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Sustainable development of rural localities in Dobrogea through digitalization

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Abstract: Romania's sustainable development strategy aims to integrate economic, social and environmental development objectives in such a way as to ensure sustainable and equitable economic growth that does not negatively affect people's quality of life or the environment. Promoting innovation through digitisation is necessary to enhance competitiveness and support economic and social development, including rural areas. This article contains a first analysis of how digitisation, as a European and national programme, can enhance the sustainable development of rural localities in Dobrogea, with application to the elaboration of such a digitisation strategy for dobrogea's rural area

1. Introduction

Dobrogea is a region located in southeastern Romania, situated between the Danube River and the Black Sea. It has a rich history and culture, as well as a diverse economy with significant potential for sustainable development (Figure 1).

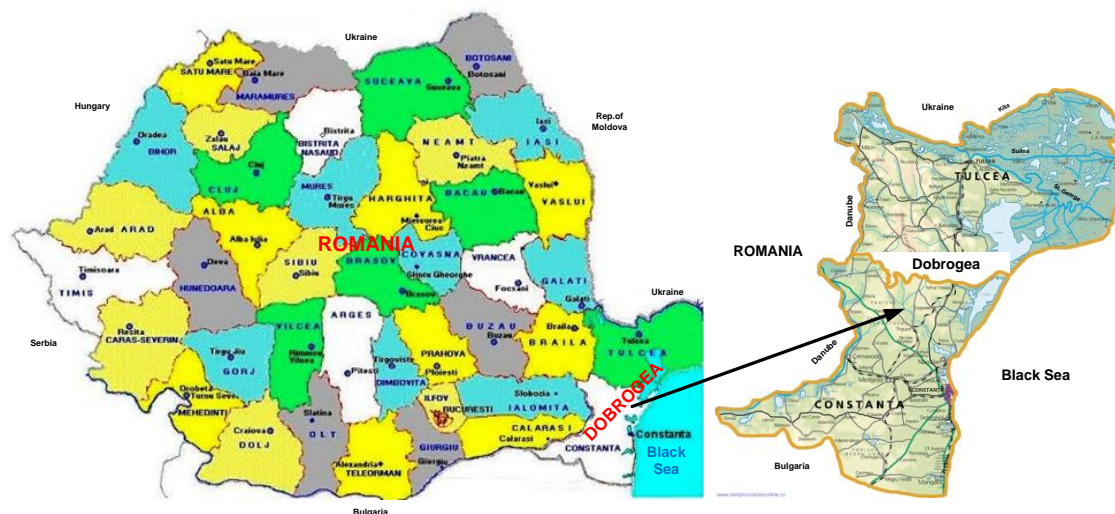


Figure 1 Dobrogea – area of study

Source: adapted from maps:

https://www.google.com/search?q=romania+impartire+administrativa&oq=romania+impartire+administrativa&aqs=chrome..69i57j0i22i30.16636j0j7&sourceid=chrome&ie=UTF-8#imgrc=Lfw9P54NcC7_4M; <http://www.hartaromanieonline.ro/harta-judet-Constanta/>;
<http://www.hartaromanieonline.ro/harta-judet-Tulcea/>

Historically, Dobrogea has been inhabited by various civilizations. After the region was incorporated into Romania in the late 19th century, it underwent significant modernization, including the construction of infrastructure such as railways, ports, and irrigation systems. The region has been the site of numerous wars and conflicts throughout its history, including World War I and World War II. Today, Dobrogea is home to a mix of Romanian, and other ethnic communities, which reflects its diverse cultural heritage. Dobrogea is known for its agriculture, fisheries, and tourism industries. The region has a long tradition of farming, with crops such as wheat, corn, and sunflowers being major contributors to the local economy. The Danube Delta being one of the most biodiverse areas in Europe. In recent years, tourism has emerged as a growing industry, with visitors attracted by the region's natural beauty, cultural heritage, and historical landmarks. In terms of sustainable development, Dobrogea has significant potential for renewable energy, particularly solar and wind power. The region's flat terrain and abundant sunlight make it an ideal location for solar energy projects, while its proximity to the Black Sea and strong winds make it a potential hub for wind power. Additionally, the region's fisheries industry has the potential to be developed in a sustainable manner, with measures to protect fish stocks and prevent overfishing. There are also opportunities for sustainable tourism development in Dobrogea, particularly in the Danube Delta. The region's unique biodiversity and cultural heritage could be leveraged to attract eco-tourists and promote sustainable tourism practices. This would require investments in infrastructure, education, and training, as well as policies and regulations that promote sustainable tourism practices.

2. Data and Methods

Sustainable development of rural localities requires a comprehensive approach that takes into account social, economic, and environmental factors. To achieve this, it is essential to collect and analyze relevant data using appropriate methods. Sustainable development of rural localities involves the implementation of policies and practices that ensure long-term social, economic, and environmental well-being for rural communities [1]. Data and methods are crucial for assessing the current state of rural areas, identifying challenges and opportunities, and developing effective strategies to achieve sustainable development goals. Data collection and analysis play a crucial role in sustainable development planning. The data collected must be relevant and reliable to make informed decisions. Relevant data includes information on the demographic profile of the population, their socio-economic status, and the natural resources available in the locality. Reliable data is necessary to ensure that the decisions made are based on accurate information. Data sources for sustainable development of rural localities may include national statistical agencies, and administrative records. These data sources can provide valuable information on economics, population characteristics, employment, income, education, health, and other indicators relevant to rural development. The methods used for data collection and analysis are appropriate for the specific context of the rural locality. Some common methods used are: surveys, interviews, and secondary data analysis. Surveys can be used to collect data on the population's socio-economic status and their needs and preferences. Interviews are effective in collecting data on specific topics such as agricultural practices or community development initiatives. Secondary data analysis involves reviewing existing literature, reports, and data sets to gain insights into the local context. Methods for sustainable development of rural localities may include participatory approaches that engage local communities in decision-making processes. Community-based planning and development programs can help ensure that development strategies are aligned

with local needs and priorities. Public-private partnerships and collaborative governance structures can also. Once the data has been collected, it made the analyze to identify trends and patterns. This information is used to inform decision-making and policy development [2]. The analysis consider the social, economic, and environmental factors that impact the rural locality. For example, the analysis may reveal that the population has limited access to education and healthcare, or that the natural resources are being overexploited, or facilitate sustainable development by bringing together different stakeholders and expertise.

3. Results and discussions

Sustainable development is a key priority for Dobrogea, as the region faces challenges such as climate change, resource depletion, and social inequality. One area of focus for sustainable development is renewable energy, as the region's potential for wind and solar power is significant. The construction of wind farms and solar parks can contribute to reducing greenhouse gas emissions and increasing energy independence. Another area of focus is sustainable tourism, which can provide economic opportunities while preserving the region's natural and cultural heritage. This can be achieved through initiatives such as eco-tourism, cultural tourism, and responsible tourism practices. Agriculture also has significant potential for sustainable development in Dobrogea, as the region's fertile soils and diverse climate conditions allow for a variety of crops and livestock to be produced. Sustainable agriculture practices such as crop rotation, conservation tillage, and integrated pest management can improve soil health and reduce inputs. Additionally, the development of value chains for locally produced food can support small-scale farmers and promote rural development. Sustainable agriculture practices, such as organic farming, conservation tillage, and agroforestry, can help enhance soil health, reduce water and nutrient pollution, and increase resilience to climate change. Renewable energy technologies, such as solar and wind power, can provide clean and affordable energy to rural communities while reducing greenhouse gas emissions. Sustainable tourism, based on the preservation of local culture and environment, can also generate economic opportunities for rural areas [3, 4, 5].

Monitoring and evaluation of sustainable development programs are critical for assessing their effectiveness and identifying areas for improvement. Indicators of sustainable development, such as the Human Development Index (HDI), the Environmental Performance Index (EPI), and the Sustainable Development Goals (SDGs), can be used to track progress towards sustainability goals. According to the National Institute of Statistics, there were 451 localities, of which 433 rural localities in Dobrogea. These localities are spread across the counties of Constanta, Tulcea. The number of rural localities has decreased in recent years due to the consolidation of small villages and the migration of residents to urban areas. The history of rural localities in Dobrogea is closely tied to agriculture, which has been the dominant economic activity in the region for centuries. During the communist period, agriculture was collectivized, and the state invested heavily in irrigation, drainage, and mechanization. Today, agriculture remains an important sector, with crops such as wheat, corn, sunflowers, and grapes being produced. In addition to agriculture, rural localities in Dobrogea also have other economic activities, such as fishing, forestry, and tourism. Fishing is particularly important in the Danube Delta, where local communities rely on the delta's resources for their livelihoods. Forestry is also an important sector, as the region has significant forest resources that are managed by state-owned companies. Tourism is a growing sector, with the region's beaches, nature reserves, and cultural sites attracting visitors from Romania and abroad. Rural localities in Dobrogea are important for the region's cultural heritage, as they preserve traditional customs, architecture, and folklore. Many rural localities have historical landmarks, such as ancient fortresses, monasteries, and museums, that attract visitors interested in the region's history [5, 6, 7].

Statistics show that rural localities in Dobrogea face challenges such as depopulation, aging populations, and low incomes. According to the National Institute of Statistics, as of January 1st, 2021, the total population of Dobrogea region was approximately 2.2 million people, representing around 11% of Romania's total population. The region is divided into two counties, Constanta and Tulcea, and parts of Braila and Galati. Constanta is the most populous county, with over 700,000 inhabitants, while

Tulcea has a population of around 200,000. The population of the region has been decreasing in recent years, mainly due to migration to other parts of Romania or abroad, especially from rural areas. The aging population is also a challenge for the region, as the percentage of elderly people increased from 18.2% in 2011 to 20.8% in 2020. The population of rural localities in Dobrogea decreased by 2.6% between 2011 and 2020, and the percentage of elderly people increased. Additionally, rural households in Dobrogea have lower incomes compared to urban households, with the poverty rate being higher in rural areas [8, 9].

The economy of the Dobrogea region is based on several sectors, including agriculture, industry, services, and tourism. Here are some statistics related to these sectors: agriculture is an important sector in the Dobrogea region, especially in the rural areas. The region has a favorable climate and soil conditions for the cultivation of crops such as wheat, corn, sunflower, and grapes. According to the National Institute of Statistics, the agricultural sector in Dobrogea contributed 5.5% to the regional Gross Domestic Product (GDP) in 2019; the industrial sector in the Dobrogea region is mainly based on energy production, petrochemicals, and shipbuilding. The region hosts several important companies, such as the Constanta Shipyard, the Petromidia Refinery, and the Rompetrol Refinery. According to the National Institute of Statistics, the industrial sector in Dobrogea contributed 28.1% to the regional GDP in 2019; the service sector in Dobrogea includes several sub-sectors such as tourism, transport, commerce, and financial services. The region has significant potential for tourism, especially due to its natural and cultural heritage. According to the National Institute of Statistics, the service sector in Dobrogea contributed 66.4% to the regional GDP in 2019; tourism is an important sector in the Dobrogea region, especially in the coastal areas and the Danube Delta. The region attracts visitors from Romania and abroad, who are interested in the region's beaches, natural parks, historical landmarks, and cultural events. According to the National Institute of Statistics, the tourism sector in Dobrogea contributed 6.1% to the regional GDP in 2019 [9,10].

In terms of economics, Dobrogea region has a diverse economy, with sectors such as agriculture, industry, services, and tourism. Agriculture remains an important sector, with crops such as wheat, corn, sunflowers, and grapes being produced. The region is also a significant producer of fish, particularly in the Danube Delta. The industrial sector includes activities such as oil refining, shipbuilding, and chemical production. Services and tourism are also growing sectors, with the region's beaches, nature reserves, and cultural sites attracting visitors from Romania and abroad.

However, the economy of Dobrogea region faces challenges such as low productivity, low income levels, and a high poverty rate. According to the National Institute of Statistics, in 2020, the average gross salary in Dobrogea was 3,273 lei (approximately 660 USD), lower than the national average of 3,939 lei (approximately 794 USD). The poverty rate in Dobrogea was 34.3% in 2019, higher than the national average of 23.3% [11, 12, 13, 14] (Table 1).

Table 1 Dobrogea's statistics

Statistics	Constanța County	Tulcea County
Surface	7,071 km ² (3% of the Romania's total surface area)	8,499 km ² (3,6% of the Romania's total surface area)
Administrative organisation on 31 December 2017	9 cities și 3 municipalities, 58 communes and 189 villagies	4 cities și 1 municipality, 8 localities components of the cities, 46 communes and 133 villagies
County centre	Constanța	Tulcea
Budget execution: of which grants from the state budget expenditure deficit	1,921 mil lei 290.5 mil lei 2,015.3 mil lei - 6,7%	633 mil lei - 625 mil lei +1,3%
Population	1 iulie 2022: 753 331	1 iulie 2018: 239 981

Unemployment rate December 2022	2,3%	
Tourists 2022	1,253,530	
Total employed civilian population 2018/2017, of which:	284,800	80,500
Population employed in agriculture, forestry and fishing	47,400	22,600
Population employed in industry	50,200	17,100
Population employed in construction	34,400	5,800
Population employed in trade	48,400	9,900
Population employed in transport and storage	26,200	4,400
Population employed in hotels and restaurants	11,400	2,300
Population employed in information and communication	3,900	1,100
Population employed in professional, scientific and technical activities	4,400	1,400
Population employed in public administration and defence, public social security	7,100	2,800
Population employed in education	11,300	3,400
Population employed in health and social work	14,500	4,200
Population employed in entertainment, cultural and recreational activities	2,700	400
Population employed in other activities of the national economy	6,600	3,200

Sustainable development is a concept that has gained significant attention over the past few decades as a way to promote economic, social, and environmental development without compromising future generations' ability to meet their own needs. Rural localities, in particular, have the potential to benefit from sustainable development practices that can improve their economic, social, and environmental outcomes. Digitalization is one approach that can help rural localities achieve sustainable development objectives by providing access to technology and digital infrastructure that can improve productivity, connectivity, and economic opportunities [15, 16].

Sustainable development of rural localities is critical for ensuring the overall economic growth and development of a country. The advancement of technology and digitalization has revolutionized the way people live and work in urban areas, but it has also created significant disparities in rural areas. However, there is a growing realization that digitalization can provide an impetus to the sustainable development of rural areas. In this essay, we will explore the concept of sustainable development of rural localities through digitalization and how it can bring about positive changes in the lives of people living in rural areas.

Digitalization refers to the process of using digital technologies to transform traditional systems and processes into more efficient and effective ones. This can involve using technology to automate tasks, improve communication and collaboration, and enhance access to information and resources. For rural localities, digitalization can offer several benefits, including improved access to markets, education, healthcare, and public services. By providing digital infrastructure, rural localities can connect to the wider economy and access new opportunities that would not be possible without digital technology. Digitalization has the potential to transform rural areas by creating new opportunities for economic growth, improving access to essential services, and enhancing the overall quality of life. The

development of digital infrastructure, such as broadband networks, can provide rural communities with access to essential services, including healthcare, education, and financial services. This, in turn, can help to bridge the digital divide that currently exists between urban and rural areas [17].

The digitization of rural communities can help promote sustainable development by improving access to information, services, and economic opportunities.

Main elements of a digitization strategy for rural communities can be (Figure 2):

a. Connectivity: One of the most critical aspects of a digitization strategy is to ensure that rural communities have access to reliable and affordable high-speed internet. This can be achieved through public-private partnerships, subsidies, and investment in infrastructure.

b. Digital Skills: It's essential to ensure that rural residents have the necessary digital skills to take advantage of the opportunities provided by digital technologies. Digital literacy programs and training should be provided to all residents, from schoolchildren to seniors.

c. Digital Services: Digitization can help rural residents access essential services such as healthcare, education, and financial services. Governments and private sector companies should invest in digital services tailored to the needs of rural communities, including telemedicine, online learning, and mobile banking.

d. E-commerce: Digitization can help rural businesses reach a broader market by enabling e-commerce. Governments and private sector companies should invest in e-commerce platforms and provide training and support to rural businesses to help them sell their products and services online.

e. Smart Agriculture: Digitization can help farmers improve crop yields, reduce costs, and increase profitability. Smart agriculture technologies, such as precision agriculture, IoT sensors, and drones, can help farmers make better decisions based on real-time data.

f. Innovation Hubs: Establishing innovation hubs in rural communities can help promote entrepreneurship and innovation. These hubs can provide access to funding, mentorship, and networking opportunities, as well as workspace and equipment.

g. Data Analytics: Collecting and analyzing data on rural communities can help governments and private sector companies make informed decisions and better understand the needs of rural residents. Governments should invest in data analytics infrastructure and policies to protect the privacy of rural residents [18, 19].

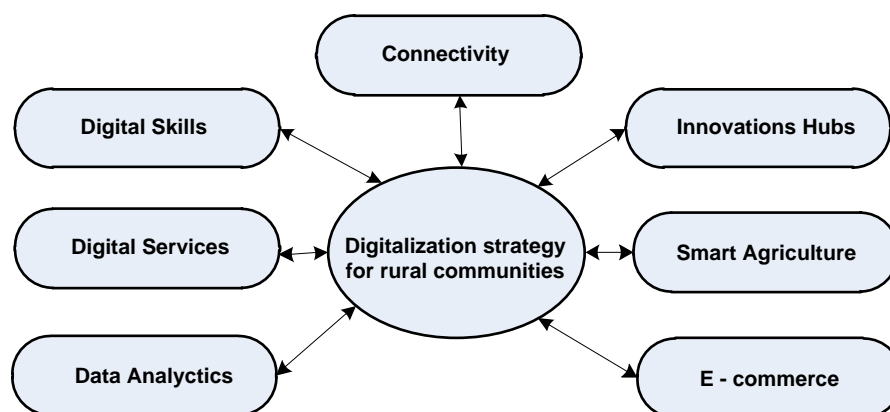


Figure 2 Digitization strategy for rural communities - main elements

Sustainable development is a concept that emphasizes the need to balance economic, social, and environmental objectives in order to create a healthy and prosperous society. In recent years, the digitalization of rural localities has emerged as a potential solution for achieving sustainable development in these areas. Digitalization, which involves the use of digital technologies to transform traditional systems and processes, has the potential to promote economic growth, enhance social well-being, and reduce environmental impacts.

Firstly, digitalization can enhance economic growth in rural areas by enabling businesses to expand their reach and access new markets. With the growth of e-commerce platforms, rural businesses can now sell their products to customers all over the world. Digitalization can also facilitate the growth of new industries, such as digital marketing, software development, and data analysis, which can create new jobs and stimulate local economies. Furthermore, digitalization can help to reduce transaction costs, increase efficiency, and improve supply chain management, which can make rural businesses more competitive.

Secondly, digitalization can enhance social well-being in rural areas by improving access to education, healthcare, and other public services. With the growth of online education platforms, rural residents can now access educational resources from anywhere in the world. Digitalization can also improve access to healthcare services through telemedicine, which enables remote consultations and diagnosis. In addition, digitalization can improve public service delivery, such as water and sanitation, waste management, and transportation, which can enhance the quality of life for rural residents.

Thirdly, digitalization can reduce environmental impacts in rural areas by promoting sustainable practices and reducing resource consumption. With the growth of precision agriculture technologies, farmers can now optimize their use of fertilizers, water, and other inputs, which can reduce waste and improve yields. Digitalization can also enable the monitoring and management of natural resources, such as forests, rivers, and wildlife, which can help to prevent overexploitation and degradation. Furthermore, digitalization can promote renewable energy sources, such as solar and wind power, which can reduce greenhouse gas emissions and mitigate climate change [20, 21, 22].

The main steps that can be included in a digitization strategy for rural communities are (Figure 3):

1. Assess the needs and challenges of the community: before developing a digitization strategy, it is crucial to understand the specific needs and challenges of the rural community. This includes assessing the existing digital infrastructure, identifying areas where digital technologies can have the most impact, and understanding the skills and resources needed to implement digital solutions.
2. Develop a comprehensive plan: based on the assessment, a comprehensive digitization plan should be developed, including goals, objectives, timelines, and resources needed. The plan should be aligned with the community's development priorities and tailored to meet the specific needs of the community.
3. Build digital infrastructure: to support the implementation of the digitization plan, digital infrastructure, such as broadband networks, wireless connectivity, and other digital technologies, should be built or improved to ensure that rural communities have access to reliable and high-speed internet connectivity.
4. Foster digital literacy and skills: to ensure that residents of rural communities can benefit from digitization, it is crucial to provide them with the necessary digital literacy and skills. This can be achieved through training programs, workshops, and other initiatives that help residents develop the skills needed to use digital technologies.
5. Encourage entrepreneurship and innovation: digitization can create new economic opportunities for rural communities, such as e-commerce, remote work, and digital marketing. Governments and other stakeholders can encourage entrepreneurship and innovation by providing incentives, such as funding, incubation centers, and mentorship programs, to help startups and small businesses thrive in the digital economy.
6. Implement digital solutions: the digitization plan should include the implementation of specific digital solutions that address the community's needs and challenges. For example, digital solutions can be used to improve access to healthcare services, facilitate e-learning, enhance agricultural productivity, and support the delivery of government services.
7. Monitor and evaluate: finally, it is essential to monitor and evaluate the implementation of the digitization strategy to measure its effectiveness and identify areas for improvement. This can be done through regular assessments, surveys, and other feedback mechanisms that allow stakeholders to track progress and adjust the strategy as needed [23, 24].

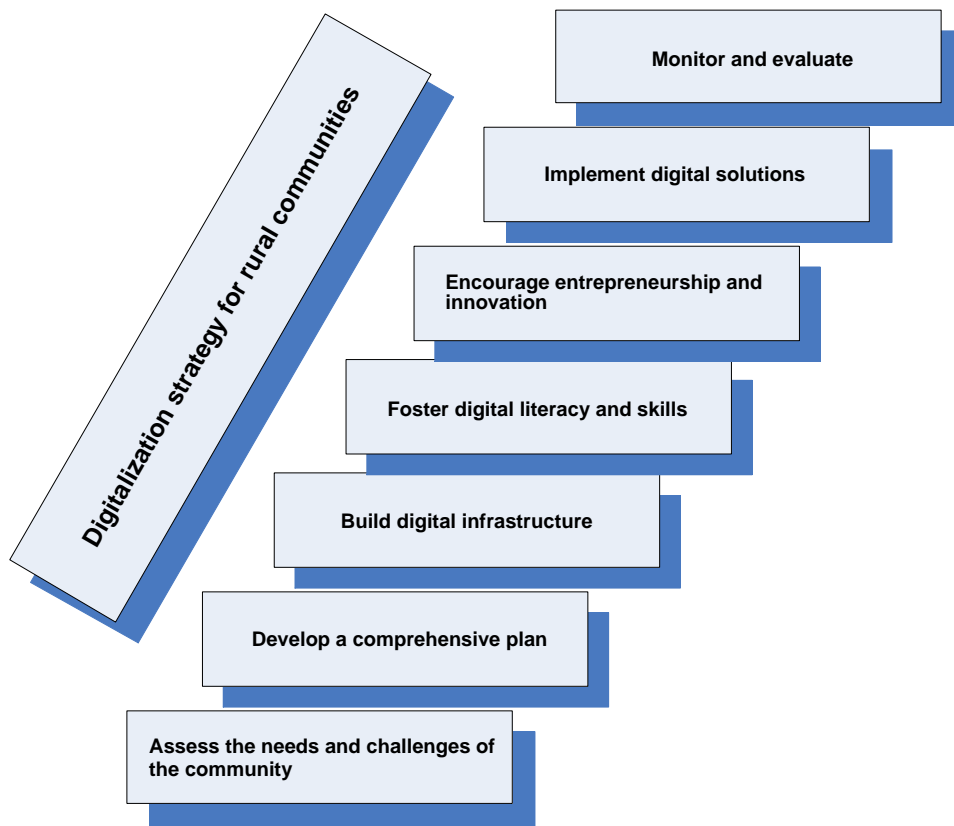


Figure 3 Digitization strategy for rural communities – main steps

Digitization of a rural locality involves the implementation of digital technologies and processes to enhance the quality of life, economic growth, and environmental sustainability of rural communities. The process of digitization can have a significant impact on the development of rural localities in various areas such as agriculture, healthcare, education, transportation, and communication [25,26].

The first step in digitizing a rural locality is to assess the current state of infrastructure and digital readiness of the community. This includes evaluating the availability and quality of internet connectivity, identifying areas that require improvement, and understanding the specific needs and priorities of the local community.

One of the key components of digitization is the implementation of high-speed internet infrastructure, which enables faster and more reliable connectivity and access to digital tools and services. This can be achieved through the deployment of fiber-optic cables, wireless networks, and satellite technologies [27,28,29].

Another important aspect of digitization is the adoption of digital tools and applications that support various aspects of daily life. These can include online learning platforms, telemedicine, e-commerce platforms, and mobile applications for communication and information sharing.

Digitization can also enable the automation of various processes in agriculture, such as monitoring crop growth, soil health, and water usage. This can lead to increased efficiency, reduced costs, and better crop yields. Additionally, digitization can facilitate the development of sustainable agriculture practices, such as precision farming and organic farming, which can improve the environmental sustainability of rural communities [30,31,32].

Overall, the digitization of rural localities has the potential to improve the quality of life, economic growth, and environmental sustainability of rural communities. However, it is essential to ensure that digitization efforts are inclusive, accessible, and sustainable to ensure that the benefits of digitization are available to all members of the community.

4. Conclusions

Digitization of rural localities in Romania has become a priority for the government in recent years, as it is seen as a key driver for economic growth and the reduction of regional disparities. The process of digitization in Romania involves the implementation of various digital technologies and processes to enhance the quality of life, economic development, and environmental sustainability of rural communities.

One of the significant benefits of digitalization is that it can provide a platform for rural entrepreneurs and small businesses to reach wider markets. The growth of e-commerce and the increasing use of online platforms have created opportunities for rural businesses to connect with customers across the world. With the right digital tools, rural entrepreneurs can create new business models that are sustainable and profitable.

Digitalization can also help to improve the efficiency of agriculture and farming practices, leading to higher productivity and reduced environmental impact. For example, precision agriculture, which involves the use of data and digital tools to optimize farming practices, can help farmers to reduce the use of inputs such as fertilizers and pesticides, leading to lower costs and better yields. This, in turn, can help to promote sustainable agriculture practices and reduce the environmental impact of farming.

Another important aspect of digitalization is the ability to create new employment opportunities in rural areas. Digital technologies can enable rural residents to work remotely, allowing them to access job opportunities that were previously unavailable. This, in turn, can help to retain talent in rural areas and prevent the migration of people to urban areas.

Sustainable development of rural localities through digitalization has the potential to transform the lives of people living in rural areas. Digital infrastructure and tools can help to bridge the digital divide, create new economic opportunities, improve access to essential services, and promote sustainable agriculture practices. Governments and policymakers must work together to promote digitalization in rural areas, including investing in digital infrastructure, providing training and education, and creating an enabling environment for rural entrepreneurs and small businesses. With the right policies and investments, digitalization can play a crucial role in promoting sustainable development in rural areas.

Developing a digitization strategy for rural communities requires investments in infrastructure, education and training, digital services, business support, and community engagement. By taking a holistic approach and tailoring efforts to the unique needs of rural communities, digitization can help bridge the digital divide and ensure that these communities are not left behind in the digital age.

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