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The role of broadband adoption/use in the survival and growth of food and drink micro-businesses in remote-rural Scotland

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Abstract

The purpose of this article is to investigate the drivers and barriers to broadband adoption/use by food and drink micro-business owner-managers based in remote-rural Scotland. This study adopts a mixed methods approach consisting of 141 questionnaires involving rural restaurants, which is then followed by 42 semi-structured interviews with restaurant owners based in remote-rural Scotland. A Thematic analysis method offered the researchers simplicity as well as rigour to explore and arrange the retrieved data, which, in the opinion of the researchers, was necessary as it also offered flexibility to support the nature of this exploratory research study. The broadband adoption drivers of bookings, customer use, monetary transactions, and security [e.g. CCTV (Closed Circuit Television)], and barriers of lack of ISP selection and location of restaurants were highlighted as findings exclusive to this research study. The research also makes a key contribution by creating and developing the Broadband Adoption Framework (BAF) along with identifying broadband adoption/use drivers and barriers from the context of restaurant businesses based in remote-rural Scotland. The generalisability and representativeness of the sample in terms of different regions in remote-rural Scotland were a challenge due to a disproportionate sample under-representing some areas. Concerning remote-rural Scotland, recommendations are made for (1) food and drink business owner-managers and maximisation of the value added through broadband adoption/use; and (2) Scottish Government policy for ensuring equality of broadband access to ensure that rural-based businesses can effectively incorporate broadband into their operations. The findings from this research may better address the social exclusion and digital divide between urban and rural communities and businesses in Scotland. This study contributes to knowledge by identifying broadband adoption/use drivers and barriers exclusive to food and drink micro-businesses in remote-rural Scotland. However, some rural areas in Scotland were under-represented, and there was no primary insight gained from Scottish/UK government policymakers for broadband infrastructure in rural Scotland. It should be noted that the authors believe that in the case of future related studies, the validity, dependability and thoroughness of the findings can be enhanced by ensuring a more representative sample in terms of rurality and location. Additionally, the authors

believe that results for drivers and barriers to broadband adoption/use may vary based on geography, sector, size and level of rurality for included businesses.

Keywords Barriers and drivers, Broadband, Micro-businesses, Restaurants, Rural, Digital divide

Introduction

The rise of Internet-driven Information and Communication Technologies (ICT) has changed the way we work and play (Craig, 2019). From a business perspective, this connectivity/new world of ICT provides opportunities and threats (competitive advantage) as broadband has transformed training/education for employees, marketing, selling, supply chain, back office processes and interfaces with the government (Kusumastuti et al., 2022; Mascarenhas & Veer, 2014; Yadav & Goyal, 2015). This demonstrates the instant power of transformation and growth for businesses from adopting broadband, which may involve enhancing their customer base from limited to unlimited, made possible by increased global visibility through an online presence, for example, a business website (Gilani et al., 2023). Therefore, broadband connectivity for businesses is seen as key to being able to function/compete effectively in the 21st Century (Carayannis & Campbell, 2009; Middleton, 2015). However, broadband access and take-up by businesses is not guaranteed in all countries, especially access to broadband of a quality which enables enterprises to operate regularly and effectively (Palmer-abbs et al., 2021).

The discussion on the varying access and adoption of broadband by businesses between regions indicates a digital divide. A digital divide in terms of broadband access and adoption by businesses is highlighted by several authors in terms of the level of rurality related to business locations (Galloway & Kapasi, 2014; Gilani et al., 2022, 2023; Palmer-Abbs et al., 2021). The UK is identified by these studies as one of the prominent examples of a digital divide between urban and rural areas in terms of broadband access and adoption by businesses (Kyriakopoulos, 2024). It should be noted that a digital divide is not simply based on broadband access issues; in fact, there have been two digital divides around the world, where the first was internet access issues in rural areas and the second is based on whether rural communities take up the internet (Carayannis & Morawska-Jancelewicz, 2022; Carayannis et al., 2012, 2022). However, amongst the rural regions in the UK, there appears to be a larger discrepancy between all UK urban areas and rural areas in Scotland. It is crucial to overcome this digital divide between businesses in rural Scotland and the urban regions, as a lack of broadband access and adoption may have a detrimental impact on the rural economy in Scotland due to businesses missing out on the widely accepted benefits of broadband. One of the leading business sectors which underpins the rural economy in Scotland is the food and drink sector; for example, restaurants, takeaways, cafes, and bed and breakfast businesses represent the food and drink sector (Clark & Rice, 2020; Food Standards Scotland, 2021). In 2021, the food and drink sector in Scotland was valued at over £14 billion, which highlights the importance of survival and growth of food and drink businesses in rural Scotland as they provide solutions to unemployment and depopulation in rural Scotland (Food Standards Scotland, 2021). 66% of the food and drink businesses in rural Scotland are small to medium (SMEs) in size (0–249 employees) (Scottish Government, 2021).

Overall, over 90% of food and drink businesses in rural Scotland are micro in size (0–9 employees) (Scottish Government, 2021). These figures demonstrate the importance of

food and drink businesses like micro-restaurants in supporting the rural economy in Scotland. In the last 20 years, there has been a substantial drive by the UK government to improve broadband access for food and drink businesses like micro-restaurants in rural Scotland where one of the initial examples of this was the Scottish government's British Telecom (BT) trigger list activation in December 2005 which led to broadband being made accessible to over 97% of the population in rural Scotland (Palmer-abbs et al., 2021). However, despite the improved broadband access, broadband take-up/adoption still appears to be lagging among businesses like micro-restaurants in rural Scotland in comparison to urban areas (Montes et al., 2024). Lagging broadband adoption in rural Scotland is not a good sign for economic sustainability (refers to long-term economic growth that does not negatively impact social, environmental, and cultural aspects of a community (González-Torres et al., 2020; Montes et al., 2024) and growth of the rural economy as broadband currently plays an integral role for businesses around the world, especially, for start-up, micro and small to medium businesses that may use broadband for daily operations (Philip et al., 2017). For example, food and drink businesses like restaurants heavily rely on broadband for operations like online reservations, orders via apps like Just Eat, payment transactions like card payments and Apple Pay, and customer feedback (Craig, 2019).

There appears to be a lack of clarity or rationale for low broadband adoption by micro-restaurants in rural Scotland, despite the improved availability of broadband in rural Scotland and the widely accepted notion that broadband adoption supports the survival and growth of smaller businesses. Studies like Leogrande et al. (2022) and Palmer-Abbs et al. (2021) discuss the lower take-up of broadband by businesses in rural Scotland; however, there is limited investigation on broadband adoption by micro-restaurants in rural Scotland. Additionally, there are also studies like Alene (2020) which investigate the role of broadband adoption by sub-groups within rural-based entrepreneurs, which, in the case of Alene's (2020) research, are women entrepreneurs based in rural Ethiopia. In the existing literature, there appears to be limited insight into the frequency of broadband adoption (daily/weekly/monthly) by businesses in terms of their size, sector and level of rurality. Based on these gaps, there is scope for research that investigates the level of access and adoption of broadband by businesses in terms of their size, sector and level of rurality. Therefore, the purpose of this paper is to investigate the drivers and barriers to broadband adoption and use by micro-restaurant owner-managers based in remote-rural Scotland.

The research in this paper also attempts to categorise the level of broadband use by owner-managers in rural Scotland, where there is an investigation not solely on the drivers and barriers related to broadband adoption, but also on drivers and barriers affecting the level/frequency of broadband use by owner-managers. This research ensures a singular focus on micro-restaurants in Scotland, by ensuring a sample representative of micro-sized (9 or fewer employees) and restaurant (business details retrieved from food and drink business databases) businesses based in remote-rural Scotland (this level of rurality for locations in Scotland is categorised via the rural dimensions of Gilani et al. (2022) which is informed by the Scottish Government's (2018b) definition of rural areas). In addition to gaining insight into drivers and barriers for broadband adoption, this research also aims to gain insight from owner-managers related to the perceived role of government in enabling broadband adoption/use amongst rural businesses.

Along with enriching existing literature on broadband adoption by rural businesses, the research findings may have practical and policy-based implications for rural businesses. Additionally, the findings may inform theory related to innovation/technology adoption, where, at present, the TOE framework investigates technology adoption by companies and the DoI theory explores the level and period of innovation adoption by communities/groups of people (Qazi et al., 2018; Red et al., 2018). Therefore, the research questions for this paper are as follows:

1. What is the most appropriate theory to understand broadband adoption by rural businesses?
2. What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?
3. Is broadband adoption sustained by all micro-restaurant owners?

To fulfil the research questions and purpose outlined in this paper, the rest of the paper is structured as follows: Sect. "Literature review" will conduct a literature review on key areas as well as related worldwide studies to gain a contextual background insight into the research area. Based on the key findings from Sect. "Literature review", a conceptual framework will be developed in Sect. "Is broadband adoption sustained by all micro-restaurant owners?". The methodology implemented in the research for this paper will be outlined in Sect. "Methodology". The results and findings from the research will be presented in Sect. "Results and discussion". Sect. "Discussion/implications of the findings" will consist of a discussion related to the key findings from the research to determine the level of impact made by the research findings in terms of contribution to knowledge in the area. Sect. "Discussion/implications of the findings" will discuss the key conclusions from this paper as well as implications in terms of practice, policy and theory, along with recommendations for future researchers, business owners and policymakers.

Literature review

As mentioned in the previous section, broadband adoption can be crucial in ensuring the creation, survival and growth of businesses, especially in the case of start-ups, smaller businesses or even less-resourced enterprises that can save costs from using broadband for different operations, for example, free promotion of business on social media and cost-effective avenues to engage with customers and suppliers (Kyriakopoulos, 2024). The value of broadband appears to be even more crucial for business survival and growth in isolated areas, but as demonstrated in the points from the previous section, there seems to be a digital divide/deficit in terms of broadband adoption between urban and rural businesses, especially in a Scottish context. In rural Scotland, over 66% of employing businesses are SMEs, of which over 90% are micro in size (Scottish Government, 2021). These figures show the positive impact on the Scottish rural economy from micro-enterprises creating jobs, which may also have a positive effect on the depopulation of rural areas and the survival of ancient cultures exclusive to these rural regions (Gilani et al., 2023). However, a varying understanding of rural is demonstrated from a review of different studies (Gilani et al., 2022). For this research, the classification of rurality in terms of accessible-rural and remote-rural (Scottish Government, 2018b) is informed by the dimensions of Population and population density, Proximity to urban areas, Development, Culture and Social perception (Gilani et al., 2022).

As mentioned earlier, food and drink businesses also have a positive impact on the rural economy, where over 90% of these businesses are micro in size (Scottish Government, 2021). The widely accepted definition for food and drink businesses in the rural Scottish context is that they are organisations that process and offer raw or semi-processed food/consumable products at wholesale/retail outlets (Scottish Food & Drink, 2019). However, in the case of this research, solely micro-restaurants from rural Scotland will represent food and drink businesses as the Scottish restaurant sector contributes significantly to the growth of the national economy and job creation, for example, 15% of all companies in rural Scotland are restaurants (Scottish Government, 2018a).

While taking these points regarding the definitions of micro-enterprises, rurality and food and drink/restaurants into consideration, a review of studies (period of 1999–2021) from around the world (e.g. Africa, Asia, Australia, New Zealand, North America, Europe, England, Wales, and Scotland) was undertaken to identify drivers and barriers to broadband adoption/use by rural businesses. Each reviewed study is critically analysed in Table 1 in terms of provenance (what are the author's credentials? Are the author's arguments supported by evidence?), methodology (were the techniques used to identify, gather, and analyse the data appropriate to addressing the research problem? Was the sample size appropriate? Were the results effectively interpreted and reported?), objectivity (is the author's perspective even-handed or prejudicial? Is contrary data considered, or is certain pertinent information ignored to prove the author's point?), persuasiveness (which of the author's theses are most convincing or least convincing?) and value (are the author's arguments and conclusions convincing? Does the work ultimately contribute to an understanding of the subject in any significant way?).

As shown in Table 1, all authors of the reviewed studies are from a legitimate background as they are researchers contributing to published peer-reviewed research. There has been qualitative, quantitative, and mixed methods research identified among the reviewed studies. There are a couple of Scotland-based studies involving qualitative, quantitative, and mixed-methods research. The business size, sector, and business locations' rurality, as well as the frequency of broadband adoption, are not clarified in most of the reviewed research studies. However, Scotland-based studies like Galloway and Kapasi (2014) and Sanders et al. (2014) clarify the rurality of the businesses involved in the research, but the sector and size of the included businesses and frequency of broadband use are not explained.

As highlighted in Table 1, there is a value highlighted for all the reviewed studies as they all identify drivers and barriers to broadband adoption/use by rural businesses. Based on the critical analysis of the reviewed studies in Table 1, a gap has been highlighted for primary research investigating drivers and barriers for initial broadband adoption as well as regular broadband use by businesses based on their sector and size, as well as the rurality of their location in Scotland. Therefore, in addition to the highlighted value of broadband adoption, ensuring the survival and growth of SMEs, especially micro-businesses in rural and isolated areas, the findings from Table 1 identify the original contribution and value from future primary research investigating the drivers and barriers for broadband adoption/use by micro-restaurants based in remote-rural Scotland. In Table 2, the findings from the review of worldwide studies are presented in terms of drivers, barriers, location, and authors.

Table 1 Critical analysis of the reviewed studies.
Source: Authors

Author(s) and Location	Provenance (what are the author's credentials? Are the author's arguments supported by evidence?)	Methodology (were the techniques used to identify, gather, and analyse the data appropriate to addressing the research problem? Was the sample size appropriate? Were the results effectively interpreted and reported?)	Objectivity (is the author's perspective even-handed or prejudicial? Is contrary data considered, or is certain pertinent information ignored to prove the author's point?)	Persuasiveness (which of the author's theses are most convincing or least convincing?)	Value (are the author's arguments and conclusions convincing? Does the work contribute to an understanding of the subject in any significant way?)
Bosworth and Salemink (2014) in England	University-based academics who regularly publish peer-reviewed research	The quantitative Research and Sample size are 111	The findings do not clarify the size and sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Clark and Douglas (2011) in New Zealand	University-based academics who regularly publish peer-reviewed research	The quantitative Research and Sample size are 522	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Groves-Phillips (2013) in Wales	University-based academics who regularly publish peer-reviewed research	The quantitative Research and Sample size are 597	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Freathy and Calderwood (2013) in Scotland	University-based academics who regularly publish peer-reviewed research	Quantitative Research and the Sample size is 2077	The findings do not clarify the size and sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Highlands and Islands Enterprise (2015) in Scotland	University-based academics who regularly publish peer-reviewed research	Quantitative Research and the Sample size is 2193	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Kuhn et al. (2016) in North America	University-based academics who regularly publish peer-reviewed research	The quantitative Research and Sample size is 600	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Martin et al. (2013) in England	University-based academics who regularly publish peer-reviewed research	The quantitative Research and Sample size are 494	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Ojanji (2013) in Africa	University-based academics who regularly publish peer-reviewed research	The quantitative Research and Sample size is 50	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses

Table 1 (continued)

Author(s) and Location	Provenance (what are the author's credentials? Are the author's arguments supported by evidence?)	Methodology (were the techniques used to identify, gather, and analyse the data appropriate to addressing the research problem? Was the sample size appropriate? Were the results effectively interpreted and reported?)	Objectivity (is the author's perspective even-handed or prejudicial? Is contrary data considered, or is certain pertinent information ignored to prove the author's point?)	Persuasiveness (which of the author's theses are most convincing or least convincing?)	Value (are the author's arguments and conclusions convincing? Does the work contribute to an understanding of the subject in any significant way?)
Galloway and Kapasi (2014) in Scotland	University-based academics who regularly publish peer-reviewed research	Qualitative Research and the Sample size is 4	The findings do not clarify the sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Sanders and Galloway (2012) in Scotland	University-based academics who regularly publish peer-reviewed research	The qualitative Research and Sample size are 40	The findings do not clarify the sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Sanders et al. (2014) in Scotland	University-based academics who regularly publish peer-reviewed research	The qualitative Research and Sample size are 28	The findings do not clarify the sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Beacom and Nanere (2010) in Australia	University-based academics who regularly publish peer-reviewed research	Mixed methods research and the Sample size is 9	The findings do not clarify the size and sector of the businesses included in the research. The level of rurality for the location of the businesses is not clarified. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Doherty (2012) in Ireland	University-based academics who regularly publish peer-reviewed research	Mixed methods research and the Sample size are not disclosed	The findings do not clarify the sector of the businesses included in the research. The frequency of broadband adoption is also not clarified. The level of rurality for the business's locations is not clarified	The Diffusion of Innovations (DoI) theory was adopted and developed, which supports the findings of the research	The study identifies drivers and barriers to broadband adoption by rural businesses
Dwivedi et al. (2014) in England	University-based academics who regularly publish peer-reviewed research	Mixed methods research and the Sample size are not disclosed	The findings do not clarify the sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	The Technology Acceptance Model (TAM) was adopted and developed, which supports the findings of the research	The study identifies drivers and barriers to broadband adoption by rural businesses
Deakins et al. (2004) in Scotland	University-based academics who regularly publish peer-reviewed research	Mixed methods research and the Sample size is 324	The findings do not clarify the sector of the businesses included in the research. The frequency of broadband adoption is also not clarified	It could have been more convincing with the inclusion of a theoretical framework/model	The study identifies drivers and barriers to broadband adoption by rural businesses
Palmer-Abbs et al. (2021) in Scotland	University-based academics who regularly publish peer-reviewed research	A survey was conducted in rural regions within North-East Scotland	The findings do not clarify the sector of the businesses included in the research. The sample is not representative of the whole of rural Scotland	It could have been more convincing with the inclusion of a theoretical framework/model	The key finding is that the availability, quality, and adoption of broadband amongst rural businesses is not necessarily determined by the proximity of rural businesses to the nearest urban area. Accessibility of businesses to digital engineering infrastructure connectivity nodes better determines how well broadband is accessed and adopted by rural businesses

Table 1 (continued)

Author(s) and Location	Provenance (what are the author's credentials? Are the author's arguments supported by evidence?)	Methodology (were the techniques used to identify, gather, and analyse the data appropriate to addressing the research problem? Was the sample size appropriate? Were the results effectively interpreted and reported?)	Objectivity (is the author's perspective even-handed or prejudicial? Is contrary data considered, or is certain pertinent information ignored to prove the author's point?)	Persuasiveness (which of the author's theses are most convincing or least convincing?)	Value (are the author's arguments and conclusions convincing? Does the work contribute to an understanding of the subject in any significant way?)
Gilani et al. (2023) in the UAE	University-based academics who regularly publish peer-reviewed research	Semi-structured interviews with 20 farms from rural regions in the UAE were conducted	The findings clarify drivers and barriers for machine learning (ML) but not for broadband adoption by the farmers. The rurality is clarified by the dimensions outlined by Gilani et al. (2022). The sector of the business is identified as farms. The frequency of adoption is not clarified	The Innovation Adoption Framework is included in this research, which is a combination of the Diffusion of Innovations (DoI) theory and the TOE (Technological Organisational Environmental) framework	The study identifies drivers and barriers for ML by rural farms in the UAE
Remaining studies	University-based academics who regularly publish peer-reviewed research	Secondary research and sample size are not applicable	There is a lack of clarity on the size, sector and rurality of the businesses involved. The frequency of broadband adoption is also not addressed	The Internet adoption framework was adopted in Noor Fadiha's (2013) study, which adds legitimacy; however, the adoption of the theory has not been included in other secondary research-based studies	The study identifies drivers and barriers to broadband adoption by rural businesses

As seen in Table 2, the identified drivers and barriers to broadband adoption by rural businesses have originated from the external and internal environments of the included businesses. Table 2 also shows that some geographies are under-represented in comparison to others, for example, Africa, the Middle East, Australia and New Zealand are under-represented in comparison to other regions. The authors acknowledge that there are many broadband-related studies based in the under-represented regions, but in an initial check, which involved selecting studies focusing on broadband adoption by rural businesses, other broadband-related studies were discarded, which led to the remaining studies in Table 2. The review of the studies also informed the authors' understanding of defining drivers and barriers. Therefore, for this research, a driver was defined as something that promotes or encourages broadband take-up and use thereafter (Horberry et al., 2014; Kyriakopoulos, 2024) and a barrier was defined as something that limits/completely stops broadband take-up (Kyriakopoulos, 2024; Lima et al., 2018).

As highlighted in Table 2, the review of the studies identified 'communication', 'culture' in the business, 'infrastructure', 'marketing' and 'planning' as the main drivers for broadband adoption/use by rural businesses to facilitate daily business operations. The main barriers to broadband adoption/use were identified as a 'lack of government support' and 'poor infrastructure'. However, findings from European-based studies like Delalic and Oruc (2014), and Doherty (2012) identified confidence/training as a driver for broadband adoption but findings from Isley and Low (2022) in the USA highlighted that confidence/training can be a driver as well as a barrier for broadband adoption based on contextual factors. Unlike most of the reviewed authors, Kyriakopoulos (2024), in a cross-country study, along with studies like Palmer-Abbs et al. (2021) based in Scotland, identifies the factors of culture and infrastructure as barriers and drivers for broadband adoption, which they also believe is attributed to contextual factors. Therefore, there may be scope for future research in clarifying such contextual factors that influence the behaviour of broadband adoption-related factors in changing from drivers to barriers or vice versa.

The size, sector and rural classification of the area where they were based for businesses in the reviewed studies were not clarified. While considering the research question of "3. Is broadband adoption sustained by all micro-restaurant owners?", there also appears to be a lack of clarity on whether initial broadband adoption or regular broadband adoption by rural businesses was investigated in the reviewed studies, especially in the context of micro-sized restaurants. Additionally, while considering the research question of "2. What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?", there appears to be no literature investigating the role of broadband adoption in rural restaurant businesses in the context of remote-rural Scotland. Further research relating to the economic sustainability of micro-businesses in rural Scotland is crucial as such research may offer solutions to negating depopulation and the extinction of cultural heritage (i.e. ancient languages, customs and traditions only exclusive to these rural regions) in such areas which may allow rural Scotland to preserve its national identity and culture, i.e. Gaelic language, folk music and the Highland Games (Barlagne et al., 2021). Therefore, the scope and rationale for research investigating the drivers and barriers to broadband adoption/use by food and drink micro-businesses based in remote-rural Scotland have been identified from the review of studies. Along with enriching existing literature on broadband adoption by rural

Table 2 Summary of the identified broadband adoption/use drivers and barriers. Source: Authors

Drivers	Location	Author(s)
Access to business information	Asia	Srinivas et al., 2014
	Scotland, UK	Deakins et al., 2004; White et al., 2016
Affordability (cost)	Africa	Groves-Phillips, 2013; Masita-Mwangi et al., 2012
	Europe	Doherty, 2012
	Cross-country	Kyriakopoulos, 2024
	New Zealand	Clark & Douglas, 2011
	North America	Kuhn et al., 2016
Communication	Africa	Finbarr, 2015
	Asia	Bagchi, 2013; Srinivas et al., 2014
	Australia	Beacom & Nanere, 2010
	Cross-country	Kyriakopoulos, 2024
	Scotland, UK	Townsend et al., 2014
	Wales, UK	Cardiff University, 2019
Confidence/training	Europe	Delalic & Oruc, 2014; Doherty, 2012
	North America, USA	Isley & Low, 2022
	Cross-country	Kyriakopoulos, 2024
Culture (growth-driven business)	North America, USA	Isley & Low, 2022
	Africa	Finbarr, 2015, Olaniyi, 2018
	Asia	Srinivas et al., 2014; Vakataki 'Ofa, 2018
	Cross-country	Kyriakopoulos, 2024
	England, UK	Bosworth & Salemink, 2014; Warren, 2004; Wilson et al., 2018
	Europe	Delalic & Oruc, 2014
	New Zealand	Fabling and Grimes, 2016
	North America	Passerini et al., 2012
	Scotland, UK	White et al., 2016
	Wales, UK	Cardiff University, 2019
Environmentally friendly	Scotland, UK	Steiner & Atterton, 2014
Improved income for businesses	Asia	Vakataki 'Ofa, 2018
	England, UK	Wilson et al., 2018
	Cross-country	Kyriakopoulos, 2024
	New Zealand	Fabling and Grimes, 2016
	Scotland, UK	Freathy and Calderwood, 2013; Lodwick, 2015; Mack et al., 2024; Palmer-Abbs et al., 2021
	Wales, UK	Cardiff University, 2019
Infrastructure, eg satisfactory broadband quality and speed	Australia	Glance, 2017
	Cross-country	Kyriakopoulos, 2024
	England, UK	Gerli & Whalley, 2018
	New Zealand	Fabling and Grimes, 2016
	North America, USA	Isley & Low, 2022
	Scotland, UK	Mack et al., 2024; Palmer-Abbs et al., 2021
	Wales, UK	Davies, 2014
Marketing/Promotion	Africa	Finbarr, 2015
	Asia	Kriechbaumer & Christodoulidou, 2014
	Cross-country	Kyriakopoulos, 2024
	Scotland, UK	White et al., 2016
	Wales, UK	Cardiff University, 2019

Table 2 (continued)

Drivers	Location	Author(s)
Support towards daily operations (Planning)	Africa	Ojanji, 2013
	Asia	Vakataki 'Ofa, 2018
	Cross-country	Kyriakopoulos, 2024
	England, UK	Wilson et al., 2018
	New Zealand	Clark & Douglas, 2011
	Scotland, UK	Galloway & Kapasi, 2014; Palmer-Abbs et al., 2021
Confidence/training	Marlin & Bruce, 2006	Canada, North America
	Isley & Low, 2022	USA, North America
	Philip et al., 2017; White et al., 2016	Scotland, UK
	Davies, 2014; Groves-Phillips, 2013	Wales, UK
Cost	Marlin & Bruce, 2006	Canada, North America
	Bourreau et al., 2017	Europe
	Wilson et al., 2018	England, UK
	Mack et al., 2024; Tookey et al., 2006; Townsend et al., 2014	Scotland, UK
Culture	Olukayode et al., 2014	Asia
	Marlin & Bruce, 2006	Canada, North America
	Isley & Low, 2022	USA, North America
	Battisti et al., 2013	New Zealand
	Burnett & Danson, 2017; Townsend et al., 2014	Scotland, UK
Lack of government support (awareness)	Srinivas et al., 2014	Asia
	Choudrie & Middleton, 2014	Australia
	Marlin & Bruce, 2006	Canada, North America
	Price et al., 2013	England, UK
	Znidarsic and Werber, 2012	Europe
	Hill et al., 2016; Mack et al., 2024; Palmer-Abbs et al., 2021	Scotland, UK
Poor Infrastructure	Finbarr, 2015; Olaniyi, 2018	Africa
	Chuabsamai, 2016; Srinivas et al., 2014; Vakataki 'Ofa, 2018	Asia
	Ameeta & Courvisanos, 2013; Park et al., 2019	Australia
	Marlin & Bruce, 2006	Canada, North America
	Isley & Low, 2022	USA, North America
	Cowie et al., 2013; Wilson et al., 2018	England, UK
	Allardyce, 2017; Burnett & Danson, 2017; Mack et al., 2024; Ogston, 2017; Palmer-Abbs et al., 2021; Philip et al., 2017	Scotland, UK
	Cardiff University, 2019	Wales, UK
Security/Level of trust	Townsend et al., 2014	Scotland, UK

businesses, this research may add value and significance to the wider population by possibly contributing towards practical solutions for rural SMEs and informing policy-makers in improving operating environments to ensure the survival and growth of rural SMEs.

Considering the research question of "1. What is the most appropriate theory to understand broadband adoption by rural businesses?", there is no theoretical framework/model included in the majority of the reviewed studies in Tables 1 and 2. Amongst the studies, Dwivedi et al. (2014) in England adopted TAM (Technological Acceptance Model), Doherty (2012) in Ireland adopted the DoI (Diffusions of Innovation) theory, Gilani et al. (2023) in their rural UAE-based study adopted the Innovation Adoption

Framework (a hybrid of the DoI and TOE (Technological Organisational Environmental) theory) and Hersleth et al. (2023) in their Norway based study developed a three-pillared framework for Market Driving Practices in food micro-businesses ((1) taking the risk and following their passion, (2) innovativeness led by a passionate personal value proposition and (3) proactively and perseveringly building a new category). However, there were no theoretical frameworks/models adopted in studies based in Scotland. A critical analysis of established innovation/technology adoption frameworks/theories of the Bass Diffusion Model, DoI theory, TAM and the TOE framework where the selection of these theories/frameworks for critical analysis was based on their inclusion in past broadband adoption-related studies, for example, the Bass Diffusion Model was adopted by Boucher (2019), DOI theory was included in a study conducted by Qazi et al. (2018), Adams et al. (2017) adopted the TAM and TOE was adopted by Red et al. (2018). Additionally, there was a consideration of era-based factors (COVID-19 pandemic era) to inform the development of a theoretical framework/model, which was identified by Meramveliotakis and Manioudis (2021).

The critical review involved assessing each theory's flexibility (e.g. an ability to change the theory's characteristics or to merge it with other theories to match the focus of a study), and how it works. (eg do the perspectives consider yes/no answers or/and the reason(s) behind the answer?), and level of compatibility/relevance to the aim of this paper (e.g. how or/and why would the framework/model support the aim?). The review indicated that no one theory can investigate the level and period of broadband adoption by businesses, which is the focus of this research. Therefore, like Gilani et al. (2023) the authors combined the TOE framework (can investigate technology adoption by businesses (Red et al., 2018)) and the DoI theory (can assess the period and level of innovation adoption (Qazi et al., 2018)) to create the conceptual framework of the Broadband Adoption Framework (BAF) which is illustrated in Fig. 1. Additionally, the creation of the BAF was also informed by the identified broadband adoption drivers and barriers from Table 2.

As shown in Fig. 1, the Innovation Decision Process (IDP) from the DoI theory (to measure the level and period of broadband adoption), and the technology, organisational and environmental perspectives from the TOE framework (to investigate broadband adoption by businesses) were both integrated into the BAF. The drivers and barriers to broadband adoption/use are presented under the technological, organisational, and environmental contexts within TOE in Fig. 1. The words and lines in Fig. 1 labelled with D represent drivers; words and lines labelled with B represent barriers; words labelled D/B represent both drivers and barriers. Additionally, the single arrows in the lines labelled with D and B in Fig. 1 are respectively represented by drivers leading to broadband adoption/use, barriers leading to non-broadband adoption/use and the interconnectivity between the contexts of technology, organisation and environment are represented by the double arrowed black lines. Knowledge is represented by 'K', Persuasion is represented by 'P', Decision is represented by 'D', Implementation is represented by 'I', and Confirmation is represented by 'C'. Additionally, Adoption is represented by 'A' and Rejection is represented by 'R'.

In terms of theoretical implications, the development of the BAF adds significance and value as it addresses a void of limited theories that individually investigate the period of broadband adoption by businesses. The authors believe that this proposed framework

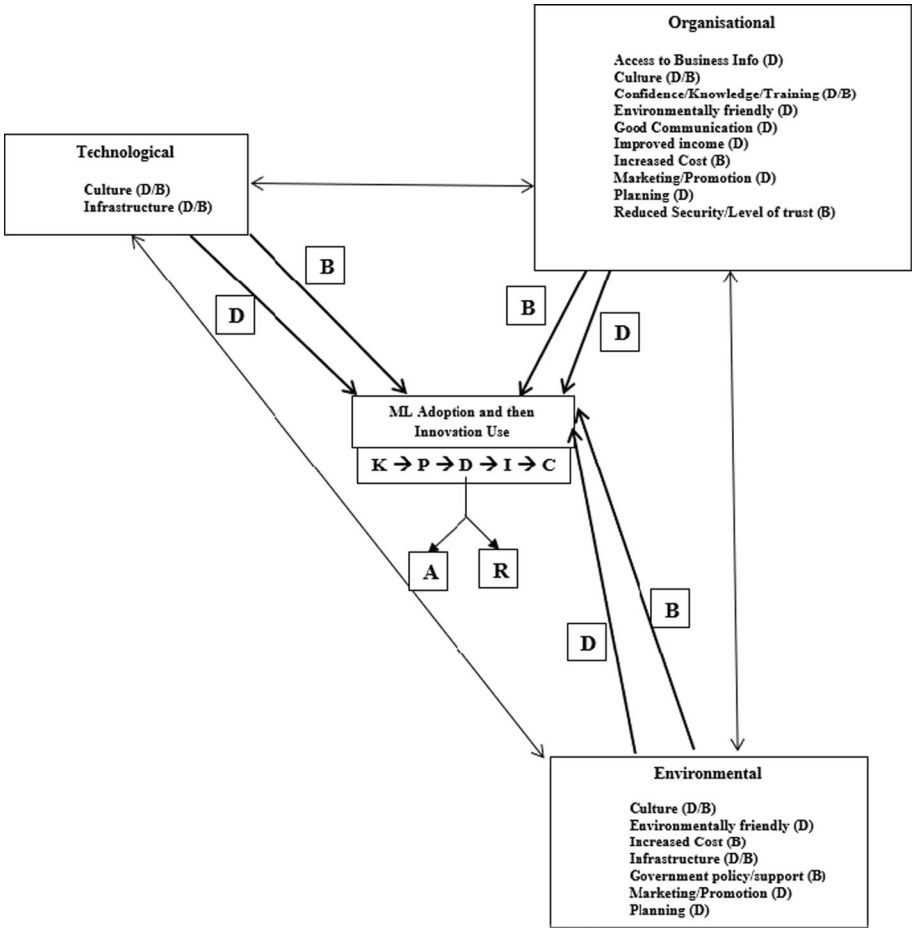

Fig. 1 Broadband Adoption Framework version 1 (BAF 1).
Source: Authors

can be used to inform future broadband/innovation/technology adoption-related research.

Methodology

Research philosophy

The widely accepted definition of a Research Philosophy is that it is a set of fundamental beliefs that guide the design and execution of a given research study (Saunders et al., 2019). Epistemology and Ontology are two main areas which dictate the direction of research in a given research study. Epistemology focuses on the nature of beliefs and knowledge, whereas Ontology refers to the study of the nature of reality (Saunders et al., 2019). These Ontological and Epistemological considerations were reviewed during the selection of research methods, where these considerations informed the selection of an appropriate research method and research design in this study (Silverman & Patterson, 2022). The two leading positions within Ontology are Realism and Relativism. The Realist position focuses on the beliefs and reality that already exist in the surroundings. In contrast, the Relativist position believes that reality is individually constructed, as there are as many realities as there are individuals.

After considering the different positions in Ontology and Epistemology, in this research, the Ontological position was identified as Relativism, and the Pragmatic

philosophy was identified as the Epistemological position (Saunders et al., 2019). The justification behind the selection of Relativism is that it views reality as something individually constructed, whereas this research is also looking to learn about owner-managers' realities regarding their perceptions of drivers and barriers for broadband adoption/use for business processes (Levine, 2019). Therefore, Relativism aided this research in exploring the research question of "2. What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?". The Pragmatic philosophy was selected in this research as it is a philosophy that is willing to overlook everything in favour of what is practical/works in achieving a given research study's aim (Levine, 2019) which is appropriate for this research study which is looking to venture into an unexplored niche area involving Scottish remote-rural micro-businesses from the food and drink sector (unlike the studies reviewed in Table 1).

Sampling approach

The rural dimensions outlined by Gilani et al. (2022) (searches were also informed by the Scottish Government (2019) definition of remote-rural areas) and the business databases of Taste of Scotland, Trip Advisor and Visit Scotland (keywords of restaurants and rural were inputted into the search engines to generate results) informed the identification of 141 restaurant businesses as being appropriate for inclusion in this research. Therefore, a purposive sampling method was adopted to identify the appropriate sample based on characteristics and a non-probability-based approach (Foley, 2018). It should be noted that this sampling method was incorporated till the final 42 business owner-manager sample included in the semi-structured interviews. Purposive sampling was selected over other sampling methods as it allowed the researchers to whittle the initial 141 sample down to a group of businesses which directly aligned with the focus and target participants in the research aim, who were owner-managers of micro-sized firms from the food and drink sector in remote-rural Scotland. Therefore, this sampling method aided in this research in better exploring the research question of "2. What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?". From the understanding of the authors, this would not have been achievable by implementing any other sampling method (Saunders et al., 2019).

Research strategy and data collection

The research strategy implemented in the research was a survey. The survey was selected over other strategies as it allowed the researcher to better manage and understand a large sample size of 141 from a holistic view rather than a more granular view offered by other research strategies (Levin, 2019; Saunders et al., 2019). The survey consisted of two data collection methods that involved telephone questionnaires with 84 food and drink businesses (that responded from the initial 141 samples) in remote-rural Scotland, followed by semi-structured interviews with 42 food and drink micro-business owner-managers in remote-rural Scotland.

Data collection and analysis methods

The telephone questionnaire stage involved outbound calls to 141 restaurants from March 1st to 10th March 2023. The contact numbers for the businesses were obtained from the restaurant profiles in the business databases. During these outbound calls

[consisting of questions looking to identify owner-managers, micro-sized restaurants (9 or fewer employees (Philip et al., 2017), and owner-managers willing to participate in follow-up interviews], 84 businesses responded, from which 42 micro-sized restaurant owner-managers were willing to participate in follow-up semi-structured interviews (Questions are provided in Table 3). At this stage of the survey, questionnaires were the most appropriate data collection method as they allowed the researchers to capture responses from a large sample size in a short time frame due to the closed-ended question design of a questionnaire. Data collection at this stage would not have been possible via the interview method, as it has a greater inclination towards open-ended questions, which, in addition to the large sample size, could have made this stage challenging and time-consuming for the researchers. Thematic analysis was adopted for the questionnaire results to aid in identifying businesses appropriate and willing to participate in follow-up interviews. For example, restaurants micro in size with owner-managers willing to participate in follow-up interviews were selected for inclusion in the semi-structured interviews, while other businesses were discarded. The Thematic analysis method was selected as it allowed the researchers a greater degree of flexibility and simplicity during the data analysis, which also aligned with the exploratory nature of this research. The authors do not believe the same level of convenience and flexibility would have been afforded to them through the adoption of other analytical methods (Saunders et al., 2019; Silverman & Patterson, 2022).

Then, in stage 2 of the survey, a semi-structured interview was the other data collection method adopted with the 42 restaurant owner-managers from March 11th to March 30th through online-based face-to-face interviews on the Zoom platform. The contact details to conduct online interviews with the 42 restaurant owner-managers were obtained during the initial survey phase. Of the 42 interviewed businesses, 16 were based in the mainland areas of Aviemore, Mull of Galloway, Campbeltown and the Highlands, whereas 26 of the owner-managers were based in island areas of Arran, Isle of Mull, Orkney, Hebrides, Shetlands and Skye. The questionnaires and semi-structured interviews with the respective respondents from the 84 and 42 participants aided the research in exploring the research question of "2. What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?". From the authors' understanding, semi-structured interview over other options was the most appropriate data collection method as it allowed the researchers to explore the research topic on a

Table 3 Interview questions for broadband adopter owners .
Source: Authors

Question No.	Question	Close/Open ended question(s)
1	What is your previous background in terms of employment/education and are you a native of this area?	Close ended
2	How long did it take for you to adopt broadband driven ICT once it was made available in your local area and where or how did you learn to use ICT?	Open ended
3	Who encouraged you to take up ICT and then did you encourage others to do the same?	Close ended
4	How do you adopt ICT? How often do you use ICT? and what do you use ICT for?	Open ended
5	What can make using ICT better for you?	Open ended

more granular level via open and close-ended questions which aligned with the exploratory nature of the research but also added structure to the data collection to address the research aim (Saunders et al., 2019; Silverman & Patterson, 2022). For example, the authors were able to gain insight regarding the research question of "3. Is broadband adoption sustained by all micro-restaurant owners?" through the granular level insight gained from interview questions that explored initial broadband adoption and the frequency of broadband adoption by micro-restaurants.

It should be noted that three different individuals were involved in conducting the semi-structured interviews to minimise bias stemming from the interviewer's personal beliefs on the interview topic. In Table 3, the rationale behind questions 1 to 3 in the semi-structured interviews was that these questions allowed the researchers to get a background insight into the interviewees in terms of their employment/education history as well as their origins. Additionally, these questions gave the researchers an insight into whether the interviewee was an early adopter or a laggard when broadband access was made available to them. Questions 4 and 5 were specifically aimed at the interviewees, identifying the drivers and barriers for them in adopting broadband in their business, which directly addressed the focus of the research aim of identifying drivers and barriers for broadband adoption/use by food and drink micro-business owner-managers based in remote-rural Scotland.

Once again, the Thematic analysis method was adopted for the data retrieved in the semi-structured interviews. As mentioned earlier, the method allowed simplicity and flexibility for this exploratory research study, which at this stage was looking to understand open and closed-ended data via a granular lens. For example, investigating perceptions of restaurant owner-managers regarding broadband adoption/use for the facilitation of daily business operations. The Thematic analysis method was applied to the transcribed information. A Verbatim style was adopted during the transcription process. Additionally, the identification of any new drivers and barriers to broadband adoption/use led to further developments in the conceptual framework, which addressed the fulfilment of the research question "3. What is the most appropriate theory to understand broadband adoption by rural businesses?".

Ethical approval

Ethical approval was secured from the ethics committee at Glasgow Caledonian University on the 15th of January 2023. The ethics for this study were approved as part of the PhD programme pursued by the lead author.

Problems/limitations and generalisability

Notably, the researchers did anticipate and encounter some issues during the empirical stage of the research, which included ensuring that the participants were the actual owner-managers of the business, reluctance by target business owner-managers to participate in the follow-up interviews and the representativeness of the samples in the questionnaires and semi-structured interviews. Therefore, the initial 141 sample or the final 42 sample were not representative of remote-rural Scotland, as areas like Campbeltown and the Outer Hebrides were under-represented. To overcome this issue, there was an effort made by the authors to contact initial non-responders multiple times to ensure a higher response rate, which may have minimised underrepresented groups in

the sample. Additionally, methods like oversampling were considered to avoid sampling bias, which included weighing responses regarding broadband adoption drivers and barriers by micro-restaurant owners in terms of percentages of the total participant numbers from each rural Scotland area.

Results and discussion

Analysis based on the research objective

The purpose of the semi-structured interviews was to gain background insight into broadband adoption/use by Scottish remote-rural business owners. For example, the owner-manager's origins, academic and professional background, broadband knowledge/training, and whether people follow them/they follow others in adopting broadband, along with how often and for what broadband was used in their business. Of the 42 interviewed businesses, 16 were based in the mainland areas of Aviemore, Mull of Galloway, Campbeltown and the Highlands.

The findings related to drivers and barriers to broadband adoption/use from interviews with mainland businesses are presented in Tables A and B. The questions in the tables were created while keeping in mind the broadband use (e.g. to facilitate daily business processes) stages (in the IDP feature, the stages of implementation and confirmation following the decision made to adopt broadband) following on from the initial decision to adopt/not adopt broadband in the adjusted IDP feature which is located in the 'Broadband Adoption and Use' box in the BAF 2 (Fig. 2).

The findings (in Tables A, B, C and D shared in the supplementary file) highlight that only a minority of the interviewees confirmed adopting broadband from day 1 of

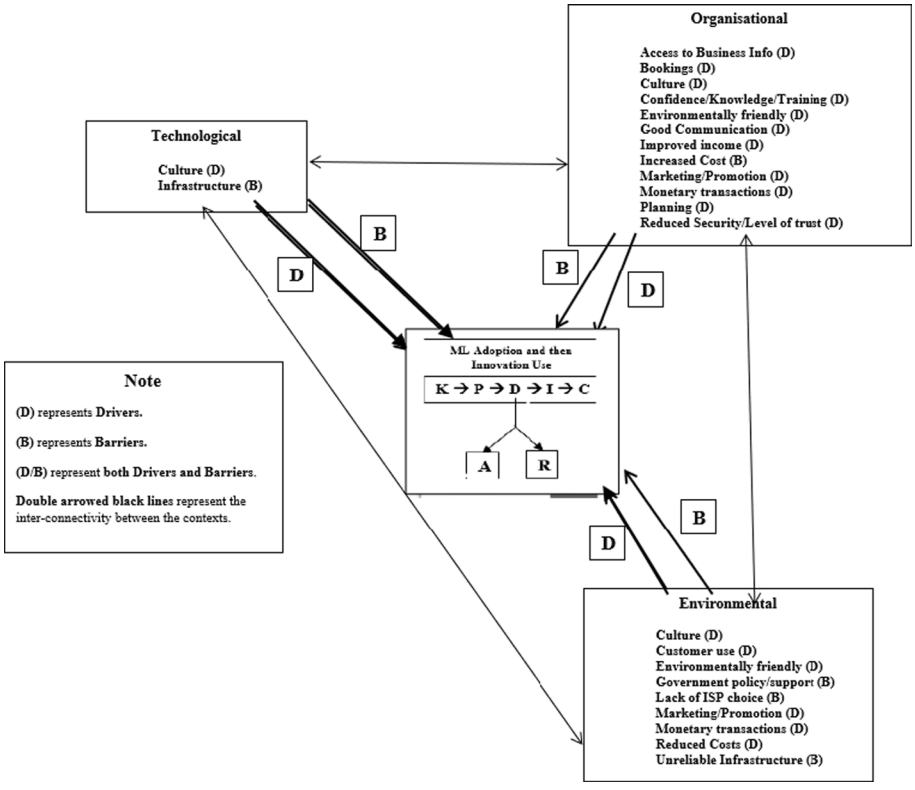

Fig. 2 Broadband Adoption Framework version 2 (BAF 2).
Source: Authors

starting the business, which was attributed to issues with local broadband infrastructure. This appears to be a more prominent issue amongst Highland businesses. Another key finding highlighted in Table A was that communication, customer use on-premises, planning, online bookings, and marketing were identified as the most prominent drivers for broadband adoption/use by all mainland restaurants. However, customer use of on-premises, planning and online bookings did not emerge as broadband adoption/use drivers in the literature review, which is then highlighted as an exclusive finding in this research. Table B presents findings in the form of cultural influence and barriers against broadband adoption/use, along with other profiling questions related to mainland businesses.

The key finding highlighted in Table B was that, unlike in the literature review, culture was identified as more of a driver for broadband adoption/use by mainland restaurants. All owners agreed that the benefits of broadband are well known to everyone, but it has not been adopted to facilitate daily business operations. The most common barriers against broadband adoption/use identified by mainland restaurants were poor infrastructure, lack of government activity/support, cost, and lack of ISP choice. A key finding was identified by the lack of ISP selection and location being exclusively identified as barriers against broadband adoption/use, unlike the literature review. As shown in Table B, the majority of mainland owner-managers worked in other sectors as well as restaurants. All these owner-managers developed broadband usage skills through trial and error. All mainland owner-managers highlighted their dissatisfaction with the broadband service they were able to access.

Of the 42 interviewed businesses, 26 of the owner-managers were based in island areas of Arran, Isle of Mull, Orkney, Hebrides, Shetlands and Skye. Findings from interviews regarding drivers for broadband adoption/use by island owners are presented in Table C. Table C presents more information regarding each island-based restaurant owner, along with drivers for their broadband adoption and broadband use (e.g. to fulfil daily business processes).

One of the main findings regarding broadband adoption/use by island-based owners was that, similar to mainland owners, island owners identified communication, marketing, online bookings and planning as the main drivers. Unlike mainland businesses, on-site customer use was not as popular a driver for broadband adoption/use amongst island-based owners. Findings from interviews are presented in Table D in terms of the influence of culture and barriers against broadband adoption/use, along with results of other profiling questions related to island owner-managers.

Like mainland-based owners, findings from island owners identified a lack of government activity/support, cost, poor infrastructure, and a lack of ISPs as the most prominent barriers against broadband adoption/use. Like mainland businesses, Island restaurants highlighted culture as a driver for broadband adoption/use.

A key finding was highlighted by mainland and island-based restaurants not recognising a lack of confidence/training in using broadband as a barrier against broadband adoption/use. Therefore, based on the findings, the list of drivers and barriers to broadband adoption and use (initially informed by the literature review) by restaurant owners has been updated, where a definition for each of the drivers for broadband adoption/use identified in interviews is provided in Table 4. The drivers and barriers for both

Table 4 Broadband adoption/use drivers in the interviews and their definitions.
Source: Authors

Drivers	Definitions
Access to business information	Such information informs owner-managers' purchase of stock, revision of policies and strategies related to the daily running of the business.
Affordability (cost)	Daily costs for operations like banking and marketing reduced through online banking and e-marketing where owner-managers also save money through online price comparison sites for stock and equipment.
Bookings	**Confirming orders online through advanced payment or pre-booking rather than handling call bookings.**
Communication	Communication with consumers, employees and suppliers through email or social media.
Confidence/Training	Confidence from a good understanding and training of using ICT.
Customer use	**Customer using ICT on the business premises.**
Culture	The business' ambition along with the beliefs, religions, rituals and virtues of the local population.
Environmentally friendly	All operations completed online are paperless which has a positive impact on the environment.
Improved income for businesses	An online presence allows businesses to have visibility amongst a larger customer base where products through online shopping lead to a higher probability of sales, therefore, increasing the chances of an improved income for the business.
Infrastructure	Up to date infrastructure for broadband will lead to consistent broadband connectivity within the business which then allows the business to operate without disruptions that are normally caused by an intermittent broadband service.
Marketing/Promotion	Promoting the business through website or social media.
Monetary transactions	**Internet driven chip and pin system which secures and tracks transactions.**
Planning	Support towards daily operations, such as time saved and convenience in tasks like market research, accounting, stocking ordering and recruitment.
Security	**Things like CCTV to protect business staff and premises.**

Table 5 Broadband adoption/use barriers in the interviews and their definitions.
Source: Authors

Barriers	Explanation
Confidence/Training	Owner-managers under the impression that they do not have the ability to effectively use ICT for different operations.
Cost	The initial cost of buying the equipment along with paying for a subscription.
Culture	The business' ambition along with the beliefs, religions, rituals and virtues of the local population.
Lack of government support	Lack of awareness campaigns regarding ICT training and availability.
Lack of ISP choice	**A monopoly in the local market of one or two ISP who resolve(s) technical issues and offer pricing at their own convenience.**
Location	**Perception amongst owner-managers regarding their ineligibility for up to date services due to the remoteness of their location.**
Poor infrastructure	Inability to access a level of service which allows owner-managers to carry out online based operations.
Security/Level of trust	Possibility of online fraud and a lack of uncertainty related to not meeting customers/manufacturers/suppliers face to face.

broadband adoption and broadband use highlighted in bold in Tables 4 and 5 are the new drivers and barriers that have emerged exclusively from the interviews.

A definition for each of the barriers to broadband adoption/use identified in interviews is provided in Table 5.

From the findings in Table 5, it can be concluded that there were as many island-based owners who worked in other sectors in addition to restaurants as there were owners who solely worked in restaurants. However, this was not the case for mainland owners. Like mainland businesses, all island-based owners developed their broadband usage skills through trial and error and most owners were dissatisfied with their current broadband service.

Therefore, the key finding here is that in the case of the availability of satisfactory broadband service, all restaurants were willing to adopt broadband for daily operations, where local culture did not play a role.

Discussion/implications of the findings

The review of broadband adoption studies involving rural businesses identified that there was a dearth of literature that investigated broadband adoption as well as the level and period of broadband adoption by rural businesses while pinpointing their sector, size and rurality. Therefore, this research carried out semi-structured interviews in the context of micro-restaurants in remote-rural Scotland, which led to the identification of broadband adoption drivers and barriers. The arrangement of the drivers from the semi-structured interviews was informed by the broadband adoption driver themes established from the literature review in Table 2. Access to business information, Cost, Communication, Confidence, Culture, environmentally friendly, Improved income for businesses, Infrastructure, Marketing, and Planning were the themes established. So, based on these established themes, the common drivers between the literature review and the semi-structured interviews, as well as the drivers exclusive to this research, are arranged via Thematic analysis and provided in Table 6. In Table 6, 'drivers labelled with Current research' represent an original contribution made by this research.

In Table 6, business information (eg White et al., 2016), communication (eg White et al., 2016), confidence/training (eg Delalic & Oruc, 2014), culture (eg White et al., 2016), infrastructure (eg Gerli & Whalley, 2018), marketing/promotion, and planning (eg Wilson et al., 2018) were identified as common drivers for broadband adoption/use in both the literature review and interviews. The literature review on broadband adoption/use drivers of environmentally friendly, time management and cost were not identified by restaurant owners as drivers for broadband adoption/use. However, unlike the literature review, monetary transactions, bookings and customer use were identified as drivers for broadband adoption and broadband use by owner-managers. Therefore, the newly

Table 6 Comparison of broadband adoption/use drivers from literature review and interviews

Drivers (Literature Review)	Drivers (Findings from this research)	Author(s) from Literature Review
Business Information	12 out of 42 businesses	Srinivas et al (2014); Deakins et al. (2004); White et al. (2016)
Communication	36 out of 42 businesses	Kyriakopoulos (2024); Townsend et al. (2014)
Culture	39 out of 42 businesses confirmed that culture was not an issue	Burnett and Danson (2017); Sanders et al. (2014); Townsend et al. (2014); Kyriakopoulos (2024); Isley and Low (2022)
Infrastructure	3 out of 42 businesses were happy with their broadband service	Tookey et al. (2006); Van der Loo (2015); Isley and Low (2022)
Confidence/Training	40 out of 42 businesses did not have training/knowledge issues	Philip et al (2017); White et al. (2016); Kyriakopoulos (2024); Isley and Low (2022)
Marketing/Promotion	32 out of 42 businesses	Finbarr, 2015; Kriechbaumer and Christodoulidou (2014); Cardiff University (2019)
Planning	15 out of 42 businesses	Deakins et al. (2004); White et al. (2016); Kyriakopoulos (2024)
Environmentally friendly	No mention of businesses interviewed	Steiner and Atterton (2014)
Time management	No mention of businesses interviewed	Galloway and Kapasi (2014)
Cost (saved)	No mention of businesses interviewed	Freathy and Calderwood (2013); Lodwick (2015)
Bookings	22 out of 42 businesses	Current research
Customer use	22 out of 42 businesses	Current research
Monetary transactions	13 out of 42 businesses	Current research
Security (eg CCTV)	2 out of 42 businesses	Current research

Table 7 Comparison of broadband adoption/use barriers from literature review and interviews

Barriers (Literature Review)	Barriers (Findings from this research)	Author(s)
Cost incurred	17 out of 42 businesses	Tookey et al. (2006); Townsend et al. (2014)
Cultural issues	3 out of 42 businesses	Burnett and Danson (2017); Townsend et al. (2014); Kyriakopoulos (2024); Isley and Low (2022)
Government policy/support	28 out of 42 businesses	Hill et al (2016); Palmer-Abbs et al. (2021)
Poor infrastructure	36 out of 42 businesses	Tookey et al. (2006); Van der Loo (2015); Isley and Low (2022); Palmer-Abbs et al. (2021)
Lack of training (Confidence)	2 out of 42 businesses	Philip et al (2017); White et al. (2016)
Security	1 out of 42 businesses	Townsend et al. (2014)
ISP choice	14 out of 42 businesses	Current research
Location	1 out of 42 businesses	Current research

identified drivers for both broadband adoption and broadband use are key findings of this research.

From the literature review in Table 2, the themes for broadband adoption barriers were established as Confidence/training, Cost, Culture, Lack of government support, Poor infrastructure, and Security. In Table 7, the findings related to broadband adoption barriers in this research are compared to the findings from the literature review via the established themes on barriers in Table 7. Once again, the barriers labelled with 'Current research' in Table 7 represent an original contribution to knowledge made by this research.

A key finding is highlighted in Table 7 where findings from the literature review and interviews identify cost (eg Philip et al., 2017), culture (eg Burnett & Danson, 2017), lack of government support (eg Hill et al., 2016), poor infrastructure (eg Philip et al., 2017), and confidence/training (eg Philip et al., 2017) as common barriers against broadband adoption/use. However, in the interviews, only 3 out of 42 owners and 2 out of 42 owner-managers, respectively, identified culture and confidence/training as barriers against both broadband adoption/use. Therefore, the other key finding was that owners identified culture and confidence/training mainly as drivers for broadband adoption/use (only three businesses identified culture and confidence as a barrier in Table 7), unlike, authors like Kyriakopoulos (2024) and Isley and Low (2022) who identify culture as a barrier or equally as a driver and barrier depending on contextual factors. In Table 7, ISP choice and location were identified as barriers to broadband adoption that were exclusive findings of this research.

The new drivers and barriers for broadband adoption identified in Tables 6 and 7 represent an original contribution to knowledge in the context of micro-restaurants based in remote-rural Scotland. It should be noted that the findings from Tables A, B, C and D also established that in terms of frequency and period of broadband use, all micro-restaurant owner-managers categorised themselves as long-term and regular broadband users by confirming (in response to questions 2 and 3 in Tables A and C) that they have been regularly using broadband to run their business over some time. Therefore, unlike the broadband adoption drivers and barriers identified in the literature review, where the frequency of broadband use was not clarified, the drivers and barriers identified in the semi-structured interviews are based on findings from regular and long-term broadband adopters. The authors believe that the exclusivity of the broadband adoption drivers and barriers to this research may be attributed to the contextual factors of micro-restaurants in remote-rural Scotland. In terms of theoretical contribution, the new drivers

and barriers, as well as the established frequency and period of broadband use, inform further developments in the BAF, which is the empirically informed version of BAF 2 illustrated in Fig. 2.

As illustrated in Fig. 2, the BAF 2 consists of the new drivers of bookings, customer use, monetary transactions, and security [e.g. CCTV (Closed Circuit Television)] along with the new barriers of lack of ISP selection and location for broadband adoption/use. Therefore, the development of the BAF 2 has added value to the conceptual framework in this research, as the BAF 1 did not consist of the new drivers and barriers for both broadband adoption and broadband use identified in the interviews.

In Sect. "Introduction", micro-restaurants from remote-rural Scotland were identified as crucial players in supporting the rural economy via employability and job creation, and also in preserving ancient cultures exclusive to rural communities through minimising depopulation via job creation. Hence, these micro-restaurants have implications for the wider population. Despite the widely accepted benefits of broadband adoption for the survival and growth of smaller businesses, especially micro-restaurants in the isolated areas of remote-rural Scotland, lower broadband access and adoption between rural and urban businesses in Scotland were identified in Sect. "Introduction". However, a research problem was established in Sect. "Introduction" in the form of an identified dearth in literature for studies investigating broadband adoption by micro-restaurants in remote-rural Scotland. Therefore, based on these points, there was a need for further research, which led to a review of worldwide studies investigating broadband adoption by rural businesses (Tables 1 and 2). The review established themes for broadband adoption drivers and barriers, and it also identified a limited contextual understanding of broadband adoption by rural businesses based on business size, sector, rurality, and the frequency of broadband use. The review also identified a gap in theory to investigate broadband adoption, as well as frequency and period of adoption, which informed the creation of the BAF, which was a significant contribution from this research. The established themes for broadband adoption drivers and barriers were applied via Thematic analysis while comparing the findings from the literature review and 42 semi-structured interviews to reveal new drivers and barriers from micro-restaurants in remote-rural Scotland that were confirmed as long-term and regular broadband adopters. This finding of new drivers and barriers in the context of long-term broadband-adopting micro-restaurants from remote-rural Scotland is a significant and original contribution to knowledge, which addresses the research problem. Finally, another significant contribution from this research has been made through the development of an empirically informed BAF 2, which was informed by the new drivers and barriers and also adds value and insight to the limited theoretical domain focusing on technology adoption in terms of frequency and period of use.

Conclusion

Revisiting the research questions and research purpose

Broadband has revolutionised business creation, survival and growth due to the many benefits offered by broadband adoption for overseeing daily operations. Broadband adoption has, especially, transformed the prospects for start-ups entering a market or SMEs looking to expand due to the cost-effective and convenient options offered by broadband take-up; for example, online banking and online communication can

save time and money. Despite the widely acknowledged significance and importance of broadband adoption for smaller businesses, there appeared to be lower broadband access and adoption amongst smaller businesses in rural areas in comparison to urban areas. This was especially the case for smaller businesses in rural Scotland in sectors like restaurant businesses. It was highlighted that such businesses were crucial in supporting the rural economy in Scotland in terms of job creation and survival of local rural cultures by preventing depopulation. However, despite the significance of broadband and rural Scotland-based restaurants to the wider population in terms of job creation and the national economy, there appears to be a dearth in literature related to the contextual factors of micro-restaurants and remote-rural Scotland. Hence, a research problem was identified. Therefore, the purpose of this paper was established as an investigation of drivers and barriers to broadband adoption/use by micro-restaurant owner-managers in remote-rural Scotland. The purpose of the paper was underpinned by the following research questions.

1. What is the most appropriate theory to understand broadband adoption by rural businesses?
2. What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?
3. Is broadband adoption sustained by all micro-restaurant owners?

The responses to each of the research questions are explained below.

What is the most appropriate theory to understand broadband adoption by rural businesses?

A review of worldwide literature related to broadband adoption by rural businesses identified drivers and barriers for broadband adoption by rural businesses around the world. This review informed the authors in establishing themes for drivers and barriers to broadband adoption. The findings from the literature review identified a lack of precision regarding broadband adoption by businesses in terms of their size, sector and rurality (accessible-rural or remote-rural). The review of literature also identified limited innovation/technology adoption theories that can individually explore broadband adoption, as well as the frequency and period of broadband use by businesses. Therefore, the identified broadband adoption drivers and barriers, in addition to the highlighted paucity in technology adoption-related theory, informed the development of the BAF, which is a significant theoretical contribution.

What are the drivers and barriers to broadband adoption by micro-restaurants in remote-rural Scotland?

Semi-structured interviews with 42 micro-restaurants in remote-rural Scotland identified new drivers of bookings, customer use, monetary transactions, and security [e.g. CCTV] along with the new barriers of lack of ISP selection and location, while establishing that all participants were regular and long-term users of broadband in their businesses. The identification of new drivers and barriers to broadband adoption for micro-restaurants in remote-rural Scotland was a significant contribution to knowledge, where it also had significant implications on literature, as subsequently there was a clear paucity in literature established for studies involving broadband adoption in terms of

frequency and period of adoption while considering the contextual factors of micro-restaurants and remote-rural Scotland.

Additionally, the new drivers and barriers for broadband adoption informed further developments in the conceptual framework, which led to an empirically informed version of the BAF that was the BAF 2. In terms of theoretical implications, another significant contribution was made through the development of the BAF 2.

Is broadband adoption sustained by all micro-restaurant owners?

The findings from the semi-structured interviews with the 42 micro-restaurant owner-managers established that all participants were regular and long-term adopters of broadband for business operations, where local or business culture as well as confidence/training were not deterrents against continued long-term broadband adoption. The main deterrent against sustained broadband adoption amongst micro-restaurants in remote-rural Scotland was highlighted as limited infrastructure that restricted or stopped broadband adoption for business operations.

The purpose of this paper has been achieved through the responses to each of the research questions, which have demonstrated the identification of new drivers and barriers for initial and long-term broadband adoption amongst micro-restaurant owner-managers based in remote-rural Scotland. Additionally, significant literature and theoretical contributions have been demonstrated from the findings of this research. However, further literature and theoretical contributions can be achieved by varying the contextual factors in future broadband adoption-related research. For example, the findings from broadband adoption research focusing on micro-restaurants in remote-rural England or on construction businesses in accessible-rural Scotland may vary from the findings of this research. Despite the significant contribution of the findings of this research, there were challenges encountered by the authors during the research study.

Problems/limitations encountered during the research

The main limitation of this research was the generalisability of the sample involved in the interviews. The research contributed to knowledge in terms of investigating drivers and barriers to broadband adoption/use by restaurants in remote-rural Scotland for facilitating daily business operations; however, food and drink businesses from areas like Campbeltown and the Outer Hebrides were under-represented.

Additionally, the information for food and drink businesses retrieved from the databases of Taste of Scotland, TripAdvisor, Visit Scotland and Yell.com may have been inaccurate/incomplete for several reasons, e.g. outdated information related to businesses in terms of their name, location, and open/closed status.

Theoretical implications

The review of innovation/technology adoption-related theories in this research highlighted the limitations related to existing theories' inability to explore initial as well as the frequency and period of broadband adoption by businesses, which informed the development of the BAF. The authors believe that the structure and interpretation of the BAF may vary based on the variability of related contextual factors.

Implications for managers

The findings from this research may inform a guide/road map to ensure optimum or improved broadband adoption in business operations amongst rural businesses representing different sizes, sectors and regions, which may enable businesses to overcome social exclusion and digital divides.

Policy-based implications

The findings from this research on the role of infrastructure and government in supporting broadband adoption amongst rural businesses in Scotland may inform policymakers on how to best develop appropriate and relevant policies to improve broadband availability and take-up in rural/isolated regions.

Concepts for future research

The sample size from a few remote-rural areas in Scotland was much smaller than other included areas; therefore, the complete sample was not fully representative of food and drink businesses from remote-rural Scotland due to the under-representation of a few areas. So, there is an opportunity for future researchers to carry out a similar research study in terms of aim, with a more representative sample of restaurant businesses from remote-rural Scotland.

The authors of this paper also believe that the results of this research may vary based on contextual factors like business region, rurality of location, sector, and size. Therefore, there is scope for future research with the same focus as this research, being carried out in regions outside of Scotland, while including businesses of different sizes and different sectors, compared to the businesses included in this research.

There is also scope for future research to involve policymakers in the primary research to get an insight into the role of the government in supporting broadband adoption amongst rural enterprises.

Recommendations

The recommendations for researchers, policymakers and business owners are outlined below.

Conduct research in a different geographic and sector context, which may lead to different results in terms of drivers and barriers to broadband adoption/use.

Ensure a more comprehensive and larger sample by eliminating the over/under-representation of Scottish remote-rural areas for the participating businesses.

Policymakers should introduce policies that support the entry of ISPs into remote-rural areas, which will give businesses alternatives to a possibly poor service offered by an established ISP in the area, which will support them in completing daily operations.

Businesses should consider lobbying the local council/government to improve broadband connectivity/adoption/use in their area, which may support them in daily business operations.

Food and drink business owners can use the BAF to inform broadband connectivity/adoption/use towards facilitating daily operations.

Abbreviations

BAF	Broadband adoption framework
BT	British telecom
CCTV	Closed circuit television

DOI	Diffusion of innovations
HRSA	Human resources and service administration
ICT	Information communication technology
IDP	Innovation diffusion process
ISP	Internet service provider
SRUC	Scotland's rural college
TAM	Technology acceptance model
TOE	Technological organisational environmental
UK	United Kingdom
USA	United States of America

Supplementary Information

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Supplementary Material 1

Author contributions

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Not Applicable.

Competing interest

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