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**Romanian Smart Villages Conceptualization
and Bibliometric Analysis**

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Abstract

In this paper, the researchers explore the Smart Village concept, which implies the social innovation and economic growth, as both a conceptual and practical means of delivering positive social, economic and environmental outcomes in rural areas of Romania.

Smart Villages are rural communities that use innovative solutions to build their capacity to meet social, economic and environmental challenges, building on the strengths of the community, including local authorities as well as opportunities in the area.

This study proposes an analysis of the main factors that can contribute to the development of rural areas. In this context, the partnerships/cooperation between local actors, professionalization of local actors and LEADR approach, can be the support tools for implementing intelligent solutions in Smart rural areas. The research innovation is determined through the multiple ways of defining and prospecting this approach in the current paper and its applicability in the Rural Romanian.

In this sense, the authors propose to analyze and present through a SWOT analysis and a quantitative international abstract and citation database analysis the new trends regarding this new rural concept of Smart Villages.

The main objective of the current analysis is to highlight the key concepts resulting from the bibliometric analysis and to determine what the scientific community is currently focusing on.

Keywords: Smart Village, Rural Development, sustainability, digitalization, research papers.

JEL Classification: Q01, Q19.

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1. Introduction

Many of the policies and financial instruments offered by the European Commission already provide valuable building blocks for the socio-economic consolidation of the smart villages of the European Union. Smart villages is a relatively new concept in the field of EU policy making and as such in our country. The emerging concept of smart villages refers to rural areas and communities that build on their existing strengths and assets, as well as the development of new opportunities.

In smart villages, both traditional and new networks and services are being enhanced through digital technologies, telecommunications, innovation, and better use of knowledge for the benefit of local people and businesses.

Technologies and digital innovations can support quality of life, a higher standard of living, public services for citizens, better use of resources, less impact on the environment, and new opportunities for rural value chains in terms of improved products and processes. The concept of Smart Villages does not propose a single solution for everyone; it is based on the needs and potential of the territory, but especially on the administrative organization capacity of the leaders of a rural community.

According to the new EU policies and strategies, Smart village is an autonomous structure capable of managing its own development projects and solving the problems generated by a series of administrative and economic disfunctions. The smart village must not ignore the social dimension, which implies the existence of a climate of equity, by fighting poverty and eliminating discrimination between generations, while the presentation of the rural dimension highlights the importance of processes related to land use and urban planning. The development of smart villages therefore implies an economic and social development with a direct impact on the quality of life of members of the rural community and on their expectations in relation to the actions of public authorities. (EC, 2017).

Now, in Romania, a direct and concrete planning of smart village policies is not yet drawn, however, smart villages cannot be implemented without the concept of Smart Village assimilation, which cannot be applied in isolation and must be incorporated in the existing strategies for development of rural regions and localities. In this sense, actions are taken to define this concept, and to generate a common policy from all the factors involved in rural development, and finally, to identify the investments needed to achieve this concept.

The Stage of Knowing the Problem

Based on integrated strategic approaches that reflect EU priorities as well as the needs of a territory, the Rural Development Programs 2007-2013 (MADR(a), 2021) and 2014-2020 (MADR(b), 2021) as well as the new NSS 2023-2027, have supported, support, and will continue to support a mix of measures to contribute to when implementing the new Smart Village Concept. These measures include rural

business development, including farm modernization, investment in small-scale local infrastructure and connectivity projects, village renewal, knowledge development, knowledge sharing, and bottom-up initiatives.

Smart & technological requirements are the key to successful implementation. The Internet of Things (IoT) is a primary provider of information sharing and control platforms for various decisions and smart devices. This novel technology has proven to be one of increased efficiency, time execution reduction, and cost reduction (Degada, Thapliyal, Mohanty, 2021).

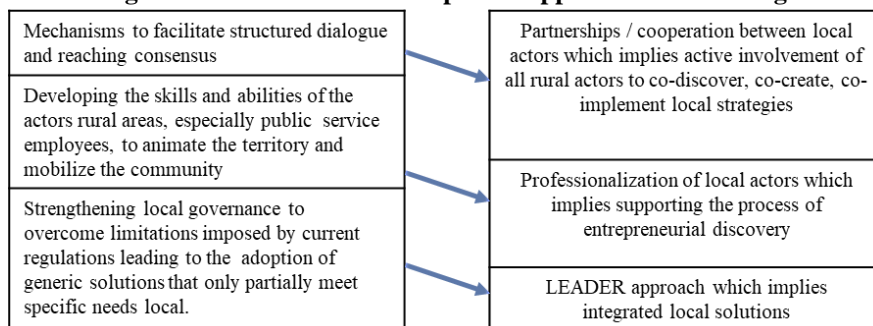
Smart village concept is a broad perspective approach conditioned by the localization, as well as the social and economic aspects of the community. The vulnerabilities that the respective community cannot overcome should be overpassed by the ability of innovation absorption and skill acquisition (Adamowicz, Zwolińska-Ligaj, 2020).

Rural development policy also hosts LEADER, a bottom-up approach to local development, which is a vehicle for social innovation and local capacity building, empowering rural citizens to take ownership of their area development through design and implementation. Local Development Strategies (SDL) and projects.

Financing smart villages remains the main problem because certain funding flows ("measures") of rural development programs can contribute to smart approaches to villages more than others. Applied "individually", they will not be enough to cover the real need for funds. In particular, the coordinated and harmonized use of different types of EAFRD interventions would be needed to effectively support smart villages.

An interesting solution could be to achieve integrated support by creating a single fund to finance the creation of a Smart Village. This would be an ideal scenario in which portions of different funds should be allocated specifically to support smart village approaches. This could be done experimentally (through a pilot approach), setting aside only a relatively small proportion of the relevant funds. An important advantage for those who seek to apply for these funds is that they do not have to act on several funds at once, each fund having a precise destination and specific rules.

Figure 1. Factor that could improve support for smart villages



Source: Authors' conceptualization.

In the above figure are presented the main factors that can contribute to revitalization of smart rural areas in our country and the expected results.

1.1 Material and Method

In order to substantiate the methodology of this case study, the classical tools of observation and examination were used. Procedures based on factual analysis were used, an intensive documentation at the level of the existing literature in this new field. The methodology of the paper has as direct tools the collection of information from the specialized literature and from the existing practice at the level of the relevant public institutions in our country, respectively, MADR, AFIR, as well as aspects related to the activity of the Local Action Groups and RNDR. On the other hand, the new provisions and guidance documents in this field were analyzed, offered and consolidated by the new CAP post 2020, the new PNS 2023-2027 and the European Network for Rural Development (ENRD, 2021).

In this context, the authors of this study case, developed a SWOT Analysis on the concept of Smart Village in Romania, based on data and information collected in the present research.

Table 1. SWOT analysis on the concept of Smart Village in Romania in the context of the Post 2020 CAP

Strengths	Weaknesses	Opportunities	Threats
Stresses the importance of a participatory approach; Requires the development of a holistic strategy at the local level; Allows focus on technological innovation (digitization) and social innovation; Focuses more on local communities than on ATU level; Adds value to local communities. <u>Dimensions and areas of activity</u> 1. Administration Public Services - Efficiency of administrative services; Use of ICT to provide services to the community Transparency - Governmental info transparency and Financial transparency Policies - Improving management / leadership; Public participation 2. Technology ICT - Internet access; IT infrastructure Technologies specific to the rural environment Sensor-based technologies used in agriculture and animal husbandry; IoT. The Internet operation of physical devices that have network connectivity that allows the collection and exchange of data between them. 3. Resources Natural resources - The condition of the ground; Access to running water; Energy supply, including renewable Economic resources - Agriculture; Fishing; Animal farms Human resources - The rural community; Level of education; Opening to the new 4. Village services / Public services Essential services - Health services; Educational services, Economic services Entrepreneurship; Access to jobs; Economic institutions; Distribution / logistics facilities 5. Standard of living Security and comfort - Waste management; Environment protection; Public safety; Disaster management Access to public services - Green space facilities; Sports field; Banking services; Road and bridge infrastructure 6. Socio-historical, cultural and religious	- Creates confusion (without a well-defined implementation framework); - Doubles an already existing concept; - There is no clear policy to include this concept; - The focus is too local; - Focuses too little on digitization; - Lack of or limited access to the internet and digitization in some rural areas; - Digitization level still low in the agricultural sector, at the level of farms and farmers; - Low level of education of young farmers (31.6% of EU farm managers 28 have basic and complete agricultural education while 96.7% of Romanian managers had only practical agricultural experience, compared to the EU average of 68.3 %);	- Creation of fiscal facilities granted by the state; - EU funding through EAFRD RDNP 2020, respectively Strategic Plan (SP) 2023-2027; - Alignment with the principles of the Green Agreement; - Achieving integrated support by creating a single fund to finance the creation of a Smart Village; - Government support by creating a special fund to support smart villages; - The creation of a structure to coordinate several funds involved in the investments needed to achieve the concept of smart village; - Increased digitalization trends and the development of "remote" jobs in the context of the evolution of the COVID-19; - Increasing access to national / EU funding programs dedicated to the innovation research sector;	- entry of new competitors on the market; - calamity of crops due to natural phenomena; - increasing the poverty rate in the conditions of the economic crisis; - relatively constant demand.

Source: Authors' conceptualization.

1.2 Programs, Respectively Policies that Could Have a Positive Influence on the Development of Smart Village in Romania

Combining research and innovation, the Horizon 2020 program can also make a significant contribution to Smart Villages' building strategies, which can ensure technology transfer in many areas of interest to Smart Villages. Seen as a means of stimulating growth and creating jobs, Horizon 2020 benefits from the political support of European leaders and members of the European Parliament.

Horizon 2020 includes several elements relevant to the development of smart villages. In Social Challenge 2, a special call for "rural renaissance" is closely related to the development of the knowledge base for smart villages. The idea behind the Smart Villages strategy is that, although the rural environment faces many challenges today, rural areas offer different and very valuable things for the whole of European society. The EU's strategy is to ensure that people in rural areas have access to educational training to develop their knowledge and skills, jobs and services comparable to those in urban areas, and that the community is connected to transport and utility networks.

The Smart Villages Action Plan finds many initiatives in the areas of rural development, regional policy, transport, energy, digital, and research.

1.3 Cross-Cutting Issues: Cooperation, Recovery, and the Green Agreement

The main consideration in the context of the new Post 2020 CAP is the existence of specific support for the emerging cooperation of smart villages, and / or support for cooperation between villages and other types of areas (cities) or other stakeholders (e.g., research). The Strategic Plan Regulation stipulates that when providing investment support, Member States should provide special attention to the overall cross-cutting goal of modernizing the sector by encouraging the adoption and exchange of knowledge, innovation, and digitalization in agriculture and rural areas. Support for investment in the deployment of digital technologies in agriculture, forestry, and rural areas, such as investments in precision agriculture, Smart Villages, rural enterprises, and ICT infrastructure, should be included in the description of the CAP Strategic Plans on its contribution to general transversal support and consolidation of "Environmental protection, including biodiversity and climate action, and to contribute to the achievement of the Union's environmental and climate objectives, including the commitments made under the Paris Agreement".

Support from Member States should make it possible to establish and implement cooperation between at least two entities in order to achieve the objectives of the CAP. Support can involve, among many other environmental and climate collective actions and actions; promoting the short supply chain and local markets; pilot projects; EIP Task Force projects for agricultural productivity and sustainable local development projects, Smart Villages, agricultural partnerships; networks and clusters; social agriculture; community-supported agriculture; LEADER actions;

and the establishment of producer groups and producer organizations, as well as other forms of cooperation deemed necessary to achieve the specific objectives of the CAP.

Among the cooperation proposals mentioned in Article 71 on Cooperation, emphasis is placed on the possibility / need for cooperation in order to achieve and implement strategies for smart villages.

"A smarter, more modern and sustainable CAP must embrace research and innovation in order to serve the multifunctionality of the Union's agricultural, forestry, and food systems by investing in technological development and digitalization, as well as improving the effective adoption and implementation of technologies, in particular digital technologies, as well as increased access and exchange of impartial, solid, relevant, and new knowledge".

For the financial programming period 2023-2027, the latest form of the new strategic plan regulation provides for the allocation of interventions set by Member States with the objectives of the Green Agreement on achieving climate neutrality by 2050. To this end, the Commission undertakes to assess the combined contribution of interventions. Member States' strategic plans to meet the Union's environmental and climate commitments, those arising from the European Green Agreement.

Supporting and improving the protection of the environment and climate action and contributing to the achievement of the Union's environmental and climate objectives are a high priority in the future of the Union's agriculture and forestry. The optimal combination of types of action to address these targets will vary from one Member State to another, including reductions in greenhouse gas emissions and increased carbon sequestration, which are very important in mitigating climate change. Article 6.d of the same regulation, which refers to the Specific Objectives of the Strategic Plans that aim to contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and improving carbon sequestration, and promoting sustainable energy.

At this moment, the National Strategic Plan for the programming period 2023-2027 related to our country, Variant 1, was sent to the European Commission on February 28, 2022, and in the next 6 calendar months, Romania will receive comments and then be approved (MADR(c), 2021).

The section on digitalization and computerization, in the new PNS 2023-2027 with reference to the agricultural sector and rural development, aims to establish / adapt a system of knowledge and innovation in agriculture (AKIS), but also to support through LEADER actions aimed at revitalizing services through digital and social innovation, improving services in LEADER territories (smart villages) - where these types of needs have been identified at the level of each local community in Romania.

The new concept for Romania on innovation in agriculture introduced in PNS 2023-2027 is AKIS, a concept that together with vocational training and counselling services, is part of the category of horizontal interventions needed for

the development of future agriculture in the context of new challenges such as climate change, digitalization, precision agriculture, etc.

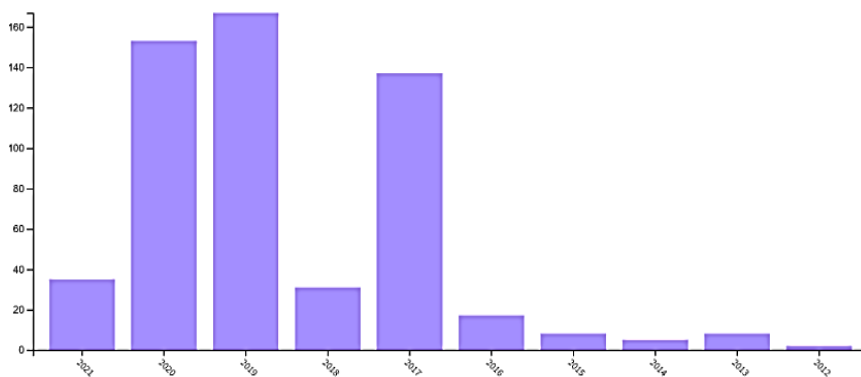
2. The Smart Village Concept in the Research Literature & Analysis

A concept that was briefly exposed during the September 2016 European Commission rural stakeholders 'meeting in Cork, Ireland, the “ Smart Village ”proposition was necessary in order to diminish the rural-urban digital gap; to provide growth prospects to both villages and rural areas; none of them could be achieved without thriving entrepreneurship environment or fully unlocking local actors potential. Part of the Common Agricultural Policy, the European Agricultural Fund for Rural Development, with finances of almost 100 billion EUR across the EU 2014-2020 multiannual framework (EC, 2017). The main objective of a smart village is to empower ecosystems and generate growth, innovation, and sustainable development, therefore, the topic of Smart Village should dictate the future of local rural development in the upcoming period (Profiroi, Radulescu, 2019).

The main objective of the current analysis is to highlight the key concepts that result from the Smart Village term interrogation and to determine what the scientific community is focusing on.

The current analysis has taken into consideration, up to this point, the local aspects of the Smart Village concept, which is interlinked with the sustainable development ability of rural communities; in the following chapter of the paper, the applicability and research interest of this topic will be assessed using consecrated research methods such as the one of bibliometrics. In order to perform this query, the present paper aims to interrogate and quantitatively measure the latest scientific database for this subject. A number of 578 research papers have been identified as the study's population using the “Smart Village” key for both title and abstract, in the Web of Science Database, papers that will be scrutinized in the following paragraphs.

Figure 2. Yearly number of papers on the topic of “Smart Village”



Source: Author's concept using Web of Science.

As seen in Figure 2, the research interest has drastically increased in the last couple of years, year 2019 marks the maximum value with more than 160 papers on this topic, the increasing interest matches with the concept introduction in late 2016. More than 90% of the papers have been published since 2017, but what exactly these work papers focus on will be observed in the following figure (Figure 3), describing the Web of Science topics; Engineering related orientations, together with Sustainable and Technological. Technology marks the importance of innovation that is directly linked to engineering and science. Fewer papers belong to the economic sphere (pink and brown), marking the lack of applicability and concept preparedness.

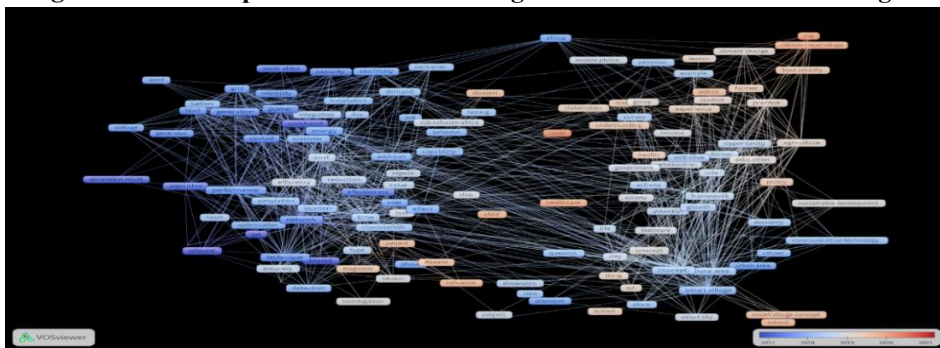
Figure 3. Number of papers on the topic of “Smart Village” by scientific category



Source: Author’s concept using Web of Science.

Going through the 578 research titles, only one paper marks the presence of “Romania” within the title line, strong indication that the paper relates to Romanian smart villages, an immaterial number that clearly marks the novelty of the current studied topic, same results can be drawn from the abstract inspection, the only one being published in 2019. Searching for the “European Union or EU” within the title, 2 papers appear, a situation with a slight change over the abstract search, where 15 papers could be identified directly referring to the European Union as study population or research focus. A more detailed term analysis will be conducted in the following paragraphs, using the VOS Viewer software to draw the term correlation maps.

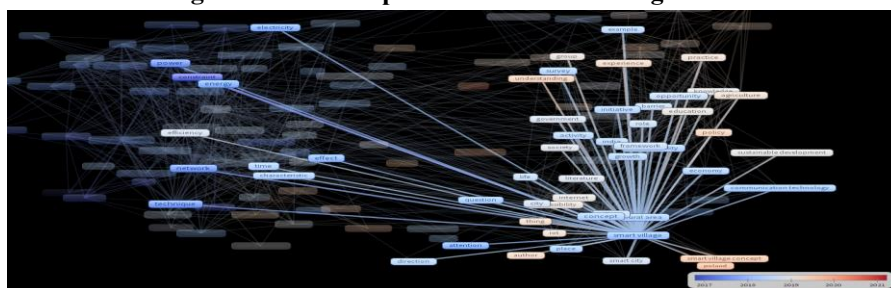
Figure 4. Term map based on “Smart village” search on Web of Science engine



Source: Author’s concept using Web of Science & VOS Viewer.

The first picture of the correlated terms (Figure 4) points out the multitude of interlinked word clusters by publishing year, the cloud being mostly blue, indicating the numerous papers written before 2020. The clusters contain 140 items and 5 major clusters have been identified, the first one containing 38 terms with parts of the “smart” concept, integrating terms like: efficiency, energy, grid, optimization, performance, optimization and wind; the second cluster containing 35 items containing parts of the “village” concept with notes as: agriculture, climate change, education, farmer, food security; the third cluster with 34 items focusing on the health related aspects; the 4th cluster with 30 items linking the rural with the urban concept of smart living, also enhancing the economic side of the theme; and the 5th cluster with only 3 terms, representing the most high-tech cloud with the Internet of Things concept in the middle.

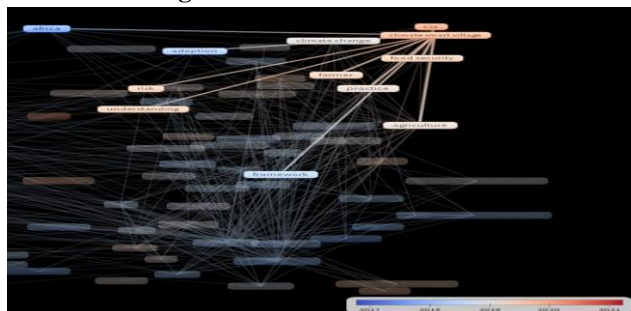
Figure 5. Term map based on “Smart village” link



Source: Author’s concept using Web of Science & VOS Viewer.

The smart village item in the above figure (Figure 5) as the central term points out links to both pre and post 2019 terms, such as network, power, rural area, initiative, opportunity, policy, sustainable development, agriculture and also the internet of things concept that is in strong relationship with. The smart village subject that can definitely co-exist in perfect harmony with the smart city orientation and such alignment at all levels could not be achieved without a few things that have already been mentioned in the last chapters and also visible within the links: rural sustainable development, social and economic growth, ways of implementation and local communities.

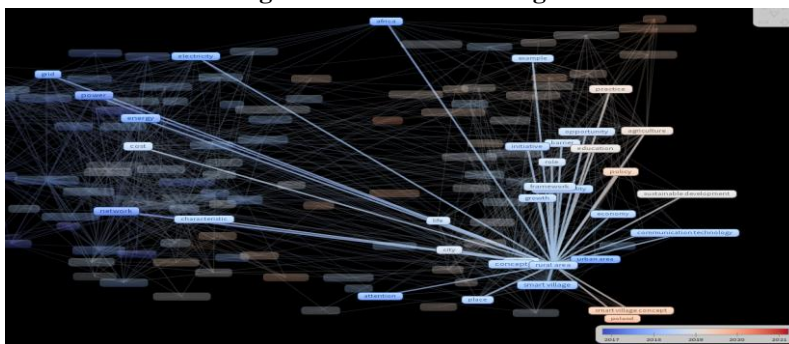
Figure 6. Most relevant terms



Source: Author’s concept using Web of Science & VOS Viewer.

In the above figure (Figure 6) the top two terms by relevance strength generated by the used software can be seen, these two terms occur in more than 10 papers each and refer to the climate smart village and CSA (climate smart agriculture), both concepts being also recognized as recent research interest between, shaping the future path that a rural community should follow in order to secure the status of a smart village through climate neutrality within the community and climate-friendly agricultural practices.

Figure 7. Rural area linkages



Source: Author's concept using Web of Science & VOS Viewer.

In the above figure (Figure 7) the central aspect of the new research theme has been selected - the rural areas – the resulting parallels to other clusters and publishing years present how the smart village concept can be applied into reality, using the energetical breakthrough and sustainable development practices, framed properly as a tailored policy that can be achieved through education, practice, well-defined role of the agriculture and using efficient communication across stakeholders.

In the last paragraphs a couple of points have been addressed in order to successfully implement the smart village concept, these research themes assessed through the quantitative analysis do represent key points and opportunities that should not be skipped when actions are considered to shape the future of Romanian rural communities.

3. Conclusions

The digital era of today's world means that the population is witnessing the dawn of a new approach in the agricultural sector, which relies on a joint effort to meet growing global nutrition needs and the future challenges, given the fast-growing pace of the global population. This factor alone has led to an increasingly more pressing demand for a vast array of agricultural products, while maintaining an eco-friendly perspective.

Given the need to produce more and faster in a sustainable way, precision agriculture has the remarkable potential to rapidly become an essential tool for the sustainability of the agricultural sector and increasing competitiveness. The use of innovative technologies generates socio-economic effects such as: increased

production, improved working conditions of farmers, maintaining soil structure, preserving and improving soil characteristics, increased soil water supply, reducing crop irrigation costs, reduced costs with the administration of plant protection products and chemical fertilizers, the use of genetic material resistant to drought and certain diseases and pests, etc.

Considering that the widespread adoption of cutting edge technologies and / or new agricultural practices usually modifies the exchange of knowledge from farmer to farmer, but also between farming communities with the support of third parties, such as associative forms in the agricultural sector, farmers organizations, local civil society organizations, agricultural research and development units should become more and more useful and necessary.

The modest collaboration between farmers and entities that promote research and innovation has led to a limited transfer of knowledge and technological solutions from suppliers to farmers, mainly on specific issues. It is therefore necessary for farmers, consultants, research units and other stakeholders to work together in order to identify innovative solutions to the specific problems facing the sector, such as the use of environmentally friendly practices, optimizing the use of resources and factors of production.

The implementation of leading-edge technologies and processes adapted to the needs of the farmers of today, developed and supported by research and innovation activities, will generate positive socio-economic and environmental consequences, which will increase the performance of farms while maintaining a low impact on the environment.

Furthermore, in order to meet European standards, the approach needs to focus on how digitalization supports on-farm efficiency and performance. Strategic advice on digitalization and e-infrastructure is needed, as it is linked to knowledge exchange, communication, dissemination, and operation.

The research focus has been demonstrated throughout the paper that is oriented in boosting this novel concept, and also via the proposed methods, the Romanian Rural side can think of the complete incorporation of this structure in development individual objectives.

Within the Local Development Strategies, the concept of “Smart Villages” can be supported, by increasing smart village development projects that aim to capitalize on the willingness and knowledge of local communities to identify solutions using technology and innovation. This will offer the prospects of an improved life quality in rural areas, address depopulation and demographic challenges, remodelling the quality of local services in the field of health and safety of citizens and laying out the prospects of a transition to a circular, low-carbon economy, as well as the digitalization of social, administrative and educational sectors.

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