Community broadband networks and rural digital divide: A UK case study

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Abstract

Community broadband networks have recently emerged as an alternative to both public and private players in the delivery of superfast broadband in rural areas. The impact of these initiatives upon the rural digital divide is, however, largely unknown. Focusing on Broadband for the Rural North (B4RN), a community FTTH network in the UK, this paper explores how a community-led initiative can contribute to bridging the access, adoption and outcome divides in rural areas. Following a bottom-up and demand-driven model, B4RN has managed to expand the supply and demand of superfast broadband in remote areas previously ignored by commercial and subsidised deployments. Its overall impact upon the rural digital divide has been constrained by the small scale of the project as well as its reliance on private contributions. Although it may not be replicable on a national scale and suitable for large organisations, the approach developed by B4RN confirms that involving local communities in the design and execution of broadband projects help minimising both access and adoption divides in rural communities.

Keywords: broadband, community networks, UK, rural digital divide.

0. Executive summary

Community broadband networks have long existed as an alternative to commercial ISPs, but only recently emerged as response to both market and government failures in the provision of rural broadband. This paper aims to explore how community broadband networks contribute to reducing the rural digital divide.

This analysis focused on a single case study, Broadband for the Rural North (B4RN), a community FTTH network in the UK. A combination of interviews and ethnographic analysis was employed to understand how this initiative has addressed the market failures underlying the access and adoption divide in the rural UK.

B4RN adopted an innovative business model, based on demand aggregation and the involvement of local volunteers, that enabled the company to deploy FTTH in areas otherwise underserved. The project has constantly expanded over the year, thereby reducing the rural access divide in the affected communities. Nevertheless, its overall impact at national level has been questioned, as the coverage of B4RN's network remains limited in terms of geographic scope and number of connected premises.

On the demand side, B4RN actively supported broadband adoption and digital inclusion by providing tailored guides and weekly trainings. Although it may be early to assess its overall impact upon the adoption and outcome divide, this case study proved the potential of digital technologies in a rural context and the importance of engaging with local communities when designing and executing broadband projects in rural areas.

1. Introduction

With the Internet being a key input for the use and development of digital services, access to superfast broadband[1] has become a vital necessity (ITU & UNESCO, 2015). Nevertheless the availability of mobile and fixed broadband varies significantly at regional and cross-country level (European Union, 2015; OECD, 2018). Furthermore, the adoption and use of Internet-based services is not even across different social groups (Scheerder, van Deursen, & van Dijk, 2017).

This gap in the access and use of digital services is usually referred to as a 'digital divide' and has, in particular, affected rural areas (OECD, 2018). The rural digital divide results from failures on both sides of broadband markets, thereby being historically addressed by public interventions (Gomez-Barroso & Feijoo, 2010). The latter, however, have often failed to provide universal access to broadband (Farrington et al., 2015). As a result, community broadband networks have recently emerged as an alternative approach to deliver superfast broadband in rural areas (Gerli, Wainwright, & Whalley, 2017).

Community broadband networks have been extensively researched from a multidisciplinary perspective (Powell & Shade, 2006; Salemink & Strijker, 2018), but a comprehensive understanding of their impact on the rural digital divide is missing. This research gap is addressed here by exploring how a community NGA network has contributed to reducing the rural digital divide in the UK. Based on multiple qualitative methods, this case study analysis sheds light on the factors affecting the development of the community-led initiative and its impact on the failures in broadband markets.

The remainder of the paper is structured as follows. In Section 2, extant literature on community broadband networks is reviewed and a conceptual framework to analyse the rural

[1] Superfast broadband may be defined in different ways. In line with ITU (2013), this paper defines it as connectivity delivering a minimum download speed of 30 Mbit/s.

digital divide is presented. Section 3 outlines the methodology used in this study, whose findings are analysed in Section 4. Drawing on the discussion in Section 5, recommendations for policymakers and further research are summarised in Section 6.

2. Community broadband networks: a literature review

Community broadband networks refer to broadband infrastructure developed by "interested, concerned, and technologically able citizen and community groups" (Tapia, Powell, & Ortiz, 2009, p. 355). These ventures are generally funded by private investors but managed as not-for-profit cooperatives, thereby differentiating them from both public and private ISPs (Gerli et al., 2017).

Whereas cooperative telecommunications operator have long existed in the U.S. (Hollifield, Donnermeyer, Wolford, & Agunga, 2007), community networks have flourished across the world since the advent of the Internet (Internet Society, 2018). Community Wi-Fi networks were established in the early 2000s as an alternative to commercial ISPs for the provision of affordable broadband (Middleton & Bryne, 2011). These initiatives were based on the sharing of Wi-Fi connectivity and driven by multiple goals, such as generosity, digital inclusion and citizen empowerment (Powell, 2008; Sandvig, 2004; Shaffer, 2017).

More recently, local communities have also engaged in the rollout of next-generation access[2] (NGA) networks in order to address both market and government failures in the provision of superfast broadband (Sadowski, 2017; Salemink & Strijker, 2018). Although the public sector is expected to correct market failures (Gomez-Barroso & Feijoo, 2010), public interventions do not necessarily aim to achieve universal access to broadband (Gerli & Whalley,

[2] NGA networks refer to broadband infrastructure partially or entirely composed of optic fibre (ITU, 2013)
2 Although different definitions of superfast broadband exist, this usually refers to connectivity with a minimum download speed of 30 Mbit/s (ITU, 2013)

2018). As predicted by Weisbrod (1975), non-profit organisations have eventually emerged to serve the demand previously unsatisfied by either private or public providers.

These initiatives rely on the mobilisation of the human and financial resources existing within local communities (Gerli et al., 2017; Shaffer, 2017). Consequently, community broadband projects are expected to enhance local development and the resilience of rural communities (Ashmore, Farrington, & Skerratt, 2015; Salemink & Strijker, 2016). However, the reliance on endogenous resources was also identified as a major limitation to the sustainability of community broadband projects along with their inability to manage exogeneous policy and market shocks (Salemink & Strijker, 2016; Shaffer, 2017).

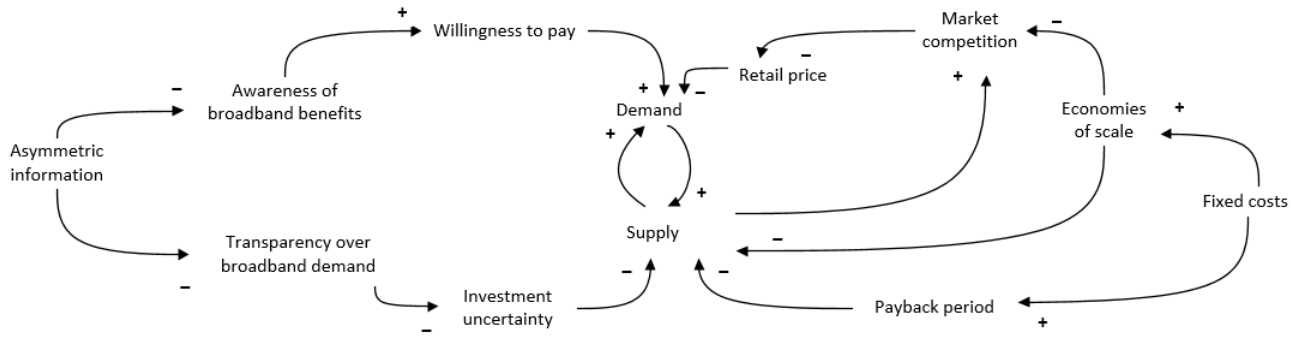
Earlier research investigated the impact of community Wi-Fi networks on digital inclusion in a urban context, questioning the ability of these initiatives to engage with digitally illiterate users (Powell & Shade, 2006; Tapia et al., 2009). Little attention has been paid, so far, to the impact of these initiatives on the rural digital divide. This paper addresses such a gap by exploring how a community-led initiative contributes to supporting the supply and demand of superfast broadband in the rural UK.

The digital divide is commonly described as the combination of three layers – access, adoption and outcome divide (Scheerder et al., 2017). The access and the adoption divides refer respectively to the uneven distribution of broadband infrastructure and digital skills (Van Dijk, 2012). The outcome divide, instead, reflects the different benefits that Internet users are able to obtain from the use of digital services (Kwok-Kee, Hock-Hai, Hock Chuan, & Tan, 2011).

The urban-rural digital divide is here conceptualised as the result of market failures affecting both the supply and demand of superfast broadband (Gerli & Whalley, 2018; Gomez-Barroso & Feijoo, 2010). As outlined in Figure 1, there are two major sources of market failures in this context: asymmetric information affecting both the demand and the supply of broadband

and the economies of scale due to the high fixed costs of broadband investment (Martinez Coral, 2013).

Figure 1: market failures and digital divide



Source: developed by the author based on Gerli & Whalley (2018)

The rural access divide reflects the incompleteness of broadband markets. Due to the low density of population in rural areas (Rendon Schneir & Xiong, 2016), private ISPs have no incentive to serve rural users even when the demand for broadband is high (Strover, 2001). Furthermore, information asymmetries on the existing and potential demand for broadband boost the risks associated with broadband investment (Martinez Coral, 2013).

The adoption and outcome divides are, instead, affected by the asymmetric distribution of information on the demand side. Due to the lack of education and other socio-demographic factors, such as age and income, the awareness of broadband benefits is not consistent across different social groups (Van Dijk, 2012). Their willingness to pay for superfast broadband varies accordingly, hence certain groups are less likely to adopt broadband services (Hauge & Prieger, 2010). The adoption divide is also influenced by the price of broadband access, which, in turn, depends on competition in the supply side (Lehr, Sirbu, & Gillett, 2006).

As shown in Figure 1, the demand and supply of broadband mutually influence one another. Lacking a significant demand for digital services, private suppliers have little incentive to invest in broadband networks, thereby exacerbating the access divide (LaRose et al., 2014). Likewise the unavailability of broadband access further discourages the adoption of digital services (Townsend, Sathiaseelan, Fairhurst, & Wallace, 2013).

3. Methodology

The framework depicted in Figure 1 was used to analyse a longitudinal case study. Although it may hamper the generalisability of this research, the focus on a single case is consistent with the aim to explore a relatively new and geographically circumscribed phenomenon such as community NGA networks in rural areas. Furthermore, the triangulation of different methods and the longitudinal analysis enhanced the construct validity of the case study (Yin, 2009).

As detailed in Table 1, 11 interviews were conducted to explore how the project developed over time and affected the target communities. Interviewees were identified through a purposive and snowball sampling approach in order to include both internal and external stakeholders (Ritchie, Lewis, Nicholls, & Ormston, 2013).

Ethnography was employed to observe the interaction of users and volunteers in four different circumstances: two IT workshops, a public meeting with a community joining the project, and an on-field session with a group of volunteers deploying the network. Furthermore, multiple sources of secondary data were included, such as the company's newsletter and financial reports.

Both primary and secondary data were imported and coded in Nvivo for the purpose of directed content analysis (Hsieh & Shannon, 2005). The longitudinal case study analysis allowed for the tracking of the development of the project over several years, clarifying both

the drivers behind this initiative and its impact on the local communities. The interaction with multiple stakeholders also sheds light on the strengths and weaknesses of this project, thereby contributing to understanding its overall impact upon the availability and adoption of superfast broadband.

Table 1: List of interviewees

Internal Stakeholders	Interview 1 – Founder of B4RN (Lancashire) Interview 2 – Volunteer for a local project (Cumbria) Interview 3 – User and volunteer of B4RN (Cumbria)
External stakeholder	Interview 4 – Expert in telecommunications policy Interview 5 – District Councillor (Cumbria) Interview 6 – Representative of a local charity (Lancashire) Interview 7 – Representative of a local charity (Cumbria) Interview 8 – Business user (Cumbria) Interview 9 – Business user (Cumbria) Interview 10 – Local MP (Cumbria) Interview 11 – Representative of a trade organisation (Lancashire)

4. Case study: description and analysis

4.1 The rural divide in the UK

A significant divide still exists between rural and urban areas in the UK (OECD, 2018). As of May 2017, 91% of the UK premises had access to superfast broadband but 34% of the households in rural areas where still uncovered. Furthermore, 17% of them were provided with a download speed lower than 10 Mbit/s (Ofcom, 2017). Detailed data on broadband adoption in rural areas are lacking, but a survey by Farrington et al. (2015) found that inhabitants in rural areas were less likely to adopt broadband and use Internet-based services.

In 2011, the UK government launched Broadband Delivery UK (BDUK), a nation-wide programme to subsidise private investment in rural areas and expand the coverage of superfast broadband to 95% of UK premises. BDUK funded seven pilot projects to test alternative approaches for the delivery of broadband in remote areas but never developed a specific strategy for providing superfast broadband to the remaining 5% (Rathbone, 2016). A reform of the universal service obligation was launched in 2016, to ensure that any citizen will get at least 10 Mbit/s in download and 1 Mbit/s in upload, but its implementation is still ongoing (DDCMS, 2018).

Several NGA projects have been launched in urban and rural areas by small ISPs and local communities since the early 2010s (Rathbone, 2016). These initiatives have challenged the status quo in the UK superfast broadband market, by targeting those niches previously overlooked by both commercial and subsidised deployments (Gerli et al., 2017). Among these projects, B4RN has attracted a lot of attention for its innovative approach to provide remote communities with superfast broadband (OECD, 2018).

4.2 Broadband for the Rural North

B4RN is a community interest company based in Melling (Lancashire). It was founded in 2011 by a group of residents with previous experience in telecommunications and community networks (B4RN, 2011). Their original plan was to develop a fibre-to-the-home[3] (FTTH) network covering eight parishes in the northeast of Lancashire. This area had historically been underserved by commercial ISPs, as explained by one of the founders:

> "they kept promising that we had broadband, and Ofcom said we had broadband and the BT Checker said we had broadband, but we didn't have broadband and we didn't

[3] Fibre to the home (FTTH) is an architecture for NGA networks, entirely composed of optic fibre. It can achieve download and upload speed up to 1 Gbit/s and is the considered the most future-proof technology for superfast broadband..

> have mobile, and in some of our areas we didn't have terrestrial television, it's that bad. And in some areas, even the dial-up wouldn't work because the lines were too crackly and couldn't hold the dialup… it's that bad!" (Interview 1)

Initially, the communities were meant to obtain funding from BDUK but with the condition that the project would have gone to tender and be supervised by an external project manager. The founders ultimately renounced to the public subsidies, because BDUK's requirements were perceived as a threat to the project:

> "if we had brought those people in and those people were telling us, the volunteers, what to do, and we knew it was wrong, we would have all left, we wouldn't have carried on working for nothing" (Interview1)

Consequently, the network has been entirely funded and built by local volunteers. The latter are first required to aggregate demand and raise enough money to cover every premise in their parish, as underlined by one of the founders:

> "people buy the shares and Barry[4] has already told them" it's going to cost £ 50,000 to do your parish or £ 100,000 to do your parish", and they say "well, we only want to do our houses", who is in the village, 20 of them, and Barry says: "Tough! If you are going to do your parish, you do the whole parish, or you don't do it" (Interview 1)

Successively, local communities are involved in the design of the network in order to identify the best route. The participation of locals to this phase enables the company to minimise disruptions in the rollout of the network and maximise the efficiency of each project:

> "when you take it to the people and you say 'here is the way we're digging in', they look at the maps and then they say 'well, there's no point in going through that garden, because it's all concrete now, we are going to have to move that line and go through that garden'…(...) or 'you can't dig straight that field, it's an alluvial plan … yet the field next to it is peat, you know, that's the field will have to come through'. And so, all the feedbacks means Barry changes the maps to suit the people and the landlords and the wayleaves and everything else" (Interview 1)

[4] Barry Forde, the CEO of B4RN

Once the route is defined, the network is built by local volunteers under the supervision of B4RN's staff. Fibre is laid into farmland in order to minimise digging costs (B4RN, 2013). The combination of innovative digging techniques, free wayleaves and voluntary work has enabled B4RN to reduce the cost of FTTH rollout to an average of £700 per premise (B4RN, 2017). Nevertheless, the spokesperson of a local project highlighted that the reliance on volunteers may also threaten the sustainability of this model:

> "when we actually started digging, we got nearly a hundred that might volunteer. Experience so far has shown that you don't get very many people turning up for the work days and because of that we are now going to be talking about to buy some machineries to speed up the workers' installation" (Interview 2)

In the past seven years the project has extended way beyond its original footprint. As of September 2017, its FTTH network had 42 nodes and 15 more were under construction, across Lancashire, Cumbria, East Anglia, Northumbria, Cheshire and the Scottish Borders (B4RN, 2017). However, the fast expansion of the company emerged as threat to the progress of local projects, as highlighted by the volunteer of a local project in Cumbria:

> "B4RN is being too successful in one sense and that is that so many parishes have started doing their own broadband project that the delay in B4RN checking routes and so on has been excessively long and it causes a lot of delays for us." (Interview 2)

As of September 2017, B4RN covered 3,500 premises in total (B4RN, 2017). Users can decide whether to just get the network installed in their homes (for £150) or also subscribe to broadband services (for £30/month). The latter only include connectivity: unlike most of ISPs, B4RN does not offer voice or TV services, as remarked by a user and volunteer:

> "BT is spending so much money on essentially football and wages (…) because they want to make people stay with BT Sports otherwise people would be rushing to people like B4RN. You don't get nothing with B4RN except the fantastic service" (Interview 3)

The average take-up across the local projects was 65% (B4SW, 2016). For the sake of comparison, the projects funded by BDUK (2018) across the UK had achieved an average take-

up of 44% as of December 2017. The analysis of Broadband for South Westmoreland (B4SW), a project involving three parishes in Cumbria, provided further insights on the evolution of the demand within the local communities. At the launch of the demand aggregation in November 2015, 36% of the households had expressed an interest in joining the project (B4SW, 2015). One year later, the involvement of local broadband champions "caused the number of expressions of interest in connecting to the network to rise to (…) 66.9% of the total" (B4SW, 2016). As of January 2018, the expressions of interested amounted to 97% of the residents (B4SW, 2017).

Since its inception, B4RN has been committed to "promote the take up of broadband, the Internet and the use of ICT generally" (B4RN, n.d., p. 2). Volunteers run a weekly IT club in the company's headquarters, where users can find assistance with both B4RN services and generic IT-related issues. During the IT Club, the participants also have the chance to compare their experience with different services and devices. In general, B4RN invites its users to share tips and circulates their recommendations via the company's website, as specified in their newsletter:

> "If you want a free phone line, there are now a couple more providers who have been recommended by our customers. As ever, we don't recommend any, but we pass the info to you so you can decide for yourself. If you have a VoIP service to recommend, please let us know and if you are prepared to explain it all like Vince[5] has, we can add it to our resource section on our website" (B4RN, 2016)

Both interviews and the ethnography highlighted how B4RN enabled local communities to fully exploit the potential of digital technologies. For example, during an IT Club a volunteer explained to me that elderly people had started shopping online while farmers were using webcams to monitor their livestock at night (Observation 1). Furthermore, faster broadband had

[5] A user of B4RN that authored a guide on VoiP for the company's website

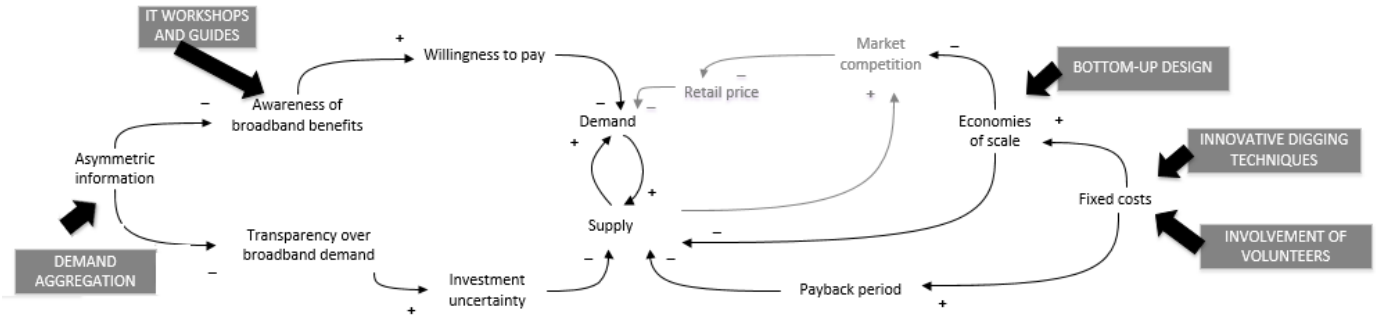
brought new opportunities to local businesses, as explained by the manager of a local company providing photography courses:

> "we used to dread 4 o'clock when all the world just seems to slow down, you get the dreaded wheel of death, as we used to call it. And now, there's still a little bit of slower traction at 4 o'clock here, however downloading picture, being able to stream online, is an enormous gain change for our business, because our operations is now transferring, these have to be practically 80% online" (Interview 8).

5. Discussion

The analysis of interviews, ethnography and secondary sources shed light on the business model adopted by B4RN for the provision of superfast broadband markets in rural areas. By following demand-driven and bottom-up approach, the company has been able to address the failures on both sides of the broadband markets, as outlined in Figure 2.

Figure 2: the impact of B4RN upon the market failures underlying the rural digital divide



Source: developed by the author, based on Gerli & Whalley (2018)

On the supply side, B4RN managed to deploy FTTH by involving local communities in various phases of the project. The reliance on volunteers and the use of innovative digging techniques contributed to minimising the deployment cost, but the efficiency of FTTH deployment was further enhanced by involving locals in the design of network routes. In

addition, the uncertainty of the investment was reduced by aggregating demand prior to starting the rollout in each community.

Demand aggregation also contributed to raising awareness and interest within the local communities. In order to collect enough expressions of interests, volunteers were forced to reach out to those that had never subscribed to broadband before. The users with little or no digital skills have been supported for free, through weekly IT clubs and online guides. The involvement of volunteers in these activities also ensured that training and tutorials were consistent with the needs of local users.

This bottom-up and demand-driven approach enabled B4RN to expand the coverage and stimulate the demand of superfast broadband in remote areas that both commercial and public initiatives had failed to serve. Consequently, this initiative has contributed to alleviating the divide *between* rural and urban areas across the northern England. Furthermore, being committed to serve 100% of the premises in each parish with "no exclusions because a property is too far away or too difficult to reach" (B4RN, 2013, p. 3), B4RN has eliminated the access divide *within* its target communities (Rendon Schneir & Xiong, 2016).

Nevertheless, the overall impact upon the rural digital divide in the UK has been constrained by the small scale of the project. Although the community network has constantly extended over the years, its coverage is still limited in terms of geographic scope and number of connected premises. Consequently, the ability of community-led initiatives to undertake large-scale deployments has been questioned by, among others, the representative of a charity in Cumbria:

> "their expansion across the whole of the County would be a very very slow process. And they don't have the investment potential of someone like BT to do the big projects" (Interview 7)

Furthermore, the reliance on voluntary work and private funding implies that the approach followed by B4RN is viable only for communities that "have got the ability, have got the money to do this" (Interview 5). Consequently, this initiative is unlikely to radically solve the divide *between* rural communities, as highlighted by the spokesperson of a charity in Lancashire:

> "B4RN is doing very well, I mean, they're providing, they're meeting all their needs and that's a great thing, but it's still creating, well, it's still maintaining an inequitable position for rural communities" (Interview 6)

On the demand side, it is hard to isolate the effect of B4RN on the adoption of broadband services. The high take-up rate likely reflects the existence of a strong demand for connectivity previously unsatisfied (Farrington et al., 2015). However, the ethnographic analysis revealed the diversity of B4RN's users in terms of their digital skills and familiarity with ICT. For those users with limited expertise, the IT workshops provided a unique opportunity to obtain free support and enhance their digital skills.

This case study, therefore, supports the view that infrastructure rollout should be combined with demand-side interventions in support of digital literacy (LaRose, Strover, Gregg, & Straubhaar, 2011). Furthermore, it is suggested that the effectiveness of these demand-side initiatives is maximised when local champions are involved in the design and delivery of trainings, as this participatory approach ensures that the information on digital technologies is made accessible and understandable to everyone in the community (Warren, 2007).

This approach may also help individuals and businesses to appropriate digital technologies and integrate them in their daily activities (Armenta, 2012). Both ethnography and interviews provided anecdotal evidence of technology appropriation occurring in the affected communities, but this aspect needs to be further investigated to understand the overall impact

of B4RN upon the outcome digital divide. Nevertheless, these preliminary findings emphasised the potential of digital technologies for rural communities, thereby reinforcing the rationale for further interventions against the rural digital divide.

6. Conclusion

Community broadband networks have increasingly come to the attention of researchers and policymakers, but little is known about their impact on the rural digital divide. By exploring a community FTTH network in the UK, this longitudinal case study clarified how rural communities can bridge the access and adoption divides, by addressing market failures in the demand and supply of superfast broadband.

The adoption of a demand-driven and bottom-up approach enabled B4RN to minimise the cost of FTTH rollout and expand the coverage of NGA networks in remote communities that were otherwise unserved. Consequently, this initiative contributed to reducing the access divide between urban and rural areas in northern England. Nevertheless, its overall impact upon the rural digital divide in the UK was hampered by the limited scale of the project and its reliance on voluntary contributions.

In fact, the bottom-up approach followed by B4RN is sustainable only for rural communities owning adequate financial and human resources. As a result, community-led initiatives may perpetuate the divide *between* relatively affluent and deprived rural areas. In conclusion, this case study proved that community networks do contribute to solving market failures in the provision of superfast broadband but represent a complement rather than a substitute to public and private initiatives.

However, the focus on a single case study limits the generalisability of these finding. Further research is, therefore, needed to include and compare other community networks in and

outside the UK. Such comparisons would also help with understanding what are the contextual factors that help community networks to flourish. As these initiatives much rely on the skills and resources of local communities, further research is needed to understand when and how this capital can be leveraged to support the development and diffusion of superfast broadband networks in rural areas and what role public authorities can play to encourage these initiatives.

Despite its limitation, this case study provided useful insights for researchers and practitioners, thereby contributing to the theoretical understanding and the policy debate on the rural digital divide. From a theoretical perspective, the analysis of B4RN confirmed the view that rurality per se does not imply a lower demand for digital services but the latter is significantly constrained by the lack of broadband access (Farrington et al., 2015; Scheerder et al., 2017). Policymakers and practitioners should take this into account when designing intervention against the rural digital divide, in order to identify and leverage the demand existing within rural areas.

Furthermore, the case study provided anecdotal evidence of the ability of rural communities to appropriate and take advantage of digital technologies. These preliminary findings reinforced the rationale for public interventions against the rural digital divide and call for further research to explore the socio-economic impact of superfast broadband in rural areas. A comparison between public and community-led initiatives would also contribute to understanding whether the impact of digital technologies varies across different intervention models.

Whereas the scalability and long-term sustainability of community broadband networks have yet to be proved, this research underlined the benefits of involving local communities in broadband projects. Extant literature also identified the lack of engagement with external stakeholders as a major source of failure for public initiatives in broadband markers (Po-An Hsieh, Keil, Holmström, & Kvasny, 2012; Tapia et al., 2009). If nothing else, the model

developed by B4RN may provide policymakers with a valid reference to enhance the effectiveness of their interventions in support of the demand and supply of superfast broadband.

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