sustainability

MDPI

Article

Rural Digital Innovation Hubs as a Paradigm for Sustainable Business Models in Europe's Rural Areas

Simona Stojanova, Nina Cvar, Jurij Verhovnik, Nataša Božić, Jure Trilar, Andrej Kos and Emilija Stojmenova Duh *

Faculty of Electrical Engineering, University of Ljubljana, Tržaška cesta 25, 1000 Ljubljana, Slovenia
* Correspondence: emilija.stojmenova@fe.uni-lj.si

Abstract: One of the possible solutions of rural development is rural Digital Innovation Hubs (DIHs). Rural DIHs represent an efficient way of improving local environments in a more sustainable way, by affecting local businesses, people and local authorities. The purpose of this paper is to analyze the concept of a rural DIH by exploring the following elements: business model, digital technology and competences, and the policy instrument. We investigate the above-mentioned conceptual elements by conducting a literature review study and synthesizing the findings. Additionally, we provide a case study of the Divina Wine Hub Šmarje as an example of a rural DIH, whose activities are aimed at supporting rural businesses and individuals. The results show that a rural DIH does have a positive impact on local businesses, in particular regarding their sustainability aspect. The local DIH explained in the case study provides possibilities for local businesses to use innovative technological solutions, by supporting them with the right technological equipment and skilled people. From an economic point of view on sustainability, this resulted in business processes optimization, cost reduction, employment opportunities, as well as the strengthening of sustainable consumption and marketing for the winegrowers. Furthermore, it adds to environmental sustainability by adequately assessing the conditions in the vineyards to determine the optimal time and location of effective action, resulting in reducing the environmental footprint. All of this together also contributes to social sustainability by providing fairer distribution of social opportunities and digital inclusion. In this manner, we conclude that rural DIHs should be part of the Smart transformations of rural areas and included in rural development policies.

Keywords: sustainability; sustainable strategies; rural digital innovation hubs; rural policies; business model; digital technology; digital competences

Citation: Stojanova, S.; Cvar, N.; Verhovnik, J.; Božić, N.; Trilar, J.; Kos, A.; Stojmenova Duh, E. Rural Digital Innovation Hubs as a Paradigm for Sustainable Business Models in Europe's Rural Areas. *Sustainability* **2022**, *14*, 14620. https://doi.org/10.3390/su142114620

Academic Editor: Gioacchino Pappalardo

Received: 31 August 2022
Accepted: 2 November 2022
Published: 7 November 2022

1. Introduction

There are three key points in the sustainable development concept: protection of the ecosphere, stable economic development, and fair distribution of social opportunities [1]. In regard to rural development, rural areas and sustainable development are closely interlinked [2], meaning that the concepts of sustainable development should also be applied to rural development. In 2018, 29.1% of the European Union's (EU) population lived in rural and peripheral areas [3], urging politics and research to focus on rural regions to develop an accurate understanding of the needs of these communities in such a way that communities can attract and advance their own innovative potential, preventing the risk of poverty and social and digital exclusion. Sánchez, for instance, argues that mixing Information and Communication Technology (ICT) and sustainability concepts facilitates Smart destinations, resulting in the stimulation of sustainable economic growth (e.g., socio-economic, environmental, and cultural) [4]. In fact, if we want to assure that digital transitioning is sustainable and successful, and by success the authors of this paper are proposing the approach of universal inclusion, where the benefits of digitalization are extended to all the people living

in rural areas, a strategy needs to be applied that actively involves communities and their most important stakeholders.

Deriving from the authors' extensive experience in rural bottom-up innovation support as well as policy design and implementation activities, it is a fair assessment that the support from subjects such as rural DIHs is crucial for coordinating many dimensions of the rural innovation ecosystem. Rural DIHs' activities range from promoting access to funding opportunities, market research, connecting to other regions and networking, bottom-up co-creation processes, policy integration, and recommendations to actual technical development. This contributes to operationalizing economic and environmental sustainability in the special context of rural digital solutions for rural SMEs and individual entrepreneurs. Thus, a rural DIH can be a central point, a rural one-stop-shop for enhancing sustainability-based rural business in local environments where economic opportunities are sparse in comparison to the urban context of Smart Cities, where technological and institution-related capacities are more adequate.

The rural–urban gap is heavily present in the literature, covering different perspectives of research, such as wellbeing [5], health [6], the social aspect of living [7], the economy [8], business growth, and performance [9–12]. All of these inequalities were even more vivid during the recent coronavirus pandemic [13]. Frequent developments of rural DIHs offered different perspectives for further improvements and reducing the discrepancies. Rundel et al., in their recent research on rural hubs, demonstrate that rural DIHs can contribute to community resilience. However, the authors provide possibilities for further improvement; namely, they suggest more in-depth case study research in order to gain a better understanding of the connections between rural hubs and people [14]. Zavratnik et al., conclude that the social change and community elements should be seen as key components of sustainable living [15]. Furthermore, Tiwasing et al., suggest that future research should include a synthesis of technical and socio-economic approaches and provide more evidence-based results related to the support of rural businesses in the digital economy [16]. Stojmenova Duh stresses that digital technology can fuel economic growth by introducing new business models, resulting in increasing added value in the local rural area [17]. Roberts et al., encourage researchers to further consider the development of new technologies but also policies that will support rural entities [18].

In line with this notion, this research will therefore show the complex nexus of key elements of sustainability in rural areas, the development of sustainable business models, which, according to Bocken et al., "/ ... /seek to go beyond delivering economic value and include a consideration of other forms of value for a broader range of stakeholders", and digital transition in rural areas [19]. Using the case study of the Divina Wine Hub Šmarje, created in Šmarje (2020), we aim to concretely demonstrate how, via rural DIHs, a rural village located within the pilot region of Slovenia, digitally equipped with sustainable business models in rural areas, can enhance the paradigm for the future of Europe's rural areas in terms of long-term sustainability. By introducing this case study and analyzing the concept of a rural DIH from the rural business perspective, we conclude that rural DIHs can not only help in improving the business models of rural entities, but they can also contribute to achieving environmental and economic sustainability by providing digital solutions and competences.

The paper is structured as follows: it begins with the introduction, which is then followed by the methodology, presented in Section 2. In Section 3 we present the role of rural DIHs in rural areas. This is then followed by Section 4, which provides a review of the existing rural policies. Business models for rural entities are explained in Section 5. The next section, Section 6, is related to digital technologies, infrastructure, and competences. Section 7 presents the case study. Sections 8 and 9 represent the discussion and concluding sections, respectively.

2. Materials and Methods

The purpose of this study is to explore the role of rural DIHs in rural businesses and local communities as an example of a sustainable rural development strategy. Indicated conceptual elements are underlined by the case study of the Divina Wine Hub as it is an example of a rural hub that is encompassing all fundamental elements of Smart digital transformation: digital technologies, the community aspect (stakeholders), education (skills and competences), businesses, and the need to proceed with Smart digital transformation in accordance with sustainable development. The research question that we are addressing is: How can we encourage economic sustainability while supporting environmental sustainability in the special context of rural digital solutions for rural businesses?

To address the presented research questions, we are using the following methods:

- Literature review, covering the aspects of: business model, technical and sector-specific expertise, existing policies on rural DIHs, and the social aspect, seen as key and interlinked elements of rural DIHs. We provide a tabular presentation of the systematized data.
- Case study analysis of a digital platform for wine producers. This case study illustrates the integration of rural DIH technology development capacity within the special context of the rural ecosystem's needs, based on which the elaborated traceability solution was co-designed with local Divina Hub stakeholders. The infrastructure layer consists of sensor infrastructure (Libelium) and a data aggregation hub (Thingsboard). On top of this, sensor and data aggregation infrastructure, a viticulture monitoring solution, and end-consumer application solutions are implemented. Long-term weather and environmental data collection from the sensors is presented in the monitoring dashboard. This can lead to reducing the burden of agriculture on the environment by introducing more sustainability-oriented decision support models. The traceability application is focused on enhancing social innovation and business model sustainability with support for the significantly short value chains of the local wine producers. The case study is elaborated in Chapter 7.

3. Rural Digital Innovation Hubs as a Central and Fundamental Sustainable Model for Rural Europe

Several researchers emphasize that many rural places in developed countries are experiencing a decline attributed to a sectoral change [14,20,21]. On the other hand, it is suggested that digital technologies can help rural areas to overcome these challenges. According to the European Network of Rural Development (ENRD), rural DIHs represent efficient tools for improving digital opportunities [22] and consequently enhancing local environments in a more sustainable way. In the following paragraphs, the complex relationship between digitalization and social processes, underscoring the specific uptake of digital technologies in rural areas, is explained via the demonstration of a unique case study—the Divina Wine Hub.

With digitalization, the relationship between rapid social changes and technological innovations is underscored as digitalization is dispersed through all social spheres, with almost all areas of life being subjected to digital change [23], attesting that technology is not separated from society. In fact, digitalization has an immense impact on society, promoting convergence across various sectors.

Several social developments have been identified due to digitalization [24]: (1). emergence of new occupations in computer-based activities [25]; (2). distribution of production and its dislocation from national contexts [26]; (3). formation of new class structures [27]; (4). new systems of prestige, authority and power [28]; (5). further process of secularization of values, institutions and social relationships [28]; (6). emergence of virtual communities [29] and technological advancement, acting as an opportunity and a challenge as well.

As claimed by Fernanda Ribeiro Rosa, the distribution of the new ICTs has never been equal; on the contrary, according to Rosa, it is connected to a pattern of inequality because

it first reaches "/. . . /regions where capitalism is at its most advanced and groups which live under the most favored socio-economic conditions" [30].

ICT distribution, therefore, raises issues related to the relation between the ICTs and the social structure, determining who is able to participate and who is not when it comes to the utilization of the new technologies [30]. This partition has become known as the digital divide or digital gap, which is, especially in English-speaking countries, defined as digital inclusion. Warschauer, for instance, claims that over the years the binary logic of (digital) inclusion versus exclusion has moved away, arguing that several possible gradations exist [27].

The relation between digitalization and social reality is therefore based on mutuality, meaning that digitalization needs to be comprehended as something that does not happen accidentally [23].

However, there is a real challenge: how to identify and measure digitalization. In the EU, various tools have been developed; to name a few: Digital Economy and Society Index (DESI) is most widely used, but it does not provide specific data, especially for evaluation of the degree of digitalization in rural areas. To address DESI's shortcomings, within the Interreg Alpine Space SMART Villages project, a six-dimensional method to quantify the level of Smartness of cities and urban areas has been developed [31]. The Interreg Europe CARPE DIGEM project has designed a tool that allows stakeholders to establish the digital maturity of territories, including peripheral and emerging territories, to (further) develop and improve their digital transformation strategies [32].

In particular, a general, yet versatile, specific-based tool for assessing the digital maturity of rural areas needs an adequate epistemic background. If, according to Warschauer, ICTs act as a determiner of the difference between marginalization and inclusion [27], underscoring digitalization's impact on society, the notion of digital convergence could, for instance, offer such an epistemic ground [33].

Brennen and Kreiss have proposed four dimensions of the notion of digital convergence, allowing us to look in-depth into processes of digital transformation across different sectors and (geographical and cultural) areas as well: 1. infrastructure (network); 2. terminal (device); 3. functional and the relation with the rhetorical and 4. market convergence [28].

The proposed four-dimensional structure of digital convergence allows for inspecting something that researchers are calling inclusive digitalization, which is about overcoming geographical isolation (stronger links with urban areas), the diversification of business (online services and development of new services and products), competitiveness improvement (local markets) and the reduction of brain drain and out-migration (access to high-quality mobile and broadband means the retention of young people, who tend to be more inclined to knowledge-intensive business) [34].

As digitalization is a complex socio-cultural, economic and political process, its application is not easy, especially in rural areas, because originally the digital economy was predominantly perceived as an urban phenomenon [35–39], and referring to Warren, the provision of ICT infrastructure can be considerably weaker in rural areas than in urban environments [40].

In this manner, factors inhibiting the uptake of digital technologies in rural areas have been identified. According to Servon, these are access to systems, hardware, and IT literacy content relevant for the societal groups in question [41]. Following Servon, we are therefore presenting the case study of Divina Wine Hub, addressing all three factors.

It is true that digitalization can provide opportunities in terms of employment options and services in these areas [34]; however, as it has already been claimed, the provision of ICT infrastructure can be relatively scarce in rural areas, exacerbating a vicious circle of social exclusion that leads to digital exclusion and vice versa [40]. If only the assumptions of empowering individuals are taken into account by applying user-centric and participatory approaches, disregarding the importance of the social, economic, political and technical conditions within which individual choices are made [42], the so-called emancipatory potentials of digital inclusion policies are limited. In this manner, it is important that the

process of so-called inner peripheralization of rural and peripheral areas is taken into account. According to the European Commission (EC) with "inner peripheralization" we can adequately describe the decline of rural and peripheral areas [43], considering that many of them are facing social and economic challenges, such as brain drain, aging, lower skills and dominance of traditional industries, and geographical position (long distances) [34].

With all these complex issues in mind, including the context of the post-COVID-19 era, for which it is expected that it will further enhance digital uptake, demanding adequate policy responses as well, rural DIHs are possible solutions as rural communities can be empowered by utilizing modern digital technologies. However, before we provide a definition of the rural hub, it is important to disclose the state-of-the-art in terms of already conducted research on rural hubs.

Salemink et al. claim that rural hubs have not yet received a great deal of attention in the academic community, which results in the lack of adequate epistemic base, together with the deficit of adoption studies on the use of ICT technology in rural hubs [44]. What, then, is a rural hub exactly, and which conditions does it need for successful operations in terms of its involved stakeholders, management, and general policy framework?

According to the ENRD, rural DIHs offer physical spaces with internet access that is fast and reliable, with the equally important provision of a whole range of business and community support services, e.g., networking and peer-to-peer activities, training, mentoring, and business advisory, e-commerce, as well as very basic services (crèche, library, etc.) [45]. To tackle the challenge of digital exclusion and to ensure equal access to human-centric digital technologies for better public and private services across transport, health, energy, social, and community services, Stojmenova Duh proposes the digitalization of rural areas [46] as rural hubs can play a role in the provision of this.

Price et al. provide a concise guide on how to develop a rural DIH [47], which also offers a good starting point for the study of rural hubs. On the other hand, a study conducted by Rundel et al., makes an important contribution, focusing on the potential of rural digital innovation hubs within communities in Europe [14]. Otherwise, the typology of rural hubs consists of four types of (rural) digital innovation hubs; however, it is important to underline that identified types often overlap: (1). One type is based on a public internet access point, offering high-speed internet. However, it is important to add that with an improvement in broadband coverage in rural areas, a reduced need for such a type can be expected; (2). This type operates as an incubator and a co-working space, providing meeting, desk, and collaboration spaces for small rural businesses and remote workers. Price et al. also add that they can be located in business centers or can be even co-located, together with other businesses; (3). This type is focused on providing advice, offering training and support, building on and raising awareness of digitalization, and enhancing the development of digital skills in rural communities, and it is usually located in public buildings such as libraries; (4). The fourth type is sector-specific, supporting technology needs by providing specialist technology [47], basically operating like a fab lab. The advantage of rural hubs is that they are not just about digital innovation but about social and open innovation too, meaning that they can have an integrative role in the development of their communities.

On the other hand, the typology of Rundel et al., compared to the research of Price et al., is even more detailed, including the so-called "business" dimension. Rundel et al. propose to differentiate between rural DIHs for businesses, rural DIHs for communities, and rural DIHs for businesses and communities [14]. Further diversification is preceded by proposing subcategories of each of the above-mentioned categories: enterprise and innovation hubs, PIAPs and training hubs, and fab labs [14].

For hubs to be successful, they need to be actively involved with their communities and be adapted to their rural contexts. Likewise, they do not necessarily need to provide highly innovative services, as many rural and peripheral areas "/. . . / suffer from lack of

skills and knowledge regarding digital technologies" [14]. The provision of training in digital skills is perhaps even more important.

Following EUROSTAT, data show a considerable divide between adults living in cities and those living in rural areas, meaning that populations living in rural areas (compared with urban areas) are facing the risk of poverty or social exclusion, and not having adequate digital skills only increases the danger of poverty, especially if we take into account that in 2019, the gap in digital skills between city-dwellers and people living in rural areas was, on average, 14 percentage points (pp) in the EU (as measured by the difference in relative shares of adults possessing basic or above basic digital skills) [48].

In this regard, a rural hub could be perceived as a combination of providing digital infrastructure together with associated digital skills and competences in line with community needs, pursuing the opportunities that digital technologies can bring.

However, what does the management of these hubs include? Ashmore et al. argue that two lines of management need to be considered: policymakers, who need to identify the needs of the hub and its sustainability, with the users and stakeholders, representing the second dimension [49]. As claimed, Price et al. have identified the steps that need to be followed to set up such an ecosystem: (1). identification of the type of hub a particular community needs; (2). identification of the source of funding; (3). importance of leadership (the person who leads the hub is recognized as the key success factor, especially in rural areas); (4). recognition of service users (service users are the ones who are directing the hub's planning); (5). Stakeholders, such as local, regional and national authorities and organizations, politicians, skills agencies and bodies, are invaluable for raising hubs' profiles and for the operation of the entire digital ecosystem as well; (6). space with staff (identification of the most appropriate facilities in terms of being adequately integrated into the community in question with its prerogatives (size, universal accessibility, resonation with the communities' needs, with staff including hub managers/facilitators/trainers, administrators, technical personnel, advisors); (7). services (depend on the type of hub); (8). skills based on different approaches and sustainability aspects [47].

For digitalization to be holistic in rural areas, including in rural hubs, it needs to engage rural residents individually on the one hand and communities as a whole on the other [50–52]. The undertaken methodology is characterized by community engagement via the application of bottom-up, non-hierarchical approaches that enable the effective identification of the needs of the targeted communities and consequently developing a myriad of activities that include the process of engagement and inclusion via collaboration. Indeed, it is precisely collaboration as such that is key not just for the successful management of the hubs, but for the future of the European digital ecosystem as a whole, which in contrast to the paradigms of China and the USA, is more about the model being sustainable, locally driven, regionally rooted, and inclusive [53]. It is true that via the Digital Europe Programme (DEP), the European Commission recognized the importance of rural DIHs, which are regarded as central to developing local and regional data ecosystems. It is important to add that more effort needs to be put into rural DIHs, which, as we have shown, referring to Rundel et al., can effectively address the issue of connectivity, digital skills and above all, provide community training places for enhancing digital inclusion [14]. Furthermore, a survey on the contribution of ICTs to the environmental sustainability actions of the EU businesses—the first of its kind—prepared by the EU Commission and published in November 2021, demonstrates that 66% of surveyed companies reported that they use ICT solutions as a way of reducing their environmental footprint [54], underlining an interesting relation between the ICTs and sustainability in addressing sustainability issues. If rural DIHs are about "hearing" and acknowledging local communities, economic growth, coming from their environment, social equity, livability and health, conviviality, transport, energy, water and waste management, and governance, with each of the dimensions being evaluated by local government, they are actually 11 proceeding dimensions of sustainability [55], which place themselves firmly into the paradigm of sustainable development. Although, to refer to Zavratnik et al., the opportunities offered by ICTs

need to be (re)considered and included in strengthening the collaboration between (all levels of) decision-making authorities, communities, developers, and researchers [56]. For this to occur, rural DIHs seem to offer a perfect EU (policy) instrument to address such a holistic approach.

4. Existing Policy Review

Since the emergence of the concept of the Smart Village, different methods for its technological progress have come to light. ICT technology is being applied to different fields of society, economy, and everyday life. Constant technological evolution brings new possibilities for novel and innovative ideas in the future, making sustainable development heavily dependent on digitalization. In order to use the full potential of digital technologies, there is a need for digital cooperation and interactions between researchers and policy-makers. The uniqueness of every region makes the unified rules difficult to develop and follow [57]. However, cooperation between policymakers and other stakeholders is still a challenge [58]. Recent advancements in this matter are seen from the publications of a few initiatives focused on rural development and territories with geographic specificities (TGS): (1). long-term vision for rural areas; (2). staff working document on TGS; (3). initiatives targeting islands; (4). the Smart islands initiative [59].

Tackling the digital advancement of rural communities, one of the innovative solutions that can respond to the need for the digital engagement of local stakeholders together, is establishing a rural digital innovation hub [47]. The COVID-19 pandemic is another factor that influenced the need for regional hubs, showing the importance of everyday online activities. The post-pandemic period only reinforces the need for policy interventions on this matter. However, having a digital hub by itself does not promise anything regarding solving the issue of the digital literacy gap. Community engagement is very important. Training programs might be one of the possible solutions that will lead to this success [49].

The importance of policy setting can lead to the development of the rural areas, not at the same pace, but in the same direction. It leads to an increased number of populations in rural areas, places for social activities, reduces regional disparities, improves quality of life in these areas by providing better services, and contributes to the general goal of building a sustainable, community-led future [60]. When considering policy development, they should be based on the identified need [61]. As provided by Ashmore et al., the following recommendations can contribute to strong policy development: (1). co-location is one of the important factors that hubs should consider as this will ensure the minimum number of users; (2). it should respond to the rural community by allowing users to come into contact with digital developments and to receive assistance; (3). in order to serve a varying group of users, it should not be very specialized but adapted to locals' needs; (4). it should be seen only as one of the many ways of reaching out to rural communities [49]. In a similar way, while highlighting local policy research as a primary step, Ulman et al., fully support the importance of a participatory approach involving key stakeholders in the process of policy development [62].

The policy on rural DIHs is considered an important element of the development of rural communities, both for the local economy and for the individuals who should be able to understand the latest technological possibilities [63]. In the digital targets for 2030, Europe aims for a digital future by empowering businesses and residents. The European Commission presented a vision for Europe's digital transformation by 2030, by proposing a Digital Compass for the EU's digital decade that includes four fundamental aspects: skills, infrastructure, businesses and governments, or as stated "/. . . /Government as a Platform is the new way of building digital public services" [64].

In the USA, the rural development policies towards building stronger rural ecosystems stress out that one of the challenges is the lack of a blueprint for hubs. The governance and financial support of rural areas are the most important elements for their development, and when there is no system in place, the rural place is disadvantaged [65].

Rural DIHs, regardless of the type of form they have, add a lot of value to the community and rural businesses. However, as argued by Rundel et al., [14] in their research on how digital innovation hubs are contributing to communities in Europe, only setting up a digital hub is not going to be a solution for improving digital literacy in rural communities. The success of having a digital rural hub is seen from the range of services it offers for different groups of people, accessibility and acceptance from its users and its general affirmation from the community. Furthermore, they stress the importance of rural hub policy, making a few more points: (i) in order to ensure enough users, they propose the use of co-location, including a different range of services together; (ii) the rural hubs should serve the community to get to know and stay updated with the digital advancements, but also to receive the appropriate support for other issues such as governmental tools when needed; (iii) the services it offers should not be very specialized and focused, but they should apply to the general users, meeting their needs; (iv) rural hubs should be seen as one option of reaching out to rural communities and supporting digital literacy, among other things.

It is necessary to include policymakers in all processes, from establishing infrastructure to developing digital skills and applying the knowledge and digital technologies to solving the existing issues of the rural regions and bringing them closer to narrowing the digital divide. Calls for policies and concrete actions will aid rural communities to become stronger, more empowered, and resilient.

5. Sustainable Business Models of Rural Entities

Digital business models can help rural enterprises in different economic sectors to remain competitive by facilitating direct relationships with customers and new target groups, or by making their supply chains more efficient and customer-focused. There are further opportunities to foster sustainable rural development through new technologies. Residents can attend university lectures online, receive digital support in case of illness, or get in touch with public authorities using their smartphones without having to drive to the next city. Thus, unlocking the potential of digitization for rural development can help address the grand challenge of out-migration and the growing urban–rural divide [66].

There are various definitions of the business model concept, but a general agreement is that it covers the following elements: value proposition that is related to the type of product or service that will be developed to meet customers' needs; value creation and delivery related to providing the value or benefit as a result of processes integration; value realization or value capture, which actually means defining the source of revenue [67].

With the emergence of e-commerce, conventional business models are being upgraded, which has resulted in the emergence of new business models. Those new and innovative business models work in line with the sustainable development of the organizations in which they are being applied [68]. The idea of a sustainable business model represents an innovation in the business strategy, covering the environmental, economic, and social value proposition, creation and value capture [69]. Such examples of how sustainable business models help companies in achieving their sustainability-oriented goals can be found in the review paper of Evans et al. [70].

Rural businesses face many challenges such as: lack of appropriate infrastructure and technology [67], lost opportunities for diversification [71], increased operational costs and difficulty recruiting skilled staff [72], and difficulty in obtaining external IT training [73]. Nowadays, when living in the digital era, the lack of proper digitalization infrastructure has a strong influence on businesses [66]. As a result, this limits the opportunities for income generation [74]. A report on rural perspectives on digital innovation from the Nordic countries and Latvia, for instance, concludes that the rural entities face this problem of digitalization because of two main reasons: (a) because they are small- and medium-sized enterprises (SMEs) which are less likely to embrace new digital tools, and (b) because of their geographical location, they are less likely to have access to people with digital skills and competences [75].

When we talk about business models in rural areas, agriculture plays an essential role. There is evidence that digitization in rural entities, and more precisely in agriculture, has been on the rise in recent years [76,77]. Sustainable business models in this field were also presented in the research [78–80], but compared to other sectors, they are only at the beginning of their development, both in terms of the extent of use of various digital tools and in terms of prevalence. Bouwman et al., 2019, for example, state that there is not enough attention focused on business model development by digital technology incorporation by small- and medium-sized entities [81] and that research on the digital divide is narrow [71].

The use of advantaged technologies can lead to increased success rates of sustainable business models [68]. The integration of digital technologies into the business models of rural entities can result in improved business performance but also contribute to regional development [66]. Ievoli et al., analyze three case studies from Italy where ICT technology is used for creating new business models in rural areas. They conclude that the presence of digital infrastructures generates new income and possibilities for rural entities to overcome location barriers. Furthermore, it boosts social aspects, improving the collaboration between producers, customers, community, and other institutions, which leads to sustainable rural development [82]. In the same manner, Schiavone et al. investigate how business modeling is related to the smartization of cities and how this influences the development of Smart City policies within a valid business model [83].

To formulate an effective sustainable business approach, it is necessary to understand future development trends in agriculture. Digital infrastructure is the core element for digital and social innovation and thus it is of immense importance that policies work toward broadband infrastructure provision. Furthermore, future work on embracing digital technologies in rural entities should be related to addressing the need for technology integration in rural businesses, taking into consideration individualized and company-centered approaches, consolidating strategies that are location-based and needs-based, as well as incorporating collaborative approaches [75]. Pressures for self-sufficiency on the one hand, and financial and environmental pressures on the other, force the bearers of agricultural activities to optimize production. A successful approach requires new business models that include digitization at all levels. The prospective future of the Agriculture 5.0 concept includes the creation of an extensive digital ecosystem, universal digitalization of all stages from production before the realization of agricultural production, and full automation—the transition to artificial intelligence.

6. Digital Technologies and Competences

Rural areas in Europe are still experiencing difficulties regarding connectivity, with 10% of the premises not having access to a fixed broadband network and only 41% of them being covered by any Next Generation Access (NGA) technology [84]. Overcoming the issues with digital infrastructure is a necessary step in bridging the digital divide and providing equal opportunities for all. Access to the internet opens rural communities up to new possibilities, ones that are often taken for granted by the majority of urban populations. The Interreg project CORA (Connecting Remote Areas) has tackled these challenges, exploring ways to bring together various stakeholders, users, and municipalities in order to improve the delivery of broadband infrastructure in remote areas. For successful rural area digitalization and improvement of infrastructure, the involvement of political leaders and strategic planning is necessary [85]. Tackling digital infrastructure issues corresponds with addressing other issues, such as the population decline. Fast and reliable broadband connection can impact the attraction of new businesses and residents in the area, thus enabling the transition and creating Smart, connected, and sustainable communities in rural areas [84].

Access to the internet and the possibilities it creates provide empowerment for rural communities, enabling them to participate in innovations and be more progressive, bringing new solutions for rural development. Digital infrastructure acts as a facilitator of the linkages created in the interaction between rural areas and the external context, offering

ICT-supported innovations and new ideas to agri-food systems and rural economies in general [82].

Lacking suitable digital infrastructure in remote and rural areas leads to the lack of digital skills among the inhabitants of said areas [86], which consequently results in further deepening the digital divide between urban and rural areas. In 2019, the EU estimated that only 58% of the population had the most fundamental digital skills, despite the fact that digital literacy is a vital driver of social cohesion and economic growth [87]. This means that supporting the development of digital skills among rural populations often starts by focusing on entry-level skills and building up to more complex ones, relying on the community approach and open dialogue to clarify the needs of said populations.

DIHs can provide training for developing digital skills [88], which provide an opportunity for the rural population to take advantage of new technologies and tools [45], helping in bridging the digital divide. Developing digital skills in DIHs relies on the community approach, as seen in the example of Vejle Municipality in Denmark, where the Vejle Library Service's staff engaged with the local community with a series of workshops and dialogues, aiming to understand the specific requirements of the area regarding the inhabitants' needs for developing digital skills [87]. This approach can assist in the efforts to gain the trust of the local populations, presenting the DIHs as something that belongs to them and are created for them.

A shift towards the use of digital technologies in traditional rural businesses is challenging since these operations are often based on routines learned and transferred through many generations and many years of experience. One more reason is the level of distrust towards innovations facilitated by ICTs because it is hard for traditional farmers to foresee positive outcomes and benefits [82]. Another difficulty regarding the use of digital technologies is that they are often used inadequately by both farmers and other businesses as well as the general population and administration, even in areas with already established infrastructure and access to the internet [82]. Since rural DIHs are places where rural communities can gain digital skills, access knowledge and expertise as well as access a fast and reliable internet connection, establishing a DIH can lead to many positive results. These results are related to raising awareness about the constructive impacts of digital technologies, therefore motivating the locals to take part in educational activities with the aim to develop the necessary skills and reap the potential benefits of innovation.

The use of Internet of Things (IoT) technology has proved to be suitable for rural as well as urban settlements, therefore proving that it is not limited to the context [50]. The different applications of IoT solutions in rural and urban areas are not only about technology itself but are rather rooted in complex socio-economic, cultural, and political aspects of the regions and the different needs these regions have. For example, rural areas require IoT solutions that can cover large areas, while in urban settlements, it can be efficiently used in close-range solutions [50].

The use of digital technologies in rural areas is dependent on the digital infrastructure, as a precondition, and on the level of digital literacy of the local inhabitants in rural regions. Digital competences can vary between different individuals or places, but they consist of technical competences, the ability to assess and use digital technologies on a daily basis and motivation to be part of the digital culture [89]. DIHs can bring together various stakeholders, such as local authorities, businesses, and wider communities, and provide them with a space that offers reliable and fast broadband connection and different learning and networking opportunities. DIHs also contribute to raising awareness about the potential benefits of digital technologies in rural communities. This can have a positive effect on acceptance of the changes to the traditional ways in which business is conducted in these areas. A better understanding of the potential positive outcomes for local communities can lead to overcoming trust issues, which improves the overall impact of digital solutions, making rural areas more attractive and able to compete on the market with innovations. Digitalization in rural areas enables the fairer distribution of social opportunities, bringing rural communities closer to closing the gap. Furthermore, it contributes to the development

of local rural economies, making changes to the traditional ways that business is conducted, making it more likely to minimize the negative impacts on the environment.

7. Case Study: Wine Information and Traceability for End-Consumers

One of the examples of the use of IoT in rural areas is the village, Šmarje, located in Slovenia, in the municipality of Koper in the coastal rural region. This village has been a pilot area for testing new solutions in Smart viticulture within the EIP project SmartAgroGrape. The overall goal of the project is to obtain relevant sensory data directly and indirectly from selected locations in order to set up an advanced digital platform that will enable technologically, economically and environmentally efficient management of agricultural land (vineyards) with the aim of reducing the impacts of agriculture on the environment [90].

Šmarje was a pilot area in other projects as well, such as the Interreg project SmartVillages, involving the SMART digital transformation of villages in the Alpine space. This project aimed to strengthen the potential of rural areas in the Alpine space through new forms of community involvement, bringing together policymakers, academia, local businesses, and civil society in order to make rural regions more attractive for life and work [91]. Šmarje was the first village in the territory to develop its own digitization strategy, which led to the implementation of various solutions and initiatives in the region, such as the installation of open wi-fi service in the village center and the implementation of different digital solutions for wine producers, which helped to develop novel approaches and techniques for Smart and sustainable agriculture in the region [92]. Another project in which Šmarje was a pilot area is the Interreg project CARPE DIGEM, which aims to develop inclusive digital innovation ecosystems to address the present and future needs of remote, rural regions in Europe. Developing digital innovation ecosystems enhances digital transformation strategies in areas that are traditionally regarded as being outside of the innovation and change-producing digital, economic, and social core of Europe [93].

Through the innovative solution described in this section, the authors illustrate the complexity of a rural DIH operationalization, where the technical solutions development and business model design respect the complexity of the rural context of the (digital) ecosystem, and where the digital infrastructure, digital skills and access to funding are less accessible and less structured when compared to their urban counterparts of Smart Cities. In such ecosystems, the local rural DIHs provide possibilities for local businesses to use innovative technological solutions to promote business models based on enhancing the environmental and economic sustainability of existing traditional commercial activities. Here, the contribution to the discourse on the primary research question, specifically how rural DIHs connect environmental and economic sustainability in context of rural digital solutions and influence the business model of rural entities, is evident. DIHs operating in rural areas can provide decisive capacity in utilizing digital technology for the distribution of opportunities and stable economic development. The case study presented here is an example of how to apply economic sustainability while supporting environmental sustainability in the special context of rural digital solutions for smaller rural business entities, i.e., wine producers. The digital solution for wine information and traceability for end-consumers is introduced as an upgrade to the SmartAgroGrape project, led by the University of Ljubljana, Faculty for Electrical Engineering, and co-financed by the Ministry of Agriculture, Forestry and Food to support rural development and farm-to-fork strategies. The original solution, a vineyard monitoring system that consists of sensor infrastructure (Libelium) to measure 9–12 weather and viticultural parameters, manage data aggregation (ThingsBoard), interacts (via NB IoT) with the monitoring application, and alerts the farmers in various scenarios of exceeding limit values, acts as a decision support system. The sensor infrastructure is already collecting data in seven vineyards—five in Slovenia's coastal region and two in Slovenia's Steiermark region. While the monitoring system is used by the wine producers to enhance their existing core processes, the blockchain-based application is intended for end-consumers of their products to examine and appreciate

additional data collected and provide traceability of the products, thus involving more stakeholders in the solution life cycle. As such, the digitalization efforts are paired with the multidisciplinary methodology and non-hierarchical community building.

7.1. Technical Scenario

In this scenario, the sensor data are used for enhancing the trust of consumers in the product as it provides traceability capacity, from grapevine growth to harvesting, to barrel processing, and finally, bottling. In this chapter, we present an explanation of the technical solution design, namely the sensor system, data collection method, and consumer blockchain solution.

7.1.1. Sensor System and Telemetry Data

The general flow of data for this example starts with the collection of data for the following parameters: soil volumetric water content, soil conductivity and soil temperature; leaf wetness; oxygen content in soil; air temperature, air humidity and air pressure; solar radiation; weather station for measuring rainfall, wind speed and wind direction. For the measurement of viticultural parameters and managing data aggregation and data communication, the professional Libelium Plug and Sense Smart Agriculture Xtreme is chosen as the most suitable. The system is supplied by an internal rechargeable battery with a capacity of 6600 mAh and solar cells (7 V–500 mA). The central unit of the sensor system contains a microprocessor and various modules (e.g., networking module, SD card module) and it is responsible for the aggregation of measured parameters and uploading the data to the server. The Libelium device has six inputs to which different sensors can be connected. Some sensors have the ability to measure multiple parameters. As there are multiple sensors to choose from, multiple sensor configurations can be set up. For the future, the data reported by the sensors will be the basis for the development of new predictive models that will enhance the vineyard monitoring application.

7.1.2. Connectivity

A Libelium device with configuration that allows NB-IoT (Narrowband Internet of Things) connectivity has been chosen due to the low energy consumption without the need for additional gateways. Downside of this scheme is using a SIM card and with it the monthly network operator fees. The communication architecture between the sensor system and the server is the following: devices are connected to NB-IoT cell towers through which telemetry data are sent to the ThingsBoard server, where they are stored. Communication is bi-directional; when a Libelium device requests to receive settings from the server, the server sends new sensor configuration to the Libelium device. The protocol used for packet transfer is HTTP (Hypertext Transfer Protocol—HTTP/1.1 2021).

7.1.3. Thingsboard Platform

The data collection model is implemented on the Thingsboard platform, where sensor platform data are stored and are available for further use via an application programming interface (API). Thingsboard is an open-source platform used for device management, data collection, visualization and processing. Thingsboard provides MQTT-, HTTP-, CoAP- and LwM2M-based APIs and enables a server-side infrastructure for IoT applications. The data pushed from devices can be visualized in real-time in an end-user dashboard. With rule nodes in a rule engine and processed data, an alarm can be created to support the vine producers' processes.

7.1.4. Data Display in Decentralized Application

Upon winemakers' requests, the data from sensors are collected from the Thingsboard data collection platform and compiled according to the definition of the time period at the beginning of the winegrowing cycle, followed by the harvest and cellar wine processing period, and completed by the bottling process. The data sets are compiled in coherent

timelines of sensor data, which are displayed in end-consumer decentralized application (dApp), simple JavaScript and HTML5 script and hosted in the InterPlanetary File System (IPFS) with data cryptographically sealed in a Smart contract. This Smart contract operates as a data repository and can be implemented in several ways, corresponding to regional winemakers' requirements and technical capabilities. Either they can be saved on the public blockchain (Ethereum), which requires no additional server or cloud infrastructure yet involves fees for publishing the data, or they can be saved on a dedicated EVM instance running in the consortium's (winemakers and rural DIH) server or cloud infrastructure, which does not involve any transaction fees, and also supports the future development of distinctive new data and transaction scenarios.

7.2. User Scenario

In this next paragraph, the user scenarios of the actual technical solution are presented. In the first instance, the winemaker's input is only required at the step of deciding which vineyard and wine cellar data period to publish for the specific wine bottle batch. When publishing data for distinct wine bottle batches, the winemaker isolates selected sensor data that are of particular interest to end-consumers, e.g., solar exposure of specific vineyard, perception, or soil parameters by period, starting with the first day of the vine growing season and ending with the harvesting date. In line with the winemaking process, additional barrel monitoring data are adjoined, thus contributing to data completeness in relation to the wine production cycle from vine and grapes to bottling. The data are cryptographically sealed, timestamped and published on selected blockchain-based repository solutions to provide an incorruptible and immutable audit trail and a certificate with a QR code, and a unique public URL for distinct batches of bottles is produced. In the next step, when consuming the product, the QR code can be scanned or the URL can be typed into the browser by the curious end-consumer. The web application reveals the additional information about that specific batch of wine, including variety, regional relevance, etc. The chosen parameter data from vineyards or wine cellars are presented in diagrams, overlapping with comparable data from wine batches of other consortium members producing the same sort of wine. An additional function to appease the end consumer is the CO_2 footprint estimate.

7.3. Stakeholder Engagement and Motivation

The wine sector has been associated with traditions related to territory and local production methods, and with increased (global) competition, consumers favor high-quality products and the sustainability of the processes, further emphasizing the uniqueness of each bottle and its added value [94]. Via the presented solution, smaller winemakers, with the help of rural DIHs, have a chance of adopting cutting-edge technology that provides globally available reliability of information of regional relevance to the consumer [95]. The comparison of associated data allows for the absence of intermediaries, supports environmental and economic sustainability of the region, has regional/wine region data of relevance to the consumer, and showcases their already implemented sensor infrastructure. In order to thrive in a connected world, the burden of technical and business development should not rely on individual business entities or winemakers; rather, it should be a case of consortium building through often-imperfect dynamic and inclusive processes. In this "cooperation approach" lies the source of motivation and the outlines of mechanisms for implementing bottom-up-built, economically and socially sustainable business models associated with the sociotechnical systems approach. Being part of the (classic) consortia model through cooperating, by pursuing common objectives and sharing data infrastructure, does not mean that members cannot compete and maximize their economic gain. In this specific case, the business entities, small farmers and winemakers are owners of the sensor infrastructure on their property, the equipment is co-financed through SmartAgroGrape project, while the role of the (rural) DIH is over-the-top, auxiliary digital solution development. Joint decentralized and distributed web infrastructure is established in order to be robust, durable and simple-to-use, while defining the rules of engagement

for the members of the consortium, allowing for adding new members or removing less trustworthy actors through defined governance mechanisms (e.g., 2/3 majority vote).

There are various challenges regarding the trustworthiness of the system. To what degree can the end-user trust the system and its information? How can we punish fraudulent behavior? Can production process data be forged? Can origin certificates and labels simply be copied and printed elsewhere? Generally, we can distinguish between "upstream", which concerns sourcing and production activities and "downstream counterfeiting", which concerns distribution and retail activities [96]. Moreover, as in the majority of blockchain projects, the sole technical aspect is worthless without accounting for motivation and end-user requirements. While some trust-related challenges are addressed through innovative technological means, such as the use of cryptography and timestamped immutable records that would allow for the recognition of old data and factual errors, the most important relate to business models and community building aspects. The propositions for avoiding trust-related problems in this specific case study are:

- Monitoring by the consortium is enabled on a vineyard monitoring application level and end-consumer application level by enabling the comparability of data for the same sort of wine and the regional proximity of winemakers. In case of fraudulent or low-quality data, the consortium can initiate a governance mechanism for removing a member from the consortium, hence restricting data publishing and retrieving.
- Sunken costs of already installed vineyard monitoring infrastructure, which are relatively high without co-financing, are a factor in the motivation to publish wine batch data and share them with the end-users. Without this over-the-top application, winemakers would miss the opportunity to share success stories and provide added value to their customers. The cost of publishing the accurate, automatically retrieved data and printing correct labels is minimal if a winemaker has the aspiration to create trustworthy local brands and the ambition to continue working with the consortium's digital solution.
- Short supply chains and small-scale batches are the distinction of this specific use-case that mitigate the traditional wine supply-chain integration problems [97]. The end consumers and restaurant managers buy directly from the person or family who cultivated the vines, harvested grapes, fermented the produce in barrels and bottled the wine. It is a case of hyperlocality, as it is unlikely that products will be sold multiple times or outside the wider region.

8. Discussion and Directions for Future Research

The sections that we cover in this paper, including rural policies, business models, digital infrastructure and technology are currently seen as the most important for setting up a rural DIH, but future research should not be limited to them. By this, we do not aim to develop a complete guideline for rural DIHs; rather, we want to focus on the insight gained from the conducted research and field work. Based on the literature review of rural DIHs and the key elements that lead to their establishment and operation, at the same time influencing rural entities and society, we provide a systematic summary of relevant sources, summarized in Table 1.

By explaining the definition of rural DIHs, reviewing the possible forms they can take, and exploring their operations and their digital maturity, supported by the presented case study, a relation between rural businesses and communities, technological infrastructure and competences, and policymakers can be observed. As presented in Chapter 1, their applications are not easy; however, once established, they have a huge influence on overcoming the digital rural–urban gap, enhancing the sustainable futures of local inhabitants, and also fostering the resilience of rural communities.

Table 1. List of rural DIH dimensions.

Dimension	Summarization	References
Digital Innovation Hubs	Examination of the concept of rural DIHs by focusing on guidance for setting up, development and design; conceptualization; typology.	[14,47,49,61,88]
Existing Policies	Review of rural development policies and practices; institutional support for data ecosystems; policy recommendations; ICT-enabled process innovations; future solutions for territorial planning and governance; policies for citizens' initiatives.	[30,41,42,51–53,62,63,85]
Communities	Understanding of the social elements arising from digitalization and technology, in line with the economic and environmental resilience: conceptual frameworks; understanding of rural community trajectories; directions for social development; social changes.	[7,14,15,20,21,40,41,56]
Rural Businesses	Comparison to urban businesses, inequalities and disadvantages; impact of the local business's location on its growth; entrepreneurial activities in rural tourism.	[10–12,16,71]
Business Models	Development of rural business models using the advantages of new technologies, consisting of: review, classifications, frameworks; directions for creating balanced social, environmental, and economic value; sustainability requirements; model innovation; economic efficiency.	[19,66–70,72,78–83]
Digital Skills and Competences	Technical competence or literacy: types of skills, levels, usage of digital technologies; proper infrastructure; possibility for learning and improvement.	[7,61,85,88,89]
Technical Solutions	Precision agriculture which affects the business processes by using timely and precise information leveraging different advanced machine learning techniques; adoption of blockchain in the wine industry and its impact on the complex inter-organizational supply chain systems SMEs are engaged in.	[50,76,77,94–97]

On the policy level, it can be witnessed that although rural areas and their businesses differ from each other, certain similarities can be identified regarding policies related to rural DIHs. They all suggest that rural DIHs should be established, providing services that are based on local needs, and they should not be very specialized, so as to beat the service provided to the general population. In the future, using rural DIHs should be considered as a strategic priority and included in rural development policies, in order to ensure Smart and sustainable transformations of rural areas.

The analysis of the business models behind a rural DIH proceeds by suggesting that there is a lack of research on the business model development of rural businesses and digital technology integration by rural businesses. The challenges that these enterprises face, for instance, increased operational costs and difficulty recruiting skilled staff, are different from those that businesses in urban areas are facing. Within the case study presented in this paper, it can be seen that part of the business model is the importance of data sharing, which adds additional value to the customer. This element is integral to customer relations as it delivers the value proposition by providing a whole new brand experience that consumers can receive when buying a product. Additional business value comes from the short supply chains and small-scale batches, as well as from the new business model it offers, namely the cooperative approach of joint production.

In the digital age, insufficient broadband infrastructure and service provision, as well as insufficient digital skills, contribute to the challenges of business competences. The establishment of rural DIHs can help local businesses by providing new technological solutions, skills and competences, which add to the value proposition of their products. Businesses themselves providing these technological solutions by would be very costly, time consuming, and maybe even unaffordable. Technology-based innovative solutions

help by supporting the growth of rural businesses as they allow access to new consumers as well as reinforce the relationship with existing, local consumers.

The case study presented in this paper is heavily dependent on technology and digital skills and competences, as well as having the right infrastructure in the rural areas and overall stakeholders' support. By utilizing advanced IoT technologies, a cost-efficient and durable solution is provided to enable optimization, efficiency, productivity, biodiversity protection and environmentally friendly—and above all—sustainable agricultural practices. The use of this platform represents human-centered digital transformation, with the potential to be transferred as an example of a sustainable and scalable innovative business model in a rural area.

From all of the above, we can conclude that a shift toward the use of digital technologies in traditional rural businesses is challenging. Having support from DIHs can ease various challenges. However, as it has been demonstrated in Chapter 3, for digital transformation to be successful in rural areas—and by success we mean the engagement of rural communities via bottom-up, non-hierarchical approaches—the enhancement of digital inclusion is key. This community engagement approach follows the concept of the digital innovation ecosystem, which suggests addressing digitalization in rural areas via the epistemic approach of considering various actors with different roles that interact in mutual interdependence [50]. To underline this holistic methodological stance, we have presented a case study through which we suggest that rural DIHs are an example of such an approach, as they can support local businesses and residents as well as contribute to decreasing the rural–urban gap. However, more research would be needed to better understand the interconnections between the hubs and other aspects.

9. Conclusions

The advancement of rural development is something that is heavily dependent on the design and development of policies and initiatives that will enable residents and businesses to access the resources they need to drive innovation in their environments. As is concluded in this paper, rural DIHs represent a good, sustainable strategy for rural development, targeting rural businesses, their customers, and communities at the same time, and addressing the challenges of digital exclusion. Their services provide support on a regional level, where extensive, thorough investments on behalf of the region as a whole are designed. This research builds on the detected disadvantages of technological infrastructure, high costs, and weak user knowledge. Based on the paper's findings with the presented case study, rural DIHs can lead to sustainable rural development via: (i) targeting sustainable economic factors by enhancing a specific business model, adjusted to rural entities, providing a cost-efficient and durable solution that enables optimization, productivity, and new possibilities for reaching out to new customers and the community as a whole; (ii) the environmental aspect, by Smart use of data collected for efficient use of resources and biodiversity protection; (iii) improving residents' lives and allowing social equality by providing technical infrastructure and competences. Rural DIHs should therefore be seen as a key policy instrument model with great potential for the long-term visions of rural areas, and they should therefore be made integral for the EU (rural) policies. After all, 30.6% of the EU's population lives in rural areas, and rural areas account for more than 341 m ha, which represented 83% of the total EU area in 2018 [98], and missing these areas out means leaving these communities behind.

Author Contributions: All authors, S.S., N.C., J.V., N.B., J.T., A.K. and E.S.D., have designed the paper structure, research methodology and analyzed the data; All authors, S.S., N.C., J.V., N.B., J.T., A.K. and E.S.D., were equally responsible for provision of study materials; S.S. wrote Introduction, Chapter 2, Chapter 4, Chapter 5, Chapter 8 and Conclusion; N.C. wrote Introduction, Chapter 2, Chapter 3, Chapter 8 and Conclusion; J.V. wrote Chapter 5; N.B. wrote Chapter 6; J.T. wrote Introduction, Chapter 2 and Chapter 7; E.S.D. and A.K. were responsible for supervision and funding acquisition; All authors, S.S., N.C., J.V., N.B., J.T., A.K. and E.S.D., reviewed and edited the paper; All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Slovenian Research Agency (ARRS), P2-0425: Decentralized solutions for the digitalization of industry and Smart cities and communities.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Kantar, S.; Svržnjak, K. Development of sustainable rural tourism. *J. Reg. Dev. Tour.* **2017**, *9*, 26–34. [CrossRef]
2. Magda, S.; Magda, R.; Marselek, S. Sustainable development of the rural economy. *APSTRACT Appl. Stud. Agribus. Commer.* **2009**, *5*, 31–36. [CrossRef] [PubMed]
3. EUROSTAT. Available online: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200207-1 (accessed on 9 May 2020).
4. Vargas-Sánchez, A. Exploring the concept of smart tourist destination. *Enl. Tourism. A Pathmaking J.* **2016**, *6*, 178–196.
5. Lagakos, D.; Mobarak, A.M.; Waugh, M.E. *The Welfare Effects of Encouraging Rural-Urban Migration*; National Bureau of Economic Research: Cambridge, MA, USA, 2018; p. No. w24193. [CrossRef]
6. Glauber, R. Rural depopulation and the rural-urban gap in cognitive functioning among older adults. *J. Rural Health* **2022**, *38*, 696–704. [CrossRef]
7. Zarifa, D.; Seward, B.; Milian, R.P. Location, location, location: Examining the rural-urban skills gap in Canada. *J. Rural Stud.* **2019**, *72*, 252–263. [CrossRef]
8. Lagakos, D. Urban-Rural Gaps in the Developing World: Does Internal Migration Offer Opportunities? *J. Econ. Perspect.* **2020**, *34*, 174–192. [CrossRef]
9. Lee, J.; Xu, J. Why do businesses grow faster in urban areas than in rural areas? *Reg. Sci. Urban Econ.* **2020**, *81*, 103521. [CrossRef]
10. Phillipson, J.; Tiwasing, P.; Gorton, M.; Maioli, S.; Newbery, R.; Turner, R. Shining a spotlight on small rural businesses: How does their performance compare with urban? *J. Rural Stud.* **2019**, *68*, 230–239. [CrossRef]
11. Greenberg, Z.; Farja, Y.; Gimmon, E. Embeddedness and growth of small businesses in rural regions. *J. Rural Stud.* **2018**, *62*, 174–182. [CrossRef]
12. Mura, L.; Ključnikov, A. Small businesses in rural tourism and agro tourism: Study from Slovakia. *Econ. Sociol.* **2018**, *11*, 286–300. [CrossRef] [PubMed]
13. Visagie, J.; Turok, I. Rural–urban inequalities amplified by COVID-19: Evidence from South Africa. *Area Dev. Policy* **2021**, *6*, 50–62. [CrossRef]
14. Rundel, C.T.; Salemink, K.; Strijker, D. Exploring rural digital hubs and their possible contribution to communities in Europe. *J. Rural. Community Dev.* **2020**, *15*, 20–44.
15. Zavratnik, V.; Superina, A.; Duh, E.S. Living Labs for Rural Areas: Contextualization of Living Lab Frameworks, Concepts and Practices. *Sustainability* **2019**, *11*, 3797. [CrossRef]
16. Tiwasing, P.; Clark, B.; Gkartzios, M. How can rural businesses thrive in the digital economy? A UK perspective. *Heliyon* **2022**, *3797*, e10745. [CrossRef]
17. EU Rural Review 32 'Long-Term Vision for Rural Areas'. Available online: https://enrd.ec.europa.eu/publications/eu-rural-review-32-long-term-vision-rural-areas_en (accessed on 20 May 2022).
18. Roberts, E.; Beel, D.; Philip, L.; Townsend, L. Rural resilience in a digital society: Editorial. *J. Rural Stud.* **2017**, *54*, 355–359. [CrossRef]
19. Bocken, N.; Short, S.; Rana, P.; Evans, S. A Value Mapping Tool for Sustainable Business Modelling. *Corp. Gov.* **2013**, *13*, 482–497. [CrossRef]
20. Wilson, G. Multifunctional 'quality'and rural community resilience. *Trans. Inst. Br. Geogr.* **2010**, *35*, 364–381. [CrossRef]
21. McManus, P.; Walmsley, J.; Argent, N.; Baum, S.; Bourke, L.; Martin, J.; Pritchard, B.; Sorensen, T. Rural Community and Rural Resilience: What is important to farmers in keeping their country towns alive? *J. Rural Stud.* **2012**, *28*, 20–29. [CrossRef]
22. Rural Businesses: Rural Digital Hubs. Available online: https://enrd.ec.europa.eu/publications/rural-businesses-rural-digital-hubs_en (accessed on 16 April 2022).
23. Musik, C.; Bogner, A. Book title: Digitalization & society. *Osterr. Z. Für Soziologie* **2019**, *44*, 1–14. [CrossRef]
24. Lehn, D.V. Digitalization as "an Agent of Social Change" in a Supermarket Chain: Applying Blumer's Theory of Industrialization in Contemporary Society. *Symb. Interact.* **2020**, *43*, 637–656. [CrossRef]
25. Scholz, T. (Ed.) *Digital Labor: The Internet as Playground and Factory*; Routledge: London, UK, 2012.
26. Burkhardt, R.; Bradford, C. *Addressing the Accelerating Labor Market Dislocation from Digitalization*; Brookings Institute: Washington, DC, USA, 2017; Available online: https://www.brookings.edu/research/addressing-the-accelerating-labor-market-dislocation-from-digitalization/ (accessed on 29 June 2022).
27. Warschauer, M. *Technology and Social Inclusion: Rethinking the Digital Divide*; MIT Press: Cambridge, MA, USA, 2004.

28. Brennen, J.S.; Kreiss, D. Digitalization. In *The International Encyclopaedia of Communication Theory and Philosophy*, 1st ed.; Jensen, K.B., Rothenbuhler, E.W., Pooley, J.D., Craig, R.T., Eds.; John Wiley & Sons: Hoboken, NJ, USA, 2016. [CrossRef]
29. Rheingold, H. *The Virtual Community, Revised Edition: Homesteading on the Electronic Frontier*; MIT Press: Cambridge, MA, USA, 2000.
30. Rosa, F.R.; da Silveira, S.A.; Silva, A.J.C.; Pautassi, L.; Burt, J.M.; Cagley, C.; Viegas e Silva, M.; Gilbert, J.; Timo, P.B.; Maués, A.M.; et al. Digital Inclusion as Public Policy. *Sur. File Inf. Hum. Rights* **2013**, *10*, 32–53.
31. Martinez-Gil, J.; Pichler, M.; Beranič, T.; Brezočnik, L.; Turkanović, M.; Lentini, G.; Polettini, F.; Lué, A.; Vitale, A.C.; Doukhan, G.; et al. Framework for assessing the smartness maturity level of villages. In Proceedings of the European Conference on Advances in Databases and Information Systems, Bled, Slovenia, 8–11 September 2019; Springer: Cham, Switzerland, 2019; pp. 501–512. [CrossRef]
32. Carpe Digem Interreg Europe Territorial Digital Assessment Tool. Available online: https://carpedigem.eu/ (accessed on 10 August 2022).
33. Gorenšek, T.; Kohont, A. Conceptualization of digitalization: Opportunities and challenges for organizations in the Euro-Mediterranean area. *Int. J. Euro-Mediterr. Stud.* **2018**, *11*, 93–115.
34. Vironen, H.; Kah, S. *Meeting the Challenges of Digitalisation: Implications for Regional and Rural Development*; EU European Policies Research Centre, University of Strathclyde: Glasgow, UK, 2019.
35. Graham, S.; Marvin, S. *Telecommunications and the City: Electronic Spaces, Urban Places*; Routledge: London, UK, 1996. [CrossRef]
36. Kitchin, R. The researched opinions on research: Disabled people and disability research. *Disabil. Soc.* **2000**, *15*, 25–47. [CrossRef]
37. Castells, M. Materials for an exploratory theory of the network society1. *Br. J. Sociol.* **2020**, *51*, 5–24. [CrossRef]
38. Leamer, E.; Storper, M. The economic geography of the Internet age. *J. Int. Bus. Stud. Palgrave Macmillan J.* **2001**, *32*, 641–665. [CrossRef]
39. Grimes, R.L. Ritual theory and the environment. *Sociol. Rev.* **2003**, *51* (Suppl. S2), 31–45. [CrossRef]
40. Warren, M. The digital vicious cycle: Links between social disadvantage and digital exclusion in rural areas. *Telecommun. Policy* **2007**, *31*, 374–388. [CrossRef]
41. Servon, L.J. (Ed.) *Bridging the Digital Divide: Technology, Community, and Public Policy*; Blackwell Publishing: Oxford, UK, 2002.
42. Mariën, I.; Prodnik, J.A. Digital inclusion and user (dis) empowerment: A critical perspective. *Info* **2014**, *16*, 35–47. [CrossRef]
43. Walsh, C. Territorial Agenda of the European Union 2020: Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions. *Plan. Theory Pract.* **2012**, *13*, 493–496. [CrossRef]
44. Salemink, K.; Strijker, D.; Bosworth, G. Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *J. Rural Stud.* **2017**, *54*, 360–371. [CrossRef]
45. 2016–2017 ENRD Thematic Group on Smart & Competitive Rural Businesses. Case Study: Rural Digital Hubs. Available online: https://enrd.ec.europa.eu/sites/default/files/tg_rural-businesses_case-study_rural-digital-hub.pdf (accessed on 19 June 2022).
46. Digitalisation of Rural Areas Emilija Stojmenova Duh Boosting Sustainable Digitalisation in Agriculture, Forestry and Rural Areas by 2040, 30. 6. 2021. Available online: https://www.youtube.com/watch?v=p2ykFpQ6v5I (accessed on 29 August 2022).
47. Price, L.; Deville, J.; Ashmore, F. A guide to developing a rural digital hub. *Local Econ. J. Local Econ. Policy Unit* **2021**, *36*, 683–694. [CrossRef]
48. Eurostat. Data Browser. Available online: https://ec.europa.eu/eurostat/databrowser/explore/all/science?lang=en&subtheme=isoc.isoc_sk&display=list&sort=category&extractionId=ISOC_SK_DSKL_I21__custom_2397093 (accessed on 22 August 2022).
49. Ashmore, F.; Price, L.; Deville, J. *Be Bold. Be Innovative. Be a Digital Hub*; The University of Lincoln: Lincoln, UK, 2019.
50. Cvar, N.; Trilar, J.; Kos, A.; Volk, M.; Stojmenova Duh, E. The Use of IoT Technology in Smart Cities and Smart Villages: Similarities, Differences, and Future Prospects. *Sensors* **2020**, *20*, 3897. [CrossRef] [PubMed]
51. Zavratnik, V.; Kos, A.; Duh, E.S. Smart Villages: Comprehensive Review of Initiatives and Practices. *Sustainability* **2018**, *10*, 2559. [CrossRef]
52. Stojanova, S.; Lentini, G.; Niederer, P.; Egger, T.; Cvar, N.; Kos, A.; Duh, E.S. Smart Villages Policies: Past, Present and Future. *Sustainability* **2021**, *13*, 1663. [CrossRef]
53. Calzada, I.; Almirall, E. Data ecosystems for protecting European citizens' digital rights. *Transform. Gov. People Process Policy* **2020**, *14*, 133–147. [CrossRef]
54. Bijwaard, D.D.; Gyupchanova, T.T.; Dunne, A.A.; Gosse, J.; Hoffreumon, C.; van Zeebroeck, N. *Survey on the Contribution of ICT to the Environmental Sustainability of Actions of EU Enterprises*; (No. 2013/341441); ULB—Universite Libre de Bruxelles: Brussels, Belgium, 2021.
55. Taecharungroj, V.; Muthuta, M.; Boonchaiyapruek, P. Sustainability as a place brand position: A resident-centric analysis of the ten towns in the vicinity of Bangkok. *Place Brand. Public Dipl.* **2019**, *15*, 210–228. [CrossRef]
56. Zavratnik, V.; Podjed, D.; Trilar, J.; Hlebec, N.; Kos, A.; Duh, E.S. Sustainable and Community-Centred Development of Smart Cities and Villages. *Sustainability* **2020**, *12*, 3961. [CrossRef]
57. Gupta, S. How Digitalization is Supporting Sustainable Development. Globaldev. 2019. Available online: https://www.globaldev.blog/blog/how-digitalization-supporting-sustainable-development (accessed on 4 June 2022).
58. UN. *The Age of Digital Interdependence, Report of the UN Secretary General's High-Level Panel on Digital Cooperation*; UN: New York, NY, USA, 2019.

59. Dubois, A.; Sielker, F. Digitalization in sparsely populated areas: Between place-based practices and the smart region agenda. *Reg. Stud.* **2022**, *56*, 1–12. [CrossRef]
60. Forde, A. Our Rural Future. Policy 2021. Available online: https://www.gov.ie/en/publication/4c236-our-rural-future-vision-and-policy-context/ (accessed on 26 August 2022).
61. Miörner, J.; Kalpaka, A.; Sorvik, J.; Wernberg, J. *Exploring Heterogeneous Digital Innovation Hubs in Their Context*; Publications Office of the European Union: Luxemburg, 2019.
62. Ulman, M.; Šimek, P.; Masner, J.; Kogut, P.; Löytty, T.; Crehan, P.; Charvat, K.; Oliva, A.; Bergheim, R.; Sabbatini, T.; et al. Towards Future Oriented Collaborative Policy Development for Rural Areas and People. *AGRIS-Line Pap. Econ. Inform.* **2020**, *12*, 111–124. [CrossRef]
63. Salemink, K.; Strijker, D. The participation society and its inability to correct the failure of market players to deliver adequate service levels in rural areas. *Telecommun. Policy* **2018**, *42*, 757–765. [CrossRef]
64. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 2030 Digital Compass: The European way for the Digital Decade, COM/2021/118 final/2, 9. 3. 2021. Available online: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021DC0118 (accessed on 25 August 2022).
65. The Aspen Institute. *Strengthening America's Rural Innovation Infrastructure*; The Aspen Institute: Washington, DC, USA, 2019.
66. Norris, L. The spatial implications of rural business digitalization: Case studies from Wales. *Reg. Stud. Reg. Sci.* **2020**, *7*, 499–510. [CrossRef]
67. Zhang, X.; Hu, L.; Salimath, M.; Kuo, C.-C. Developing Evaluation Frameworks for Business Models in China's Rural Markets. *Sustainability* **2018**, *11*, 118. [CrossRef]
68. Nosratabadi, S.; Mosavi, A.; Shamshirband, S.; Kazimieras Zavadskas, E.; Rakotonirainy, A.; Chau, K.W. Sustainable Business Models: A Review. *Sustainability* **2019**, *11*, 1663. [CrossRef]
69. Boons, F.; Lüdeke-Freund, F. Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. *J. Clean. Prod.* **2013**, *45*, 9–19. [CrossRef]
70. Evans, S.; Vladimirova, D.; Holgado, M.; Van Fossen, K.; Yang, M.; Silva, E.A.; Barlow, C.Y. Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models. *Bus. Strat. Environ.* **2017**, *26*, 597–608. [CrossRef]
71. Morris, J.; Morris, W.; Bowen, R. Implications of the digital divide on rural SME resilience. *J. Rural Stud.* **2022**, *89*, 369–377. [CrossRef]
72. Leksina, A.; Nesmyslenov, A.; Bryzgalina, M. Digital business model of the agricultural organization of the region. *Sci. Pap. Ser. Manag. Econ. Eng. Agric. Rural. Dev.* **2021**, *21*, 529–537.
73. Wilson, B.; Atterton, J.; Hart, J.; Spencer, M.; Thomson, S.G. *Unlocking the Digital Potential of Rural Areas across the UK*; SRUC: Aberdeen, UK, 2018.
74. Tarafdar, M.; Singh, R.; Anekal, P. Impact of ICT-Enabled Product and Process Innovations at the Bottom of the Pyramid: A Market Separations Perspective. *J. Inf. Technol.* **2013**, *28*, 279–295. [CrossRef]
75. Randall, L.; Ormstrup Vestergård, L.; Wøien Meijer, M. Rural perspectives on digital innovation: Experiences from small enterprises in the Nordic countries and Latvia. *Nordregio* **2020**, 1–35. [CrossRef]
76. Ghazvinei, P.T.; Darvishi, H.H.; Mosavi, A.; Yusof, K.B.W.; Alizamir, M.; Shamshirband, S.; Chau, K.-W. Sugarcane growth prediction based on meteorological parameters using extreme learning machine and artificial neural network. *Eng. Appl. Comput. Fluid Mech.* **2018**, *12*, 738–749. [CrossRef]
77. Wong, P.K.; Wong, K.I.; Vong, C.M.; Cheung, C.S. Modeling and optimization of biodiesel engine performance using kernel-based extreme learning machine and cuckoo search. *Renew. Energy* **2015**, *74*, 640–647. [CrossRef]
78. Barth, H.; Ulvenblad, P.-O.; Ulvenblad, P. Towards a Conceptual Framework of Sustainable Business Model Innovation in the Agri-Food Sector: A Systematic Literature Review. *Sustainability* **2017**, *9*, 1620. [CrossRef]
79. Ulvenblad, P.; Hoveskog, M.; Tell, J.; Ulvenblad, P.O.; Ståhl, J.; Barth, H. Agricultural business model innovation in Swedish food production: The influence of self-leadership and lean innovation. In Proceedings of the DRUID Society Conference 2014 on Entrepreneurship–Organization–Innovation, Copenhagen Business School (CBS), Copenhagen, Denmark, 16–18 June 2014.
80. Tell, J.; Hoveskog, M.; Ulvenblad, P.; Ulvenblad, P.-O.; Barth, H.; Ståhl, J. Business model innovation in the agri-food sector: A literature review. *Br. Food J.* **2016**, *118*, 1462–1476. [CrossRef]
81. Bouwman, H.; Nikou, S.; de Reuver, M. Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs? *Telecommun. Policy* **2019**, *43*, 101828. [CrossRef]
82. Ievoli, C.; Belliggiano, A.; Marandola, D.; Milone, P.; Ventura, F. Information and Communication Infrastructures and New Business Models in Rural Areas: The Case of Molise Region in Italy. *Eur. Countrys.* **2019**, *11*, 475–496. [CrossRef]
83. Schiavone, F.; Paolone, F.; Mancini, D. Business model innovation for urban smartization. *Technol. Forecast. Soc. Chang.* **2018**, *142*, 210–219. [CrossRef]
84. Price, L.; Deville, J.; Ashmore, F. *CORA Policy Brief 2: Digital Infrastructure: Boosting the Delivery of Digital Infrastructure in Rural Areas*; CORA: Paris, France, 2021.
85. Alam, K.; Erdiaw-Kwasie, M.O.; Shahiduzzaman, M.; Ryan, B. Assessing regional digital competence: Digital futures and strategic planning implications. *J. Rural Stud.* **2018**, *60*, 60–69. [CrossRef]

86. Philip, L.; Cottrill, C.; Farrington, J.; Williams, F.; Ashmore, F. The digital divide: Patterns, policy and scenarios for connecting the 'final few' in rural communities across Great Britain. *J. Rural Stud.* **2017**, *54*, 386–398. [CrossRef]
87. Price, L.; Deville, J.; Ashmore, F. *CORA Policy Brief 3: Enhancing Digital Skills in Rural Areas*; CORA: Paris, France, 2021.
88. Rundel, C.; Salemink, K. Hubs, hopes and high stakes for a relatively disadvantaged low tech place. *Local Econ. J. Local Econ. Policy Unit* **2021**, *36*, 650–668. [CrossRef]
89. Ilomäki, L.; Paavola, S.; Lakkala, M.; Kantosalo, A. Digital competence—An emergent boundary concept for policy and educational research. *Educ. Inf. Technol.* **2014**, *21*, 655–679. [CrossRef]
90. Smart Agro Grape. Digitalna Platforma za Vinogradnike. Available online: https://ltfe.org/reference/smart-agro-grape/ (accessed on 15 August 2022).
91. Smart Villages. Smart Digital Transformation of Villages in the Alpine Space. Available online: https://ltfe.org/en/portfolio/smart-villages/ (accessed on 27 June 2022).
92. Smart Digital Transformation of Villages in the Alpine Space. 2020. Available online: https://www.alpine-space.org/projects/smartvillages/news-and-events/newsletter/newsletter-4-en-22-09-2020.pdf (accessed on 17 June 2022).
93. Catalysing Regions in Peripheral and Emerging Europe towards Digital Innovation Ecosystems. Available online: https://projects2014-2020.interregeurope.eu/carpedigem/ (accessed on 10 May 2022).
94. Adamashvili, N.; State, R.; Tricase, C.; Fiore, M. Blockchain-Based Wine Supply Chain for the Industry Advancement. *Sustainability* **2021**, *13*, 13070. [CrossRef]
95. Cuel, R.; Cangelosi, G.M. In Vino Veritas? Blockchain Preliminary Effects on Italian Wine SMEs. In *Digital Business Transformation*; Springer: Cham, Switzerland, 2020; pp. 301–314. [CrossRef]
96. Danese, P.; Mocellin, R.; Romano, P. Designing blockchain systems to prevent counterfeiting in wine supply chains: A multiple-case study. *Int. J. Oper. Prod. Manag.* **2021**, *41*, 1–33. [CrossRef]
97. Popović, T.; Krčo, S.; Mišić, N.; Martinović, A.; Jovović, I. Blockchain-Based Transparency and Data Provenance in the Wine Value Chain. In Proceedings of the 2022 26th International Conference on Information Technology (IT), Shanghai, China, 23–26 December 2022; pp. 1–5.
98. European Commission. EU Rural Areas in Numbers. Available online: https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/long-term-vision-rural-areas/eu-rural-areas-numbers_en (accessed on 4 August 2022).