools that are responsive to the specific needs, values, and aspirations of the community. Interviews provide a depth of understanding of individual experiences, perceptions, and interactions with technology, offering detailed insights into the ways in which digital tools and platforms are appropriated, resisted, or transformed within specific cultural and social contexts (Morgan, 1997). Focus groups, on the other hand, offer a more dynamic setting for the collective articulation of community narratives, allowing researchers to see the negotiation of meanings, priorities, and values among diverse community members (Kitzinger, 1995).

This engagement with the community through interviews and focus groups resonates with the principles of engaged research, which emphasises the co-production of knowledge through collaboration between researchers and community participants (Israel et al., 1998). This approach is crucial for ensuring that the development of technological tools is not only informed by the lived experiences of those they are intended to serve but also actively involves them in the creation process. This participatory methodology supports the development of algorithmic systems that are not only technologically sound but also culturally sensitive and socially inclusive.

What is more, these methodologies allow for the identification of potential barriers to technology adoption and opportunities for community innovation that are grounded in the local context. By engaging with/in the community, one can bring in the insights onto how digital divides manifest in specific spaces and how they can be tackled through situated interventions. The collective knowledge generated through these discussions can inform the design of algorithmic ecosystems that are tailored to meet the community's unique challenges and use its strengths.

The insights gathered from interviews and focus groups can also inform a broader understanding of the socio-technical systems within which these communities operate. This understanding is essential for designing interventions that are not only effective in addressing immediate technological needs but also sustainable in promoting long-term socio-economic development and cultural preservation.

The use of interviews and focus groups as fundamental components of the research process also represents a commitment to a decolonial and engaged approach to technology development. It acknowledges the agency of community members as experts in their own right and prioritises their participation in shaping the technologies that will impact their lives. This methodological framework sets the stage for the co-design of community-based algorithmic ecosystems that are equitable, empowering, and reflective of how diverse traditional ecological knowledges in rural communities are (Eubanks, 2011).

At the same time, focus groups support a space where participants can discuss, debate, and co-construct knowledge about the challenges they face and envision collective solutions (Lloyd-Evans, 2017). The dynamic and more collective nature of focus groups can also encourage discussions that reveal consensus or differences within the members of the community, offering insights into how the digital divide can be approached as a communal experience.

Scholarship (Noel, 2016; Kumer et al 2020) emphasises how qualitative methods may sometimes conform with participatory and emancipatory research models in the sense that they seek to empower marginalised communities by involving them directly in the research process. Such approaches are critical in studies of digital exclusion, where understanding the nuances of community experiences and perspectives is essential for developing effective, culturally sensitive interventions.

Furthermore, qualitative research is instrumental in challenging and expanding the theoretical frameworks around the digital divide, providing empirical evidence that can inform policy and practice (Aziz and Naima, 2021; Sanders, 2020). By highlighting the experiences of a rural community, this research contributes to a more equitable and inclusive discourse on technology access, use and opportunities for co-designing our own digital tools.

A consistent analytical approach in qualitative research makes sures that reliability and credibility is present in the methodology, especially in the context of interviews and focus groups which helps as a foundational element for making sure there is validity and reliability in the research process. This involves adopting a systematic methodology, such as qualitative

content analysis, to methodically code, categorise and interpret textual data (Schreir, 2012). To achieve research rigor, strategies such as triangulation and reflexivity are commonly employed.

According to Lincoln and Guba (1985) triangulation strengthens the credibility of findings by combining data from multiple sources, such as interviews, focus groups and social media data, to corroborate emergent themes. Reflexivity is equally critical, as it enables researchers to critically reflect on their own positionality and potential biases throughout the study (Finaly, 2002). Furthermore, detailed documentation practices, including the creation of audit trails make sure there is transparency and allow for external scrutiny and replication of the data.

The consistent application of an analytical approach confers some advantages to qualitative research. Firstly, it establishes a structured framework for data analysis and makes sure the coding and categorisation processes conform with the predefined objectives while remaining adaptable to emergent themes (Charmaz, 2006).

Secondly, the use of validation strategies such as triangulation by incorporating diverse perspectives further strengthens the depth and breadth of analysis. Finlay (2002) argues that reflexivity allows researchers to engage in critical introspection and thus enriching the interpretative richness of the data.

Despite these strengths, the consistent application of such as analytical approach is not without challenges. Reflexivity, while invaluable, can complicate the research process, as researchers must balance their introspective reflections with an objective analysis of participants' perspectives.

What is more, triangulation, although beneficial, demands significant time and resource investment, particularly when managing multiple datasets (Braun and Clarke, 2006) from interviews, focus groups and social media data.

Moreover, maintaining consistency in coding across diverse data sources can be labour intensive and may require iterative refinement to address discrepancies. Such challenges arise from the variability in qualitative data, especially when combining data from interviews, focus groups and social media content.

For instance, interviews and focus groups often provide detailed, context-specific narratives that are rich in subjectivity but may lack standardisation (Braun and Clarke, 2013), whereas social media content often contains fragmented, informal and rapidly changing discourse (Kozinets, 2015). This variability creates challenges in arranging themes, identifying common

patterns and accounting for contextual nuances, which can complicate the coding process and require additional efforts to rectify inconsistencies.

To counteract these challenges, triangulation methods are widely used, as they involve combining multiple data collection techniques such as interviews, focus groups and social media data to cross verify findings and strengthen analytical robustness (Denzin, 2012; Flick, 2018). For example, interviews and focus groups offer opportunities to explore in-depth participant experiences, while social media data provides a broader perspective on public discourse and cultural trends (Kozinets, 2015; Zimmer and Proferes, 2014).

Hsieh and Shannon (2005) argue that through qualitative content analysis, researchers can systematically categorise data and combine diverse themes to make sure that the findings are consistent and coherent. Consistency in this context refers to the reliability of the coding process and the extent to which the data categorisation remains stable across different parts of the dataset and between coders, making sure that similar data is coded in the same way throughout the analysis (Hiseh and Shannon, 2005; Schreir, 2012. Coherence, on the other hand, refers to the logical combination of themes and categories, that makes sure the findings match with the research questions and theoretical framework, thus creating a comprehensive and interconnected narrative that reflects the data (Shreier, 2012).

Moreover, iterative coding practices, together with reflexive practices play a critical role in addressing coding discrepancies (Braun and Clarke, 2013). These iterative methods allow researchers to revisit and refine coding schemas, which can then be matched with the evolving context of the data.

In terms of focus groups as a method, it presents an additional layer of complexity, as dominant voices may overshadow others, potentially skewing the data unless there are mitigations in place through facilitation and analysis strategies (Krueger and Casey, 2015). For example, in group settings, participants with stronger personalities or more assertive communication styles may inadvertently influence the discussion, leading to a phenomenon known as ‘groupthink’ where other participants conform to dominant perspectives rather than expressing their own views (Myers, 2012). This dynamic can sideline other viewpoints, reduce the diversity of responses and compromise the representativeness of the data.

However, mitigation strategies are crucial in focus groups to address these challenges where skilled facilitation plays an important role, with the moderator encouraging equitable participation and redirecting discussion when dominance is observed (Nind et al., 2020).

According to Barbour (2018) techniques such as using structured questioning or themes and breaking participants in smaller groups before discussion helps make sure all voices are heard. In this project, predefined themes were used as well as organising participants into small groups of three, to make sure all voices were heard.

Additionally, the use of anonymous response methods, such as written input collected during the session, can provide an opportunity for less vocal participants to share their insights without fear of judgment (Sim and Waterfield, 2019). This study used this method to make sure all participants were able to share their insights. However, this can also be seen as a limitation, while it makes sure that less vocal participants can contribute, it may dilute the primary purpose of a focus group which is to encourage dynamic interaction and discussion among participants. Nevertheless, this project prioritised inclusivity and feelings of trust and safety for the participants.

This project employed a single analytical approach for all the data collected across both stages. Such approach provided a structured framework for interpreting data from interviews, focus groups and social media data. By focusing on one methodology, researchers can simplify and standardise the analytical process, reducing complexity and maintaining consistency across the data (Elo et al. 2014).

Using a single analytical approach offers advantages such as analytical coherence, flexibility, efficiency and replicability. For instance, following one method allows for a unified analytical framework that facilitates a deeper understanding of its principles and nuances as well as it leads to more accurate and insightful interpretation (Elo et al. 2014)

Since qualitative content analysis also provides a structured pathway, it also allows for either inductive or deductive exploration, depending on the characteristics of the data (Charmaz, 2006). The project used an inductive approach, according to Kyngas (2020) an inductive approach in research emphasises flexibility and adaptability as it allows theories to emerge from the data rather than imposing preconceived hypotheses.

What is more, this method allows researchers to adjust their focus as new insights arise, maintaining analytical coherence throughout the study. Thus, by grounding findings directly in empirical observations, the inductive approach guarantees that conclusions remain deeply rooted in the data (Timmermans and Tavory, 2012).

Another strength of the inductive approach is its capacity for depth and richness in data interpretation and unlike deductive methods which may impose rigid frameworks, inductive analysis allows for more grounded understanding of the data, allowing for subtle variations in participant responses to not be overlooked (Braun and Clarke, 2006). Thus, by using an inductive approach, the research can bring together the differing data types cohesively, uncovering both individual and collective themes.

What is more, qualitative content analysis requires immersion in the data, and the inductive process facilitates a logical progression from raw data to thematic findings. A progression that according to Schreir (2012), allows for the systematic organisation of data without compromising its interpretative data. Additionally, the reliance that the inductive approach has on emergent themes ensures that the analysis remains relevant to the specific context of the study, strengthening its credibility and transferability (Lincoln and Guba, 1985).

However, the inductive approach has certain limitations, and one potential challenge is the subjectivity that is ingrained when identifying themes, as the process relies heavily on the researcher's interpretation. To counteract this, reflexivity is essential, as it helps mitigate it by making sure that biases do not unnecessarily influence the coding and categorisation process (Finlay, 2002).

Furthermore, the open-ended nature of inductive analysis can be time consuming, especially since dealing with large datasets from multiple data types such it is the case of this project. Braun and Clarke (2006) caution that the iterative process of codes and themes requires a sustained engagement with the data.

Overall, the use of an inductive analytical approach offers significant advantages for the interpretation of interviews, focus groups and social media data and by allowing themes to emerge directly from the data, ensures depth, flexibility and contextual relevance.

There are other challenges pertaining the application of methods across data types, especially since the project works with three different data sources, interviews, focus groups and social media data. For example, interviews and a focus group typically produce rich, narrative data characterised by depth and context (Bryman, 2016; Patton, 2015) whereas tweets are succinct and often limited to 280 characters (Marwick and boyd, 2011; Murthy, 2018).

This disparity adds complexity to the development of having a unified coding scheme applicable to all data types. Kozinets (2019) argues that adapting traditional qualitative methods

such as qualitative content analysis to analyse social media requires methodological flexibility to account for the unique characteristics of digital communication.

Furthermore, Hurlstone et al (2019) highlight that performing qualitative analysis across large social media datasets is complex and often impractical without appropriate frameworks to manage data extraction and analysis.

This project tackled these challenges by employing an iterative, inductive approach and as initial themes were identified through qualitative content analysis of social media data, these were refined as the themes from interviews and focus groups data analysis emerges in a way that social media data and themes expanded on the main themes from the interviews and focus groups. By merging insights from both datasets, the project developed a comprehensive framework that combines large scale patterns from social media data with the rich, situated, narrative depth provided by interviews and focus groups.

While tweets often lack the contextual richness that interviews and focus groups hold, makes interpretation challenging, as the brevity of tweets can lead to ambiguity, which requires to infer meaning without the benefit of probing questions or clarifications. Bouvier and Rasmussen (2019) emphasise that understanding the cultural and social contexts of social media interactions is crucial for accurate qualitative analysis. Thus, integrating other advanced analytical tools for large datasets can allow the process of initiating finding patterns easier (Hursltone et al. 2019). As mentioned earlier, the project in stage one used Voyant tools as a way to have a preliminary overview of main words, followed by in depth qualitative content analysis.

Another significant aspect of doing research is making sure that there is transferability, which refers to the extent to which findings from a qualitative study can be applied to other contexts or groups. In the context of interviews, focus groups and social media data, ensuring transferability requires a careful balance between providing enough contextual detail and maintaining analytical coherence. For example, Lincoln and Guba (1985) emphasise that transferability is not achieved through statistical generalisation but rather through deep description, a detailed account of the research context and data, facilitating readers to assess the applicability of findings to their settings.

For interviews and focus groups, transferability is often facilitated through detailed descriptions of the participants, the setting and the dynamics of the discussion (Creswell and Poth, 2018). This includes noting demographic and contextual specifics as well as the socio-cultural

environment in which the research was conducted (Krueger and Casey, 2015). For social media data, transferability depends on documenting the characteristics of the dataset such as the volume of tweets analysed and the preprocess of the final dataset.

However, achieving transferability with social media data has its challenges as tweets are often decontextualised, lacking depth and background provided in interviews and focus groups (Kozinets, 2019). To address this, the project used triangulation which is a strategy used for making sure the research has transferability. Thus, by combining data from multiple sources such as interview, focus groups and tweets, the credibility and relevance of the findings is strengthened.

Another important aspect of qualitative research methodologies is the managing of resources and time constraints, especially when analysing and working with large datasets from social media data and diverse types of data from interviews, focus groups and tweets. For example, for interviews and focus groups high quality transcription is essential to preserve the nuances of participant responses, yet it requires substantial manual effort (Braun and Clarke, 2006).

In this project, transcription was followed by iterative coding from the social media data and since all interviews and focus groups were written responses, the time-consuming element was translating them from Spanish to English. Social media data, on the other hand, was proven to be more time consuming since working with tweets introduces additional resource challenges. While the use of tools such as Voyant provided a preliminary overview of word frequency patterns, the subsequent manual identification and thematic coding of tweets demanded significant time and attention. As Kozinets (2029) points out, analysing social media content involves not only managing large volumes of data but also interpreting fragmented and context dependent information, which adds to the analytical workload.

What is more, time constraints also influence the depth and scope of qualitative analysis (Silverio et al. 2020) and as Lincoln and Guba (1985) argue, prolonged engagement with the data is critical for ensuring credibility. In this project, prioritising the combination of themes across datasets and data types from interviews, focus groups and tweets required careful time management to avoid superficial coding. Schreir (2012) emphasises that qualitative content analysis is iterative in nature and rushing through this process can result in the omission of subtle yet significant insights.

To mitigate these challenges, this project adopted a staged approach to data collection throughout 2.5 years where the social media data was collected in the first year with interviews

and focus groups the year after and throughout the last 6 months due to time constraints. Furthermore, the initial exploration of social media data which is the most time consuming and large datasets allowed enough time between the different datasets and datatypes to be familiarised with and analysed.

Ethical considerations and research relations

This research was guided by principles of community reciprocity and responsibility which make sure that the community's interests and need are prioritised throughout the projects. At its core, this approach aims to make sure that the needs, values and priorities of the community and communities this project centres.

The project's two stage methodology highlights different challenges in maintaining ethical rigor. For example, the first stage relied on the analysis of publicly available Twitter data, raising concerns around privacy and consent. In contrast, the second stage engaged directly with a rural community in Mexico, embedding decolonial approaches into the research.

Reciprocity and responsibility, as highlighted in the work of Tuhiwai-Smith (2012) form a foundation for ethical research as these principles encourage researchers to acknowledge and value the expertise and agency of marginalised communities. In the second stage of this project, these principles were enacted through direct collaboration with community members, allowing them to share their perspectives around digital divide concerns in ways that are authentic to their experiences.

However, the reliance on digital data in the first stage posed ethical questions about working with publicly shared content without engaging directly with its creators. The ethical considerations of collecting and analysing Twitter data required careful thought and reflection and although Twitter is a public platform, users may not anticipate their posts being studied by researchers. For instance, scholars (Zimmer, 2017; Franzke et al., 2019) call attention to this challenge by urging researchers to protect user anonymity and respect the original context of online content.

In this project tweets are directly cited to provide evidence and context, and anonymity is taken into account by erasing any clues of identity from who wrote it. This decision was made because the original textual artifacts themselves hold intrinsic value in showing broader themes and

dynamics. As Highfield and Leaver (2016) argue, researchers must find a balance between the accessibility of social media data and their ethical responsibilities which is achieved in this project by emphasising transparency and harm reduction.

Another important aspect in the project is the ethics of data ownership and intellectual property which can further complicate the ethics of the project. While tweets are user generated publicly available content and legally the intellectual property of their creator and which through its corporate ownership and data commodification which perpetuate colonial dynamics, where data of marginalised communities is extracted for academic or corporate purposes, without reciprocity (Ricaurte, 2019). Ramanathan and Fruchterman (2022) discuss combating data colonialism by emphasising community ownership, consent and privacy by suggesting models where communities maintain control over their data, challenging power imbalances that are part of data collection and use.

The practice of collecting and analysing social media data, even with rigorous safeguards for accuracy and contextual integrity, operates withing what Couldry and Mejias (2021) term as data colonialism where both platforms and researchers benefit from data generated by communities without making sure there is reciprocal value. While this project employs careful measures to maintain data integrity and prevents misrepresentation, it must acknowledge its position within these broader structures of data extraction.

To address these concerns, the projects approaches data use through a lens of both individual intellectual property rights and collective data sovereignty, meaning it is not only make sure that transparent and contextually accurate analysis is done but also critically examines and situates how research practices might reinforce or challenge existing patterns if data colonialism. Thus, and following Kukutai and Taylors' (2016) framework for Indigenous data sovereignty, the projects seek to balance academic rigor with ethical obligations to the communities whose experiences form the basis of this project.

While decolonial scholarship has significantly critiqued digital platforms as colonial continuities, it is essential to reconsider the outright rejection of these spaces as purely colonial and the processes of data collection as inherently harmful. Instead, researchers can adopt reciprocal and dialogical methods to engage with data, centring community perspectives and narratives present in social media to strengthen and further advance communities' position as active doers, thinkers, theorisers.

This approach has been presented by other researchers such as Castillo (2022) who call for decolonial research methodologies that challenge rather than actively dismiss the colonial underpinnings of digital platforms. Thus, by using these platforms to research back against colonial narratives, scholars can support communities in reasserting this agency. Despite their origins in capitalist and colonial frameworks, digital platforms such as Twitter also offer spaces where marginalised groups express their identities, organise, collective and challenge dominant narratives.

Research by Smith (2015) and Jones (2020) highlighted the critical role of these platforms in facilitating collective action and identity expression, especially among marginalised communities. Johnson (2018) argues that these platforms serve as tools for counter-narratives and mobilisation too, which are essential for challenging hegemonic discourse. Furthermore, as demonstrated by other studies by Brown (2019) and Carter (2021), digital platforms not only amplify marginalised voices but also provide avenues for strategic organisation and advocate against systemic inequalities.

This is exemplified by Garza Montemayor and Rivera Robles' (2020) study that examined two cases in Latin America where social media played a pivotal role in resisting neoliberal policies, highlighting the importance of virtual public spaces as sites of articulation and opposition to neoliberalism.

Another significant ethical theme arises in this project, data sovereignty, which is particularly important in the context of community-based research. Since the methodology of this project is grounded in decolonial perspectives, data sovereignty maintains that data generated by communities belongs to them and should remain under their agency. As Kukutai and Taylor (2016) emphasise, respecting data sovereignty is essential for addressing colonial legacies in research.

This study strives to uphold this principle while navigating the inherent tensions between decolonial research ideals and institutional requirements. While data storage followed University regulations and data protection legislation, the research process seeks to maximise community agency within these boundaries. This is why the project sought consent from the community members in how their contributions would be used and were reassured throughout the process of their agency to withdraw if wanted.

By doing this, the project acknowledges that while institutional frameworks may constrain full data sovereignty, meaningful collaboration remains possible and vital for ethical research practices. However, and while institutional frameworks might be a challenge, this is addressed in other ways, such as making sure that the project delivers tangible benefits to the community.

Therefore, the project seeks to amplify the community's experiences, perspectives and visions and shed light on the lived realities of the digital divide. According to Tuck (2009) research with communities should move beyond documenting harm and instead adopting methodologies that position community visions and values at the centre. Consistent with this perspective, the study's findings are presented in a way that respect communities' priorities and emphasises their context.

Reflexivity and positionality are a critical part of the ethical framework of this project. As both a researcher and a member of the rural community where the second stage was carried out, I navigated the complexities of being both an insider and an outsider, a role which requires a reflexive approach to examine biases and address power dynamics in the process.

Furthermore, the potential for harm or misuse of findings is minimised by situating the findings within broader socio-political frameworks to avoid reductive interpretations that could perpetuate stereotypes or misunderstanding about the users tweets content. Ethical approval was obtained for the first stage of the project on the first year of this project running, by the Research Ethics Committee of the University of Southampton ethics committee (Number: 70029).

In the second stage, informed consent was required to engage with members of my rural community. When working with communities, obtaining informed consent is crucial to make sure that ethical research practices are followed. Ethical guidelines emphasise that informed consent must be more than a formality and it should be a process that preserves autonomy and builds trust with participants.

For example, Sim and Waterfield (2019) highlight that the dynamic nature of focus group discussions can make obtaining clear consent challenging, underscoring the need for researchers to address confidentiality and the risk of harm in a transparent manner, as consent can be seen in terms of creating appropriate expectations in the participant, this may therefore

be hard to achieve. Adding that it is also less straightforward for the participant to revoke consent than in one-to-one interviews.

However, as Lenette (2022) argues, informed consent should be an ongoing dialogue rather than one time agreement. This perspective resonates with the way relationships and responsibilities are understood within our community, where written agreements are not typically used to formalise community relationships or kinship ties. Instead, relational accountability, as described by Wilson (2008) forms the foundation of our interactions, where the relationships are based on mutual trust, shared understanding and collective responsibility (Louis, 2007).

Since I am both a community member and a researcher, reflexivity is central to this process. My positionality within the community means I am both known to participants and hold knowledge of the community's protocols as well I will continue to be known to the community after this research. This dual role requires careful navigation to make sure that my actions do not unintentionally exploit or disrupt these established relationships. However, this also requires honouring the community's relational ethics which while unwritten unlike many Western and institutionalised spaces, accountability is not only procedural but deeply tied to personal and communal responsibility.

Thus, participants throughout interviews and focus groups and afterwards were provided with clear and accessible information about the research objectives, methods and potential outcomes. Consent was revisited during the focus groups again to make sure that participants remained comfortable and fully informed throughout the process. Such iterative approach emphasises what Chilisa (2020) call for research to be a tool of collective healing and with Simpson (2017) concept of grounded normativity, which emphasises ethical engagement that emerges from our relationships with the community and the land.

Research in this context must honour the informal yet embedded protocols of trust and reciprocity that govern community life. As Kovach (2009) emphasises, Indigenous methodologies require researchers to respect the collective benefit and shared knowledge systems which are part of the community.

Following Tuck's (2010) framework, the project adopted a collaborative stance whereby the communities' perspectives, experiences and visions are central to knowledge creation, which

means I remain responsive to the community's needs. Wilson's (2008) work on relational accountability grounds this work further by reminding that research is ceremony, bound in relationships with land, community and knowledge systems.

Through Kovach's (2009) framework, the projects honours story, reciprocal relationships and collective benefit in every aspect of knowledge creation as well as community protocols and local ways of knowing, recognising what Deloria Jr (1969) describes as spatial and relational knowledge systems that cannot be separated from place and lived experience.

Finding common threads across both stages

This section provides a summary overview of the main finding through the qualitative content analysis with the next three chapters detailing the main themes as novel findings from this research. Some findings confirm well documented barriers such as infrastructure barriers and challenges which appear throughout the data as unreliable internet connectivity, power outages, and inadequate technical infrastructure. Additionally, socioeconomic barriers identified in previous studies (Ragnedda, 2020, van Dijk, 2005) emerged clearly in this research too, particularly regarding urban-rural disparities. The data also corroborates established patterns of gendered digital engagement (Ancheta-Arrabal et al., 2021; Eubanks, 2011).

While the data confirms well documented digital divide patterns such as infrastructure barriers, socioeconomic challenges and aspects of gender technology gaps, the significance of this research is in its revelation of deeper patterns and complex dynamics. The extensive qualitative evidence gathered through interviews, focus groups and social media research provides strong supporting evidence for novel findings under three main themes which are under Chapter 5 'Commercialised empowerment: the digital divide as a market opportunity'; Chapter 6 'Algorithmic agroecologies: nurturing community digital futures' and Chapter 7 'Communal roots, network routes: materialising digital futures'.

In Chapter 5, 'Commercialised empowerment: the digital divide as a market opportunity' exposes how private providers, state actors, and NGOs predominantly, approach the digital divide through market driven, control oriented and superficial interventions that fail to meaningfully engage with communities' needs and realities. Through discussion of communities lived experiences shared both online and from the interviews and focus groups, this chapter demonstrates how digital divide discourse, initiatives and frameworks from these

three actors – private providers, the state and NGOs – often serve institutional interest rather than foster genuine community empowerment.

Chapter 6 'Algorithmic agroecologies: nurturing community digital futures' presents evidence of how communities conceptualise technology through relational frameworks, a relational perspective that sets the state for the model of algorithmic agroecologies, which is borne out of the evidence in the data of how communities incorporate technologies not as external solutions but as embedded components of their broader systems of ecological knowledge and collective organisation practices, presenting algorithmic agroecologies both as a significant theme that emerged from the analysis and as a potential model for addressing digital divide challenges.

Chapter 7 'Communal roots, network routes: materialising digital futures' lays out the evidence supporting this main finding themes, revealing how established decision-making mechanisms, specifically ejidos meetings and assemblies and community committees, serve as fundamental spaces for technological infrastructure co-design, which the chapter terms as communal roots and shows how these organisational structures operate in conjunction with what the chapter terms networks routes as the ways communities actively reconfigure, adapt and create from and through open technologies and transnational relationships.

Chapter 5: Commercialised empowerment: the digital divide as a market opportunity

This chapter shows the evidence found throughout the data and examines how private providers, state actors and NGOs frame and operationalise digital divide interventions through market driven approaches that often fail to address community needs. Through the analysis of social media data and community testimonies from interviews and focus groups, the evidence reveals how commercial interests as well as control and hierarchical dynamics within state systems shape how the digital divide and its inclusion initiatives work in ways that can perpetuate rather than resolve digital divides.

The relationship between market failure and digital exclusion emerges clearly through the insights from social media analysis and the community data. The following tweet highlights a critical market gap where financial institutions and insurers avoid rural network investments due to perceived risks: *"No insurer covers rural network risks says @-------- and surely no*

bank gives access to capital at affordable rates...". This institutional reluctance to finance rural digital infrastructure finds direct confirmation in community experiences where community members expressed their understanding of how their digital exclusion stems from interlinked market and state failures.

Community members' testimonies reveal three key dimensions of how the digital exclusion of their community exclusion comes from interlinked market and state failures. First, community members clearly identify the urban-rural divide as a display of market logic, as one community member observes: *"One that I think is because we are in a rural community and well, everything that is useful is in the city, that has to do with technology",* while another shared how *"It is very noticeable how urban areas receive all the attention and resources, leaving the towns behind."* Such spatial dimension of digital exclusion emerges not as an accident but as a systematic outcome of market-driven development.

Second, community members demonstrate a clear understanding of how infrastructure development requires substantial investment. One member explicitly notes: *"I think that the most important reasons why there is no access to technologies in the community has a lot to do with the fact that sometimes technologies cost and require time to build - a type of investment is needed".* While others emphasise the basic "*Well lack of investment" and "That there is no investment in infrastructure and priority is not given to rural areas".*

These observations are of particular significance when paired with the financial institutions unwillingness to provide capital for rural networks, showing how market mechanisms actively contribute to digital exclusion.

Third, the experiences from the community reveal how market failure intertwines with a state policy paradox. While Mexico's CFE Telecommunications and Internet for All initiative shared in the literature review explicitly frames internet access as a public right, promising non-profit telecommunications services to guarantee access to information technologies, the community testimonies expose a profound disconnect between this rights-based policy and local reality.

There is a complete absence of NGO mention in community testimonies, social media discussions from community providers and community organisations. Such disconnect in this finding adds another dimension to the understanding of commercialised empowerment and provides a novel finding to the literature because they highlight that communities' testimonies

from the interviews, focus groups and social media data articulate their experiences and solutions without reference to NGOs.

This absence points to a significant gap whereby institutional efforts, such as those from NGOs even when well-intentioned, frequently fail to engage with or reflect the lived realities of these communities and instead, they operate in parallel to other market driven or standardised solutions that do not address the nuanced and specific challenges faced by the communities.

Thess finding offers a critical contribution and challenges digital divide literature to move beyond proposing more institutional presence and policy frameworks in tackling the digital divide in underserved communities and calls for a critical examination of how these interventions interact and relate with, or remain disconnected from, community-led strategies and needs.

This becomes even more relevant as this project provides findings that help shift the focus to the agency of communities, offering a counterpoint to the dominant narratives of commercialised empowerment by showing that genuine tackling of the digital divide requires meaningful engagement with local knowledge and initiatives whereby communities also see NGOs as part of this relation which currently they do not.

State-market dynamics

When a community member notes that *"I think one is the lack of care on the part of the government and that there are no government policies that truly genuinely promote access to technology in communities like ours",* it reveals not just a gap in service provision, but a complete disconnection from a national programme specifically designed to counter market-based exclusion.

This disconnect becomes particularly significant when considered alongside the market barriers revealed from the tweet about financial institutions' unwillingness to invest in rural networks. This suggests how commercialised empowerment creates a combined form of exclusion, while banks and insurers deem rural areas financially unviable, even existing state programmes meant to counter this market failure also fail to effectively reach or engage with rural communities.

As one community members shares*: "I think it is due to the lack of interest of companies and the government in investing here and the little importance that the government sees in improving our situation"*; a statement that becomes significant when we understand that government programmes technically exist but remain invisible or unheard of at the community level. This observation shared by the community member captures both the market failure where private providers see insufficient profit potential to invest and the governance gap where despite having formal programmes for digital development, such as Internet for All, these initiatives are not known to the community members.

There is a disconnect between policy existence and practical implementation highlighting how digital exclusion is perpetuated not only through absence of programmes but through their ineffective delivery and communication of intended beneficiaries.

The promise of CFE Telecommunications becomes particularly questionable when considered alongside CFE (Comisión Federal de Electricidad - Federal Electricity Commission) track record in fulfilling its constitutional mandate to control and develop Mexico's national electric industry. So, while the CFE Telecommunications programme explicitly frames internet access as a right to be guaranteed through non-profit telecommunications services, the Mexican constitution already makes the government responsible for electrical infrastructure development, yet the evidence reveals systematic failures in this basic infrastructure provision.

Therefore, the promises of CFE Telecommunications and Internet for All programme as a public enterprise providing non-profit telecommunications access must be examined against CFE's existing record of electricity provision. Community experiences reveal systematic infrastructure failures that have become normalised in rural areas, and this is evident through these statements:

"The internet is very bad in the community and the power goes out a lot during the rainy season", with service interruption becoming routine: *"The electricity and internet service is not very stable since days could constantly pass without having the service working".*

This instability particularly affects digital participation, as one community member notes:
"The lack of internet almost every day and sometimes electricity when it is rainy season makes it very difficult for me to follow my online classes, for example accessing university material when I come on the weekends."

Furthermore, the spatial dimension of this infrastructure inequality becomes clear through testimonies comparing rural and urban experiences, as one community member observes: *"...when I'm in Puebla (a major city about 2 hours' drive from the community) I don't have problems with access to technology in general, and in the town sometimes the internet goes out or generally it's not very good although we have electricity, it's annoying that it goes out temporarily".*

The normalisation of poor electricity services emerges as a critical finding here, with community members expressing: *"It has become normal that the internet is very bad, and we simply wait, and the same with electricity..."*. This resignation appears frequently throughout the interviews' responses, even as community members recognise, they deserve better: *"...but if we see it well it does affect because we should have services that we pay for that should work".*

When asked about solutions to the digital divide in the community, community members consistently emphasise basic infrastructure needs: *"Have good quality internet, and also electricity"* and *"To make sure that basic infrastructure, such as electricity and access to Internet is available throughout the community."*

The social media analysis adds further evidence and political context to these infrastructure failures, such as tweets about electricity cutoffs during teacher protests in Oaxaca:

"RT @---------: Mr @EPN we ask: what is happening in the main square of Oaxaca where the teachers are, they have cut off the electricity..." reveals how state control of infrastructure becomes a tool of political power with another tweet adding *"RT @---------: In the main square of the city of #Oaxaca, as well as in Hacienda Blanca Etla #Oaxaca, they cut off the electricity and cell phone signal…"*

Furthermore, community organisations highlight broader struggles around electricity access: *"RT @----------: From Chiapas we take care of Mother Earth that gives us life and we demand fair electricity rates! RT x #DefensaMtierra"* calling for fair electricity rates and questioning the model of energy provision and well now internet with the CFE programme; *"@---------- Putting the entire economy, security, sustainability and mission-critical infrastructure in the*

hands of an electricity monopoly is to understand nothing about risk mitigation, disincentives to corruption and resilience."

An interesting finding is private providers attempt to position themselves as alternative: "*Internet access is as necessary as having electricity and water services. That is why Altán La Red Compartida does its bit by bringing 4.5G LTE internet to lagging communities. #InternetCoverage"*. Yet, community experiences suggest more fundamental issues, as captured in observations: *"We must not let connectivity suffer the same fate as basic services, such as water and electricity, which in many communities do not exist"* coupled with the harsh choice some communities face: *"When they started the project, the community had to decide between electricity and the Internet. They had simple cell phones. After deploying the network, they now have smartphones and can take advantage of the Internet to expand their opportunities"* revealing how deeply infrastructure inequality is embedded.

The limitations of CFE Telecommunication programme and public enterprise become further evident when examining how the rural community interviewed articulates infrastructure needs. For instance, some community members consistently framed access to both internet and electricity as a basic right while also acknowledging their current commodification:
"Yes, they (private technology companies and the government) should make their technologies work first and make them accessible to these areas. They should work together and make sure that there is access to electricity even when it rains and the internet always works, not just a few hours a day or sometimes".

There is an underlying tension revealed here that centres the gap between institutional capability and actual services delivery in marginalised communities and which manifests in few ways. Firstly, there is a disconnect between government capacity and implementation which is evidenced through a community member statement:
"Yes, they have the power, right? And the resources to make your services work first. Make sure that necessary infrastructure such as electricity works and suppliers offer cheaper solutions"; showing how both public and private sectors possess the necessary resources and authority to provide essential services, yet fail to do so effectively, creating a clear contrast between potential and reality in service delivery.

Second, the following statement shared by a communitarian organisation shows how this servce delivery failure exacerbates existing marginalisation: *"The Indigenous peoples of Guerrero*

have the highest levels of marginalization and poverty in ᴍx. The right to health, food, education and housing is denied by the government that deploys a welfare social policy that deepens pauperisation. 📷 *@----------".* The reference to "welfare social policy that deepens pauperisation" suggests that even attempted solutions fall short.

Third, regarding technology access specifically, the community member's observation about "lack of care" and absence of genuine government policies reveals a critical insight, that even when formal programmes exist to address digital divides, there appears to be a significant implementation gap. Suggesting that the issue is not only about creating policies, but making sure they meaningfully connect with and serve their intended beneficiaries.

The fact that rural communities still need to demand: *"Access policies to communities like ours, although in reality I don't know how much they work but more in specific things like guaranteeing that there is basic quality infrastructure, not only working halfway like the internet definitely most of the time and sometimes electricity and water"* while specifying there must be a guarantee of basic quality infrastructure in electricity reveals how state owned enterprises can reproduce rather than challenge market-based service inequalities.

This is furthered evidenced by how private technology providers capitalise on electric blackouts: *"Did they run out of internet? With @---------- we didn't have any problems.* 👍 *#Withoutelectricity #Blackout";* or when Altan La Red Compartida frames their service as addressing community needs, they reveal how public enterprise failures and limitations create opportunities for market solutions or what I call commercialised empowerment providing an evidence-based warning given CFE's record with electricity provision.

As seen from evidence in the previous chapter, some communities must decide between electricity and the internet which exposes how deeply infrastructure inequality is embedded in current development models whether market-led or state-led. So, when community members in the rural community demand that both companies and the government should make their technologies work first and make them accessible to these areas, they are articulating a critique if both market based and state failure equally to treat both infrastructure and access as a genuine public good. This strongly suggest that CFE Telecommunications, despite its social mandate, may replicate rather than resolve the limitations of commercialised empowerment.

Social media analysis further supports these perspectives on electricity infrastructure failures and service provision: *"Hello @CFE_Contigo, there has been no electricity for several hours on ----------. Businesses are being hurt by this. We have report M21392952188 and we have not had any answer as to when there will be electricity again".*

However, there is also evidence that there are some community approaches to this failure of both the state and the market to provide basic technology access such as electricity and internet. From the social media analysis, some shared: *"#VideoColumn: #MakeElectricity... But clean Blackouts, reforms and energy from the communities: collaboration of #Onergia".*

The extensive evidence from both the rural community experiences and social media research about unreliable electricity service reveal deeper institutional problems that raise serious doubts on the CFE's Telecommunications and Internet for All initiative and its capacity to expand into telecommunications while still struggling with its core constitutional obligations around electrification. Such relationship between existing infrastructure failure and digital access ambitions suggests how state-led initiatives, even when framed around rights and public social mandates can reproduce rather than challenge patterns of exclusion.

Interestingly, a contrasting perspective emerges from social media post shared by a Mexican community technology provider, highlighting how *"Spectrum is not scarce everywhere. Unused spectrum abounds in rural areas. US proposes sharing spectrum to close digital discrimination in Native territories. FCC Proposes New Program to Promote Tribal and Rural Wireless Services".*

While this indicates that the US Federal Communications Commission is acknowledging and proposing interventions to address digital discrimination in Native territories, the US government has a well-documented record of failing to honour Indigenous treaties and provide adequate resources and infrastructure to Native American reservations.

This comparative finding underscores the importance of critically evaluating state framings of the digital divide and their proposed interventions, especially when they involve communities that have been historically oppressed and disenfranchised. By critically examining the shortcomings of state-led digital inclusion initiatives in both Mexico and the US, this project helps to further reveal the tangible ways in which these efforts can perpetuate exclusion and reinforce existing hierarchies.

This finding advances decolonial theory by examining how infrastructure failures and programme implementation choices actively maintain inequality. While decolonial work has focused on state power, this project is showing how specific technical and administrative decisions, such as the CFE expansion into telecommunications despite unreliable electricity service; or the FCC acknowledgment of discrimination without corresponding infrastructure investment, both perpetuate historical patterns of exclusion.

What is more, this finding reveals that colonial dynamics persist not only through obvious discrimination, but through apparently neutral programmes and technical decisions that exclude historically marginalised communities from programme development and implementation. In both Mexico and the United States these dynamics manifest throigh state-led inititiaves that, despite their public service rhetoric, operate within commercialised frameworks of empowerment.

For example, Mexico's CFE's programme while positioned as a public enterprise with a social mandate, approaches infrastructure development with the same delivery focused logics as private companies, whereby they prioritise service expansion over addressing fundamental infrastructure failures that affect rural communities. Similarly, the FCC's proposed interventions in Native territories, while acknowledging discrimination, follow market-based solutions that treat digital access as a commodity to be delivered rather than as infrastructure to be developed collaboratively with communities.

This connection between state and market approaches reveals how commercialised empowerment extends beyond private sector initiatives to shape how public institutions conceptualise and implement digital access initiatives. What we see is the persistent gap between ambitious digital access programmes and basic infrastructure needs demonstrates how sate-led initiatives, even when framed around public good, can reproduce rather than challenge market-based patterns of exclusion.

This limitation becomes particularly clear when compared with the model proposed in the previous chapter, algorithmic agroecologies which shows how digital futures could be nurtured through genuine community participation rather than treated as another opportunity for top-down service delivery. Rather than treating rural communities and other communities who may identify with the experiences evidenced here, as passive recipients of technology infrastructure,

algorithmic agroecologies as a model, recognises the communities' existing organisational and relational practices and places them at the centre of co-designing digital futures.

Therefore, the evidence so far, of market and state failure in delivering reliable technological infrastructure suggests that addressing the digital divide requires more than just alternative services providers or more policies but that it requires a fundamental rethinking of how we conceptualise and develop technology in relation to how many communities experience and organise.

Within this context, the relationship between the structures of pricing and costs of technologies and the digital divide emerges through multiple interconnected experiences, further highlighting how structural inequalities are reinforced, making affordability a key barrier to digital access under the current models and showing the need for systemic change and challenging these systems too.

Furthermore, the explicit call out for accountability from both companies and the government reveals a deeper issue in how the state's inability or unwillingness to regulate private providers reflects its broader incapacity to govern its own practices. This exposes a critical paradox in relying on state policies to address the digital divide which is what most digital divide literature posits as the answer. So, if the state cannot enforce basic oversight of private actors, it is unreasonable to believe or expect it to regulate its own role in perpetuating exclusionary systems.

By connecting these findings, the evidence presented here deepens the understanding of the digital divide as not only a failure of neoliberalism but as a system intentionally designed to exclude, with the state as a complicit author and actor. Thus, the promises of the CFE Telecommunications and Internet for All programme, launched within the current government that claims to challenge neoliberal practices, adds to this novel finding.

Such findings reveal that the problem runs far deeper than rhetoric or decolonial theory against neoliberalism or reliance on state structure and market mechanisms but real-life experiences from communities continue to name and re-live exclusionary tactics from both the state and the market repeatedly. So, when programmes such as the CFE Telecommuncations under the banner of public enterprise run by the state appear, it reveals two main things.

One reinforces digital divide literature that has documented how the digital divide is a byproduct of insufficient resources or poor policy making. Second, this is a novel finding that contributes to the field. It positions the digital divide as a mechanism entrenched within broader systems of governance that prioritise profit, as it is the case of private providers. In contrast, while the state may not prioritise profit directly, it does prioritise control over equitable access.

This evidence also challenges the notion that the state can act as a neutral or corrective force. It highlights the need to shift focus away from top-down solutions towards co-designing community-led initiatives, which are already demonstrating innovative approaches on the ground and organisational processes that provide the most viable alternative to the digital divide.

Through the lens of commercialised empowerment, we can better understand how both market and state actors systematically exclude communities. An exclusion that particularly affects rural and other underserved communities that practice agroecological methods as their approaches for land relationships, economy and community organisation which conflict with market driven development models.

Thus, the findings so far show how commercialised empowerment functions not only as a development strategy but as a sophisticated mechanism that reinforces hierarchical structures of control and decision-making by prioritising market principles and state control over community driven approaches to technology design, development and use.

This dynamic becomes particularly evident when examining more closely the findings on price and cost structures implemented by service providers. Through standardised pricing discrimination, we can see a concrete sign of how commercialised empowerment reinforces existing hierarchies while claiming to promote equal access.

Price and cost structures

A major finding from the interviews and focus groups with the community reveal a fundamental contradiction and an overt lie from private providers as rural community members pay the same as urban areas but receiving systematically inferior service and in fact paying more.

Community members consistently articulate a fundamental inequity in service provision, exemplified by statements such as *"we should be able to have internet as good as in the city, we pay the same";* a critique that extends beyond service quality to challenge provider's authority, as community members explicitly questioning why providers should play the big role they current play, as demonstrated in this statement: *"I don't think they should play the big role they play right now, like deciding what they think we need, apart from the fact that their services are useless, we pay the same prices as if you were paying in the city"*.

A particularly revealing incident reinforces this pattern of discriminatory practice, as shared by a community member when confronting Telmex, a major telecommunications provider in Mexico: *"I told Telmex their things that we do pay the same price as in the city so why not give us the same amount of internet"*. This interaction shows how private providers are not only failing to deliver adequate service but are actively engaging in discriminatory practices while maintaining a facade of market fairness. This is not only poor service delivery but a systematic extraction of value from rural communities through charging urban equivalent prices for obviously inferior services.

This finding is novel in that helps reveal how commercialised empowerment operates in practice through a specific mechanism which is discriminatory service provision masked by standardised pricing. This evidence reinforces the understanding that major providers exacerbate these inequalities by charging prices for obvious inferior services.

What is more, while digital divide literature has documented rural-urban disparities in prices and services, what sets this evidence as a major contribution is in revealing the agency of the rural community which not only identifies this exploitation but actively challenges it. However, this also reveals how market based digital access demands constant vigilance and resistance from underserved communities, further emphasising grassroots resistance and demonstrating once more that communities are not only observers but take direct action and advocate for the community.

Another relevant part of this finding is that is that it changes how we think about the digital divide as not something the government or businesses need to fix since the digital divide is something the state and the market actively maintain for their favour. This means that when providers can openly charge equal prices for unequal services, both digital exclusion and

therefore inclusion become profitable. So, this represents a shift from seeing the digital divide as a market failure to recognising it as a market strategy or by design.

The comparative urban-rural experience that allowed the community to make this comparison adds novelty too, by seeing how this disparity became visible because the community member lives in both the city and the rural community, suggests a much broader pattern of hidden exploitation in rural communities without this comparative knowledge at hand.

This moves the digital divide discourse beyond documenting disparities or proposing policy or market-based interventions to providing evidence on how market mechanisms themselves systematically reproduce inequality while being presented as solutions, making them unreliable and a non-viable source of meaningful change.

The interplay between state and private actors in maintaining commercialised empowerment becomes more evident through community experiences with digital access failures. For example, community members directly implicate both sectors in perpetuating technological exclusion, stating *"Yes, all of them, because it is their duty to provide services, we pay the same but we do not get the same" and "Telmex and many other internet companies promise the same but they don't work either".*

While these testimonies reinforce existing documentation of systemic inequities in standardised pricing and service delivery, they reveal a novel insight: the state's role as a co-conspirator through its failure to enforce equitable access ad regulate service providers effectively.

The depth of this market control becomes particularly evident when examining community attempts to create alternative service models through mobile virtual network operators (MVNOs)[2]; as revealed in the social media data:

"@---------- @---------- from what you can see, it is a group of cooperatives that have come together to create an MVNO. To the extent that they do not have their own infrastructure, there is little "new" they can do because they are tied to the prices and policies of their commercial provider."

[2] A Mobile Virtual Network Operator (MVNO) is a company that sells mobile services under its own brand name, but uses the network of a licensed mobile operator. MVNOs lease wireless capacity from a mobile network operator (MNO) at wholesale prices and resell it to consumers at a lower retail price.

This attempt at establishing a community-led MVNO exposes a core limitation of commercialised empowerment which is that even when communities strive to create their own service models, they remain bound by existing market infrastructure and pricing structures.

This forced dependency on commercial providers' infrastructures shows how commercialised empowerment maintains control even through supposedly alternative service models and while communities can provide wireless services under their own brand, they must lease network capacity from existing mobile network operators, remaining bound by their pricing structures and policies.

These dynamic reveals how commercialised empowerment creates a system of technological dependency that persists even when communities actively seek to establish more equitable alternatives. This pattern of discriminatory pricing and dependency becomes even more problematic when examining the multiples costs burdens faced by rural communities. So, when the rural community faces multiples costs *"cell phone data is very little and because it is expensive"* and *"when there is no internet at home, and I have to grab data"* we see how this market control creates compounding forms of exclusion which are not isolated barriers but interconnected mechanisms through which commercialised empowerment captures underserved communities and their resources and labour while failing to provide the quality they pay for and work to access.

This sophisticated system of exclusion, operating under the guise of addressing the digital divide makes algorithmic agroecologies even more relevant as a viable alternative framework since communities are not just victims of commercialised empowerment under profit and control capture as evidenced in their confrontations with providers, but are actively developing alternatives to challenge and reject this market and price logic. This is demonstrated in their development of community networks:

"Given the lack of Internet or its high cost, #Indigenouspeoples are building #community networks through collaborative systems under their own principles and values, and @------- accompanies #CommunityCellularTelephony and #CommunityIntranets projects in #Mexico"

In contrast, evidence from NGOs and private providers from the social media data shows how deeply entrenched commercialised empowerment remains in conventional approaches to the

digital divide. The NGOs approach to digital access is contradictory and reveals a disconnect between institutional and community perspectives and this is evident when NGOs make observations such as this:

"In Latin America, science museums discover that technology is very expensive, especially when you want to invest in the most advanced technology to cover the entire museum" sharing concern on institutional challenges around cost but while looking at the data, they never mention how this may impact communities, which shows how NGOs understand and approach technological inequity.

This emphasis on institutional approaches is particularly concerning given that museums, while important cultural spaces, represent a very different context from underserved communities struggling with basic connectivity. Such institutional perspective carries through in their framing of gender barriers as data notes that *"@---------: Among the obstacles to women's access to technology is the cost of connecting to #internet".* While acknowledging costs as a barrier, this observation remains at surface level, failing to engage with systematic issues that communities have identified in their experiences with service providers.

Furthermore, this institutional framing extends to how NGOs approach solutions, as these are based on policy-based solutions and which advocacy focuses primarily on reducing data transmission costs on international routes which is an approach that works within existing market structures rather than questioning them. This is demonstrated in this statement: *"VI Summit of the Americas, 1st. mandate, as well as reduce data transmission costs on international routes".*

While cost reduction might improve access, it fails to address the fundamental issues of market control and community autonomy that we have seen consistently raised by communities in their experiences with services providers and state providers alike.

The limitations of this institutional approach become particularly evident in NGOs engagement with community projects. For example, they celebrate initiatives that reduces costs:
"*The project not only reduced the cost of communication through a telecenter and Internet signal expansion but also opened opportunities for women in the community.* 📺 *Know the story..... CommunityNetworkWeek"*

However, their support for community led work remains constrained by their lack of awareness and the way their institutions often follow market-based frameworks by failing to challenge their structures.

There is evidence from the data that speaks to how communities have had some kind of formal engagement with other regulatory systems and have not had a good experience:
"But there was an obstacle. The project required no-cost access to experimental spectrum frequencies and needed government approval. In 2019 @----------o signed an agreement with the @Ministerio_TIC, which allowed them to access the spectrum for a local GSM network" , where a state ministry account on twitter or in another case: *"Mexico granted an injunction to Telecomunicaciones Indigenas Comunitarias in defence of its right to a spectrum concession for Internet services exempt from the payment of use rights. The cost would be an access barrier for Indigenous peoples."*

Marketing language

The previous findings showed how private provider's and NGOs' institutional perspectives and solutions within market driven frameworks fail to address fundamental issues of the digital divide. Their focus on cost reduction and market-based metrics reveals the limitations of working within commercial frameworks rather than challenging them.

This dynamic becomes even more pronounced when examining how private providers engage with the digital divide through their marketing language. While NGOs acknowledge cost barriers, providers undertake the commercial framing further by transforming structural inequities as matters of individual choice and making their marketing narratives create a facade of accessibility, empowerment and agency while maintaining the very market structures they create and further perpetuating the digital divide.

This transformation of market relationships into superficial constructed rapport which is exemplified in private providers' social media engagement: *"@---------- Hello, it would be a pleasure if you joined the #---------- family. 😃 I share the link where you can check the costs of our packages at: 📞Sales----------📱WhatsApp 📱Telegram"*

While directing people to review package costs, they employ language of belonging and community to mask what is fundamentally a commercial transaction. Private providers use the

marketing approach by emphasising affordability through cost saving measures, such as Altan's promotion: *"---------- is an example that you can have internet and 4.5G LTE mobile telephony at a lower cost and with greater social coverage. *Consult directly with your mobile operator for more information" or "With the Stay at Home plan, get more data, calls and SMS messages at a lower cost. Consult available operators at --------"*

While these quotes suggest some kind of inclusion, they reinforce affordability as they key metric of empowerment, ignoring broader structural challenges such as infrastructure deficits or uneven service quality in rural and Indigenous communities as already evidence previously.

What is more, private providers emphasise commercialised empowerment though the framing of customisation and choice, as Izzi's marketing language shows: *"Now with izzi you can choose the Megas you want, the Channels you like the most and all the ViX+ content. Subscribe now and receive it for free",* illustrating how empowerment is framed through consumer choice, an approach that commodifies digital access, presenting it as flexible, individualised service while reinforcing dependence on market-driven solutions.

Private providers also do this commercialised empowerment through promotional offers and they use them as incentives such as: "*Don't think about it anymore!* 💔🚴 *Take advantage of the promotional price that the Gran Fondo Adolfo Lagos izzi Kardias has for you*" capitalising on urgency and scarcity to drive consumption since their promotions are temporary which benefit the provider's market share rather than addressing the long-term challenges of the digital divide.

These findings are relevant and novel as they provide granular, context specific evidence of how commercialised empowerment operates in practice and while existing research has examined the role of market dynamics and private providers in driving the digital divide, this project offers the following novel contributions, micro level insights through social media research; findings of the framing strategies used by private providers; localised context to how private providers operate in Mexico.

While existing research often critiques private providers at a structural or policy level, this project, rooted in specific marketing discourse from providers, adds a micro level perspective, demonstrating how commercialised empowerment is communicated and normalised through everyday marketing language, reframing the digital divide as a matter of consumer choice. This

connects already broad critiques to the actual mechanisms that sustain exclusion, providing a direct link between theory and practice.

Furthermore, these findings show how providers use personalisation, affordability claims and promotional offers to reframe digital access as a customisable, consumer driven experience which emphasises how neoliberal ideologies are organically a part of the market language itself, something that is not explored in the digital divide literature. While the broader digital divide literature critiques neoliberal influences on the digital divide, much of this work remains theoretical or touches on different aspects of the digital divide.

For example, as seen in the literature review, Couldry and Mejias in the Costs of connection (2019) have theorised and presented examples on the structural implications of digital capitalism and data colonialism which offers a compelling critique of commodification but also surveillance within the frameworks of neoliberalism and colonialism.

However, while their arguments might be grounded in examples, they do not provide systematic analysis of the specific linguistics or semiotic strategies used by providers to market digital access, leaving gaps in how these ideologies materialise in everyday market practices.

Similarly, decolonial and feminist critiques, even those around the subject of the digital divide frequently address structural inequities, colonial continuities as seen in the literature review and theoretical framework, and the commodification of access, often with broader sociopolitical implications. However, these works generally prioritise systemic critiques over empirical studies of how neoliberal ideologies operate through marketing language and the promotion of individual consumption.

With this chapter, it challenges their limitations by offering a detailed, evidence-based analysis of how private providers' linguistic and semiotic strategies and by grounding critiques of neoliberalism in the concrete practices of market language such as rhetoric of personalisation, affordability, and consumer choice. This helps in bridging that gap between theory and practice by making the abstract critiques of neoliberal ideologies more accessible and actionable for scholars, policymakers, and practitioners concerned with the digital divide. Thus, by revealing how market driven narratives actively shape the lived experiences of digital access and shows the discursive mechanisms that normalise structural inequities under the guise of consumer empowerment.

Adding to these findings, this helps situate the digital divide as a profound form of social harm by showing how neoliberal market language perpetuates and reinforces commodified models of connectivity through practices of commercialised empowerment to broader systemic injustices. Such framing of access as a customisable, individual consumer driven experience obscures the collective and structural dimensions of the digital divide and shifting the responsibility from systemic solutions to individual consumers. This individual consumer driven approach deepens exclusion, as those who cannot meet market defined thresholds of access are further marginalised, leaving systemic inequities intact.

Systemic market capture

Further evidence shows how commercialised empowerment operates through selective market infrastructure in rural areas, where certain commercial networks function in an efficient way while other essential services remain unreliable or absent. Such selective development of rural infrastructure becomes clearer through contrasting experiences. As one user observes:
"@---------- @------- Chips and soft drinks certainly have the best and most efficient distribution network to the most remote corner of rural Mexico, unfortunately for food health. They could learn something. Anyway, a sarcasm so as not to cry!!"

Meanwhile, when communities attempt to develop their own communications solutions, they face basic logistics barriers, as seen from these experiences: *"@DHLMexayuda @DHLMex are delaying delivery of @TIC_AC_OAXACA sim cards essential for communication in rural areas. There has been inaccurate and slow information regarding the package and suddenly they indicate that it will be returned to the sender."*

The contrast between efficient junk food distribution networks and the need to physically travel to access basic communication services reveals how market infrastructure develops not based on community needs but on opportunities for value extraction. This selective way in which market systems operate in rural areas represents a mechanism of commercialised empowerment, where communities face layers of costs and barriers to access essential services while remaining well connected to networks of consumption. Further research is advised here.

Broader patterns of market control

So, when community members shared their experiences on how they face standard prices for inferior services, they are experiencing the same logic that was found in the social media data – shared by communitarian organisations and providers -- of what local coffee producers face,

"Premiere! Part II ☕

🙋 🧑🌾 What problems do small #coffee producers face?

📈Since large transnational companies set prices according to the stock market, small scale farmers do not have the opportunity to decide the prices they consider fair."

This is not a coincidence; it is how commercialised empowerment operates, presenting market-based exploitation as development opportunity while systematically limiting community autonomy in both digital technology and food systems processes. However, the operation of commercialised empowerment as a mechanism that perpetuates the digital divide rather than dismantling it becomes even clearer when examined alongside other communal market dynamics. For example, when communitarian organisations share

" 🔴One of the repercussions caused by the #war is the rise in food prices, which causes the industry to opt for the cultivation of genetically modified foods.

✅ The proposal is to say yes to #foodsovereignty through AGROECOLOGY"

"#FromtheFurrowtoyourTable 🍄□ 🍌

#OrderWednesday

The products we offer have been harvested by producers from different regions of the state of #Oaxaca. All at a fair price and from agroecological production.

#consumelocal #AgroecologicalNetwork"

The parallels between digital and agroecological (also agricultural) exploitation reveal how commercialised empowerment operates as a systemic mechanism of geographies with strong practices in agriculture and agroecology, highlighting how the market is always trying to capture all operation of communal life.

This parallel shows how this is not coincidental since many communities facing the digital divide are those whose traditional agricultural practices and good systems are also under threat from market-based development models.

This finding makes a crucial contribution to the digital divide literature which often identifies structural barriers without grounding them in communities lived experiences. The testimonies so far reveal how the digital divide intertwines with broader patterns of market capture and the same way telecommunications providers charge standardised prices for inferior service, industrial agriculture imposes market mechanisms that threaten communal food systems and traditional agricultural practices.

Such grounded evidence challenges digital divide scholarship by allowing us to recognise how the digital divide operates as part of broader patterns of communities' displacement, their knowledge and their resources through market mechanisms and it suggests that addressing the digital divide requires understanding how communities' relationships with land and traditional agricultural practices inform their capacity to develop alternative models to commercialised empowerment.

So, rather than treating the digital divide as a vague structural problem, which has been widely recognised in the literature, we must move to recognise it as part of systemic market capture of communal ways of life and recognise communities' sophisticated capacity to resist this capture across digital and agricultural domains, which helps to further strengthen algorithmic agroecologies as a model that can led us towards co-designing community-led algorithmic ecologies.

The following tweet allows us to see this in the way that communitarian organisation engage with technological infrastructures the same way they do for food systems.
"Hello!
We want to share with you that at SURCO we are organizing a network of local consumption, at fair prices and agroecological production."

This shows how such grassroots initiatives also embed technological infrastructures into broader systems of care and sustainability, such as agroecological food networks seen earlier and emphasise a community-led understanding of needs and capabilities which aligns with the main theme finding before on algorithmic agroecologies which propose a model for co-designing and building solutions grounded in local contexts and lived experiences.

Commercialised narratives

This section further shows how different actors frame the digital divide and the core argument is how these actors construct competing narratives about the digital divide and how to tackle it. This relevant finding arises from the analysis of social media data and the interviews and focus groups with the community, and this is the fact while NGOs are not mentioned by communities, private providers are mentioned often, as we have been able to see from evidence before, especially when communities share experiences around private providers failures in their services and infrastructures.

This finding becomes more notable when we contrast community experiences and what private providers are sharing online. While communities have widely shared infrastructure failures and service inequality, private providers put themselves as agents of social transformation. This is evident in their claims:

"Through @FTelefonicaMX we have managed to positively impact 3 Million girls, boys and adolescents in vulnerable communities in the country between 2020 and 2021, who today have trained teachers to get the most out of digital resources" @----------

As we can see, private providers claims reveal a kind of sophisticated transformation of market expansion into narratives of social impact. For example, Telefonica's claim of having managed to positively impact that many people in vulnerable communities reframes the provision of commercial service as educational empowerment, especially in vulnerable communities. Such positioning of market solutions as social transformation represents a key mechanism of commercialised empowerment.

But we can see that infrastructure provision becomes another vehicle for this narrative, as Vasanta claims when it says *"#Vasanta facilitates the adoption of information technologies in urban and rural areas, because it has infrastructure"* presenting market-based development as community enablement. This framing continues when Altan shares: *"@--------- At Altán la Red Compartida we are focused on deploying our 4.5G network homogeneously throughout the country, which allows users to experience high speed, lower latency, large data transmission capacity and efficient coverage in urban and rural areas"*. Altan's emphasis on technical capabilities and equal coverage masks how standardised market approaches often maintain rather than address rural urban digital inequalities.

These marketing narratives show how commercialised empowerment operates by recasting market expansion into underserved communities as social development. Through using metrics of children and vulnerable communities being impacted, infrastructure deployment, and technical promises, private providers position themselves as agents of digital inclusion while obscuring how their market-based approaches may perpetuate existing inequalities.

However, there is another layer into private providers social media content which reveals a sophisticated mechanisms of market capture in digital inclusion discourse that goes beyond their infrastructural claims and promises of social impact, where providers engage in the strategic appropriation of digital inclusion activism. This is evidenced in corporate initiatives targeting young people in rural communities, and institutional discourse around 'solidarity digitalisation' that seems to acknowledge 'the digital divide between rural and urban areas; as the following tweets tell us:

"If you are a young leader promoting digital inclusion in rural communities, you can still apply for the #Movistar @42MadridFTef @OneYoungWorld Digital Inclusion Scholarship and be part of the #OYW2022 Summit to increase your social impact ¡Last days!"

"We invite you to read the column of our Director @--------- that talks about solidarity digitalization and how the digital divide between rural and urban areas is still very important, which reflects the urgency to take action"

This strategy of combining claims of technological transformation with the incorporation of digital inclusion language shows how commercialised empowerment operates though both material and discursive mechanisms. We can see how private providers position themselves not only as technology providers but as supposed leaders in addressing digital inequality by transforming the digital divide into an opportunity for corporate engagement through scholarships and public discussions of solidarity digitalisation.

This evidence extends our understanding of how the digital divide functions as a market opportunity beyond simple service provision. For example, through this evidence we can see how providers develop strategies that frame both technical provision and digital inclusion work within market logic and by doing so they effectively position their market-based solutions as the answer to digital exclusion while maintaining the mechanisms that produce it. Such insight contributes to the digital divide literature by demonstrating how market capture operates not

only though service provision but through the strategic framing of digital inequality as an opportunity for corporate leadership.

There is a stark disconnect between private provider claims and community experiences, as we have seen in the chapter before and throughout this chapter, and this reveals how commercialised empowerment operates through marketing narratives that mask the reality. The social media data further shows how providers strategically use digital divide statistics to frame market expansion as a social necessity.

"Did you know that according to the Digital Society Report in Latin America #SDIL 20-21, the digital divide between rural and urban areas has increased in the last four years? Learn more about relevant data from the region"

"The digital divide in the country between rural and urban areas has widened in the last four years, increasing inequality, inclusion is essential for digitalization to have a greater impact @----------"

While private providers acknowledge how severe exclusion is and even cite reports showing it, the use this acknowledgement of worsening inequality to then position themselves and their market solutions as urgent and necessary while also transforming their market failure into justification for further market penetration.

For example, we can see how Altan messaging demonstrates a strategy of linking market expansion to fundamental rights and development goals, by stating: *"Internet access is as necessary as having electricity and water services. That is why Altán La Red Compartida does its bit by bringing 4.5G LTE internet to lagging communities. #InternetCoverage",* positioning their services as basic infrastructure

Then they go to reference the UN and INEGI (the National Institute of Statistics and Geography) statistics: "*According to the UN, rural women represent a quarter of the world's population. Today, at Altán La Red Compartida, we congratulate them for their efforts as we continue to provide coverage to locations where they carry out their work. #InternationalRuralWomenDay"*

"*Altán La Red Compartida seeks to increase the 3.2 million rural students who currently have access to computers. Source: INEGI.",* showing how they appropriate development and cultural preservation narratives to further justify their market expansion.

Another important finding is that even when private providers acknowledge cultural diversity, they frame it through the lens of market capture:

"Much of the cultural and ethnic variety that keeps Mexican traditions alive is found in rural and semi-urban areas. At Altán we commemorate the Day of the Pluricultural Nation in Mexico, with the work of continuing to bring coverage to remote communities."

Their language choices are particularly significant where they consistently refer communities as 'lagging' or 'unconnected', positioning them as potential markets waiting development, rather than spaces with existing organisational structures and vast experiences in their provision of technological services.

"RT @OAS_CITEL: More than 300 participants in the current seminar CONNECTING THE UNCONNECTED IN RURAL AND REMOTE AREAS" also shared by an NGO,
"We are live at the @OAS_CITEL seminar - "Connecting the unconnected in rural and remote areas." The framing that private providers use to refer to rural communities reveals another dimension of commercialised empowerment, so when they claim their service will allow schools and hospitals in rural areas to access international quality services, they further reinforce this position that rural communities are passive recipients awaiting market intervention.

For instance:"Altán La Red Compartida's 4.5G LTE internet will allow thousands of schools and hospitals in rural areas to access international quality services. #InternetCoverage". This framing deepens as they state: *"Join the network and be part of the Altán La Red Compartida team, to bring voice and data services to urban and rural areas with our infrastructure. Find out here how you can be part",* suggesting rural spaces as empty vessels awaiting technological filling rather than active communities with existing practices and needs and plenty of negative experiences with private providers.

Private providers' engagements in social media also revealed a patronising approach to refer to rural communities through specific language patterns: *"Because economic activities in rural*

areas can also be enhanced with the internet, Altán La Red Compartida brings access to these populations" which not only implies rural economies are somehow deficient, but positions market based digital services as a kind of salvation. This positioning of rural communities as spaces needing some kind of improvement through market intervention reflects how commercialised empowerment operates through narratives of deficiency and rescue.

This approach becomes evident in their claims to reach *"hospitals, schools, libraries, entertainment centres... Regardless of whether these places are in urban or rural communities, Altan La Red Compartida reaches them".* While this statement presents to the world universal provision as an achievement, it further shows how private providers deploy uniform solutions across different contexts. An approach that has already been contradicted by community experiences, where community members have documented systematic disparities in service quality and other infrastructure failures by private providers.

There is something telling when they state "regardless of whether..." as it suggests their service model does not consider or adapt to the distinct characteristics, needs and existing practices of rural communities, using it as standardised approach to reaching out rather than making an emphasis on caring whether their services will actually work or not. This standardised approach becomes more significant when viewed alongside other claims such as how economic activities in rural areas can be enhanced with the internet.

Together, these statements further reveal how commercialised empowerment operates through a one-size fits all market model that ignores the specific contexts and needs of rural communities. This mirrors the same market logic that has marginalised rural communities in other sectors, such as industrial agriculture that impose standardised market mechanisms that ignore local agricultural knowledge and practices.

Such approaches reflect how commercialised empowerment through market-based development consistently fails to recognise or build upon existing community practices and knowledge systems, strengthening the argument that we need to move towards co-designing community-led algorithmic ecologies which can be done through the algorithmic agroecologies model presented in the chapter before.

Further evidence from the findings reveals some distinct but overlapping patterns in how private providers and NGOs refer to rural communities and frame digital inclusion. While providers

position rural areas as markets awaiting improvement; NGOs frame them as spaces requiring institutional intervention or approval through panels.

"On July 20 and 21, the panelists will provide an overview of what Community Networks are and how they can contribute to connecting the unconnected to the Internet, especially in rural and underserved areas. Register now!"

The institutional positioning of NGOs becomes clearer in how they discuss community networks, by requiring some intervention and asserting that they must help these communities.

"What should we do? 1️⃣ Continue supporting the development of #CommunityNetworks. Communities manage the networks and make them work 2️⃣ We must create capacities to make that happen. These communities belong to rural areas and we must help them" @s-------- at #IGF2019"

Such institutional positioning is presented through institutional partnerships too that maintain a kind of hierarchical relationship where rural communities are objects of intervention rather than agents of change.

These framings become somehow complex when examining the contradictory claims shared by NGOs about rural connectivity. For example, when an NGO shared this post:

"For the first time we are a digital country, not only in urban areas but also in rural areas and the majority of the population has access to the internet": @cuevas_adolfo in presentation of #ENDUTIH" .

This statement contributes to a broader discursive strategy that situates digital inclusion within the framework of commercialised empowerment by relying on statements from government officials that work within institutions that rely on statistical narratives to convey progress. ENDUTIH (the National Survey on Availability and Use of Information Technologies in Households in Mexico) is a statistical institution frequently cited in policy and academic discourse, and which has been instrumental in revealing rural-urban patterns in digital access, as seen in the literature review.

However, in this case, the NGOs uncritical and unrefuted sharing of the government's assertion that Mexico is now a digital country where the majority of the population has access to the internet demonstrates a significant dynamic and a novel finding. By amplifying this claim

without questioning its validity or contextualising it within ongoing challenges in rural areas, the NGO contributes to the narrative, whether intentional or not that aligns with statistical narratives that equate access with digital inclusion, sidelining the persistent disparities in meaningful use, affordability and infrastructure quality that communities have shared.

While the scholarship has emphasised the limitations of access-based approaches, this finding here extends the critiques by demonstrating how institutional actors such as NGOs reinforce this narrative by not challenging it, whether intentionally or not through the uncritical dissemination of governmental statistical claims.

As seen previously with private providers, this reliance on statistical narratives is not confined to NGOs. Private providers adopted and amplified data driven claims that emphasised access-based narratives through framing digital inclusion as a market driven solutions and emphasising infrastructure expansion and penetration. Even more relevant perhaps is the finding revealed through these statements shared by private providers:

"Covering at least 92.2% of the population of our country by 2024, this with the aim of achieving a more and better-connected Mexico, thus contributing to closing the gap between connected and unconnected that still exists in the country through digital inclusion"

"At Altán La Red Compartida we continue to deploy our network daily to meet the goal of covering 92.2% of the population. Getting closer to the figure, we invite you to learn about our current coverage"

There is a pattern among private providers, governmental institutions and NGOs that rely on statistical narratives. For example, the government does this through revealing percentages of who has access and who does not, and private providers rely on these statistical narratives to frame their promises and progress around digital inclusion.

This connection between the statistical framing used by governmental institutions such as ENDUTIH and the language that private providers use, as well as the endorsing by NGOs represent a novel finding in the literature on the digital divide because it highlights the discursive alignment between institutional actors in constructing access-based narratives to tackle the digital divide. Thus, while existing critiques in the literature agree on the limitations of access only based approaches and their inadequacy, this finding extend these critiques by

examining how these narratives are reproduced and legitimised across institutions and private providers while at the same time capturing the qualitative dimensions of this limitation.

These findings open up new avenues for further research to examine how the reliance on statistical data from the side of the government and the use of statistical language by private providers shapes public perceptions and policy decisions around the digital divide.

Furthermore, by situating these findings within broader critiques of neoliberal development models, this project emphasises the need to interrogate how state led statistical tools and market led narratives co-produce a limited, access centric vision of digital inclusion and the implications this has for historically underserved communities.

These insights gain further depth when examining how individuals engaging with the digital divide discourse on social media frame rural communities and digital inclusion in contrast to the already mentioned state-led and market driven narratives. While institutional actors such a private providers and government agencies emphasise statistical metrics to portray progress, individual perspectives shared online offer more context-specific insights that challenge access centric assumptions, allowing us to see more clearly into the limitations of statistical tools like ENDUTIH census in fully capturing the lives realities of individuals.

Such tension between individual perspectives and institutional narratives as well as market promises to reflect a broader critique of commercialised empowerment in the digital divide, whereby individual perspectives offer a counterpoint to these access centric narratives.

Quotes such as:
"@---------: I am a teacher in a rural community. I am dedicated to disseminating academic digital content, working with materials" and
"@----------: Allocation of microwave spectrum for rural backhaul of Indigenous cellular network in Mexico is an unprecedented milestone here…" as well as
"@-------: Almost two thirds of the rural Latin American population does not have significant connectivity", emphasise experiences and context specific aspects of rural connectivity.

These perspectives challenge the commodified approach to commercialised empowerment by highlighting the social, cultural and infrastructural complexities of the digital divide in rural spaces that institutional statistics lacked and that private providers failed to point.

Perspectives shared by individuals on social media such as "@----------: Community networks address the access gap in rural and remote areas and additionally help with bettering education" reveal tangible approaches within rural communities to tackling the digital divide.

What is more, perspectives such as *"@----------: Invited to reflect on rurality, sustainability, communication and technology @---------- @---------- @----------"* echo earlier findings and discussion in the previous chapter on algorithmic agroecologies which highlighted nurturing digital futures. Such perspectives show how the digital divide can transcend market logics by showing how local agency looks like, and how there are references to broader subjects within such as sustainability.

Chapter 6: Algorithmic agroecologies: nurturing relational digital futures

This chapter presents evidence of how communities actively shape and nurture their digital futures. Through analysis of interviews, focus groups and social media data, the findings demonstrate how communities develop organised and collective practices that reflect their values and contexts. Of particular significance is how these practices reveal not only innovative approaches to digital engagement but also highlight communities' practices for developing sustainable and culturally grounded digital futures.

The findings indicate that the rural community conceptualises technology through relational frameworks, which is widely supported by evidence from communitarian providers and organisation data from social media. In contrast to most of the digital divide literature, which frequently frames digital engagement or making in terms of barriers and limitations, this research suggests that technology hold meanings primarily in its capacity to sustain and strengthen existing social relationships and practices.

This relational perspective extends the concept of algorithmic agroecologies, showing how communities incorporate digital technologies not as external solutions but as embedded

components of their broader systems of ecological knowledge and collective organisation practices. This chapter presents algorithmic agroecologies both as a significant theme that emerged from the analysis and as a potential model for addressing digital divide challenges.

The evidence presented here moves beyond simplistic narratives of technological adoption to reveal how communities actively resist, oppose and/or negotiate with state and private actors but most importantly how they build what this projects terms algorithmic agroecologies, as a adynamic systems of knowledge, practices and relationships that bring together technologies, digital and non-digital, with existing ecological and collective practices.

Through the analysis, five key dimensions of algorithmic agroecologies emerged: relational frameworks, traditional knowledge sovereignty, collective learning, ecological stewardship and communal autonomy. The findings reveal that traditional knowledge, collective practices and local agroecological practices do not simply intersect with digital and non-digital technologies but actively shape how communities reimagine and repurpose these technologies.

This approach emphasises how communities nurture technological systems that are inherently relational, locally rooted and community-led, thus presenting a significant counterpoint to conventional top-down solutions.

As evidenced in the interviews and focus groups data, the first component of algorithmic agroceologies stems from how the rural community conceptualises technology which sets the stage to framing relational perspectives throughout as the community's relational understanding and practices demonstrates how technological engagement is embedded within broader social and ecological relationships rather than treated as a socio-technical domain.

Community perspectives on technology: framing digital relations

The interview data highlights that the rural community conceptualises technology within deeply relational frameworks which challenges digital divide literature which often frames technology engagement in rural contexts to questions of barriers, be it socio-economic, socio-political, technological or how they use them.

While participants acknowledge the immediate association of technology with digital devices, as shared in the statement: *"the first thing that comes to mind when I hear the word*

"technology" is machines or digital" is significant for understanding the digital divide because it reflects a broad view of technology that includes but it is not limited to digital tools but either machine or digital. This already challenges digital divide literature that has overfocused on separating digital technologies from technologies.

Furthermore, this conceptualisation becomes clearer in how participants define technology as a process *"Technology is processes and tools that make our lives a little easier, like not burdening our bodies or our minds so much"*, a concept that evaluates technology through its ability to reduce physical and mental strain, highlighting a perspective on technology that challenges the prevailing focus of digital divide literature. By defining technology as tools and processes that do not burden us physically or mentally, the community members emphasise a more human centred approach that deviates from the current functional driven approach in most of the literature.

What that response also reveals is the evaluation community member gives around technology, digital or otherwise, rather than predetermined categories of technological importance.

There is a sort of refusal to separate digital from other technologies and one may say that this is because of how the questions was framed but participants did provide many responses in relation to digital technologies. However, this refusal is especially significant for digital divdie literature and frameworks which although have expanded to consider socio-economic and sociopolitical dimensions of access, they still overwhelmingly trat digital technologies as a distinct technological category requiring specialised analysis. In contrast, this project shows though community lived experiences and responses the need for frameworks that can examine how digital tools functions as part of a broader technological systems serving community needs.

Another participant articulation: *"For me, technology is the need we have to solve problems, improve our lives and make them more effective through the use of techniques applicable to a lot of disciplines and areas"*, demonstrates a nuanced, multidimensional understanding of technology, unlike the common focus on external frameworks for addressing the digital divide, this perspective situates technology as an embedded, context-sensitive element of daily life, rooted also in problem-solving and cross-disciplinary relevance.

Furthermore, statements such as *"I think that nowadays or at least in my context, technology is present in practically all the actions that I carry out in my daily life, I also believe that well-*

used technology can improve people's quality of life and the environment" introduces ethical and ecological dimensions often absent from mainstream digital divide discourse. What makes this insight relevant and novel and contributory to literature is that while existing frameworks increasingly account for context and meaningful use, they rarely emphasise technology's potential to strengthen environmental subjects from the point of view of a rural community. This focus on ecological and collective well-being not only broadens the understanding of how a rural community conceptualises the purpose of technology, but challenging frameworks also that predominantly centre on individual or market driven benefits.

What is more, the framing that *"technology is present is practically all the actions that I carry out in my daily life"* as other community members shared *"A tool that makes our daily lives easier"* highlights how integrated technology is in their everyday lives and is not a gap to be filled.

One of the most relevant findings is how technology is viewed as a means of sustaining and strengthening social relationships, especially across distances. Reponses consistently emphasised that technology enables them to remain connected with family and friends, especially those separated by physical distance.

For example, participants noted: *"Technology helps me stay informed about things that interest me, such as social media, Facebook and WhatsApp"* and also that "*That keeps me connected with the people I love, especially now that we are separated and when they want to know about me or I want to know about them. Also to connect with my friends here in town"*. Such accounts resonate with values that prioritise the social affordances of technology over only functional capabilities, suggesting that technology's value is often derived from its ability to enhance relational and communal ties, rather than its standalone utility. Another one shared *"Well now it is more essential in my daily life. It helps me run my business a little better, but it helps me more in staying connected with my daughters in the US"*, showing how technology serves transnational family connections.

The data also reveals how technology is embedded in the infrastructure of daily life, supporting both individual and collective needs. For instance, participants described technology as *"an indispensable tool that allows me to manage my construction projects efficiently, stay in touch with my team and clients, and stay connected with my family during my travels"*. Other shared it importance for education and leisure, explaining that *"it helps me study, access university*

material, keep in touch with my friends". While these examples may not seem relevant, it is a window into seeing how at first, technological conceptions fall within what has already been widely established in digital divide research around everyday uses.

Interestingly, while many participants framed technology as essential, there was also a recurring acknowledgement of the need to balance its role in daily life. For example, one participant noted "*it is important but not vital, since I still have a life where I do not want to totally depend on technology"*, while another community member observed, *" it is a daily necessity now, but you can also live without it when the conditions are there".* Such statements highlight a nuanced perspective in which technology is viewed as both indispensable and non-essential. This ambivalence suggests a critical awareness of the potential limitations and overreach of technology, offering a more balanced narrative that us often found in digital divide frameworks pushed by state inititiaves or market led inititiaves.

Furthermore, the data underscores how technology is perceived as a collective resource that supports communal and economic activities. This can be seen in how some community members described technology: *"a set of processes that we have acquired over time and tools that help us have easier processes"* as well as *"a necessity for daily life in all its aspects because you can find everything on the internet"* highlights the idea that technology is not simply an external tool imposed upon the community.

A community member shared how *"The inclusion of technology in the life of rural communities can be a generator of new opportunities as long as its use is derived from a diagnosis and an approval process suitable for the economic and social activities of these*". A quote that starts highlighting the community's critical awareness of the conditions under which technology can become beneficial and suggest that technological interventions must resonate with the community's specific needs and contexts. This insight is novel in that it foregrounds the experiences and articulations of the community itself, rather than presenting typical researcher driven interpretation or recommendations that dominate much of the digital divide literature.

While existing studies often emphasise the need for context-driven approaches, this recommendation often emerges from external experts rather than directly centring the lived experiences, words and perceptions of the communities impacted. Thus, by directly quoting the community's own articulation of "*diagnosis and approval processeses"* for example, this

research offers a unique insight into how a rural community conceptualises and prioritises participatory planning.

This contribution challenges the literature by shifting from an externalised advocacy for participatory methods to evidence rooted in community-voiced demands. Such an approach goes beyond validating the agency of the community and extend into also critiquing the tendency of digital divide research to tokenise pr generalise communities without deeply engaging with their localised, self-identified needs.

Moreover, by directly incorporating the community's language and framing into these findings, this work highlights a key gap in the literature which is the lack of focus on how communities theorise their relationship to technology and participation. This moves beyond theoretical assertions about decolonisation or inclusion to provide empirical evidence of what participatory processes in practices, as expressed by the community.

Having established how the community conceptualises technology through their daily experiences and social relationships, uncovering how they define it through relational frameworks rather than functional ones, as most of the digital divide literature does as well as digital divide initiatives, it sets the stage to how such understandings shape impacted communities' approach to how they relate to technologies and thus digital technologies. This relational framing forms the foundation for understanding how the next dimensions of algorithmic agroecologies emerge through community practices.

Traditional knowledge sovereignty

The data shows that traditional knowledge sovereignty is central to how communities build their algorithmic agroecologies, challenging digital divide scholarship that often portrays rural communities through their technological gaps or deficits. However, through careful analysis of community responses, this project uncovers how communities actively bring together their agricultural expertise with digital practices to create new possibilities.

This connection emerges clearly in how community members discuss potential solutions to the digital divide, where rather than seeing traditional knowledge as less valuable than digital skills, they position different types of expertise as equally important and complementary. As one

participant expressed: *"Just as young people know more about cell phones and computers, we know a lot about ways to grow crops, store water and capture it too."*

More specifically, this finding reveals how the community asserts epistemic sovereignty by bringing in agricultural knowledge and traditional knowledge with digital practices which challenges dominant narratives of technological progress as well as existing decolonial frameworks.

When community members share about what is at the root of their technological access challenges, their responses consistently point to deeper connections between technology access and the preservation of agricultural knowledge and these can be seen through specific references to traditional agricultural practices and infrastructure, such as *"Maybe more effort should be made around the wells or cisterns that we still have in some houses",* highlighting how existing agricultural infrastructure remains relevant to current community needs.

At the same time, when asked what they think are the root causes of the lack of access to technology in the community (Q5), some community members frequently referenced the declining interest on traditional agricultural practices, as community member notes, *"Like there are some traditions that are no longer taken as seriously as the milpa or the cisterns or the wells",* while another shared *"perhaps lack of knowledge of some things that we have always had such as wells, forms of agriculture".*

These responses show how community members understand technological access not as separate from but intertwined with agricultural knowledge systems. The connection of agricultural knowledge and digital engagement extends beyond the interviews and focus groups and within the broader social media analysis, evidence emerged of how communities actively engage with agricultural knowledge in digital spaces.

These insights make notable contributions to both digital divide literature and decolonial theories. First, they challenge dominant digital divide frameworks that focus primarily on infrastructure, devices and digital literacy, as seen in the literature review. By showing how community members understand technological access through the lens of agricultural systems, the findings demonstrate the importance of engaging directly with community understandings of technology and access.

Second, these insights extend decolonial theory' critique of universalist approaches to technological access as the community members references to traditional agricultural practices when discussing technological access illustrate how local ontologies and knowledge systems are central to understanding and addressing digital inequities.

For instance, content creators use digital platforms to share about their native language and rural community as well as their community's agricultural practices: *"@----------: Youtuber, Tiktoker, visual anthropologist. Share about your culture, #------ language and rural community of ----------. Virtual presence has also made her a cultural ambassador of her region and agriculture (she participates in events about potatoes* 🥔 *and other products)",* demonstrating how rural and/or Indigenous community members amplify and share about their agricultural practices as part of their cultures.

These expressions of agricultural knowledge extend into how communities conceptualise solutions to technological access as well. Community participants' responses reveal a sophisticated awareness of how rural areas are often mis-conceptualised in policy and development discourse, as one community members notes: *"When there is a talk about rural areas, there is an automatic visualisation of a geographical space or locality with primary economic activities, especially agricultural, with few inhabitants, deep rooted traditions and customs, Indigenous population…".*

This automatic perception creates what the community member describes as "*leading to a somewhat biased perception of our localities who are then also excluded in the design of public policies".* An observation that challenges both mainstream digital divide literature and policy approaches that treat rural areas as homogenous spaces defined primarily by lack.

These insights challenge dominant approaches in bath digital divide literature and policy frameworks that tend to characterise rural areas primarily through deficits. Instead, the evidence suggest that community members actively engage and critique these characterisations, showing agency in how their communities and agricultural practices ate represented and understood in both digital and policy processes.

However, the data also shows how characteristics often framed as deficits can be reinterpreted as strengths. While the participant acknowledges that stereotypical views of rural areas *"run the risk of widening social gaps",* they add that *"these differentiating characteristics of rural*

areas like ours are an opportunity to enhance our own development through digital technologies".

These reframing gains further strength through other community members' statements such as: *"we know a lot about ways to grow crops, store water and capture it too",* showing how traditional knowledge and practices can be foundations for development rather than obstacles to it.

The evidence shows how communities purposefully reshape these narratives that have been put on them but the data also reveals a clear vision of community-led development. For example, as a community member emphasises: "*the key is to prepare proposals appropriate to the needs of our communities and have the initiative that we are the ones to take control of our creations".* This emphasis on community agency and knowledge cohesion becomes particularly evident when another community member shares "*well, since we live a lot from agriculture here, we could see what technologies could benefit the community in general, such as fertilizer technologies, combining techniques that we already have with newer techniques";* a vision that extends to creating balanced approaches, as evidenced by a community member statement to *"find a balance between the technologies of now and those we have used before".*

The evidence demonstrates how traditional knowledge sovereignty becomes a strong foundation to algorithmic agroecologies through the community's active combination of agricultural knowledge with technological development. Thus, when a community members notes "*throw open and general ideas and give space to concretise the final output" ,* emphasising active community agency in in this process of technological development.

These insights significantly challenge dominant digital divide literature by demonstrating how characteristic typically framed as deficits in rural communities can be reinterpreted as strategic assets for development. While state-led and market-led solutions often position rural spaces as barriers to overcome, these findings show how communities actively reframe these as foundations to be merged with technologies.

This data advances decolonial theory by showing how communities move beyond simply resisting dominant technological narratives to actively creating new pathways that honour both traditional and emerging knowledge systems. Such vision suggests a hybridisation in

development and extends decolonial theory's understanding of how communities can maintain knowledge while engaging what that they called modernity.

Furthermore, these findings reveal a nuanced approach to community-led technological development that contributes to digital divide and decolonial literature through their emphasis on agency and knowledge sovereignty. Thus, concretising how communities envision combining agricultural knowledge with technological possibilities while maintaining decision-making power, it challenges the digital divide emphasis on deficit-based understanding of rural communities and decolonial theories' sometimes rigid positioning of traditional versus modern knowledge systems.

These findings point to a more nuanced approach that recognises community agency in crafting solutions that preserve knowledge sovereignty while advancing technological capabilities. This agency extends into how the community conceptualises their participation in the digital economy, as one community members shares "*taking part in this new ecosystem of the digital economy",* other community members articulate specific visions of how this might work *"Where we all have stable access to the internet and can use technology not only for entertainment, but as a tool to improve our education, health and work"*.

In particular, we can see the combination of agricultural practices with technological development emerges as a central themes in these visions, as community members share practical applications, noting *"I think implementing technologies in agriculture, because currently it is very important to worry about caring for water, and where there is the greatest impact is in agriculture, if it is achieved making water management more efficient by implementing irrigation systems, water collection brings benefits throughout the community"* while another community members shares *"I would like to see our community using technology not only to improve agricultural productivity, but also to make our agriculture more sustainable, continue using traditional methods and only use modern technologies to waste less water, for example."* which show how community members articulate specific ways to strengthen traditional agricultural practices through targeted technological applications that still prioritise sustainability and resource stewardship.

The data shows how traditional knowledge sovereignty extends beyond agricultural practices to broader cultural elements, essential to communities' life, such as is the case of language preservation through technology. For example, social media data from communitarian

organisations highlights the broader scope of traditional knowledge sovereignty and this can be seen through the following tweets: " *@----------: "Artificial Intelligence" NLP tools for Mexican languages @----------" or "Interested in how Natural Language Processing can be done when you have languages with limited digital resources? Join ---------- online class now. June 9, 1:00 p.m. #FacultyOfEngineering #UNAM"* demonstrating how communities actively seek ways to preserve and develop their traditional knowledge using digital tools.

This complements earlier insights where community members spoke about integrating agricultural knowledge with new technologies, showing a consistent pattern of communities asserting their traditional knowledge with digital development. We can see how both, agricultural and linguistic examples demonstrate how traditional knowledge sovereignty involves communities actively determining how their cultural practices and knowledge systems interact with digital technologies and the creation of them too. With social media analysis showing how communities actively pursue technological tools such as Natural Language Processing to support Indigenous language preservation, demonstrating a holistic approach to maintaining cultural sovereignty on digital spaces.

This vision makes important contributions to both digital and decolonial literature; while digital divide literature has focused primarily on barriers to access, motivations, and gaps, these findings reveal how communities envision technological development as inseparable from cultural preservation across multiple themes, from agricultural practices to language, challenging digital divide solutions that treat technological adoption and localised knowledge as irrelevant to being adopted.

For decolonial theory, these demonstrate how communities reshape technological tools to serve cultural sovereignty, moving beyond critique to show how communities can maintain autonomy while engaging with emerging technologies, showing an approach that neither reject technology completely nor accepts it uncritically, but rathe adapts it to strengthen traditional knowledge systems.

The significance of these insights so far helps extend current theoretical frameworks in digital divide scholarship, so that while scholars such as van Dijk (2004, 2015, 2020) who is quite renowned and recognises the importance of social structures and power dynamics while also advocating for policy-driven solutions, this project reveals how are interested in moving beyond structural inequalities. As we have seen, the evidence shows communities exercising active

agency in knowledge creation and selective thought through digital adoption. This advances digital divide literature by shifting focus from never ending top-down proposals to community-led innovation proposals.

These findings more specifically reveal a key limitation found in abstract decolonial frameworks, such as Quijano (2000, 2007) coloniality of power and Escobar's (2018) pluriversality which discuss resistance to colonial knowledge hierarchies and the existence of multiple ways of knowing but remain detached from concrete community experiences. The evidence so far shows how communities are not simply resisting or demonstrating alternative ways of knowing, in fact, they are actively creating new approaches to technological innovation that these theoretical frameworks fail to capture.

What is more, through community members' own words, actions and visions, we can see practices that go beyond theoretical concepts of resistance or pluriversality to show concrete examples of knowledge sovereignty in action. Such active creation of new approaches can be seen clearly in how gender intersects with the agricultural knowledge and technology within community settings, reshaping some of the common narratives.

While the data shows that the role of women in agriculture remains underrepresented, as one community members shares: *"As an agronomist I have seen that women are often not seen in the field or using agroecological technologies"* with this marginalisation being shared on social media too *"RT @----------: Only 18% of the land in Latin America and the Caribbean is in the hands of rural, peasant, Indigenous women"*.

This systemic inequity extends to how women's knowledge is perceived and valued, often shaped by gendered expectations. On the one hand, as social media data shows *"Much of the knowledge of women farmers is not recognized by the academic world because it is not based on the knowledge of men. We have to remember that it is okay to have care as the centre, that this is a very important form of knowledge*", a statement that reframes care as critical, though undervalued, form of expertise.

These insights make significant contributions to both digital divide and decolonial literature, specially around gender and technology. While digital divide literature has examined gender gaps in access and skills, it has not considered how gendered forms of agricultural knowledge might inform technological development in rural communities or communities where

agriculture is widely developed. Thus, revealing how women's agricultural expertise, though marginalised, offers important perspectives on sustainable technological adoption that many initiatives or models overlook.

For decolonial theory, these insights extend beyond documenting exclusion to show how women's agricultural knowledge represent a different epistemological approach centred on care and sustainability, further advancing decolonial frameworks by showing how gendered ways of knowing do not only resist dominant technological structures but offer alternative visions for how technology could be developed and implemented.

Therefore, the evidence of women explicitly reframing care-based knowledge as expertise, challenges both digital divide and decolonial literature to better account for how gender shapes not only access to technology but fundamental understandings of what constitutes valuable technological and agricultural knowledge.

On the other hand, focus groups data reveals the discomfort with how these gendered expectations translate into technological and agricultural practices *"I think we have seen that our mothers tend to use certain technologies more than dads, and vice versa, since kitchens and washing machines are more for women, I don't like that and since men are more attuned to rural technologies"*. Together, these tensions expose both the undervaluation of women's traditional knowledge and the restrictive gender norms that limit their engagement with broader technological and agricultural practices.

However, the data shows that these tensions are being actively challenged, with communities redefining roles through collective and community driven efforts, as this social media data shows *"In another #CommunityNetworks story, --------, tells how being part of a community project has given her infinite possibilities, independence and economic sustainability, becoming a role model for many of the women in her community"*, showing how collective inititiaves that provide women tools to assert agency, shifting their role in both technological and social context within their communities but also showing how such efforts go beyond individual empowerment to reinforce the value of community relationships and shared expertise in shaping technology.

This is tied to the principles of traditional knowledge sovereignty, as the statements above actively bring together local knowledge and practices around agriculture and technology. At the same time, these insights show how knowledge can be shared through collective initiatives.

Such insights reflect feminist critiques that further highlight the structural implications by calling for moving beyond superficial solutions focused only on representation towards collective practices, as a social media statement reinforces it *"...we must rescue the creative and emancipatory power of feminism to think and develop a different and collective digital technology. We don't necessarily need more women; we need more feminism in technology"*. This reinforces the community driven approaches documented so far, where agricultural practices as fundamental parts of the web of the community are also part of how the community operates and envisions, transforming into knowledge networks that support each other. These knowledge networks, as demonstrated through the communities' practices and experiences become systems of shared learning and mutual exchange that prioritise collective learning.

These insights reveal significant implications for how both digital divide literature and decolonial theory conceptualise gender, technology and community agency. For instance, the evidence in the last few paragraphs advances digital literature beyond its typical focus on individual access and representation to show how gendered expectations shape both technological and agricultural practices at a systemic level. More importantly, it demonstrates how communities actively challenge these limitations through collective approaches, a dimension often overlooked in digital divide literature and initiatives that tend to focus on the individual.

In the case of decolonial theory, these findings make novel contributions by demonstrating how feminist perspectives and collective action reshape traditional knowledge sovereignty and views sovereignty not as resistance to dominant systems only, but how particularly women in this case, create new collaborative models that combine technological innovation with traditional agricultural practices. Thus, extending decolonial frameworks by revealing how knowledge sovereignty operates not only as preservation but as active creation through collective inititiaves.

The emergence of community driven knowledge networks that prioritise collective learning and mutual exchange represents a particularly significant theoretical contribution. However, while both digital divide literature and decolonial theory acknowledge community dynamics, these

findings reveal more elaborated patterns of collective agency that challenge individualistic approaches to technological development and traditional knowledge preservation.

As a result, from communities actively creating systems of shared learning advances both the digital divide literature and decolonial theories that overfocus on critiquing modernity by showing how collective approaches can simultaneously preserve traditional knowledge while innovating new technological practices.

In this way, knowledge networks are not abstract constructs, but tangible efforts embedded in the lives and experiences of communities' experiences, shaping how they approach both challenges and opportunities. Building on how knowledge networks are formed and operate, the findings further show how collective education works as critical feature for communities bringing digital technologies into their lived realities.

Knowledge networks and collective education

Data from both stages demonstrates that knowledge is shared through collective practices which are also embedded in community relationships and guided by the local contexts and needs. This is closely tied to the main theme of algorithmic agroecologies, where technological engagement is conceptualised as an extension of ecological and social systems, contributing too to the communities' digital experiences and futures.

A clear contribution of the following insights to the digital divide scholarship lies in their documentation of two interconnected patterns that challenge conventional models of digital inclusion. First, educational practices are not framed as only individual skills acquisition but as collective endeavours, as community members emphasise the importance of mutual support systems, as these statements shows *"Additionally, we could organize support groups to teach each other about technology"; "support each other - on how to use technologies already available - hold workshops, groups to share knowledge"*

These articulations reveal an approach to knowledge circulation that extends beyond simple peer to peer learning and instead emphasises on contextual adaptation as we can wee in statements such as *"We could organize more workshops on technologies, make technologies with our contexts"* highlighting how digital learning becomes embedded within locally relevant frameworks.

These insights advance digital divide literature in two key ways. Firstly, by challenging conventional digital inclusion models that focus primarily on individual skill acquisition through standardised training, but the evidence shows how communities create learning ecosystems where knowledge circulates through collective practices and mutual support networks. Second, the findings so far suggest that digital learning becomes meaningfully embedded in local contexts rather than imposed through external frameworks or initiatives, a dimension overlooked. This suggests the need for frameworks that can better account for how communities actively shape technological learning through collective and contextual approaches, as algorithmic agroecologies proposes.

Particularly significant is the intergenerational dimension of these knowledge sharing mechanisms, as exemplified in this participant articulation *already have things that we do among the community - young people could, for example, give workshops to older people";* a practice that suggests how the community leverages existing social structures to facilitate digital learning, rather than treating technological education as separate from community relations.

The collective nature of these knowledge sharing practices is also exemplified in social media data where *"---------- Collective thanks everyone for attending the workshops, for sharing their experiences and for everything they experienced, from the bottom of our hearts and with all sincerity we are very grateful to everyone who gave us their great unconditional support"* demonstrating how knowledge circulation occurs through structured collective experiences.

Such collective approach is further reinforced in another post documenting how *"The participants were able to meet to reflect on #CommunityCommunication through a series of workshops and the installation of the radio. We also thank @B--------- for having contributed to this process and sharing his knowledge.*  *"*

The data further reveals how these collective learning practices extend into cultural preservation and Indigenous innovation, as evidenced by this post "*To make visible the contributions that Indigenous communities make in different regions in terms of innovation for the teaching of Indigenous languages and the promotion of cultural diversity...".*

These statements underline the critical role of intergenerational learning and peer-to-peer teaching and building technological capacity including proposals to *"do technological training workshops for all interested parties"* and *"Hold conferences or conferences to inform people*

working in agriculture, transportation or livestock about new technologies"; highlighting how the community views education not as an isolated act but as a shared responsibility that empowers local expertise and the collective.

Social media data further enriches these insights, demonstrating how communities connect their localised efforts to broader regional and global knowledge networks. For example, open calls such as "📣 *#OpenCall To participate in the Latin American Congress of Rural Sociology @alasru2022. Reception of proposals until March 31, 2022.* 👉 *More information:"* and live events such as *" @----------: TODAY 18.30!!#open chat* 💪 *How to build #community #internet networks in #rural areas and #popular neighborhoods"; "#Live Virtual Meeting of Rural Labs in Latin America Part 4"*

all showing how communitarian organisation expands the reach of these collective practices and the efforts which are seen in community driven initiatives such hosting conferences and workshops to disseminate knowledge, local needs with global dialogues.

The second pattern, which highlights how communities conceptualise digital infrastructure within their agricultural practices, connects to knowledge networks and collective learning by emphasising the embeddedness of technological practices within the broader ecological and social systems of the community. This connection is made clear through the ways in which community members share experiences of their traditional agricultural methods with modern technologies and the collective processes that facilitate this. This is articulated clearly through a community member statement:

"Right now, I think a lot about agriculture, because like everyone here, my dad is an ejidatario and it would be good to maybe learn how we could combine traditional irrigation methods with contemporary technologies. I also think that it would be good to navigate technologies where water is used to the maximum, especially because right now we have rationed water. I have heard of water collection systems and more community infrastructures as well."

Similarly, this statement:

"I think implementing technologies in agriculture, because currently it is very important to have concern about caring for water, and where there is greatest impact is in agriculture, if we can achieve making water management more efficient by implementing irrigation systems, or water collection, this will bring a benefit throughout the community." Both reflecting a

communal vision where technology serves the collective good and reinforcing the interconnectedness of their ecological systems and social relationships.

The evidence presented so far in this section makes significant contributions to digital divide scholarship in two ways. One, while existing digital divide literature often focuses on access barriers or individual skill development, this project demonstrates how communities have built knowledge networks that combine their local expertise with technology development, use and learning. Two, this project advances digital divide scholarship by documenting how collective learning operates as a critical mechanism for tackling the digital divide. So, where conventional digital divide approaches often focus on individual trainings or top-down education models, the insights presented here so far show communities have either developed or envision contextualised learning spaces.

This contribution is particularly significant because it moves digital divide scholarship beyond binary frameworks of access/no access or skilled/unskilled towards understanding how communities actively build knowledge networks that connect their local agricultural practices and knowledge and digital practices. These are innovative approaches to technological building that maintain community sovereignty over knowledge transmission, cultural and agricultural practices with technology building, knowledge and learning.

Insights around collective knowledge networks and traditional knowledge sovereignty ties together into how communities relate to and nurture digital ecological relationships which we will see in the next section. The ways in which communities nurture their digital ecological relations is a significant contribution to the literature because it shows how communities' holistic understanding of digital systems as being interconnected with their ecological relationships, while digital divide scholarship approaches technological infrastructure as separate from environmental considerations.

Nurturing digital ecological relations

This ecological understanding is clear from what a community member shares:
"Because our community is rural, our environment requires infrastructure that goes with our environment and that works based on this environment, the needs we have are also adapted to this environment, but I don't know, I think we can combine this with contemporary technologies. The point is to talk about it and know how to do it"; showing how the community

extends its knowledge systems beyond agricultural practices to include broader environmental relationships in technological development.

When asked their role in addressing technological exclusion in the community, some community members presented their solutions through ecological relationships. A community member statement highlights this by sharing *"Lately the use of water has been rationed a lot and if you don't have a well then sometimes you don't have water and you have to wait. One option would be the installation of rainwater collection systems on the roofs of each home and community structures."* An experience that shows how within the community there is a vision of technological infrastructures as part of environmental resources and communal needs.

This combination of ecological and technological thinking can be seen in other communities, as evidenced in the social media data around discussion of a rural telemedicine project shared by a communitarian organisation: *"#Telecommunication #connecctivity Learn more about this rural #telemedicine project in the #------ that has been driven by the #COVID19 pandemic";* a pattern that shows this understanding of technology and infrastructure as art of environmental resources and communal needs which as we can see emerges consistently.

A community member articulates this vision clearly: *"There are projects of houses with an architecture designed in the environmental aspects of certain places made with recycled materials and at low costs that could be implemented. Systems for the reuse of water that can be used to irrigate crops or in the same houses implement the use of biodigesters to be able to use the grey water to water the garden or backyard gardens. In the case of agriculture, the use of new crops can be implemented modified to resist drought. Also, the promotion of agriculture and livestock in a symbiosis with the land, the operation of self-sustainable biodynamic farms."*

As we can see, this relationality is present throughout but becomes particularly clearer when other community members start sharing about how they envision solar and water systems as part of broader ecological relationships and as part of the community's technological infrastructure. For instance, this envisioning of a community member: *"I imagine the community with all these technologies that we build to have digital access and the information we want but also water and electricity without thinking whether it will arrive or leave. If we could take advantage of creating technologies/infrastructures with the resources we have, such as the sun, or seasonal rain."*

These findings demonstrate how rural communities actively construct technological relationships that go beyond existing digital divide frameworks or barriers and solutions, offering a deeper reimagining of what development and inclusion mean in practice. They reveal how their relational practices and knowledge systems open up new possibilities for understanding technological engagement, moving beyond conventional policy approaches.

This vision emerges clearly in how the community approaches self-sufficiency and stewardship of resources, including digital access, water and electricity, showing a desire to move beyond reliance on external, corporate driven infrastructures and towards building local capacity using renewable techniques such as rainwater harvesting and solar energy. This expresses autonomy where the community stewards' resources to make sure there is sustainable access.

Another member expresses:

"Exceptional, let's think about real possibilities, all making the most of the resources available. The community has every possibility of generating its own clean energy through solar cells, using solar heaters to sustain their homes, implementing machinery and systems that facilitate and optimize processes in the field (the basis of the economy), cleaner harvests With fewer chemicals, houses could be built with natural materials that minimize heat without the need to use air conditioning, even saving time and money invested in returning to neighbouring communities to pay for various services, etc."

These agroecological relational approaches to technology offer an alternative framework for addressing the digital divide, one that applies agroecological collective resource management to digital infrastructures while also challenging prevailing digital divide frameworks that often emphasise technology development through top-down approaches, failing to acknowledge and capture the complexity and relationality in many rural communities, such as what are the main cultural, social, economic drivers of a community.

This raises intriguing questions regarding the nature of digital technological adoption in rural contexts, particularly how such communities reframe technologies as part of the ecological relationships and community needs. Such reframing of technology as inseparable from ecological relationships and community life opens new pathways for understanding how rural communities can and already actively shape their technological futures.

The insights so far show how algorithmic agroecologies offer both a theoretical framework and practical model for nurturing relational digital futures and this can be further shown through how communitarian organisations on social media showcase these relationships:
"Last Friday the Red De Amaranto De Valles Centrales joined the #SurcoATuMesa group. 🧑🌾👩‍🌾They are a cooperative of women and men who plant, harvest and transform amaranth into all the delights you can imagine. #AgroecologicalNetwork #LocalConsumption". Such statement brings to the table agroecological networks of food systems in this case as a collective of women strengthening agricultural networks and local economies, representing a move beyond the typical digital divide focus on access and skills in isolation into broader community and collective practices.

Community members also shared similar collective and interconnected ways to how technological access relates to other resources in the community, for example, *"I imagine the community with all these technologies that we build to have digital access and the information we want but also water and electricity without thinking whether it will arrive or leave";* making it clear that digital access is inseparable from other essential infrastructure *"That we have internet without interruptions, just as it will not cost us to have processes in which we build our technologies as we have done in several examples"* emphasising both reliability and community agency in this and such statements speak to the desire for infrastructure stability that incorporates both digital and physical resources.

Further analysis reveals a nuanced combination of both digital and ecological perspectives that contribute to digital divide scholarship in different aspects. For example, the following statement by a community member showcases this:

"Right now I think a lot about agriculture, because like everyone here, my dad is a farmer and it would be good to maybe learn how we could combine traditional irrigation methods with contemporary technologies. I also think that it would be good to navigate technologies where water is used to the maximum, especially because right now we have rationed water. I have heard of water collection systems and more community infrastructures as well."

Through that statement we can see how the combination of traditional irrigation methods with contemporary technologies while also emphasising water management during rationing shows how agricultural practices would prioritise technological priorities, which represents a very

different lens from the conventional digital divide frameworks that would treat technological access and development as separate from environmental concerns, or in reality would not even be considered at all.

Social media data from communitarian organisation reveals how communities actively challenge technological interventions that do not align with their agricultural practices and values. So, when organisation point out *"🔴One of the repercussions caused by the #war is the rise in food prices, which causes the industry to opt for the cultivation of genetically modified foods. ✅The proposal is to say yes to #foodsovereignty through AGROECOLOGY"* they are demonstrating resistance to industrial agricultural technologies that threaten local autonomy and their food systems.

This is an important insight that offers some key contributions to the literature. One, rural communities are often framed as either resistant or passive recipients of technological change, however, the evidence shows communities are actively evaluating and selecting technologies and modernities based on how they fit with local value and practices. So, where conventional digital divide theories focus on adoption rates or access barriers, this shows a more complex process of technological sovereignty.

Two, it expands our understanding of what meaningful access means in digital divide contexts and while existing digital divide scholarship typically measures access through infrastructure availability or individual skills, the evidence so far shows communities defining access through their ability to maintain autonomy over technological choices. So, when communities reject genetically modified foods while embracing other agricultural technologies or digital technologies, they demonstrate a well-developed decision-making process about technological development that current digital divide scholarship fails to capture.

Three, it connects technological decision-making to broader questions of resources sovereignty, and this can be seen by linking their approach to technology with food sovereignty, *"Write us a message to join the ------ local consumer network 😊🤗 #agroecology #consumelocal #----------"* showing us how digital divide issues cannot be separated from other forms of autonomy and self-determination. This challenges isolated approaches in current digital divide scholarship that treat technological access as different from other forms of community sovereignty.

The intersection of community driven internet access initiatives with broader ecological education and climate action is also a significantly different shift form conventional digital

divide scholarship. For example, insights from the data how community members propose: *"I like the idea of doing community initiatives such as establishing internet access centres and training workshops"* alongside evidence of comprehensive knowledge networks such as *"The M.C. ---------- from the ---------- Autonomous University of the Department of Agroecology, advises students of the #SentipensarLaMadreTierra knowledge groove in #CuexhidzaYaviche"* demonstrate how technological access becomes interconnected with other learning ecosystems, challenging the tendency in digital divide literature to treat technological training as separate from other forms of knowledge exchange.

Furthermore, the development of publications evidenced in this tweet *"In the central part of this publication we propose a set of ethical principles for the use of digital technologies in agroecology. Free download 👇"* represents a novel contribution by showing how communities actively create frameworks for technological integration that go with their ecological values which further challenges and adds to the scholarship around concerns of access and skills to move towards considering how technologies are integrated into existing ecological practices.

Building on these insights, the evidence also shows how communities develop approaches to technological integration that respond to ecological rhythms, representing a novel finding that further supports algorithmic agroecologies while also challenging conventional digital divide scholarship whereby this project demonstrates how communities envision technologies that work in harmony with natures' cycles.

For example, when a community member shares *"If we could take advantage of creating technologies/infrastructures with the resources we have, such as the sun, or seasonal rain",* further reinforced through social media data that shows how communities understand and work with seasonal rythms, *"#FurrowsToYourTable He is ------, a producer from the ------- who brings us potatoes, apples, pears and other seasonal fruits. #consumelocal #AgroecologicalNetwork".*

This deep knowledge and connection with ecological cycles could transform how we approach technological development too which becomes particularly relevant when communities envision creating technologies and infrastructures with the resources they have. But also which may offer new avenues to tackle experiences in the community with how seasons affect communities infrastructures, *"The internet is very bad in the community and the power goes out a lot during the rainy season",* with service interruption becoming routine: *"The electricity*

and internet service is not very stable since days could constantly pass without having the service working".

Another important aspect found relevant to this section and that supports this chapter is the way communities bring together approaches that connect digital infrastructure to environmental stewardship and resource management. Communitarian organisation emphasis on protecting the planet through weekly agroecological products, *"At #Surco we know the importance of protecting the planet 🌍 that is why we distribute agroecological production products every week, check out the relevance that consuming these foods has in the world"*, shows this understanding of resource management that connects to initiatives such as *"We invite you to attend the course-workshop organized by the Experience Systematization and Soil Restorers team ✨ #AgroecologicalPerspective#-----"* further showing how communities manage local resources and maintain and transfer ecological knowledge.

These findings demonstrate how the community envisions digital infrastructures autonomy through and agroecological lens that brings together digital access with other everyday life resources. The testimonies shared show how digital infrastructure can be developed following principles of self-sufficiency and ecological stewardship that they already apply to agriculture and wish to apply to water and energy systems.

These visions show how digital access is contextualised not as an isolated technical challenge, but as a deeply interconnected with other community resources and practices. When members speak of building their own technologies for internet access alongside water collection systems, or combining traditional irrigation systems with contemporary technologies, they exemplify an approach where digital infrastructure becomes part of broader agroecological systems. This emerges clearly in how they connect agricultural expertise with technological development, suggesting that agricultural knowledge can inform how digital infrastructure is incorporated and maintained.

From social media data, this agroecological understanding and connection to the ecologies of the communities is further supported: *"RT @----------: #premiere Tuesday! ✨ ✊💧The #community organization around #water allows us to guarantee its access, as well as to take care of it".*

Together these results provide important insights into how community resource autonomy for reimagining algorithmic systems through agroecological principles and rather than viewing algorithms as abstract computational processes, the community envisions them as part of living, relational systems that must be collectively cultivated and sustained. This challenges both conventional digital divide frameworks and decolonial theories by showing how digital technologies could be designed and developed to nurture digital futures.

Chapter 7: Communal roots, network routes: materialising digital futures

This chapter's central argument highlights the interrelation between grounded community practices as well as the dynamic ways in which they are always becoming through the interconnected processes within and outside of these grounded spaces. The metaphorical use of roots and routes challenges the static conceptions of community practices, in rural and Indigenous communities.

Thus, the term communal roots acknowledge how existing communal decision-making structures and organisational practices such as ejidal assemblies and community committees, serve as foundational spaces for digital infrastructure co-design. Meanwhile, network routes represent the transnational and diasporic networks and pathways through which these practices are extended, reimagined and sustained across borders.

Materialising digital futures is particularly significant theme in this chapter, as it positions rural and Indigenous communities as active agents in building their technological futures, rather than passive recipients of digital development. It highlights how communities' practices are not static but dynamic, adapting and reconfiguring the challenges posed by the so-called digital divide. This framing builds on the previous chapter theoretical exploration of algorithmic agroecologies by demonstrating how communities are actively implementing these principles in practice, through adaptive, relational and transnational engagements.

Community-based technological adaptations

This section provides further evidence that supports both algorithmic agroecologies as a model in the last chapter and ways in which communities are amaterialising their digital futures by

showing how communities rely on existing communal practices for digital access, reflecting how the community draws on their established collective decision-making structures and organisational practices to approach digital infrastructure development. For example, the community's experience with ejidal assemblies, committees, and collective organisation provides existing models for managing shared resources but also accessing these resources that they envision applying to digital access.

Community members draw on established collective decision-making processes to approach the building of digital infrastructure, as shown through these quotes:
"being able to have access to the internet in public places, like in the ayudantia, zocalo, church, schools and health centres". This vision extends through other community statements that emphasise existing organisational practices *"get together and maybe some of the improvements we already have will address this - or in school meetings"; "…and also organize ourselves to request improvements in services from the municipal or state government, I don't know".*

The social media data adds further to what the rural community shared and shows how communities are actively applying their assembly practices and collective decision-making structures to technological development. The following posts document examples where communities use assembly practices to address digital infrastructure and access; from national level gatherings such as seen in this post: *"This is how our 2018 National Assembly was experienced, in which community and Indigenous radio stations from 19 states of the Mexican Republic participated Amarc México"* to local community meeetings about educational technology *"We share with the Assembly of mothers and fathers of the community of Nejapa, Tlahuitoltepec about the @EndlessOaxaca project of the @FundacionAHHO. We will coordinate efforts to bring multilingual technology to the girls and boys of the community. #alllanguages".*

What is particularly significant is how these assemblies specifically address technological initiatives, as evidenced by running annuals assemblies *"Annual Assembly of Indigenous Community Telecommunications @----------",* demonstrating how communities are not only adapting technology but are actively governing it, which is also shown in the interviews and focus groups data *"As we already do in many other cultural and rural things, create committees or simply call an assembly to talk about how we could build these technologies"*

which was reinforced by another community member *"Organize ourselves as we already do in other things in the town - cultural things and so on".*

The data also shows references to how these processes work, *"International Day of #Cooperatives, building together in #assemblies #horizontality and #cooperating*  *"*, by referencing 'horizontally' and 'cooperating' in relation to these assemblies also highlights how these organisational structures maintain communal values wile engaging with digital development.

Moreover, these assemblies represent autonomous organisational structures that exist beyond state frameworks, as evidenced in demonstrations of self-governance: *"Just to share that there are other ways to organize beyond the State: 20 Indigenous peoples of Michoacán decided in an assembly not to be part of the electoral process as they are autonomous communities that manage their resources on their own".* But this practice of assemblies extends across different community groups and purposes, as shown in specialised gatherings such as this post shows *"You can follow some of the activities of the IV Meeting of the Assembly of Indigenous Women of Oaxaca through FB. At this time, colleagues from the Chontal region are sharing their experience. #womenschontales #communerwomen"* where knowledge and experience are shared among women from different regions.

These findings provide evidence of how communities are materialising their digital futures, by building or planning to build technological initiatives in established communal practices whereby assemblies function as organisational roots as they draw on long-standing collective decision makings structures and as routes for sharing knowledge and resources across different scales, from local meetings and assemblies to larger national assemblies.

The data reveals how assemblies serve as crucial spaces for territorial defence across multiple communities which go from regional gatherings such as *"RT @----------: Regional assembly of the central valleys of Oaxaca in San Pablo Güila, for the defence of the territory"* to more specific resistance movements such as *"@----------: #Communication: 7th anniversary of the resistance in the defence of the territory of the general assembly of the town of San Dionisio"* showing how communities' collective approaches include protecting their lands.

Evidence highlights how assembly practices extend to addressing energy infrastructure projects imposed upon communities: *" 🎙For our most recent program we interviewed Carlos Manzo, from the Assembly of Community Members of Unión Hidalgo, Oaxaca and General Coordinator of UACO Unión Hidalgo, about the imposition of #seolic #projects in the #Isthmus of Tehuantepec. Listen to it now!"* and particularly how these assembly practices are further exemplified by concrete outcomes, such as the post *"RT @----------: Closing of the Assembly of the Nahua People in Cuentepec, Morelos, with the reading of the Decree that prohibits mining…"*.

A significant insight is that assembly practices are being adapted and used to address other challenges too, such as climate change, where communities are using these organisational structures to confront climate change, as seen throughout the social media data in the development of climate assemblies: *"Learn more about Climate Assemblies, different experiences and even ways to start creating this type of Assemblies! #ClimateGroove"* or *"#ClimateFurrow Citizen Assemblies are spaces for participation, where members of a community can learn how climate change affects their community or country, and then develop and propose concrete actions in the face of the #EnvironmentalCrisis"*.

The data further shows how even during the pandemic, communities maintained and adapted these practices, as shown here: *" ✨---------- was born during the pandemic and, after 1 year of work, we met to celebrate our first Assembly. In it we endorse this collective dream and define strategies to strengthen and grow. We are already cooking the fourth season! 👊"*

A relevant insight from the data is that these assemblies, while representing powerful spaces for autonomous organisation and decision-making, also face opposition and attempts at intimidation, as this post clearly shows: *"RT @----------: In 2014 they intimidated the ejido assembly to impose the dismantling of the ejido in favor of the NAICM, its leader ----------…"* . An example that shows how these critical organisational structures are targets when they stand in opposition to large-scale development projects such as that of the NAICM which stand for the Mexico City Texcoco Airport, highlighting two main things, their effectiveness in protecting community interests and their vulnerability to external pressures.

Building on digital divide literature, research has predominantly focused on access gaps and policy solutions, while also highlighting the role of social and cultural factors in shaping digital inequalities (as seen in the literature review with Warschauer, 2002; van Dijk, 2020). While

acknowledging the social and cultural dimensions of digital inequalities, the literature tends to reproduce the very neoliberal logics it seeks to challenge by continuing to privilege and propose top-down solutions while sidelining the agency of communities.

Rather than critiquing these neoliberal models, much of the literature reinforces them by emphasising what more should be done for communities with lack of access to technologies and other resources, rather than recognising what communities are already doing or finding ways to support these communities with them at the centre.

As we can see, assemblies are a powerful and empowering living practice that continues to thrive despite dominant models of organisation and governance that function not only as spaces of resistance or alternatives as western paradigms tend to refer to these practices. But they are practices and processes and spaces where collective action, community shared struggles, and imagination converge, while being rooted in self-determination and participatory processes, directly challenging the hierarchical, technocratic approaches dominating digital divide research.

This work contributes to the digital divide literature by shifting the focus from viewing communities as passive subjects of policy reach or academic inquiry or technocratic charity and instead recognises them as active agents with established organisational practices. Thus, rather than aiming to know communities more, this work documents their practices to challenge the lack of imagination and structural awareness prevalent in much of the scholarship. By documenting how communities actively resist and reimagine state and market capture and interventions, this work highlights the inadequacy of top-down models which created the digital divide in the first place and calls for a fundamental rethinking of how the digital divide is conceptualised and addressed, positioning communities as creators of technological solutions.

Data from both stages reveals how ejidos, a form of communal land ownership and governance, as seen in the literature review, represent deeply rooted organisation structures that communities draw upon when approaching technological development. More specifically, data from interviews and focus groups with the rural community shows how the community explicitly draws parallels between agricultural organisational practices and potential technological inititiaves, as this community member shares: "*We could do initiatives like we do in art and event organization or as ejidatarios already do in working the land/agriculture".* This direct connection shows how the community conceptualises technological development not as

requiring new complete frameworks but as an extension of the community's proven collective management practices.

Another community member shares and reveals a significant insight of how ejidal meetings serves as established spaces for deliberating technological adoption: *"I have tried to be an example, adopting new technologies and sharing my positive experiences with others, and, well, with the ejidal meetings that are held in the town where we talk about issues of cultivation and land, these irrigation systems have been talked about and there have been many arguments for and against";* an statement that shows how ejidal structures provide sophisticated frameworks for collective technological decision-making, including as a spce for debate and knowledge sharing.

These insights further challenge digital divide literature's tendency to approach community technological development as needing new organisational structures or external governance models. However, as further evidence from the data, ejidos functions not only as administrative spaces but also as dynamics spaces where communities actively negotiate and debate technological change while defending the community's interests, as seen in calls for legal action: "✍ *Sign this petition demanding justice from the Nahua #------- community, so that @------- declares next Wednesday, January 19, the #MiningLaw unconstitutional and unconventional, which violates the rights of #Indigenouspeoples and ejidos".*

Furthermore, the combination of ejidos into community cultural life shows how these organisational structures maintain community cohesion while adapting to contemporary needs, as this post social media data shows: *"Tomorrow in De Pueblo en Pueblo, ---------- "Flor de Dalia", 1st place in the #LaFlorMásBellaDelEjido contest will talk about her outfit and work with beads. Tune in! Friday, 1:00 p.m. Follow the broadcast at:....."* . These last three quotes show the importance of how addressing digital needs requires also recognising how communities are materialising their digital futures through established communal practices that combine resource stewardship, cultural preservation and collective decision making.

By situating how communities bring together conversations around digital technologies adoption through existing social structures such as assemblies and ejidos, this work challenges the still narrow understanding of how cultural and organisational frameworks inside communities modify, challenge and further demystify many of the digital divide currently used frameworks to tackle it. Instead, these findings reveal a more nuanced reality where

communities actively shape their technological engagements through and along established cultural and organisational frameworks.

This produces new knowledge that demonstrates how digital participation, be it building access or use, emerges not through individual avenues, but through and along collective practices already embedded in community traditions and decision-making processes.

Through these findings we can establish that collective practices such as assemblies and ejidos are an organic way in which make communities make decisions collectively. We have seen how they manifest culturally which we cannot separate from community life because they are part of community needs. But these collective practices and decision-making processes also manifest concretely in the innovative solutions communities develop to address their digital needs.

For example, a finding emerged in how communities are creating practical and contextualised solutions for education and connectivity, as this social media post suggests: "*Digital repositories in schools help improve the teaching-learning process*  *. Given hybrid education and not having Internet access in remote communities, it is a useful proposal that is within our reach"* demonstrating how communities are responding to the challenges of hybrid education in areas with limited internet connectivity by creating practical, accessible solutions that go with their existing resources and practices.

Furthermore, the development of locally adapted technologies is clear as a crucial strategy which is particularly evident in posts that describe these innovative communication systems: *"#Hermes is a simple, economical and easy-to-use technology in communication in remote areas, that innovation according to rural needs, based on local dreams, far from the unreality of #5G"* . Locally adapted systems such as this one disrupt conventional digital divide narratives in that mainstream approaches often position rural and Indigenous communities as technologically behind or waiting to catch-up to urban standards, but these examples show communities actively rejecting this framing.

Instead, they are articulating and building technologies that emerge from their own visions and needs, explicitly positioning themselves apart from dominant technological trends such as 5G. This is significant as it not only about alternative technology, it represents an elemental

reimagining of what progress means in digital development, grounded in communal values rather than market metrics.

What is more, the implementation and spread of this system Hermes captured in another post: *"📶New low-cost internet system reaches #Indigenous #communities in the #Amazon through #Hermes, a high-frequency emergency and rural multimedia exchange system developed by @communitarianorganisation, a member of @----------"* showing how technological innovations can be successfully developed when they emerge from local needs and contexts rather than being imposed through top-down development models.

This community-driven development can be further seen across other areas of concern for communities, such as costs and prices as it has been previously shared by community members in the interviews and focus groups. Through these examples we can see other dimensions of how communities' approach digital access and tackled costs and process through autonomous, low-cost infrastructure models: *"Next Thursday 9/9 at 6 p.m. we will be telling you why #Internet community networks are necessary. But we'll tell you a little bit about what it's about* 👇 . 📣 *They are free networks that facilitate the construction of low-cost autonomous technological infrastructures"*. Here we can see how the community are not only implementing solutions but actively creating spaces to articulate why community-led networks matter, showing their role as knowledge producers and keepers and digital infrastructure.

This emphasis on autonomy and community agency further exemplified in other practical solutions such as materialising knowledge production in concrete initiatives, as shown in this post: *"Closing the year, we updated the #intrabach server, of the ---------- school in the community of "----------", in the municipality of #---------, #Chiapas; providing them with a repository of digital educational material at no cost, trying to reduce the #digitalgap in rural areas.* 📣📱*"*. This example reveals how addressing digital divides requires solutions that incorporates educational needs with tailored technological infrastructure development, which challenges dominant approaches that tend to treat internet access and educational technology as separate challenges requiring different programmes.

One may argue that the current initiative by Mexico's Federal Government Internet for All might tackle the what the above example is showing. However, the government's primary goal with that programme is to bridge the digital divide by deploying infrastructure points around

marginalised and remote areas, and it is not explicitly addressing the autonomy and self-determination of many rural and Indigenous communities in its current framework.

What makes the above example relevant is that it is a response to the lack of tailored solutions that many Indigenous communities have taken the initiative to develop their own autonomous communication networks. Projects such as Endless Oaxaca and initiatives using Libre Router as seen in these two posts demonstrate clearly how community-led solutions are addressing the limitations of one-size-fits all connectivity programmes.

"RT @----------: Do you already know the @EndlessOaxaca project? Its objective is to improve connectivity problems in rural communities"

"📣 Facilitate the construction of low-cost autonomous technological infrastructures to deploy Internet networks #LibreRouter . For more information about our work click 👉 or you can join the next conversation 😉"

What is more, these examples also challenge conventional approaches to rural connectivity in few ways. First, by showing how technological solutions need to emerge from and adapt to local contexts rather than being standardised across regions. Second, by showing that low-cost does not mean low quality when communities have agency over infrastructure development. Third, by showing how autonomous networks can effectively address connectivity challenges that national programmes cannot solve.

This evidence suggests that rather than asking how to extend existing connectivity models to rural and Indigenous communities, policymakers and practitioners in the digital divide space alike should examine carefully before they propose one-size-fits all approaches. Furthermore, the emphasis we have seen so far that communities apply in how they approach challenges through established collective practices, autonomy and local agency becomes particular significant when considered alongside Chapter 5's findings about the state's persistent failure to provide basic infrastructure.

While the Internet for All programme operates under the umbrella of public interest, its implementation through CFE, a state company with a documented history of failing to provide adequate electrical infrastructure in remote areas, raises serious concerns but also provides stronger ground for moving towards co-designing community led algorithmic ecologies.

Thus, whether through state companies maintaining control over infrastructure or private providers seeing remote, rural and Indigenous areas as untapped markets, both approaches ultimately perpetuate external control over community technological needs rather than supporting community autonomy and digital futures.

Moreover, the persistent framing of community networks as only solutions to bridge the digital divide misses their transformative potential and perpetuates deficit-based approaches to rural digital ecologies. Both state programmes and private sector continue to view rural and Indigenous communities through the lens of lack and as empty spaces waiting to be filled with predetermined technological solutions.

We have seen so far how this could not be further from the reality of what is happening inside communities and how this deficit-based framing ignores how communities are already developing and implementing their own approaches to digital infrastructure. Another significant insights to point out here, is that while digital divide literature acknowledges that the main barriers to rural and Indigenous communities are rooted in socio-economic and socio-political issues rather than technological limitations only, much of the scholarship continues to position these communities as spaces for closing gaps.

Such narrow view fails to recognise how communities' adaptations and development exemplified by community networks, tailored workshops and trainings as well as educational digital tools represent different ways of conceptualising and materialising digital futures, ones that emerge from and strengthen existing communal practices such as assemblies and ejidos and that these cannot be separated from other cultural and social dynamics inside the community.

Throughout the next quotes and insights, we will continue to see how communities' vision of digital futures as inseparable from communal life materialises in concrete examples of infrastructure development.

For instance: *"Components of a wi-fi access point with academic content #jnoptikintrabach (Server, router), for use in schools or rural community centres without an Internet connection. #Education #intraneteducativa #educaTIC #eduTIC"*. Here we can see technology being intentionally intertwined into spaces of collective learning and gathering, challenging

individualistic approaches to building technologies, that at the same time strengthen rather than replace, communal practices.

Through other posts, we can see the cultivation of community approaches to governance and ownership becoming clearer: "💻📲*Participants delved into the development and use of community-based #Internet #infrastructure. In a 6-day training promoted by @----------, they also reflected on the governance of #RuralInternet and specific cases of #innovation"* . This is not only a representation of technical planning, but it also shows communities actively theorising new models of technological sovereignty.

What is more, the way communities are approaching governance and technological development is shown in different but equally significant ways. While some communities are engaged in providing technical training along reflections of governance, others are achieving other concrete advances in spectrum rights: *"🔥 The rural operator Telecomunicaciones ----------, A.C., obtained a frequency package in the 10 Gigahertz (GHz) band to better provide entry and exit to the traffic generated by its user base when they interconnect with other networks".*

These two examples demonstrate how communities are engaging with both theoretical, technical and practical aspects of technological sovereignty, from technical training to governance discussions to securing technical resources for network operation. This commitment to building and materialising digital futures is further evidence by more long-term investments in collective knowledge and capacity building as shown in this post: *"✊ A 10 month #skillsdevelopment programme is underway. 💭 Last months, urban and rural communities met to reflect on community-led #connectivity alternatives to close the #digitalgap in their territories".*

This sustained approach to skill development and knowledge sharing, challenges conventional digital divide frameworks present in many institutional policies as well as the broader literature, showing instead how communities across different contexts can collaborate and lean from each other's approaches to connectivity. This exchange of knowledge and experiences encourages to think and embrace that addressing digital divides is not about rural areas catching up to urban standards, but about communities collectively developing solutions that work for their specific contexts.

When communitarian organisations share how *"We presented the technology, we walked with neighbors to map and set up nodes, we organized workshops so that community members could get their hands on the #LibreRouter and use the #LimeApp application so that they could manage and diagnose the nodes that provide connectivity"* they show how technological implementation becomes embedded in existing communal practices building on earlier discussion of how communities use ejidos structures assemblies and collective organisation to approaches digital infrastructure development.

Further, the organisation of events such as *"📣 .....the 2nd day of the Popular #Communication Meeting organised by @-------- begins 🕸 We will talk about #community and decentralized networks: our little piece of #internet. Experiences and challenges in the territory"* shows how communities create spaces to share these adaptations beyond their immediate context. What makes this particularly significant is how it connects to local communal practices to broader networks of knowledge exchange. The example of how *"At @----------t we give workshops so that people learn how to set up their own digital networks"* shows how local adaptations become part of a larger ecosystem of community led technological development.

The sustained approached to skill development and knowledge sharing challenges digital divide initiatives and scholarships that support state or market led initiatives by showing how communities across different contexts can collaborate and learn from each other's approaches to connectivity. Thus, revealing how this exchange of knowledge and experiences encourages us to think and embrace that addressing digital divides is not about rural areas catching up, but about communities collectively developing solutions that work for their specific contexts.

Moreover, the emphasis on sustaining skills development and reflection demonstrated how communities are reframing what closing digital gaps means, moving beyond simple metrics of accesses, adoption, to focus on building collective capabilities for long-term technological sovereignty or as this project calls it towards co-designing community-led algorithmic ecologies.

These insights add to the contributions to digital divide literature by revealing how materialising digital futures emerges through ongoing processes of community exchange and mutual learning, rather than through one-off technical solutions or infrastructure deployments. This also suggests that addressing digital divides requires creating spaces for sustained dialogue and

knowledge exchange between communities, challenging dominant frameworks that often emphasise separating technological solutions from or over social processes and collective learning.

These collective learning processes take a similar approach in how communities are implementing and managing their own digital infrastructure. For instance, this social media post by a communitarian organisation further reinforces how communities are actively materialising their digital futures through established collective processes:

"☞The community builds its own network. 👉The ---------- Assembly, in the city of ----------, builds autonomy in the digital territory, promoting its own free and community internet network. 👉Read full note....".

This represents a significant demonstration of how communities are moving beyond only adopting digital technologies to actively creating and managing their digital infrastructure which shows a sophisticated development of digital autonomy, where communities see controlling their technological infrastructure as important as accessing it. This situated strategy to digital autonomy extends to how communities adapt their decision-making practices, as evidenced by their use of other platforms to carry out their communal practices:

"@----------: We need to be able to have a virtual assembly, we can do it by voice, Mumble is useful for this, and it works as an alternative…

This is particularly noteworthy as it shows communities are not simply digitising their existing practices but thoughtfully selecting and implementing technologies that conform to their collective governance approaches and values while maintaining the core organisational principles.

These examples extend the earlier findings about community driven solutions in education and connectivity by highlighting how communities are pursuing digital sovereignty. For instance, the emphasis seen in the post before on 'building autonomy in the digital territory' suggest that communities view digital infrastructure not only as a service to be consumed, but as a domain where they can and should exercise collective decision making and self-determination.

This is an important finding because it challenges conventional digital divide narratives that often frame communities primarily as isolated spaces waiting to receive solutions rather than

as active architects of their digital environments. It is important to mention that while these findings reinforce the importance of the work done by many communities where community networks have been long established already, the way this project contributes to the literature is by adding how deeply interconnected and inseparable are these collective practices from technological making.

Such dynamic becomes even more evident and gains additional depth when we examine how principles of collective autonomy extend beyond geographic communities to organisational spaces inside higher education as exemplified by these posts retweeted by communitarian organisations from university assemblies: *"RT @----------: We march from @---------- to the Barros Sierra monument in Parque Hundido. #---------AutonomousNow #UniversitarianAutonomy #YoD…"* and *"RT @----------: From the ---------- (@----------) in Aguascalientes we also fight for #autonomy and free science."*

These examples reveal how communitarian principles of self-determination and collective decision making are adopted by collectives and organisational structures inside institutions, suggesting that the drive for autonomy is not limited to what one may think of traditional community settings but represents a broader organisational approach and philosophy to resisting top-down impositions, whether they be technological or institutional.

These findings reinforce the importance of understanding autonomy not only as a technological practice in community networks or spaces, but as a broader philosophical and organisational principle that shapes how different types of collectives approach their digital futures. These insights contribute to the digital divide literature by fundamentally reframing how we understand collective action and autonomy in terms of technological and thus digital contexts.

Rather than seeing digital divides as gaps to be bridged through external interventions to communities and/or groups most affected, this research reveals how principles of collective autonomy and self-determination operate deeply within many communities' inner processes and across different organisational spaces too – from rural and Indigenous communities to educational institutions – creating other possibilities for digital building.

This insight offers both theoretical and practical implication; theoretically, it challenges us to move beyond the current understandings of digital exclusion/inclusion towards recognising how various forms of collective organisation can generate different and situated solutions; practically, it suggests that addressing digital divide can be more effective when working

through supporting existing organisational structures that already embody principles of collective autonomy, rather than imposing standardised solutions.

This approach not only enriches our understanding of how digital futures are being shaped by different types of collective organisation but also provides concrete examples of how organisational autonomy can be amplified to create more sustainable and contextually appropriate responses to digital divides.

After laying out how communities and other types of collectives are materialising their digital futures through collective structures such as assemblies and ejidos, it is important to bring up how private providers superficially appropriate the language of communal organisation while avoiding engagement with actual collective practices.

Therefore, and building on how private providers and other institutional bodies such as NGOs and the state frame digital inclusion through narratives of social transformation and empowerment, the insights above and the following tweets reveal how these corporate actors further attempt to position themselves as agents of social change while avoiding genuine collective practices. Instead of embracing collective decision making, they reframe organisational transformation through individualistic concepts of "leadership" and market oriented metrics of "optimisation": *"Hybrid leadership requires a cultural change, which will end up transforming the organisation",* revealing how their philosophical foundation is fundamentally at odds with collective self-determination.

This clear absence of engagement with genuine collective practices in private providers discourse reveals a deeper philosophical incompatibility between market-driven and community-based approaches to digital development.

However, this clash is not only rhetorical but also represents competing visions of social organisation that produce different outcomes whereby collective practices build towards co-designing, digital autonomy and community-led futures, private providers neoliberal approach needs to produce and reproduce digital divides because it relies on maintaining dependencies, hierarchical control, and market-based exclusions. Their superficial adoption of terms such as "community" and "solidarity" in this post: *"RT @----------: The **future** that we want is built in **c**ommunity. Today, #InternationalSolidarityDay is a unique opportunity to give…"* reveals how these terms help them mask how their organisational philosophy undermines the

very collective capacities that communities have shown are essential for meaningful digital futures.

While communities demonstrate how collective autonomy and self-determination operate as core principles for building digital futures, visible through their assembly practices, ejidos and institutional organising, private providers actively avoid these approaches because they do not fit and actually challenge the core tenets of neoliberal logic.

Another clear evidence of how the incompatibility shows, is how private providers conceptualise organisational change itself, so when facing challenges that demand systemic transformation, they frame these through corporate management logics, as seen in this post: *"A challenge that organisations face is the paradigm shift, sustainability is not an independent area. Sustainability must be part of the management and strategic backbone, integrated into the company's mission and vision" ----------on @--------".* This framing is revealing, even when acknowledging the need for fundamental change, they can only envision it through the lens of corporate "management", an isolated "mission and vision" of such company.

The reductionist approach, where complex social and environmental challenges are transformed into management objectives and strategic goals, stand in direct contrast to how communities' approach similar challenges through assemblies, collective decision-making, and autonomous organisation, as seen throughout this chapter and in chapter 6.

One may say that these are different communication styles between how private providers refer to organisational practices and change, but they are not semantics only, at its core they represent different theories of change. This becomes even more evident in how private providers engage with social challenges and inequalities as their approach to planetary health and digital divides reveals the limitations of market-driven solutions.

For instance, when joining conversations about global challenges such as climate change, as seen in this post: *#WorldHealthDay 2022: "Our Planet, Our Health" calls on people, communities, governments and organizations around the world to share stories about how to protect the planet and our health. And you, what measures will you adopt for the planet and your health?".*
We can see how they reduce collective action to individual consumer choices - "what measures will you adopt for the planet and your health?" , positioning responsibility to individual

behaviour while avoiding discussions of systemic change or their own role in working towards this.

Similarly, their approach to digital divides is revealing in that rather than supporting community-led inititiaves for digital autonomy, they promote corporate and NGO partnerships: *"RT @----------: In 2019 we created @--------, a network of allied organisations to close digital gaps. From @---------- we continue to promote…*". A significant revelation that comes attached to this insight is the fact that in the social media data collected from private providers, the complete absence of any mentions, retweets or promotion of partnerships with communitarian organisations or community network providers.

While these insights may not be enough to claim that such partnerships do not exist elsewhere, their absence from provider's social media communication, a space where they actively promote their organisations partnerships and initiatives conforms with their strategy of commercialised empowerment. This avoidance, coupled with their established practices of reframing market expansion as social development through impact metrics and technological promises as seen in Chapter 5, reveals how market-driven approaches to tackling digital divides actively avoid the very collective practices that communities have shown to be essential in materialising sustainable and autonomous digital futures.

However, this contrast becomes even more relevant and striking when examining how communities themselves approach institutional engagement, as the data from the interviews and focus groups further reveals: *"... as we already do in many other cultural and rural things, create committees or simply call an assembly to talk about how we could build these technologies";* revealing how communities are extending their collective organisational practices to potential building of technologies.

By framing technological planning and decisions within existing collective processes that have already been mentioned before in the form of assemblies and committees; communities show how digital development also includes planning and ideation. Such organisational approach is complemented by this post: "*...create boards as we already do for various things, ask for subsidies from the government, from research institutions too, there are things for technologies"* which reveals communities' ways of applying resource mobilisation.

The phrase “as we already do” is particularly significant as it reveals how communities view technological development and the steps to get there not as a radical step out from certain traditions, but as an organic extension of their existing practices. So, when communities talk about creating boards and seeking subsidies for technologies in the same way they handle other community matters, they are demonstrating how engaging with digital development fits into their established practices of community organisation and resource mobilisation.

Therefore, rather than seeing technology as requiring entirely new approaches or specialised knowledge for dealing with institutions, communities are confidently applying their proven strategies of collective action to technological domains. Together, these examples challenge conventional digital divide frameworks in these ways. Firstly, they show communities as navigators of both organisational processes and institutional resources rather than passive recipients of aid, highlighting how traditional community practices are and can be effectively adapted for technological development processes. Secondly, they show how communities maintain their autonomy while accessing external resources and co-designing methods that allow them to gain and use institutional support while maintaining collective agency over their digital futures.

This organic incorporation of technological needs into and with community practices also shapes how communities perceive government support and resource mobilisation and rather than positioning themselves as passive recipients of government aid, communities articulate a more detailed and nuanced approach to state support, as reflected in these statements from the interviews with the rural community: *“Also and probably ask for financial support from the government if possible”* and *“The community can organise to request improvements and also to take advantage of any technological training opportunities offered”*. This framing is significant because it positions government support not as a charity but as a governmental responsibility.

Another significant insight is how communities conceptualise collective action as a mechanism for engaging with both state and private actors, exemplified by community members' interview responses: *“I think we can be more vocal about our needs and come together to ask for improvements from the government and private companies”* showing how their collective power as a community strengthens negotiations with institutional actors coming from their unified voice and organised demands.

This insight alone challenges conventional digital divide frameworks in two main ways. Firstly, it shows communities positioning themselves not as isolated actors dealing separately with government or private providers, but as collective entities capable of engaging with multiple institutional actors. Second, it demonstrates how the community views the relationships with these institutions not as one of dependency, but as one of strategic engagement where collective organisation is a tool for amplifying their voices and centring community interests.

The way the community approaches institutional engagement further strengthen earlier insights to how deeply their existing organisational practices and collective traditions inform their strategies for materialising digital futures. Such strategic positioning is further reinforced by statements such as: "*We could organise to request improvements together, put more pressure as a community"*, which reveals how the community understands and lives collective action as a strategy to leverage in negotiations with both public and private sectors.

However, these also further exposes many of the current digital divide frameworks with their overemphasis on market solutions or individual access metrics or policy led initiatives which are failing to recognise and support collective processes through which meaningful digital development actually happens.

Community perspectives on policy engagement are relevant here as they show how deeply communal practices are rooted in the fabric of the community as well as how these inform the paths or routes the community envisions toward digital development. When community members in the focus groups shared: *"...perhaps some combination of government policies that provide subsidies for affordable technologies in rural communities, but here it could also be done among ourselves as workshops or organising to ask for subsidies",* shows how these established collective practices organically extend into strategies for engaging with policy frameworks.

Whey they share "it could also be done among ourselves" reinforces the same expert knowledge of collective negotiation seen earlier when the community shared that their strength in negotiations with institutional actors comes from their unified voice and organised demands. So rather than seeing policy as an outside entity influencing the community, the community grounds their approach to policy engagement in established collective practices such as organising to ask for subsidies.

This insight challenges both market-driven solutions and policy-led frameworks by showing that to materialise digital futures it emerges from communal practices rather bypassing them which becomes even more relevant if we connect back to Chapter 5 insights around how even supposedly public interest initiatives such as the one being deployed by the Federal Government in Mexico, with *Internet for All*, continues to operate through top-down implementation that sidelines communities involvement in the process.

However, as we saw in the previous quotes by community members, the community shows a willingness to adapt and bring in external support into their communities. Yet and while communities work to include these external resources and policies into their existing practices, there is an absence of reciprocal effort from government initiatives or private providers to work with communities within their communal practices. It is this one-way adaptation that exposes how both state and market actors expect communities to conform to their frameworks while showing no intention or effort of adapting their approaches to work within existing community structures.

Empirical evidence so far from the rural community and communitarian organisations and providers contributes to the literature both in the digital divide spaces but also to decolonial theories that often speak in abstract terms. For instance, this one-way adaptation from the side of communities but not from governments and private providers exemplifies in real and concrete ways how coloniality is exercised in digital development.

What is more, we can clearly see how institutional actors maintain control over resources but also knowledge by imposing their frameworks while bypassing existing community structures and knowledge systems. However, findings so far offer another view that goes beyond identifying these colonial continuities, findings show concrete ways communities resist this coloniality as well as negotiate through their collective decision-making practices.

A relevant contribution from this project is in how the findings push beyond how theories of coloniality of power for example tend to generalise and while such frameworks are helpful in identifying how colonial structures persist, as shown throughout the literature review and to some extent here, they often fall into the same trap as institutional approaches by speaking broad, generalised terms rather than engaging with specific community practices and knowledge. This tendency to generalise and theorise from above can itself reproduce colonial tactics, even when attempting to critique these practices.

This project advances both digital divide literature and theories of coloniality in concrete ways as it documents how communities most affected by digital divides, create working alternatives through their collective practices. While decolonial theories may help identify structural inequalities, they often stay at a macro level, missing concrete ways communities engage in everyday life within these colonial tactics these theories speak about.

By showing how communities maintain organisational practices while strategically working with external actors to access resources, these findings move beyond identifying problems to documenting solutions and avenues already in practice. Therefore, this research contributes new evidence of how communities are not only subjects of colonial structures or market failures. Instead, communities are actively building avenues and pathways and algorithmic ecologies that challenge both market driven approaches and the theoretical frameworks that critique them.

This project shows how digital divide harms but also resistance to it is not abstract, it is grounded in specific lived experiences of communities. This evidence is novel because it requires digital divide research to shift its approach, from theorising about problems and solutions to centring communities who are already creating solutions.

This shift is evident on the ways communities are also establishing spaces for knowledge exchange that prioritise their own experiences and needs, as shown in this social media post: *" @--------: #OndaRural invites you to learn and learn about solutions and experiences from rural actors 🙋 🙋. Reviews of #Agriculture"* and *"@----------: 📣 #Let's find out what the #peasant organizations, #farmers, accompanying and #communication organizations said"* . Such initiative shows this required shift by explicitly positioning communities as knowledge holder and solution creators, inviting others to learn about solutions and experiences from rural actors.

At the same time, when peasant and farmer organisations are given platforms to share what they have to say, it shows how communities are significantly ahead of existing conventional Western digital divide frameworks as they are already positioned as active producers of knowledge about digital solutions. What is more, as this post shows: *"RT @----------: ---------- from @---------- highlights the importance of weaving networks that allow us to be connected and, above all, that support ...."*, communities acknowledge that addressing challenges requires not only

technological solutions but building supportive infrastructures that allow for sustained collective action and knowledge sharing.

Furthermore, organising events such as this post shows: *"RT @----------: Complex Realities Symposium begins "Approaches from the Social Sciences" in #Oaxaca"* demonstrates how communities are already reshaping digital divide frameworks in three ways. First, by creating their own spaces of knowledge production about digital challenges. Second, by showing that addressing digital challenges requires engaging with complex social realities rather than surface, broad and general explanations. Third, by developing frameworks grounded in their lived experiences rather than accepting external conceptualisations of the digital divide and how to tackle it.

Rather than being passive recipients of top-down technological solutions or being against accessing funds and resources from institutions, these shared voices show how the community strategically considers government and institutional support as one component of their broader self-directed digital future.

Their testimonies reflect a nuanced understanding of how to engage with institutions, by combining their collective organising practices with strategic approaches to accesing resources. This is particularly evident in how community members emphasise collective action such as "together", "as a community" when discussing government support, suggesting that even when seeking external resources, they maintain their communal approach to technological development.

A relevant observation from these responses is how they community positions external support within the broader vision of technological development and not as a primary solution, but as one resource among many that they can actively pursue and connect into their community-led digital development.

These collective organising practices show how communities are materialising their digital futures both through both grounded communal roots and dynamic routes of engagement to make this happen. As we have been able to se, their expertise in navigating institutional relationships while maintaining communal decision –making processes show how traditional practices serve as foundations (roots) for approaching challenges, including digital ones.

However, this grounded expertise in combining communal practices with strategic institutional engagement is often overlooked within dominant digital development paradigms, including academia and policy led proposals. This insight reinforces the chapter's main theme by highlighting how communities are shaping their digital futures through practices rooted in communal traditions while actively engaging with external networks and actors, now the opposite needs to be reciprocated and respected.

The evidence in this section advances digital divide scholarship by showing how communities develop organised and structured approaches to institutional engagement that allow them to maintain their autonomy while organising to access need resources. What is more, they do not view external support as either necessary aid or unwanted intervention but are strategically thinking and organising as well as using these communal practices to build networks and platforms that allow them to shape their needs.

Open technologies and community science

This section reveals crucial insights that digital divide research overlooks, that communities are not only adopting or adapting technologies, but they are transforming how technological knowledge itself is produced and validated and propagated.

This transformation is particularly evident in how communities create spaces for scientific knowledge production that are directly challenging hierarchical and detached perceptions of science from society "*Science Club in ----------'Kamaq Yachchiqku': promotes science discussion from Indigenous perspectives and collaboratively translates scientific concepts to different #----------"* revealing an active critique and reimagining of the relationship between scientific expertise and local knowledge and not only accepting external expertise as authoritative, creating dialogic spaces where scientific knowledge must be contextualised within community practices and needs.

A crucial finding is how communities are bridging traditional and scientific knowledge systems as this post suggests: *"For the development of many of the drugs used today in modern medicine - such as the treatment of #malaria - #science relies on #traditionalknowledge. However, they*

are often perceived as worlds apart." reveal how communities recognise and work to overcome false perception between knowledge systems.

The development of open technological tools further demonstrates this transformation of knowledge production, as shared through this *"We use digital memory to create free technology, web infrastructure and web services that allow us to express our rights and struggles. #feministmemory #dominemoslastic"* . A positioning of technology as a tool for rights and straggles that is extremely significant because it suggests how communities view technological development as inseparable from social justice.

This positioning of technology as a tool for rights and struggles is further exemplified in the educational and knowledge production practices of |Indigenous communities, as evidenced in these tweet announcing community sciences: *"RT @----------a: The teaching of community sciences at the Center for University Studies- Xhidza*" suggesting the importance of community sciences.

The transformation of knowledge production becomes evident through the community university approach to community education. For example, when they announce: *"We started a course on "Community Methodology of Social Development" with the accompaniment of Johannes Kniffki from San Juan #Yaeé. We thank Genaro Hernández for sharing the space. #ceuxhidza #communitysciences",* they show now only curriculum implementation, but the creatin of collaborative spaces that bridge academic and community knowledge systems which can be demonstrated in these key ways: the direct challenge to knowledge hierarchies and the institutionalisation of alternative knowledge systems.

The direct challenge to knowledge hierarchies is exemplified through provocative questions in this tweet: *"Where are the scientists who do not discuss these issues with the peasants? Why is science not contextualized in its application in the field? Sebastiao Pinheiro on his tour of the Xhidza University Study Center #CeuxhidzaYaviche".* Such questions position community engagement not as optional but as fundamental to legitimate knowledge production and also explicitly challenges the disconnect between scientific knowledge and its practical application in community contexts.

Meanwhile, what seems as the institutionalisation of alternative knowledge systems in this tweet: *"In the #CeuxhidzaCommunity we started a modular session with Arturo Guerrero*

@Yelatoo with the subject #CommunityandCommunality in the Bachelor's Degree in #CommunitySciences #AutonomousEducation #SierraZapoteca #Oaxaca" grounds the work in regional and cultural context.

The insights above push us to rethink the digital divide; through the educational practices that show an elaborated approach where technological knowledge is embedded with community rights and cultural contexts showing active knowledge production through the establishment of formal courses such as "Community Methodology of Social Development" establishing a systematic way to knowledge creation. Such practices support and challenge decolonial theory in few ways. On the one hand, it supports decolonial theory through the creation of community-based university programmes which demonstrates practical action with and in the community. On the other hand, the tweets represent a new type of educational institution, emphasising on community sciences which can create and expand new community-led disciplinary frameworks.

The evidence connects to broader themes of community roots and network routes by showing hybrid knowledge systems through mixing traditional concepts such as #CommunityandCommunality with formal education; and alternative frameworks which is palpable through the creation of autonomous educational spaces, development of community centred curriculum and the establishment of formal degrees programmes in community sciences.

What is more significant from the insights before is their novelty to digital divide and decolonial theories too since they tend to overfocus on either access and barriers to technology and recognition of alternative knowledge systems. But in these insights we see something different, the creation of spaces that transform not only how knowledge is shared but how it is produced, validated, and embedded within regional and cultural frameworks. Therefore, it is not only about communities gaining access to technological tools or knowledge, it is about communities transforming what counts as technological knowledge ion the first place.

These community learning practices further demonstrate this transformation of what counts as technological knowledge, which can be evidenced in this tweet: *"We continue compiling content to give our young people in rural communities more tools that can motivate them to take ownership of science using ICT",* through which we can see knowledge production extending beyond traditional education hierarchies. The emphasis on compilation suggest an an

active curation and creation process, where communities determine what knowledge is valuable and how it should be shared.

Another relevant tweet here *"Play and learn with @--------, #free software aimed at #ludiclearning with more than 140 #educationalgames"* reveals how communities are reimagining the very nature of technological education. By prioritising ludic learning in technological education it gives way to how communities challenge conventional approaches that separate serious technical knowledge from playful engagement, representing a crucial transformation in how technological knowledge is conceived and transmitted, suggesting ways for effective technological education that does not have to include functional technical application.

Particularly significant is how communities use open technologies to overcome infrastructure limitations through tools such as Wiktionary, as shown in these tweets: *"Using #wiktionary, #wikimedia foundation project and #KiwixOffline on #jnoptikintrabach 📱💻"* and *"Kolibri, an offline educational project, #FreeSoftware proposed by @---------- for #FreeServers. 💻📱📡"* . These implementations show how open technologies allow communities to materialise their digital futures even in contexts with limited connectivity and the ability to modify these tools for offline use shows how open technologies allow communities to create educational infrastructure that works within their material conditions while maintaining educational access and quality.

These insights show how open technologies provide both the technical and the conceptual framework for materialising educational futures that centre community needs, cultural approaches to learning and material realities. This demonstrates that open technologies are not only tools for education but are fundamental infrastructure for materialising alternative educational futures. Through their modifiable and adaptable nature, open technologies enable communities to create learning environments that transform what counts as technological knowledge while building practical systems for it to be shared.

Further evidence shows how the development of specialised tools such as what a community technology provider reveals in the following tweet, reveals how open technologies empower

communities to create intricate knowledge management systems: *"@----------z Esquite 🌽 is a free framework to manage parallel corpora. Set up a web system for word and phrase searches. Manage parallel corpora easily. Repository | Documentation ",* we can see communities creating specialised technical infrastructure for linguistic and cultuiral preservation. Also, the explicit naming of Esquite with the corn emoji symbolically connects this technological tool to agrcultiral heritage, demonstrating how open technologies facilitate communities to create tools that bridge technological innovation with cultural significance.

Additionally, the tweet: *"As we mentioned, these instances are based on the #esquite framework developed by our community. Obviously it is #free software so you can use it and improve it 😊 Do you have the code to leave? (fork it please... this is not a meme)"* reveals a crucial aspect of how open technologies help equip the materialisation of digital futures by allowing oithers to improve it. This shows the importance of not only building tools but developing frameworks that others can build upon.

Overall, this represents a novel contribution to the digital divide literature by showing how communities move from technology users to framework developers, creating foundational infrastructure that supports further technological changes and development.

Further insights from the data shows how communities are developing standardised ways for their tools to interact with other systems, as shown in these tweets: "*Do you want to know how #freesoftware drives communities like @---------x?" "From the------ Community we are happy to announce a new project: A public API for queries in parallel corpora 💶🗓️🧑💻" .*

This development of public APIs reveals how open technologies facilitate the creation of interoperable infrastructure, challenging digital divide literature and the concept of digital divide by showing how communities are creating the underlying technical infrastructure that facilitates broader technological ecosystems.

These insights demonstrate particular novelty since they reveal how open technologies apart from empowering communities to materialise their digital futures through the creation of technical infrastructure that embodies their understanding of how knowledge should be organised, preserved and shared. We can see how communities use open technologies and its values to create specialised tools that serve their needs while contributing to broader technological infrastructure and giving concrete ways and examples of how communities are

not only adapting existing technologies, but developing frameworks, APIs, and management systems that facilitate new forms of knowledge organisation and sharing.

The progression from framework development to instances of how that happens, to API creation show how communities use open technologies to build increasingly more complex technological systems. This materialisation of digital futures through technical infrastructgure developmnet represents a signifucant departure from state, market and academic narratives on the digital divide showing how communities are actively creating the technological foundations for their envisioned futures.

This represents a signifucant and novel finding since it challenges the recognition that technical barriers fall within simplistic framings of the digital divide which represents only a partia; understanding of how communities engage with technology. While scholars have pushed to move beyond questions of technical access, this often emerges from a non-situated perspective that fails to recognise how communities are actively transforming technical infrastructure itself.

The following insights coupled with further evidence from the data demonstrate how technical development, when examined from community communities' perspectives, positions their technologic as advanced mechanisms of cultural and linguistic unification that challenge state, market and academic assumptions about both access and use. This becomes evident in initiatives such as *"If you want to learn more about @PBStoryWeaver (a free software platform) and how it has been used to create more than 700 books in Indigenous languages of Mexico, join the session at @mozillafestival"* where open technologies empower communities to bypass conventional publishing markets and create their own massive cultural production.

What makes these insights particularly significant is how open technologies allow communities to develop infrastructure outside state and market control. Further initiatives such as "*Did you know that there is a #FreeSoftware localization initiative? I present to you @MozillaNativo, a community of translators*" show how software created by open technologies initiatives allow communities to participate localising core internet infrastructure. Unlike proprietary browsers, Mozilla's open framework facilitates communities to actively participate in translating and adapting the technology to their linguistic needs, representing a different model where even institutional initiatives can be shaped by community needs through open technologies.

Together, these insights show how open technologies, whether institutionally or community developed, empower communities to materialise their digital futures and how the open nature of these technologies, provides communities with the ability to shape technological development in ways that proprietary systems cannot. Such reframing reveals how open technologies promote a more nuanced understanding of tackling digital divides, one where the key factor is not only who develops the technology, but how its open nature empowers community participation and adaptation at its core.

This empowerment through open technologies becomes evident once again in community media and communication practices. For example, when communitarian organisations share: *"Free software for community radio #communityradio #somospueblo #Resistencia #freesoftware"*, they demonstrate how open technologies facilitate agency over their communication infrastructure. The continuous development of new versions as seen in this post *"And to continue the resistance, new versions of Latin American free software were released for free community radio stations!"* shows how this agency extends only use to active development and evolution of communication tools specific to regional needs.

Furthermore, the creation of complete media ecosystems through open technologies such as OBS: *"OBS is a free and open source tool that the world of Free Software brings to us so that we can professionalize our live broadcasts, broadcasts of pre-recorded materials and tutorials, in a much simpler way",* further reveals how open technologies facilitate communities to build comprehensive communication infrastructure. This demonstrates that the materialisation of digital futures through open technologies is not limited to adapting existing tool but extends to creating complete, autonomous systems that communities can have agency over and develop over time.

A significant finding in the data is how community-based laboratories such as those represented in these tweets: *"📌The ---------- is a free experimentation laboratory. We share knowledge of free technologies and accompany our collective sisters in the digital parts of their work. 📎Read full note:"* and "*Today the second season of ---------- begins. We are excited to tell you that starting today and every Tuesday the Milpa ------- returns to continue sharing knowledge about free and safe technologising a little while the ------- #41"* demonstrates elaborated approaches to technological engagement that transcends traditional institutional boundaries while creating new forms of knowledge production and dissemination.

The framing of tweet 1 as a “free experimentation laboratory” where they “share knowledge of free technologies and accompany collective sisters” reveals a critical reconceptualisation of technological education spaces. Such reconceptualisation operates on multiple levels; one by reclaiming the notion of laboratory space within community contexts, establishing collective rather than individual approaches to learning; and two, it centres feminist approaches to technological education.

It is worth noting the use of the term “laboratory” as it represents not a rejection of scientific spaces which are commonly attached to the concept, but rather their transformation and reappropriation within community contexts.

Furthermore, the second tweet shows how communities are building sustained infrastructure for technological education and of noteworthy importance is the choice of Milpa as naming their space, as it explicitly connects technological education to traditional agricultural practices and Indigenous knowledge systems. This gives a view into how communities create hybrid spaces that bring together traditional knowledge systems with contemporary technological education.

The focus on “free and safe technologies” demonstrates how these spaces bring together critical perspectives on technology with practical education representing a reflexive engagement with technology that moves beyond questions of access, barriers, definitions and motivations to actively addressing issues of technological sovereignty, safety and community control.

A significant contribution from these examples is that they push for the need to create more situated frameworks, understandings and thus initiatives that can capture the complexity of community technological engagements. Such frameworks must account for how communities create and sustain their own educational institutions, embed cultural knowledge with technological education and develop collective approaches to technological learning.

Moreover, they must be capable of understanding how communities transform rather than simply reject institutional forms associated with dominant knowledge production systems. From these insights, we can see how such community-based technological laboratories represent nuanced and situated interventions in both theory and practice.

What is more, these insights demonstrate how communities are creating new forms that transcend conventional binaries between Western and Indigenous knowledge systems, between theoretical critique and practical education, and between technological adoption and critical engagement. These spaces thus offer important insights for both digital divide research and decolonial theory, suggesting the need for more nuanced theoretical frameworks capable of capturing the complexity of community technological engagement.

The implications of these findings suggest that future research must pay careful attention to how communities create their own structures which requires approaches that can capture the dynamic and hybrid nature of these spaces without reducing them to either simple resistance to or adoption of dominant technological paradigms.

However, the implications of how communities create their own structures extend into how open technologies enable the materialisation of alternative digital futures so while educational laboratories are a demonstration of institutional transformation, the tweet *"For the first time, free technologies are included in the political declaration of a meeting of social movements in ----------. We did it. #WeContinueInFight"* reveals a crucial insight, that communities are not only adopting open technologies, but positioning them as fundamental to their visions of their future.

This positions open technologies as more than tools as they become embedded into how communities imagine and build their digital futures. The materialisation of these futures becomes evident in infrastructure development. For example, this communitarian provider characterisation of community networks as *"@----------: What are free and community #Internet networks? They are open, neutral and decentralized #networks"* dhows how open technologies allow communities to build infrastructure that embodies their values.

This shows how communities use open technologies to create not only alternative tools or technologies, but alternative technological foundations for their envisioned futures. Furthermore, the emphasis on openness and decentralisation in network architecture reveals how technical choices materialise political and social values into concrete infrastructure.

This materialisation process is further exemplified by the assertion in this twee*t "#FreeSoftware allows it to be adapted to the needs of users and not the other way around";* a principle that shows how open technologies allow communities to shape technological development according to their needs and visions, rather than adapting their practices to preexisting technological constraints.

Further evidence from the data shows how the development of community managed services shows how open technologies are critical to materialising communities' digital futures. For example, the tweet by a communitarian organisation: *" the new website and its menu of free technology services for organizations* 😊" shows how open technologies enable communities to access to technological services too.

The data reveals a strong articulation of political resistance through open technologies evidencing significant dimensions of how communities materialise their digital futures. For example, when a communitarian organisation positions *"free and community technologies*" as "*alternatives to confront energy consumption, extractives and the surveillance of digital capitalism*", we can see how open technologies allow communities to build infrastructure that actively resist exploitative practices.

This suggests that the open nature of these technologies allows communities to examine, modify and exercise agency of technological systems to make sure they respect the values around sustainability and privacy. What is more, the ability to verify and modify a technology becomes crucial for making sure technologies serve communities interests rather than capitalism.

Furthermore, the tweet *"Free software continues to fight against the dictatorship of the market"* highlights how open technologies allow communities to create alternatives to market-dominated digital infrastructures. The open nature of these technologies mean communities can develop solutions outside market logics, materialising digital futures that prioritise community needs over profit motives.

These insights reveal how open technologies provide both technical means and the conceptual frameworks for imagining and building non-market technological futures. What is more, the modifiability of open technologies means communities can make sure their digital infrastructure embodies what they consider democratic principles, giving strong evidence of open technologies as essential for materialising digital futures where technological systems strengthen rather than undermine or limit democratic practices within communities.

By allowing communities to verify, modify and have agency over their technological infrastructure, open technologies provide the foundation for building systems that resist surveillance, market domination and anti-democratic practices, allowing us to see too, how community resistance movements combine with networked technological development to create concrete alternatives to dominant systems.

So far, findings suggest that open technologies are not only tools for resistance but essential infrastructure and conceptual framework for materialising communities' digital futures that embody their community values of sustainability as well.

There is another significant finding within how open technologies allow communities to materialise their digital futures and it is the intersection of rights defence with open technologies. The tweet: *"✊ We are almost starting the virtual Forum on Free Technologies for the defence of women's rights in mobility!!"* demonstrates how open technologies intersect and allow communities to specifically address gendered dimensions of technological access and control, showing how the nature if open technologies allows for the development of solutions that explicitly tackle mobility barriers, in this case for women, clearly showing how they are materialising digital futures that prioritise gender equity.

Further, the tweet *"It is necessary to create free technologies where digital gaps of gender, ethnicity, class do not exist #LiberaTuRadio"* reveals the visions to combine open technologies that can address intersecting forms of technological exclusion. Their emphasis on creation rather than just access, show how communities use the modifiable nature of open technologies to build systems that actively work to eliminate multiple forms of digital marginalisation. This further demonstrates how open technologies enable the materialisation of digital futures that address systemic inequalities through technological design and implementation.

An interesting and critical revelation from the data is how open technologies and the building of these can put activists and communities in danger of prosecution. The case *"#FreeOlaBini On Monday, the trial against Ola Bini, a digital security expert, free software activist and human rights defender, who has been facing a criminalization process in Ecuador for 3 years, resumed".* The connection between free software activism and persecution from the state shows that open technologies represent a threat somehow to state structures.

The insights above reveal how open technologies allow communities to move beyond simply demanding rights to actively building technological systems that embed and protect those rights. What is more and from the evidence of persecution for open software activism, the open nature of these technologies means communities can verify and make sure their systems actively promote their values and rights protection. This demonstrates how materialising alternatives digital futures requires technologies that can be examined, modified, and controlled to serve community based right to safety and needs.

So far, these last insights point to how open technologies provide both the technical means and ethical framework for materialising digital futures that prioritise community life protection, thus the ability to create and modify technologies becomes crucial for making sure technological systems actively work to eliminate rather than reinforce existing inequalities.

While open technologies are not novel or new to the literature and initiatives to tackle it, what is novel in this project is how open technologies empower communities in so many different forms, from facilitating community agency and develop every aspect of infrastructures, creation of tools to distribution and how some of these open technologies are modified by communities' changes.

The insights presented in this section provide a comprehensive overview and insightful ways of how open technologies reveal new dimensions for understanding how communities materialise their digital futures and that it is not only about giving communities accesses, be it economic, technological or how they adopted. We can see that it is more about how it empowers communities to build sustainable, situated technologies and that they are able to have agency ultimately over how to develop them further.

We have seen the transformative potential of open technologies in empowering communities to materialise their digital futures, from creating educational resources and language preservations technologies to building autonomous communication infrastructure. However, this gives way only part of the entangled mechanisms communities encounter in materialising their digital futures. While open technologies empower the communities' agency in large parts over technological development, as evidenced throughout the section; the same communities must

navigate profound security challenges that reshape how these technologies can be implemented and accessed.

In the next section, we can see how the tension between technological possibilities and security realities becomes particularly evident when considering the vital necessities of many rural and Indigenous communities remain precarious due to forces such as the state, markets and another force that threatens their safety and security.

Navigating security threats

While we have seen in previous findings, communities are developing approaches to digital access and education and a combination of both, the social media data as well as data from the interviews and focus groups reveal how some vital necessities remain precarious in rural and Indigenous communities. Even tough communities develop approaches to technological adaptation through open technologies; they must simultaneously navigate serious security challenges that can undermine basic infrastructure.

For example, the following social media post, shared by a communitarian organisation shows how basic educational access is being threatened by external forces: @---------- *@SEP_mx I suggest you visit rural schools in Xochicalco Guerrero near Arcelia, narco land. They warned that there will be no teacher for first year of secondary school because the teacher will not return. Girls and boys will be left without access to secondary school! They have no other option within 3 hours!"*

This testimony of schools without teachers and students being left without access with no other option within 3 hours reveals crucial insights for digital divide research and initiatives as it shows how discussions of digital access cannot be separated from broader educational infrastructure challenges in rural areas, where even basic access to teachers and schools remains uncertain due to security problems.

This contrast between the possibilities facilitated by open technologies and the fundamental insecurities that can prevent their realisation reveals why examining security challenges and how they have to navigate them is crucial to understanding how communities materialise their digital futures.

This reality is further emphasised in another post: *"Well, I tell you that some will not be able to return to classes, like the rural high school in Xochicalco, Gro, where they were told that there*

will be no high school teacher. Do you know what it means for a girl to lose another year and be left without classes because there is no teacher or another school nearby?". The fact that communitarian digital providers are amplifying these testimonies reveals a critical blind spot in conventional digital divide frameworks, so any discussion of digital access must account for these fundamental security challenges too.

When basic educational access can be disrupted by security threats, it shows that even the most promising technological solutions, such as what open technologies may offer, must contend with complex territorial and safety realities of many communities. What this evidence further reveals is that some communities have to face challenges from not only state actors and private ones but also criminal organisations, creating additional barriers to basic services such as education. This adds a new dimension to our understanding of how communities must navigate all these systemic hurdles to materialise their digital futures.

Thus, when communities cannot maintain basic secondary school access because teachers cannot return to narco land, and students have no other options within 3 hours, it shows how security concerns can shape the possibility of any kind of educational exchange, whether technological or not. This lived reality challenges digital divide interventions that focus on technological training without addressing fundamental barriers to educational access in rural areas that are threatened by national security concerns.

Evidence shows that these security challenges are present at different scales, from educational disruption to community protection, as evidenced in this community member's experience: *"Yes, surveillance cameras, my dad added a security device in the basin as there was a theft of the pump a few months ago and they implemented a very modern security system that works only with the internet. At first impact it was stressful, worrying, etc. since in the end involve security issues, but at the end of the day in my dad's case it was resolved very quickly, in my case the truth is that I relaxed and let it pass without stress until the internet stabilised".* Further context is useful here since the community has experienced the arrival of a major criminal organisation to its territories and neighbouring ones since the 2020s which has meant extreme violence and security threats have increased considerably in the community and surroundings.[3]

[3] Recent years have since rise in violence across the region, with organised crime groups exerting control through intimidation and extortion (Infobae, 2019). Incidents throughout the region continues to reflect the pervasive influence of criminal organisation (Proceso, 2023).

This testimony reveals crucial insights about how the community materialises its digital future under complex security conditions. By implementing modern security systems that works only with the internet for protecting a communal water basin shows how the materialisation of digital futures is not only about creating new technological possibilities but about responding to immediate security threats to community resources.

This adds a critical dimension to digital divide literature by showing how security concerns actively shape the ways communities implement and depend on digital infrastructure. What makes this particularly significant for understanding the materialisation of digital futures is the layered complexity it reveals. As the community must simultaneously, protect vital physical infrastructure (the water basin); implement digital solutions such as surveillance cameras; navigate unreliable internet connectivity and adapt to new security practices in a context of increasing territorial violence.

The phrase *"at first impact it was stressful, worrying…. until the internet stabilised"* is especially revealing because it shows how the materialisation of digital futures creates new dependencies and vulnerabilities. When protecting the communal water basin requires reliable internet connectivity, we see how digital futures materialise not as abstract possibilities but as concrete necessities tied to community survival.

The active decision by the community to digitise the protection of their communal basin demonstrates how security challenges become catalysts for technological adoption, while simultaneously creating new dependencies on reliable internet connectivity, adding another layer of complexity to how security concerns and digital access intersect in some rural contexts.

This also shows how communities' digital infrastructures are not only for technological advancement or closing digital gaps but about creating complex socio-technical systems that protect community resources under threat and the fact that protecting a communal basin now depends somehow on stable internet connectivity shows how digital futures materialise through the entanglement of physical infrastructure, digital systems and security needs.

Such insights make a novel contribution to both digital divide literature and decolonial theory. In the one hand, to digital divide literature, by showing how security concern does not only create barriers to digital access, but they also actively shape how communities implement and depend on digital technologies. So, rather than treating security as an external factor that affects access which it does, this adds a new layer of complexity and shows us how security becomes central to understanding how and why some communities materialise particular digital futures.

On the other hand, this finding makes a significant contribution to decolonial theory by challenging simplified, generic narratives about rejecting surveillance technologies. While decolonial scholars (Quijano, 2012; Couldry and Mejias, 2019; Tuck and Yang, 2012) often and justifiably critique the coloniality of power and the extractive practices of modern systems, such as surveillance systems as tools of colonial and state control, this community's implementation of security system to protect their communal water basin reveals more nuanced realities.

The decision to adopt surveillance technology in a context of increasing territorial violence shows how communities must make strategic choices about technological adoption based on immediate security needs. Instead of outright rejecting or fully embracing surveillance technology, this community navigates the complexities of its use, grappling with its tensions while acknowledging its challenges and dependencies.

Furthermore, this finding contributes to decolonial theory by untangling how context specific security threats reshape theoretical assumptions about surveillance technologies and when criminal organisation threatens basic community infrastructure, the choice to implement surveillance systems cannot be reduced to simply accepting or rejecting colonial technological paradigms. It demonstrates how communities navigate nuanced decisions about technological adoption, which may appear to contradict decolonial principles but instead reveal more complex processes of community self-determination in materialising their digital futures.

This nuanced reality suggests that decolonial approaches to technology need to better account for how immediate security threats and community protection needs influence technological choices. The evidence highlights the need to move beyond blanket rejections of certain technologies, emphasising how communities thoughtfully balance resource protection and maintaining their autonomy.

When examining how security conditions affect rural communities' engagement with technology, it was found that there are complex intersections between physical safety, territorial autonomy and digital security that current digital divide literature has largely overlooked. These intersecting characteristics were found thanks to the rich amount of knowledge from both stages.

The evidence from both the interviews and focus groups with the rural communities and from other communities as found through the social media research reveals how security concerns fundamentally reshape our understanding of the digital divide, which move beyond

conventional frameworks that may prioritise technical and socio-economic barriers to access with some cultural aspects. The following posts shows further evidence of how the materialisation of digital futures happens within communities and are forced to respond to broader patterns of state and criminal violence.

When communitarian organisations and providers share posts about how "ORGANIZED CRIME MAINTAINS ITS POWER IN THE STATE OF GUERRERO, IN THE FACE OF THE INACTION AND COMPLICITY OF THE GOVERNMENT, WHILE…." , and *"Anger, indignation, sadness. How much longer do the Rarámuri communities have to endure so much violence, so much injustice, and the government putting on the theatre that nothing is happening here"*, it reveals a crucial insight about materialising digital futures, that these communitarian organisations tied to how communities work, understand that technological development cannot be separated from the broader conditions of violence communities face.

Although these posts do not explicitly mention technologies, their sharing by communitarian organisations focused on community technology demonstrates how they recognise that building digital futures is inextricably linked to addressing territorial violence and state complicity. This becomes particularly significant when we consider that these are the same communitarian organisations developing free software for communities' radios, creating digital security workshops and building autonomous networks.

Thus, their decision to amplify messages about what rural and Indigenous communities face with criminal organisations, government inaction evidenced in posts such as this one: *"Violence, organized crime and the inaction of the government of #Chihuahua and @government security ministry @president of Mexico are destroying the forests of the Sierra Tarahumara and the communities that defend it"*; and community resistance, shows how they understand that materialising digital futures is not only about implementing technology, it is about confronting the systemic violence that shows how communities can use and maintain that technology.

Reveals how communities must navigate the systemic collusion between state actors and criminal organisations which adds further threats to how communities can implement and maintain digital futures.

The post *"An x-ray that shows that #4T seeks the same transformation as previous governments, the dispossession of Indigenous peoples through the creation of a climate of generalized violence"* -- where 4T refers to the current government at the time -- takes on additional meaning when shared by community technology organisation as it suggests an understanding that threats to territorial autonomy and physical safety directly impact communities' ability to build and maintain technological infrastructure.

From the posts shared by communitarian organisations online, suggest they recognise that they cannot separate their work on technologies from the broader struggle against systemic and systematic dispossession. Thus giving evidence shows how the amplification of these security concerns, even when not explicitly tied to technology, shows how the work of building digital futures is inherently connected to addressing broader patterns of violence and resistance in these communities.

The way intersections between physical safety, territorial autonomy and digital security becomes particularly evident when communities cannot maintain basic educational continuity due to security threats, as shown before which highlights how fundamental security concerns precede and shape any possibility of technological engagement.

Evidence from the research shows how rural communities and Indigenous communities understand security as fundamentally interconnected with both territory autonomy and digital rights, a perspective largely absents from conventional digital divide scholarship. For example, when individual statements share: *"@----------: The land belongs to the people that we have inhabited for thousands of years in this territory, it does not belong to the genocidal narco-army…."* and also state " @---------: *"We meet because we know that water is in the hands of companies, governments, institutions, chiefs and drug trafficking…"* we can see how security concerns encompass struggles for the land and digital autonomy.

However, a revealing aspect here is that from a digital divide perspective, we may think that that corporate resource extraction is not connected to the digital divide, but if we look closely, communities have understood because they live these realities, that resource extraction and control of water and land are interconnected forms of violence and these cannot be separated from other aspects of autonomy and safety, and thus capacity to engage fully with technologies.

Some decolonial scholars have examined these intersections of resource extraction and control of water and land are interconnected forms of violence and these cannot be separated from other aspects of autonomy and safety.

However, and while digital divide literature has acknowledged the influence of socioeconomic and socio-political factors on digital inequalities, these are often treated as background conditions rather than as integral to understanding the digital divide. Therefore, failing to interrogate how systemic forces such as resources extraction, land control and narco-violence actively deprive communities of the means to access water, land and thus digital technologies which makes this a significant contribution to how we understand the digital divide.

This interconnected understanding gives an indication of how communities approach technological development and use and rather than treating digital security as a separate technical concern, they embed it within broader visions of community autonomy. As shared by an Indigenous community communicator: *"We dream of making the content ourselves, about how to plant corn, how to make compost...also how we can start working from the communities on the issue of security for a community of peace".* Demonstrating how communities envision technological development not as an end in itself, but as part of a holistic approach to community wellbeing that encompasses agricultural practices, knowledge sharing and the creation of peaceful communities.

The complexity of community approaches to digital security becomes evident in their multi-layered responses which reflects perspectives from communitarian organisations and community providers shared online too. While these contexts may be different, they share fundamental understanding of security as deeply connected to broader struggles for autonomy and justice. For instance, physical threats – such as those shared before in the community in the state of Guerrero and the rural community in the state of Morelos – and this Indigenous community in the state of Chiapas: *"Five observers from the ---------- withdrew from the ---------- community, in Chiapas, due to the lack of security guarantees and the worsening of attacks against Zapatista territory. Stop the attacks! 📷@--------"* highlight the ongoing challenges to territory and community safety are deeply embedded in security concerns.

These territorial security challenges exist alongside efforts to build digital security capacity, as evidenced by communitarian organisations developing practical solutions: *"---------- will publish a series of manuals for 40 weeks that will provide concrete information on how to use different free tools to improve our security and communication via the Internet"* showing how materialising digital futures requires developing comprehensive security practices and the length of the series suggests the depth and complexity if security knowledge communities need to develop.

At the same time, community technology providers show awareness of broader surveillance threats through sharing critical information about state surveillance tools and supporting movement building, as evidenced in these posts: *"How are computers infected? What you should know about NSO Group's #Pegasus malware #DigitalSecurity #SpyGovernment"* alongside developing *"Digital security guide for activists and social movements in Latin America"* shows how communitarian technology providers and communities too must simultaneously protect themselves against advanced surveillance technology while building movement capacity.

This reveals a crucial aspect of materialising digital futures whereby communities must develop security practices that address both immediate territorial threats and advanced digital surveillance systems. What makes these insights particularly significant for understanding the materialisation of digital futures is how they show communities developing interconnected approaches to security. They do not treat digital security as separate from territorial defence, instead there is both awareness and action that empower communities to protect themselves across multiple domains.

What is more, the focus on "free tools" also connects back to how open technologies empower communities to verify, develop and have agency over their security practices. These findings highlight the diversity of strategies employed to address security concerns while also revealing shared patterns in how technological adoption and development intersect with these challenges making a significant contribution to digital divide literature by demonstrating how security concerns, from physical safety to digital safety shape technological autonomy in ways rarely acknowledged by conventional frameworks.

The nuanced approach to security becomes even more critical when examining how communitarian organisations who as already established work directly with or are from rural and Indigenous and other impacted communities, must confront advanced and elaborated state surveillance systems. For example, the statement: *"New revelations about the use of Pegasus in Mexico confirm the need to guarantee truth, justice and non-repetition in the spy government case. Network in Defence of Digital Rights (R3D)"* demonstrates how communities contend with advanced surveillance technologies that threaten not only their digital communications, futures but their physical safety.

This is further emphasised in the post about how state surveillance is a threat to life, as evidenced in this post:*"Minimising espionage with the argument of alleged transparency of the*

Federal Government is a good speech. But more than rhetoric is needed. For thousands of people it is a matter of life or death".

In Chapter 5, we saw how the state as well as private providers have a sense of empowerment that falls short of what true empowerment is to communities because of the nature of their initiatives based on neoliberal logics of market prioritisation and control. In this section we can see how the government also represents a direct threat to materialising the digital futures of communities. Further evidence from this post: *"If the federal government and the #CDMX government lacks something, it is a comprehensive, avant-garde vision of what an inclusive, plural digital society, with independent and public media, should be like. dedicate $$ to train experts and enable rights with ICTs, not to monitor citizens"* helps untangle how communities are aware that authorities are not as interested and invested in true digital and technological empowerment since they dedicate their money to monitor citizens rather than empower rights with ICTs.

What is more, the connection between surveillance technologies such as *"When governments talk about security with video surveillance cameras and facial recognition"* and broader security concerns is particularly significant, especially when further evidence shows how communities and the materialisation of their digital futures requires addressing surveillance at both local and systemic levels, as this post suggest: *"We share #DigitalSafety #Tips recommended by @---------- about #DigitalCare. In other news @------- demands governments ban Pegasus after confirming spying on journalists".*

These surveillance complexities reveal a crucial insight and a contribution to the literature, especially to being careful not to treat security as a technological barrier, as this may reproduce harmful assumptions in concrete ways. For instance, framing narco violence, as uncovered before simply as a barrier to educational or internet access or infrastructure development may legitimise state security responses that often increase surveillance and militarisation of communities rather than addressing root causes. This becomes evident in how communities explicitly connect territorial defence with digital security, as show in their responses to both physical threats and surveillance tools such as Pegasus.

For instance, this post shared by a communitarian technology provider *"-------- #4: Taking care of ourselves online to be safe outside of it. The data and information we generate through our use of the Internet are of interest to governments, private companies, and even an ex-partner who harasses us for different reasons*" highlight through the recognition of " taking care of

ourselves online to be safe outside of it" of how communities understand security as an embedded challenge that crosses digital and physical spaces.

Therefore, when the communitarian provider notes "*data and information we generate through our use of the Internet are of interest to governments, private companies, and even an ex-partner who harasses us for different reasons*" it shows how security threats operate at multiple scales through multiple actors. This layered perspective is particularly significant for materialising digital futures because it reveals why simplistic approaches to security can be dangerous.

Thus, when narco violence is framed simply as a barrier to educational or internet access, it can legitimise increased state surveillance and militarisation, the very technologies that communities identify as threats to their autonomy. Instead, communities demonstrate carefully elaborated understandings that materialising digital futures requires addressing security in ways that do not invite further forms of control or surveillance.

This reveals a critical paradox in materialising digital futures, that the very solutions often proposed to address security threats such as increased surveillance and militarisation create new forms of insecurity for communities. Thus, by connecting territorial defence with digital security, communities show materialising digital futures requires security approaches that recognise the interconnection between physical and digital threats; address security without inviting increased state control; build community capacity for self-protection and challenge rather reinforce existing power structures.

The fact that communities must simultaneously navigate territorial disputes, resource control, physical threats and digital surveillance underscores the need to fundamentally conceptualise how we understand barriers in the digital divide. Thus, rather than treating security as external to digital divide issues, this evidence positions security and surveillance considerations as central to understanding both the challenges and possibilities for digital futures in communities. It also shows how treating surveillance technologies as outright colonial, scholarship misses the opportunity to further strengthen communities' reality of having to navigate security threats from the state, private providers and criminal organisations.

While it has been covered extensively the many ways communities materialise their digital futures and have community based technological adaptations through deeply embedded

communal practices, it has been shown too, how communities have adapted to negotiate and to continue to practice their agency along with digital technological building which are significant contributions to demystifying the digital divide.

The complex ways in which communities navigate security while developing and adopting technologies challenges both digital divide scholarship and state and market led initiatives. While these have somehow acknowledged barriers beyond the technical and economic, they fail to recognise how security concerns fundamentally reshape how communities can implement and use technologies. More importantly, the miss how communities embed security considerations with local knowledge system and governance practices.

Thus, when communities develop technological solutions, they do not separate security concerns from other aspects of community life. Instead, they integrate security considerations within existing community practices such as from agricultural knowledge to collective decision making through assemblies and ejidos, showing us how through these interconnections to materialise digital futures requires understanding security not as a separate challenge but as part of the broader fabric of community life and governance.

For example, the same collective practices through assemblies and ejidos that have traditionally governed land stewardship and agricultural practices, now shape how communities plan and develop digital infrastructure while addressing security concerns. This shows how communities draw on established collective practices to address new challenges in materialising their digital futures within the important role that localised knowledge systems play, which is not peripheral but central to how communities develop community based digital solutions that are adopted to function within complex security contexts.

It is also just as relevant to corroborate how the digital divide is part of a broader system of structural violence and harm. By situating the digital divide within the broader context of structural violence, through the interconnections between state, corporations and narco-violence extraction of resources and land this project highlights how resource extraction and socio-political control intersect with technological inequities, demonstrating that the digital divide cannot be fully dismantled without dismantling the systems that perpetuate these harms.

This section reveals a significant blind spot in both digital divide scholarship and state and market led initiatives which have recognised that there needs to be an understanding of context where digital divide initiatives are deployed, but have not fully recognised how local knowledge

systems and collectives practices fundamentally shape technological development, as covered on the last chapter and this one but also communities' security responses to violent threats.

Understanding how communities embed security with local knowledge systems and collective practices reveals only part of their response to systemic challenges, since communities have developed and keep cultivating approaches that move beyond local solutions to embrace broader networks of solidarity and support.

What is more, in response to the interconnected harms from systemic deprivation perpetuated by the state, private actors and criminal organisations, rural and Indigenous communities have developed transnational networks that defy reliance on these systems. Instead of remaining isolated in their struggles, rural and Indigenous communities have developed transnational networks that defy reliance on these systems. In the next section, new findings are revealed that show how these networks operate as communal routes that allow communities to materialise their digital futures.

Transnational digital solidarity networks

Data from the interviews and focus groups show how the community conceptualises transnational relationships as integral to digital development while also maintaining a critical awareness of development models, and this section, transnational digital solidarity networks shows how the community envisions a digital future through both local and diasporic networks, further supporting the chapter overall main theme of communal root, network routes and how communities materialise their digital futures.

While previous sections have shown how communities use open technologies and navigate security threats locally, these transnational connections show how communities extend their agency beyond territorial boundaries.

Taking from the findings in the last section around how communities build technologies and envision technologies departing from their governance practices and collective decision-making practices such as assemblies and ejidos, further data shows the widespread use of assembly practices across different contexts, purposes and scales.

For example, data from the interviews and focus groups with the community further challenges simplistic digital divide narratives that view rural communities as isolated or disconnected,

instead, evidence reveals how communities are actively maintaining and building transnational networks that serve as crucial connections for materialising digital futures but also offer a model for resource mobilisation, as shown in this statement: *"Could we share resources, ask family groups in the US, or even create community internet access points as is already seen in some parts?"* .

This vision of shared resources and asking family groups in the US shows how the community considers relying on this transnational connection for building technological infrastructure. What is more, when the community member shares how they can ask family members in the US also reveals a how the community mobilises resources through these diasporic networks which is something that the community has relied on, as we can see in this quote: *"..that we have been a people that fights and faces adversity, and we find how to do it, having relatives, almost all of whom are in the United States and who support us from there, has helped us build houses and have things that perhaps we could not have."*

Through this post, we can see few key elements about how the community mobilises resources. For example, the phrase "we have been a people that fights and faces adversity" positions the community's transnational networks as part of a broader history of community resilience and self-determination. Also, to reference "almost all" relatives being in the US points to the scale of diasporic connections the community maintains.

More importantly, the testimony above reveals a socio-economically embedded system that works as an alternative to current market and state models. For example, as the community ember describes how they "find how to dot it" through relatives in the US who help "build houses and have things that perhaps we could not have", the narrative moves beyond the concept of informal solidarity networks and shows instead the existence of economic routes that bypass conventional economic models.

The organisational structure behind these economic flows is evident in this statement: *"...but as has been done here almost always, organise committees of those who are in the United States or those who have the resources that they often send and give to carry out projects here",* showing how these committees are formalised practices within the community and the diaspora for pooling and directing remittances toward community defined projects. So, rather than ad hoc sharing, this shows a model that materialises a deliberate and organised process, where transnational networks functions as mechanism of resources mobilisation. This is a significant

finding because it challenges dominant narratives in the digital divide literature that situate marginalised communities as dependent on external interventions or state led policies.

However, while these practices highlight the agency of the community, they also reflect the broader socio-political and socio-economic inequities inherent in neoliberal systems. The reliance on remittances shows how neoliberal frameworks shift the burden of economic access and development from states to individuals and in this case , the community.

The reliance on remittances underscores the remarkable agency of communities in continually finding ways to thrive despite systemic neglect and extraction and while this economic routing the community has relies on clearly exemplifies failure of the state, equally important is that it shows how communities actively navigate and adapt their processes in these neoliberal structures. While operating within context of state neglect, resource extraction and socio-political marginalisation, communities transform remittance networks int organised community-led systems that support collective survival and development.

Event though these systems are not entirely independent of global neoliberal systems which makes them vulnerable to reliance on external flows, they represent creative, resilient strategies that highlight the ingenuity and adaptability of communities. This creativity is particularly evident in how diasporic communities maintain and adapt traditional practices while bringing in digital technologies and methods, as exemplified by this communitarian organisation: *"In recent years @---------- has worked closely with the --------- community in Los Angeles. The --------- community has organised itself around its committees and assemblies. We have adopted social networks to make the ------- community visible".*

This example illustrates how traditional assembly practices, shown and expanded in detail in the last section, persist and adapt even as communities migrate and in doing so, creating new forms of digital visibility and connection. Further reinforcing the already established insight that through these processes communities exemplify their agency and ability to reimagine and reconfigure their traditional system, bringing them with contemporary technologies and social processes such as migration while maintaining their autonomy and cohesion across borders. Such insight is relevant and contributes to challenging decolonial theories who may frame technology as inherently modern or external to Indigenous and/or rural life.

The enduring practices of assemblies and ejidos highlight not only the resilience if communities but also the systemic marginalisation that forces them into constant acts of resistance and survival. For instance, the international coordination evidenced here: *"FINAL DECLARATORY OF THE NATIONAL AND INTERNATIONAL ASSEMBLY OF THE NATIONAL INDIGENOUS CONGRESS / INDIGENOUS COUNCIL OF GOVERNMENT-NETWORKS OF RESISTANCE AND REBELLION, ORGANIZATIONS AND COLLECTIVES "THE ISTMO IS OURS" JUCHITAN, ISTMO OF…"* illustrates how communities must organise across geographies to address structural violence tied to resource extraction, land dispossession and state neglect.

This shows assemblies are not only acts if cultural preservation or political expression but responses to the accumulated harm of neoliberal policies that commodify land, water and technologies, leaving communities to have to organise and survive in these systems of exploitation.

The data also reveals the solidarity networks that form around ejidos: *"RT @----------: In solidarity with the call of the People's Front in Defense of Land and Water Morelos, Puebla, Tlaxcala Ejidos de A…"* showing how ejidal structures facilitate not only local governance but enable broader networks of support and resistance. This networking capacity is significant for digital divide literature, as it suggests that communities already possess established frameworks for creating and maintaining connections across geographical boundaries which is a crucial insight for understanding how communities' approach technological building and resource sharing.

This cross regional solidarity through ejidal networks provides another dimension to how communities are materialising their digital futures, further demonstrating existing routes for knowledge sharing and collective action that can inform technological development. Social media posts from communitarian organisations and communitarian providers' tweets make evident how these transnational bonds actively shape digital initiatives:

For instance: "Globalisation and the lack of opportunities have caused many people to migrate and among them the Bunyza from the central Valleys of Oaxaca. This forces us to create digital works such as for Dizhsa for the Zapotec diaspora like this..." speaks to how digital technologies are employed to preserve and transmit cultural and linguistic heritage across border which in the face of forced migration driven by structural inequalities and neoliberal

policies, the creation of digital works for the diaspora serves also as a cultural archive and a means of cultivating a sense of belonging, highlighting the role of digital technologies as tools for resistance against erasure and as platform for sustaining communal identity.

The statement *"I believe that community participation is important and replicable in digital spaces, as a way to unite migrant/resident peoples, linguistic variants and other languages, as well as unite different professions and experiences..."* further emphasises how digital technologies are being brought into communal governance and participation, reflecting a broader understanding of technology not only as an external imposition but as a resource that can be appropriated to meet community defined needs and goals.

These examples are significant within the context if the digital divide because they reveal how communities, even under conditions of systemic harm, are actively shaping their digital futures and rather than viewing technology solely as a tool for assimilation into dominant market or state systems, these practices demonstrate its potential as a medium for reinforcing transnational solidarity, cultural preservation and community autonomy.

At the same time, these findings allow for further critiquing the neoliberal framing of digital inclusion which often fails to account for the structural conditions that requires such communal efforts. These can be further evidenced through how globalisation and migration have an impact on how communities embrace digital technologies.

For example, the following migration centred initiatives further how communities are materialising their digital futures amidst systemic marginalisation.: *"New program from @----------! 📍🗺️ From #United States we can hear the testimonies of people who have migrated and how they keep their culture alive, together with @-------- from Fresnillo, #California."* which reflects how digital platforms become repositories for collective memory and cultural preservation.

By sharing testimonies of migration and cultural preservation, these initiatives resist erasure often imposed by displacement and provide a space for the articulation of identity in new territories. What is more, the emphasis on nostalgia is shown here: *"RT @----------: #podcast 🎒Migrants carry their culture everywhere, and despite the nostalgia of being far away, they form community ties in the new places they live, keeping their identity alive and sharing it with other cultures. Listen to it now!▶"* which underscores the challenges and

opportunities that migration presents, as migrants not only adapt to new socio-political realities but also actively reconstruct community in their new environments.

It is of significant importance to note how these processes rely on digital tools to connect diasporic members with one another and with their communities of origin, forming virtual assemblies and solidarity networks that echo and extend into physical ones, as this post evidences: *"Our first approaches with new information technologies were through migrants who returned to the communities" E. (Chicahuaxtla) #Alllanguages"* revealing the transnational flow of technological knowledge facilitated by migration.

What these insights further show, is how migrants act as bridges between what we saw before, with sending resources home through situated economic routes and as bridges between global technological practices and local realities by introducing technologies and knowledge to their home communities while simultaneously incorporating communal philosophies and values into these technologies.

This adds to the critique of state and market digital divide views that see rural and Indigenous communities as disconnected or dependent, instead these insights highlight how forced migration, driven by systemic inequalities and dispossession might look like it pushes communities to adapt but as we have seen, communities transform displacement into reorganisation within existing communal practices.

Further evidence from this post: *"This capsule is part of our #Migration and nostalgia program: living culture and community in #United States. Listen to it in full"* shows how digital platforms emerge as spaces for community led technological adaptations in the diaspora, where migrants' lived experiences are central, once again showing how digital divides discourses are deeply embedded in cultural, social and emotional dimensions.

There is a revealing aspect in these insights, whereby linking migrations narratives with themes of nostalgia and collective identify, these programmes reveal that the digital divide is not only about connectivity but also about who has the agency to modify and shapes digital spaces.

Migrants' use of these platforms to share their stories and build community as further exemplified in this post: *"#InternationalMigrantDay Despite the nostalgia of being far from home, #migrants form community ties in the new territories they inhabit, keeping their identity alive and sharing it with other cultures."* challenging state, market and scholarship around the digital divide by emphasising the lived realities of exclusion and adaptation. What these

initiatives reveal is how technology is used creatively and meaningfully countering the idea that marginalised groups are passive beneficiaries of digital inclusion state or market initiatives.

This reframing contributes significantly to digital divide discourse by situating technology within the broader socio-political contexts of displacement, marginalisation and resilience, making the discussion more holistic and rooted in lived experiences.

This conscious departure from simplified understanding of social complexities is particularly visible in how communitarian organisations approach their work: *"Where I work we have invested a lot of time in the collective construction of a program of Indigenous interpreters far from nationalisms and flags, our work does not focus only on one country. This program was not created to serve an institution or a government".* It is this explicit positioning of "far from nationalisms and flags" and beyond single country focus that reveals a novel insight for Western literature, that communities are consciously building programmes that transcend institutional and national boundaries.

These highlight an integral component of algorithmic agroceologies in how communities transform economic migration – a product of neoliberal policies – into networks of digital solidarity and resource sharing. Within the framework of algorithmic agroecologies, this evidence shows how rather than accepting geographical displacement as a barrier, communities actively build digital futures that strengthen cross-border ties and maintain cultural connections.

These insights expand current digital divide approaches by documenting how rural and Indigenous communities actively mobilise transnational networks in nurturing their digital futures. Within algorithmic agroecologies, these insights show how communities transform existing cross-border relationships into resources for addressing inequalities – economic, digital – moving beyond conventional models that emphasise external solutions or top-down interventions.

Meanwhile, other community-led initiatives shared on twitter, show how digital technologies can be deployed to prevent forced migration:

"✅The ------- chapter @------- launched a community network using a satellite dish in the remote rural community of Suri, connecting the health centre and allowing students to study without having to migrate, for the first time"

"Some 500 inhabitants of the locality -------, have an internet connection from a network that they built with their own hands and that prevented the migration of young people."

This evidence contributes to further emphasising how lack connectivity directly links to forced migration but most importantly it demonstrates how communities themselves actively construct these solutions to prevent forced migration.

Rather than being passive recipients of external programs, this finding shows developing technological approaches that emerge from an understanding of local needs, relating within broader community wellbeing such as health and education; builds on community led implementation and management and focuses on both nurturing community life by preventing migration.

Within this theme, this insight from social media reveals a deeper consideration about development and sustaining communities' models:

"Migration brought us benefits, but it also made us aspire to unsustainable life models..."

This insight is particularly relevant to digital divide interventions, which often promote standardised models of catching up or closing gaps that may not be sustainable or appropriate for rural contexts.

This insight demonstrates how members of communities who have been impacted by migration engage with broader implications of migration driven development models rather than simply accepting prescribed solutions. It further contributes to knowledge in the digital divide space, especially within so called digital inclusion strategies which need to consider local sustainability, not just access.

These findings demonstrate how communities navigate transnational digital solidarity networks with intention, drawing on their benefits while carefully considering how to maintain community sustainable practices.

Findings from the social media research show how transnational solidarity went beyond the Mexican diaspora in the US and other Latin American countries and the development of these transnational solidarity networks reinforces this other dimension of how communitas materialise their digital futures.

Through tweets and retweets by individuals in Mexico, we can see how through the lens of transnational solidarity in sharing the experiences of other rural and Indigenous contexts and underserved communities situating them within frameworks of community agency and working along external intervention and/or resource allocation.

For example, the quote of *"How a rural community built South Africa's first ISP owned and run by a cooperative @---------- Always important to remember how ---------- started"* shows an example of community-led innovation abroad but it reveals how communitarian providers in Mexico actively seek out and amplify similar models of technological development abroad.

This transnational solidarity becomes more significant when considered alongside earlier discussions of security challenges and open technologies *"Our partner @---------- is constantly striving to help rural communities in Northern Uganda to be ready for challenges" and "@----------: @----------s podcast will transport you to the rural north of the United Kingdom to invite you witness one of the Broadband for the Rural North (B4RN) community network assembly meetings, where knowledge is shared, and empathy transpires" s*hows how communities in Mexico and globally share not only technical solutions but models of community-led infrastructure.
This represents a contribution to digital divide literature by showing how communities are not only recipients of external knowledge, as already established, but active participants in a global exchange of community based approaches when they can have access to communicating and being part of the digital ecosystem.

What is more, the sharing of critical perspectives *such as "Governments and companies condemn people to poverty with algorithms by Karen Hao | translated by Ana Milutinovic Read full note at"* demonstrates how these networks enable communities to engage with and critique technological development at a systemic level. This build on earlier discussion of security and surveillance by showing how communities develop shared critiques of technological systems across geographical boundaries.

What makes these practices particularly significant for digital divide literature is how they reveal communities creating alternative channels for resources mobilisations but also knowledge exchange that bypass conventional models. Instead of waiting for knowledge transfer from developed to developing regions, communities create horizontal networks of solidarity and learning, challenging digital divide initiatives by showing how communities

create knowledge networks across global contexts; share and adapt models of community led infrastructure; introduce and share critiques of algorithmic systems and build solidarity networks that strengthen local initiatives.

It is about nurturing sustainable digital futures and materialising them, which are supported by these transnational dimensions, adding crucial insights and showing how communities' efforts to build autonomous infrastructure, using and developing open technologies and navigating security challenges are strengthened by connections to diasporic connections and similar efforts globally which reveals a nuanced approach where communities maintain string local roots while building global routes for resource mobilisation, knowledge sharing and solidarity.

Chapter 8: Conclusion

This project set out to examine the digital divide as a form of social harm and explore pathways toward community-led algorithmic ecologies. Through extensive qualitative analysis of social media content, interviews and focus groups, this project has revealed how the digital divide manifest as a social harm through systemic exclusion and market-driven approaches that often disregard community needs and agency.

In addressing the first research question: *How can the digital divide constitute a form of social harm?* the findings demonstrate that the digital divide constitutes a form of social harm through its perpetuation of colonial continuities through neoliberal policies and frameworks. As evidenced in *Chapter 5, Commercialised empowerment: the digital divide as a market opportunity*, the marketisation of digital exclusion efforts often serves institutional interests rather than community needs, creating patterns of dependency and exclusion that extend beyond simple access disparities.

The second research question: *How can insights from social media research, interviews and focus groups inform the need to move towards co-designing community-centred algorithmic ecologies?* was addressed through the analysis of community responses and initiatives documented in interviews, focus groups and social media content. These findings, particularly detailed in *Chapter 6, Algorithmic agroecologies: nurturing relational digital futures*, reveals

how communities actively shape and nurture their digital futures through conceptualising technology through relational frameworks.

This relational perspective provides context for the concept of algorithmic agroecologies which is borne out of the evidence showing how communities incorporate technologies not as external solutions but as embedded components of their broader systems of ecological knowledge and collective organisation practices, thus presenting algorithmic agroecologies both as a significant theme that emerged from the analysis and as a potential model for addressing the digital divide. In contrast to most of the digital divide literature, which frequently frames digital engagement or making in terms of barriers and limitations, this project suggests that technology hols meanings primarily in its capacity to sustain and strengthen existing social relationships and practices.

The evidence presented here moves beyond simplistic narratives of technological adoption to reveal how communities actively resist, oppose and/or negotiate with state and private actors but most importantly how they build what this projects terms algorithmic agroecologies, as dynamic systems of knowledge, practices and relationships that bring together technologies, digital and non-digital, with existing ecological and collective practices.

Regarding the third question: *How does working towards co-designing community-centred algorithmic ecologies support community life and care in historically left out communities?* *Chapter 7, Communal roots, network routes: materialising digital futures*, demonstrates how community centred approaches to digital infrastructure support and strengthen existing relational practices and care networks. The research reveals that when communities have agency in technological development, digital initiatives become part of broader patterns of community life and mutual support.

The significance of these findings extends beyond theoretical contributions to digital divide scholarship as it demonstrated that to effectively tackle the digital divide requires recognising and building upon community agency, knowledge and existing organisational structures. The project's implication challenges dominant approaches to digital inclusion, suggesting that meaningful change requires moving beyond the already established ways current literature outline, policy initiatives and more theorisation and instead actively support community-led technological development.

The project makes key contributions to the field. First, it introduces and elaborates the concept of algorithmic agroecologies as a framework for understanding community led technological development. Second, it provides detailed documentation of how traditional knowledge and collective practices actively shape technological engagement. Third, it demonstrates practical pathways for developing sustainable and culturally grounded digital futures that strengthen rather than replace existing community knowledge, relationships and practices.

However, certain limitations of the project must be acknowledge. The focus on specific rural context may limit the direct applicability of some findings to other settings. However, as it has already been examined in the methodology section, the project addresses this by analysing data from social media content whereby communitarian organisations and community technology providers who work either directly or represent membership if rural and Indigenous communities, the project is supported by the ideas, thoughts, initiatives, experiences shared through social media.

By revealing how communities develop algorithmic agroecologies that combine technologies with existing knowledge systems and social practices, this project suggests pathways for addressing digital divide challenges that strengthen rather than replace communities' knowledge systems, and relational practices. These findings have significant implications for practical initiatives in digital inclusion efforts, suggesting that the future of the digital divide lies in supporting community led technological development rather than externally theorising and imposing policy led or market led initiatives only.

Most significantly, this project reveals how communities are not passive recipients of technology but active creators of technological futures that reflect their values, knowledge and relationships. This understanding opens new possibilities for addressing the digital divide through approaches that centre community agency and knowledge, suggesting that effective digital divide initiatives must build with rather than upon and replace existing community practices and relationships.

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Appendices

Appendix A. Ethics Application Form for Social Media Analysis

Ethics Application Form for SOCIAL MEDIA ANALYSIS

Version 1.0

SECTION 1: About you and your research

1. **Name(s):**

   Yadira Sanchez Benitez

2. **Current Position (***staff, UG, PGT, PGR***):**

   PhD student

3. **Contact Details:**

   Faculty / School / Department: *Sociology, Social Policy and Criminology*

   University Email: *Y.SanchezBenitez@soton.ac.uk*

   Phone *(staff members only, university phone number)*:

4. **Is your research being conducted as part of an education qualification?**

   Yes X **No** ☐

5. **If Yes, please give the name of your supervisor:**

   Dr Pamela Ugwudike

   Dr Mark Weal

   Dr Anita Lavorgna

6. **Title of your research project/study** *(include SMA in the title)*:

Digital exclusion as social harm: Co-designing digital tools with communities to support community-based algorithmic ecosystems

7. Briefly describe the rationale, aims, design and research questions of your research

Some of the overarching questions of this study are:
How can the digital divide constitute a form of social harm?; How can a co-designed (digital) tool encourage other forms of digital inclusion and support community resilience (efforts) and care in historically left out communities?; How do accountability processes and tools inbuilt in co-designed tools allow for re-appropriation of technologies and spaces?

One of the study's aims is to compare the narratives around the digital divide between the communities where the study will take place and the narratives in social media spaces. One of the goals of collecting social media data is to compare the narratives between different groups (NGOs, rural communities and other left out communities in the digital divide) which will be done through qualitative analysis after collecting the data.

This research contributes to the gap in knowledge around digital needs for rural communities in Mexico; how the conversations around digital divide on social media platforms may offer some overview around the digital divide in the country, who is driving the conversations around change, policies and projects with communities.

This ethics application relates to the first stage of the project. Ethics applications for amendments required for other stages of the project (a focus group study and a survey) will follow.

SECTION 2: About your data (Type and selection of data)

8. Describe the data you wish to analyse (i.e. data sample)

Please give details of the social media data (Twitter, Facebook, Instagram, Reddit, etc.) you wish to study and what you will analyse (words, sentences, geo-data). State how big your sample will be (approximate number of data items and the number of data subjects). Will the data include identifiable data subjects?

I plan to analyse publicly available data collected from the following social media sites: twitter, instagram and reddit which will include words and sentences as well as

images. The data will include identifiable subjects based on their profile names in these sites. Approximately 200k tweets and posts will be collected.

9. Please describe how you are going to obtain the data you wish to analyse.

Identify the source from where you will be obtaining the data. Provide detailed information (see guidance at the end of form).

From publicly available tweets and posts from instagram, content from reddit. Available through the platform's APIs which allow academic researchers direct access to publicly available data (such as tweets, instagram posts, reddit posts) from their platforms, without the dangers of breaching more sensitive or personal information; the speed to access this data through their API means the data can be accessed immediately.

10. Please explain how the selection is performed.

Will you select the data manually (how?) or will you be using a programme (which programme)? Be specific (See guidance at the end of form)

I will collect tweets based on keywords and hashtags, for example: (brecha digital (digital divide); tecnopolitica (technopolitics); redes comunitarias (communitarian internet networks)); to mention some. The same will go for instagram posts, and reddit comments (posts).

I will be using my own data collection algorithm to collect the data based on keywords and hashtags. In order words I will create an algorithm with which I will access the platforms' API and request tweets based on specific keywords and hashtags which will be extracted directly into a csv file to then be exported to an excel sheet.

The algorithms will be written in the programming language python and will set the conditions to retrieve data from twitter, Instagram and reddit through their APIs authorized access. The algorithm will retrieve the users profile name, followers count, following count, total likes, statuses count, direct replies, retweets, hashtags, urls, user mentions, media type if tweet has any; these will be retrieved in rows and columns ready to be stored into a csv file.

All data will be collected automatically in full compliance with the T&C of the platforms accessed, e.g., https://help.twitter.com/en/rules-and-policies/update-privacy-policy; https://www.instagram.com/about/legal/terms/before-january-19-2013/; https://www.reddit.com/wiki/api.

After data is extracted from the web and collected it will be stored in the form of a csv and excel files for data analysis purposes. This will be kept in my secure, password-controlled university PC.

For qualitative data analysis I will be using my own algorithm by using Python's built-in analytics tools. Some of these tools are numpys and pandas that allow for basic filtering techniques based on specific conditions and allows to do sentiment and text analysis.

The time period considered for the collection of the tweets will be a year.

Number of posts for Instagram: approximately 50k

Number of tweets for Twitter: approximately 100k

Number of posts for Reddit: approximately 20k

Terms to be searched in Spanish have been mentioned above: (brecha digital (digital divide); tecnopolitica (technopolitics); redes comunitarias (communitarian internet networks)); to mention some.

There is a potential that from the data gathered, there are tweets/posts of persons I know. So, yes, I will analyse this data too.

11. What are the terms and conditions around the use of the data?

Do you need to register with the platform? Do you need to alert and request permission from a site moderator? (See guidance section at the end of form)

The study will access only publicly available posts. This means that consent is not required since the platforms in question inform users that their data will be made publicly available and could be used for research. That said, this study will maintain users' confidentiality in the following ways: all social media data will be stored securely in a password-controlled university PC.; no identifying information will be shared or included in any output produced from this research; and the extracted content will be rephrased to ensure that no quotation, phrase or other comment is traceable to the users.

12. Do you intend to process personal data?

Explain whether data subjects included in your study can be directly or indirectly identified? Note that usernames such as 'Mickeymouse' can still constitute personal data if the associated information is indirectly identifiable of data subjects through other identifiers, e.g. email addresses. (see guidance section at the end of the form)

Yes ☐ **No** X

If YES, please specify what personal data will be processed and why?

If NO, please go to section 3.

13. Are any of the personal data you are collecting Special Category Data or related to an actual or assumed criminal offence?

Special category data includes personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, genetic data, biometric data, health, sex life and sexual orientation. Criminal offence data relates to criminal convictions and offences, or related security measures. (see guidance section at the end of the form)

Yes ☐ **No** X

If YES, please specify what special category personal data or criminal offence data will be processed and why.

14. Would the data subjects reasonably expect their data to be re-used for research purposes? *(see guidance at end of form)*

Yes X **No** ☐

If yes, would they expect you to ask for consent to carry out the research (explain):

No, as noted earlier, the platforms in question inform users that their data will be made publicly available and could be used for research.

If no, might they object to the research carried out without their knowledge (explain):

15. Would it be possible to let participants know that you are doing this research? *(see guidance at end of form)*

Yes **No** X

If yes, explain how:

If no, explain why not: *Because the proposed participants are numerous (likely to be over 50,000), making it practically impossible to contact and notify them of the intended research.*

16. Would it be possible to obtain consent? *(see guidance at end of form)*

Yes **No** X

If yes, explain how:

If no, explain why not:

Large amounts of data to be extracted make it practically impossible to seek consent.

17. If it is impossible to obtain informed consent (and justified) what measures will you take to mitigate the impact of lack of informed consent?

All data will be anonymised as soon as they are used for analysis and will be kept confidential during the study, secured in my university account, and deleted following university guidelines, when the study ends.

SECTION 3: About the analysis of data

18. How will you analyse the data?

I will be analysing the data qualitatively and with help of some data analysis tools with python, such as sentiment analysis. Qualitative analysis is a key part of this part of the research; images and text from the tweets and posts will be analysed for their content to further analyse thematically.

The type of data that will be included in the analysis will be images, "main words and their context" - no specific tweets nor profiles.

All data to be used in the analysis will be anonymised.

19. Will you use data mining and/or other algorithms such as machine learning techniques?

Yes x No

If yes, how will you mitigate risks to data subjects associated processing data using Artificial Intelligence-type techniques?

I will only be using approaches in python that allow me to qualitatively analyse the data further, for example, I will be using text mining that uses natural language processing to automatically analyse text for the sentiment of the writer which I will then qualitatively analyse myself for subsequent thematic analysis.

As seen in the algorithms above, I will not be collecting identifiable personal data from the users (profile photos, geolocation). Also, the APIs from each social media platform makes sure that this is avoided.

All images, texts, analysis as output from qualitative analysis and/or using sentiment analysis will re-phrased to ensure anonymity of data subjects.

20. Are you planning to link data?

Yes No X

If yes, how will you mitigate risks to data subjects associated with linking data?

SECTION 4: About the storage of data and what you will do with the results

21. How will you store and manage the data <u>before</u> and <u>during</u> the analysis? What will happen with the data <u>at the end of</u> the project? *Please consult the University of Southampton's Research Data Management Policy (see guidance at end of form)*

The data will be stored as soon as it is retrieved into a folder in my password protected university PC. The data will be stored until my candidature ends (expected Jan 31 2024).

22. **Do you intend to share or publish your results?** *(see guidance at end of form)*

Yes X No

If yes, explain how:

I will write a paper for submission to a peer-reviewed Journal, detailing the findings, with all the data anonymised and no social media user identifiable.

23. **How will you minimise the risk that data subjects (individuals or organisations) could be identified in your presentation of results?** *How will you protect individuals' anonymity in your analysis and dissemination? Outline any risks that might result in re-identification and how you will minimise them. (see guidance at end of form)*

All data will be anonymised in the data analysis and results stages as well as keeping all data confidential throughout and after the study. Social medias posts will be also re-phrased so they cannot be easily identified.

SECTION 5: Any other issues

24. **What other ethical risks/concerns are raised by your research, and how do you intend to manage them?** *Issues may arise due to the nature of the research you intend to undertake and/or the subject matter of the data (see guidance at end of form)*

No ethical concerns are raised by my research beyond anonymity and confidentiality which have already been covered in this application.

Since I am carrying out qualitative analysis, the possibility of false representation of participants may arise. Thus, I will retain a sull set of data for examination by supervisors as necessary

25. **Please outline any other information that you feel may be relevant to this submission.**

26. **Please indicate if you, your supervisor or a member of the study team/research group (including any institution that they act for, if different from the University) are a data controller and/or data processor in relation to the personal data you intend to process as defined by the Data Protection Act 2018 following the GDPR, and confirm that you/they understand your/their respective responsibilities (** https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/key-definitions/controllers-and-processors//)

Note that researchers, who are extracting data from a site and use them for a different purpose are also data controllers.

As the main researcher in this study, I am the data controller where I will be collecting the data, making decisions about the data from the users and making sure that no identifiable personal data is misused (images from media posts will be contextualized, re-phrased; as well as texts and other posts).

Appendix B Ethics Application Form for Interviews and Focus Groups

ETHICS APPLICATION FORM
Faculty of Social Sciences

Please note:

- ***You must not begin data collection for your study until ethical approval has been obtained.***
- ***It is your responsibility to follow the University of Southampton's Ethics Policy (https://www.southampton.ac.uk/about/governance/policies/ethics.page) and any relevant academic or professional guidelines in the conduct of your study. This includes providing appropriate information sheets and consent forms, and ensuring confidentiality in the storage and use of data.***
- ***You are advised to read the Advice on Applying guidance document, downloadable from the ERGO II website, before you submit your application.***

Important notice on Risk Assessment:
Health and Safety-type risk assessment is no longer part of the ethics review process. Questions pertaining to ethical and reputational risks have been moved from the old 'Risk Assessment Form for Assessing Ethical and Research Risks' to this form. Please do NOT upload a separate Risk Assessment Form to your ethics application.
However, it is your responsibility to undertake a Risk Assessment for your research study. Depending on whether your study is office based, involves off-site data collection and/or international travel, there are different risk assessment forms you can use. Please use this link to access the forms:
https://groupsite.soton.ac.uk/Administration/FSHS-Health-and-Safety/Documents/Forms/AllItems.aspx?RootFolder=%2FAdministration%2FFSHS%2DHealth%2Dand%2DSafety%2FDocuments%2FRisk%20assessments%20and%20risk%20register%2FERGO%20interim%20documents&FolderCTID=0x012000BE79A4A3B3DC1143ABB38DFA6B580A8C&View={A5E79215-986A-4471-8CF9-B11F85214687}
If you need guidance or are unsure about which form to use, please contact your Discipline Health and Safety Rep in the first instance, and the Faculty Health and Safety Officer, Aloma Hack (A.J.Hack@soton.ac.uk), if you have further questions. Supervisors and Line Managers are responsible for ensuring risk assessments are completed for all research studies.

1. Name(s):

Yadira Sanchez Benitez

2. Current Position

PhD Candidate

3. Contact Details:

Faculty of Social Sciences
Y.SanchezBenitez@soton.ac.uk
07933996050

4. Is your study being conducted as part of an education qualification?

Yes ☒ **No** ☐

5. If Yes, please give the name of your supervisor

Dr Pamela Ugwudike
Dr Michelle Newberry
Dr Mark Weal

6. Title of your project:

Technological exclusion as social harm: Co-designing tools to support community-based algorithmic ecosystems

7. Briefly describe the rationale, study aims and relevant research questions of your study

The purpose of this project is to investigate how technological inequities harm Mexican rural society. Growing disparities in Mexico's access to and utilisation of technology have hindered rural communities' ability to access other services and opportunities such as information to public sites dues to a lack of internet infrastructure and educational resources for people of all ages on computational tools, to mention some. These disparities have reinforced assumptions and biases due to policies and processes that generalise technological divisions and community requirements.

This study aims to provide community-based solutions to technological and other barriers that may involve some kind of technology.

8. Describe the design of your study

The project employs a mixed methods approach with this part of the study being only of qualitative nature by carrying out focus groups and interviews.

This project is grounded in Indigenous feminist and decolonial frameworks, prioritising marginalised communities' voices and perspectives and challenging colonial power structures.

The study's design prioritises enabling local engagement, concerns about power structures, historical and cultural considerations, and adequate time commitment with the community. In other words, the study emphasises the need to include people of the local community in the research process to ensure that their needs and viewpoints are considered and central to the project process. The study also acknowledges the impact of power structures, as well as historical and cultural variables, on the community, and seeks to address these aspects via the research methodology. Moreover, the study acknowledges that spending time forming connections with the community is critical to establishing trust and ensuring that the research is ethical and respectful.

The focus groups will include questions about how governmental and other institutional processes and policies harm the community and what these harms (barriers) look like. This is informed by literature on internet and technology access in Mexico and around the world which also supports the role of community-based solutions that not only prevent harmful technologies but which centre the contextual and historical experiences of these communities.

The focus groups are planned to be done during 2-3 months and aim to centre the knowledge of all genders and age groups of 18+ years in the community. This will help in identifying the different feminist issues across demographics.

Technology making is often dominated by male perspectives and experiences. However, Indigenous feminist and decolonial perspectives seek to challenge dominant perspectives and promote more inclusive and equitable approaches to technology development. This is why the focus groups will include questions to the participants on giving more insight into the topics of gender and historical factors in the challenges women particularly may face and open the discussion to offer ideas, opinions and potential involvement in the development of a community solution to a challenge or barrier agreed during the focus groups that we all think needs to be prioritised and addressed.

After conducting focus groups, the next step is to carry out individual interviews with a sample of 30 people. These interviews can provide more in-depth insights into participants’ experiences and perspectives on the topic. The interview questions will be open as they are designed to encourage participants to share their thoughts and experiences openly. The data collected from these interviews can then

be analyzed to identify key themes and patterns that emerge, which can be used used to develop recommendations for addressing technological harms in the community.

Some of the ethical considerations include informed consent which will be covered by participants filling up a form prior to both the focus groups and the interviews. For confidentiality and data protection reasons, the participants' names will be anonymized in the data analysis and results.

The timescale for this section of the study is estimated to be approximately 9 months, including data collection, analysis and outputs.

9. Who are the research participants?

The focus groups will be divided into 3 focus groups with 15 people from all genders and ages, the participants are members of the community which is central to Indigenous feminist and decolonial perspectives.

The focus groups will be broken down into smaller groups of 5 to encourage participant input and reach; they will then come back to the larger group to share the main takeaway points.

The interviews will follow the focus groups to get a deeper understanding since they allow for a more in-depth exploration of the participant's experiences, attitudes and behaviours. The interviews will aim to include 30 participants from the community of all genders and ages.

10. If you are going to analyse secondary data, from where are you obtaining it?

N/A

11. If you are collecting primary data, how will you identify and approach the participants to recruit them to your study?

For recruitment, I will be working with permanent residents in the community who work on community projects and who have access to and rapport with some community members to be able to approach them.

I will be reading an information sheet to all participants and have a signed consent form. Uploaded.

12. Will you be collecting Special Category data as defined by UK data protection legislation? Will you be collecting Criminal Offence data? If so, please give details.

No, I am not collecting special category data.

13. Where will your data collection take place?

Mexico

14. Will participants be taking part in your study without their knowledge and consent at the time (e.g. covert observation of people)? If yes, please explain why this is necessary.

No.

15. If you answered 'no' to question 14, how will you obtain the consent of participants?

I will be providing a consent form to participants. Attached.

16. Is there any reason to believe participants may not be able to give full informed consent? If yes, what steps do you propose to take to safeguard their interests?

There are no reasons to believe participants may not be able to give full informed consent.

17. If participants are under the responsibility or care of others (such as parents/carers, teachers or medical staff), what permission do you have to approach the participants to take part in the study?

N/A

18. Describe what participation in your study will involve for study participants.

The focus group plan and interview questions are attached.

19. How will you make it clear to participants that they may withdraw consent to participate at any point during the research without penalty?

Since most of the community's traditions are passed down orally, I will tell the participants that their participation is voluntary and that they can leave at any time.

I will also reassure them that any data collected during the study will be kept confidential. Confidentiality is answered in question 23 below.

I will also make sure they understand that after data has been analysed, I will be unable to identify specific data they have contributed, so they will be told that the deadline date for their data to be removed is the end of June, approximately 2 months after the collection of data.

20. Detail any possible distress, discomfort, inconvenience, harm or other adverse effects the participants may experience, including after the study, and how you will deal with this.

There may be various implications for unmet expectations:
If participants have expectations about what they will gain from participating in the study, I will ensure that those expectations are managed by providing them with clear information about what the study entails and what they can expect to receive as a result of participating, which will also depend on the results of the focus groups and interviews. Such expectations will be discussed and communicated in the oral statement when I reach out to them.

21. Specify any possible distress or harm to YOU arising from your proposed research, and the precautions you will take to minimise these.

Since the study methods will not be gathering any distressing, sensitive or illegal information. I do not need to give considerations here.

22. Does your planned research pose any additional risks as a result of the sensitivity of the research and/or the nature of the population(s) or location(s) being studied?

Yes, all research with communities, especially historically left-out communities pose risk. More specifically, the relationship between the researcher (myself) and also as a community member - and the larger community will have power dynamics.
These power dynamics are dealt with by engaging with the community in a clear and respectful manner, understanding the community's historical and cultural context, incorporating participatory methods, ensuring informed consent and being honest with the community from the beginning in the implications of this project and co-developing strategies for mitigating any potential harms.

23. How will you maintain participant anonymity and confidentiality in collecting, analysing and writing up your data?

- I will store collected data in a secure location, such as an encrypted computer, to prevent unauthorized access.
- I will conduct data analysis in a way that does not reveal individual participant information.
- I will ensure that when I report data, I avoid any risk that could potentially disclose the identity of participants.

24. How will you store your data securely during and after the study?

Your data will be securely collected, analysed, stored, and transcribed. Since all data will be electronic data at this moment, this will be encrypted and password-protected with the future aim to be stored in a way that can be easily accessible to the community, both digitally and physically.

The collected data will be stored in a secure location in an e-drive and in an encrypted computer, to prevent unauthorized access. The data will be kept in a password-protected format to ensure that is only accessible by authorised members; in this case, the researcher and the university auditors. The data will be held securely and in accordance with applicable data protection regulations.

25. Describe any plans you have for feeding back the findings of the study to participants.

Yes, the idea is to have participatory workshops following the focus groups where we continue as a community working towards a community-based solution based on the challenges and barriers discussed and agreed to work on during the focus groups.

Additionally, I will be creating a community-based archive with the data collected. The archive has the potential to look in many ways (analogue, digital, hybrid) and this will be decided on the focus groups. Since the data belongs to the community, management processes will be decided in the community through a consensus on what to do with it, how to store and where? Some potential answers to be further explored with the community include:

- Use secure data storage through open sources software tools such as VeraCrypt which can be used to encrypt data on storage devices, such as hard drives or USB drives. It supports multiple encryption algorithms and is available for Windows, Mac, and Linux.

- Implement access controls of who the community decides to be allowed to access the data and manage it.
- Train community members in the handling of the data as part of the participatory workshops.
- Develop data-sharing agreements which will be agreed upon during the participatory workshops and will prioritize community benefits by ensuring that data is used for community-driven research or initiatives, and that community members have a say in how the data is shared and used.
- Conduct regular security audits

26. What are the main ethical issues raised by your research and how do you intend to manage these?

I will protect the privacy of individuals and ensure that data is collected and used ethically. Both the focus groups and interviews' data will be anonymised for it to be archived.

I will obtain informed consent from participants in the focus groups, ensuring that they understand the purpose of the research and any potential risks or benefits.

I will be transparent about the goals and methods of the research and be accountable for any potential harm that may arise from their work.

For this, I will seek input from the collaborators/participants and regularly review and reflect on the work to identify and address potential ethical concerns.

27. Please outline any other information you feel may be relevant to this submission.

As a researcher and community organiser, I have experience in organising community-based workshops around technology both online and in-person. This demonstrates my commitment to communitarian practices around technology.

Furthermore, I am familiar with communitarian and Indigenous feminist and decolonial frameworks that guide this project and I am dedicated to ensuring that the project is carried out with the utmost sensitivity and care towards the community of which I am part.