



# **The Concept of a Smart Village as an Innovative Way of Implementing Public Tasks in the Era of Instability on the Energy Market—Examples from Poland**

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Abstract: The last three years have been a period of many challenges related to the dynamically changing conditions of the economic environment. Among these many changes, some of the most important for the further functioning of private and public entities are those related to the instability of the energy market. Rapidly rising energy prices increase the costs of implementing public tasks. They also greatly increase the search for innovative, energy-saving and environmentally friendly ways of performing municipal tasks. The main aim of the article is to present the concept of a smart village as an instrument for the implementation of public tasks in rural areas. The theoretical basis of the smart village concept is the basic point of reference. The implementation of the assumptions of the smart village concept in Poland gives municipalities the possibility of an innovative approach to the implementation of local public services. In addition, examples of good practices implemented by rural local communities that can act as models for other groups of residents are also included. It was essential, from the point of view of measurable effects, to identify potential limitations and hazards in the implementation of the smart village concept, which may be identified in the outermost regions. Analysis and critical literature review were used to achieve the article's goals. These methods are characteristic for review publications. At the beginning, we presented the theoretical foundations of the smart village concept. Secondly, we indicated how the smart village concept contributes to the improvement in public service delivery in rural areas. The authors demonstrated that there is no universal model for each unit. A smart village will implement solutions tailored to economic, social, cultural, and natural conditions.

Keywords: local government; smart village; energy market; public services; digital transformation

## 1. Introduction

Local government units, regardless of their number, structure of levels and organization in different countries are, in many cases, treated as institutions that enable the implementation of part of the tasks in the state. Depending on the distribution of competences, in numerous countries, they are responsible for carrying out public tasks that are necessary in the everyday life of the inhabitants and are responsible for the standard of living and development of local communities.

Regarding the municipal economy, the commune fulfills its function on two levels. Firstly, as an entity creating energy from renewable sources, and secondly as an entity supporting its creation. Additionally, the commune acts as an energy-user on the energy market, including as a local energy regulator. In addition, attention should be paid to this entity as an investor and energy producer, and as an entity responsible for planning and financing the energy security of the public places and roads located on its premises. Therefore, there is a need to strengthen the commune as a supporting entity and partner



Citation: Satoła, Ł.; Milewska, A. The Concept of a Smart Village as an Innovative Way of Implementing Public Tasks in the Era of Instability on the Energy Market—Examples from Poland. *Energies* **2022**, *15*, 5175. https://doi.org/10.3390/en15145175

Academic Editors: David Borge-Diez and Štefan Bojnec

Received: 31 May 2022 Accepted: 14 July 2022 Published: 17 July 2022

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**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). in the implementation of the idea of distributed energy [1]. The main impulse for the development of distributed energy is technological progress. In the long run, a decrease in the costs of generating energy from renewable sources is favored. It is also important to be willing and able to use the locally available energy resources. This is especially noticeable in rural areas, for example, in terms of accumulated biomass resources.

The implementation of public tasks is associated with expenditure from local government budgets, so it is necessary to ensure the effectiveness of the actions that are taken. In the public sector, this means the requirement of achieving the best results from a set level of expenditure, or seeking to minimize costs at an assumed standard of meeting public needs. The concept of the smart village, understood as the application of innovations, and digital technologies to provide public services, as well as to improve the quality of life of inhabitants [2], may be a valuable instrument when implementing these principles into the practice of local government units.

In the context of budget constraints, the question arises as to how and to what extent public tasks are implemented. Traditionally, local public services have been provided by local government units, either directly or through specialized units that they own. At present, the ways of providing public services that are commonly present in the literature and put into practice include outsourcing, privatization, hybrid organization, co-production and co-creation. Many of these solutions use modern organizational (cocreation of public services) and technological structures. Some of these solutions are also included in the smart city concept, which, in relation to rural areas, takes the form of the smart village concept.

Initially, the smart city concept applied to cities that were implementing new technologies and innovative solutions were stimulated by private-sector entities. This is because they saw new, profitable markets in the public sector, while local government officials were fascinated by technological innovations (e.g., intelligent transportation systems) and their potential to improve, for example, traffic management in the city [3]. Over time and with experience, cities have come to understand that technology is only a tool to achieve the socio-economic development objectives. Today, the smart city as a concept responds to the changing needs of inhabitants and naturally adapts to them. The technologies in place in the city serve people by providing convenience and safety, and enhancing their quality of life [4]. In this way, the assumptions of the New Public Governance concept concerning the participation of inhabitants in the commune management are implemented in the performance of public services.

The smart village is defined as a village in which the efforts of inhabitants and institutions are supported and integrated with information technology systems and innovation to benefit local communities [5,6]. In the initial stage, the concept of the smart village was primarily accompanied by the issues of access to energy sources, a necessary factor for the occurrence of development processes and participation in technological progress. It was estimated that approximately 1.3 billion people worldwide did not have access to electricity [7]. Most of these were people living in rural areas, located far from development centers [8]. They were out of reach of the network that provides today's access to the latest innovations in information and communication technology (ICT), mobile healthcare technology, biotechnology, and finance [9]. The original approach viewed the "smart village" as a model in which access to energy acts as a catalyst for development. Effectively implemented technological change was intended to lead to improvements in the areas of education, economy and health care. Rural residents could enjoy multiple aspects of "urban life" while preserving the valuable aspects of rural life and ensuring national sustainability [7].

The concept of a smart village is a constructive response to a set of interrelated phenomena and processes, which has become more frequently perceived in the EU, which has been called a vicious circle of decline [10] (Figure 1). The conducted literature survey concludes that the idea of the smart village is most often associated with objectives such as improvements in welfare, energy savings, a low-emission economy, a reduction in inequalities between urban and rural areas, and an improvement in economic conditions.

There is also an emphasis on improving governance efficiency, improving rural livelihoods and human resources, and issues such as improving disaster resilience and reducing energy poverty [11,12].



Figure 1. The vicious circle of decline in rural areas. Source: elaboration based on [10].

The smart city and smart village concepts, through the use of intelligent solutions, are designed to reduce the cost of service without lowering the standard of service for residents and their lives [13]. At present, the greatest potential for reducing these costs lies in solutions that reduce energy consumption. A smart city tries to implement public tasks with the help of IT solutions and by involving numerous groups of stakeholders [14–16]. By including numerous entities in the process of city formation, the concept of the more inclusive development of a given territory is implemented, which, in consequence, should lead to the formation of a city that will correspond to the aspirations and ideas of the people who create and live there. Considering the specificity of the functioning of rural areas, the solutions, or the components adopted in the formula of smart city, can be successfully implemented in the development of a smart village.

The aim of the paper is to present the concept of a smart village and, against this background, to indicate possible methods of performing public services assigned to local government units (communes) in rural areas in Poland. The paper applies an analysis and critical review of the literature, which was considered to be the most adequate to achieve the study aims [17]. The literature review method was successfully used in another article concerning the topic of smart villages [18]. This method is often used in articles concerning public services and the environment in many different fields of study [19]. The article is based on the available literature and applicable legislation. The studies and reports of institutions responsible for implementing and supporting initiatives that are part of the smart village strategy were also supportive. They indicate a catalog of good practices that produce measurable effects, both economic and social. The documentation included the scope of tasks, organization, structure, financial effects, implementation and reporting of a given activity (process), either a link or a complete closed project. The assumptions in this method were reduced to ascertaining the authenticity and adequate sense of traces of human activity, i.e., the behavioral motives in the indicated organizational structure. On this basis, it was possible to understand the conditions for the emergence and course of an initiative and the activities undertaken by a group of persons, as well as their products (effects). The documentation examination technique includes a quantitative and qualitative analysis of the content. The individual case study method was also helpful in achieving

the objective. Specific events, phenomena and processes relating to particular groups of persons, whose conduct and behavior in a given organizational structure and circumstances deviated from the generally accepted norms, were examined. In these cases, the deviations should be regarded as positive, which may serve as a benchmark for others.

The article poses a research question: how can the smart village concept contribute to the improvement in the quality of public services in rural communes? The article is organized as follows. After presenting the theoretical foundations of the smart village concept, we indicated the possibility of its implementation to perform local municipality tasks. Then, the process of digital transformation was discussed and, against this background, examples of applications of innovative solutions were indicated for the provision of public services in rural areas. The final section also presents the limitations of implementing the smart village concept in Poland.

#### 2. Smart Village—Theoretical Foundations of the Concept

The smart village first emerged as a concept in 2015. It was then applied to aid programs in Africa and Asia. In these cases, the main focus was the issue of inhabitants' access to modern energy sources, basic education and health care, and food security [7,20].

One of the basic assumptions of the smart villages concept is the recognition that ongoing technological progress may create new opportunities to increase income and provide services in rural areas. However, to achieve a significant improvement in the standard of living in rural areas, it is necessary to integrate the concept with other initiatives [21]. The sustainable strengthening of local communities can only occur if the actions taken are coherent. They should be part of a well-considered, established and socially consensual rural development programme.

In addition to classic infrastructure investments, business development, human capital growth and civil society development, the smart village concept pays particular attention to the application of the latest technological developments. Access to and use of public e-services, environmental protection through increasing the share of the circular economy, innovative communication technology (ICT), and the implementation of locally defined regionally smart specializations, e.g., in the field of tourism, culture or promotion of local products, including agricultural and food products, are also emphasized [22,23].

It has been emphasized for several years that, in line with the diffusion of innovations, wealthy cities and those with a higher population density are the first to benefit from the latest technologies [24,25]. Rural areas, however, are characterized by certain lags in the adaptation of innovative solutions [26,27]. In Poland, in accordance with strategic documents, a further polarization of development is expected, which means the concentration of economic and socio-cultural functions in metropolitan centers. Only then do the development processes induced in this way have a chance to "spread" to the neighboring areas, and then to the outermost areas. This mechanism means that the outermost areas are almost condemned to a disadvantage in development, a relative deterioration in living conditions, and the consequent washing-out of their human capital and financial resources [28]. In turn, some ongoing research indicates that the role of growth poles does not always have to be associated with metropolitan areas [29]. Internal development impulses can also be triggered in the outermost regions. However, this requires the creation of so-called local demand, for which a certain critical mass is necessary, and in the absence of such a critical mass, the development impulse must be sought in the so-called endogenous local resources (Figure 2).



Figure 2. The factors involved in the model of smart village.

In a rapidly changing economy, the development lags in the outermost areas are one of the reasons for their lower competitiveness in attracting investments, capital, and creative human resources. Therefore, there is a need to increase innovative rural development with a high share of social innovation [30]. Social innovations are supposed to create positive changes, resulting in the development of social capital and contributing to the more effective implementation of technological innovations in these areas [31].

The economic development that took place in the second half of the 20th century led to more territorial inequalities and, consequently, to competition between different areas. This issue has been recognized in the European Union, which has set smart, sustainable, and inclusive growth as one of the objectives of the Europe 2020 strategy. The greatest assistance in achieving this goal is attributed to innovation, education and the research and development sector.

In addition to the aforementioned theory of growth poles and the concept of centers and peripheries, the theory of territorial embeddedness is of great importance for the presentation of the smart village concept [32]. It has been described by Granovetter and, according to its characteristics, is understood as the anchoring of different actors in a particular environment or surrounding in a regional or local structure [33,34]. The concept of embeddedness refers to the use of local resources for the economic and social development of a given area and assumes that a specific system of interdependencies is created which, through the appropriate management of resources, allows for the maximum retention of their benefits in a given area for the benefit of the local community. The social innovation system developing in a given area, which results from specific social and economic conditions and is embedded in a specific institutional environment, is also a consequence of the local development processes taking place in that area [35]. As this includes many local entities and institutions, the role of initiator and coordinator is often assumed by local government units.

Other theories that influenced the emergence of the smart village concept were industry cluster theory and core product theory. The founder of the industry clusters theory is considered to be M. Porter, who, in his research, proved that enterprises operating in related sectors, together with the institutions surrounding them, create cooperation networks by locating their activities in industry clusters. Recognizing their development potential, regional and local authorities should pursue the policy of supporting the development of industrial clusters [36,37]. The theory of industry clusters demonstrates some links with the core product theory, which states that the production of a group of goods that are likely to be most competitive in the external markets is concentrated in a particular area as a result of a process of progressive specialization. This results in benefits such as a reduction in transaction costs, improved organization of production processes and an increase in the quality of manufactured goods.

Other theories from which the smart village concept takes advantage are the theory of learning regions and the innovation environment model. Both theories emphasize the importance of knowledge and innovation in local development. In accordance with the theory of learning regions, their ability to create intangible resources, such as knowledge, skills, and qualifications, is assumed to be the key competitive factor. The model of innovation environment associated with the theory of learning regions emphasizes the role of endogenous institutional potential influencing the creation of innovative dynamics in enterprises. The enterprises operating in a given area are not isolated innovation units, but form part of an environment with innovation potential. In this way, their impact has the potential to create synergies in the region. The existence of an innovative potential in a given area, together with the ability to learn, provides a great opportunity for making development processes more dynamic.

The smart village concept also emphasizes the role of the so-called smart regional specializations. Recognition and appreciation of the role of knowledge and innovation represents a breakthrough in relation to the existing, traditional perception of the directions of rural development [38,39]. The traditional approach viewed rural areas as areas with a dominant agricultural function, and the development concepts that exist to date admittedly drew attention to the need to switch from mono-functionality towards multifunctionality; however, never before has the need to launch the so-called intelligent development mechanism been so strongly emphasised [40]. This was probably partly due to the fact that the previous approaches treated innovation as a technological phenomenon specific to urban centers, which are saturated with the companies' activities, as well as research and educational institutions. At present, pro-innovative activity is more broadly understood as supporting new social solutions based on collective action (social capital) and the promotion of modern production and service concepts implemented in small and local markets [35,41–43].

As indicated earlier, the smart village takes certain inspirations from the smart city concept that has already been put into practice. Initially, the smart city concept was associated only with the use of information technologies [44,45]. This was a result of the challenges that were emerging at the time, which related to technological progress, the knowledge-based economy, innovative equipment and environmental pressures [46]. The support of international institutions (UN, OECD, European Union) was also of significance [47]. At present, the smart city concept is considered more broadly and is included in the three dimensions of urban research: the digital city, the knowledge city, and the green city [48,49]. Research carried out in recent years has produced other terms, such as the resilient city and sustainable city [50]. This demonstrates the extension of the smart city concept into different areas of the city.

The smart village concept takes advantage of these experiences to use modern technologies for the production and delivery of goods and services, including information and communication technologies, to achieve a higher standard of living for the inhabitants and reduce negative environmental impacts. In relation to public tasks of a technical nature, carried out by local government units, this also includes the application of smart solutions in public transport, which adjust their availability and quality to the actual demand to minimize the need for inhabitants to use their own means of transport. Thus, it will also influence rational energy management, both in terms of the means of obtaining energy (energy-efficient means of transport and lighting or bus shelters) and limiting the negative effects of its use, as evidenced by reduced emissions of, e.g., sulfur dioxide, nitrogen oxide, carbon monoxide and dioxide, or waste and sewage from flue gas desulfurization plants. In another area of local government activity—the implementation of tasks of a social character—the use of smart village solutions may promote the implementation of the latest methods and teaching techniques (including remote learning) in the area of education. In terms of water and sewage management, smart solutions will enable the rational management of environmental resources by analyzing changes in the level of demand for these municipal services. The smart village concept includes and advocates for a real increase in the efficiency of management and service provision, with the aim of increasing the competitiveness of rural areas while respecting the economic, social and environmental needs of current and future generations.

# 3. The Smart Village Concept as an Answer to the Problems of Implementing Tasks in Rural Areas

In the European Union countries, an important point in the development of the smart villages concept became the Declaration of 2016, entitled "A Better Life in Rural Areas" [51]. During the discussions of the European Conference on Rural Development, new directions for rural development and EU agricultural policy were developed. The declaration emphasizes that particular attention must be paid to overcoming the digital gap and developing the opportunities offered by better network connectivity and digitization in rural areas. The EU's rural areas vary greatly in terms of development and some are lagging behind in terms of the availability of digital services. Such actions would contribute to the elimination of social exclusion and would facilitate coherence in the satisfaction levels of the needs of the inhabitants of individual EU regions [52]. Consequently, this would lead to a reduction in the risk of social tensions in some European Union countries [53].

Rural areas are often considered to be lagging in development. Frequently, their outermost location, as well as the insufficient level of development in transport infrastructure, prevent them from fully participating in this progress. In the other side this placement create chance becoming the location of significant investments and economic activity [54,55]. The limited sectoral structure of the economy and high dependence on external consumers are also some of the problems in these areas. In order to increase their level of coherence with more developed areas, actions have been taken to strengthen their development potential through new opportunities provided by innovation, new smart digital technologies, and institutional changes [56–58]. Another issue for a large portion of rural areas are unfavorable demographic phenomena, such as ageing and migration, especially of young people, which, in the longer term, leads to the depopulation of these areas.

In order to counteract these unfavorable tendencies, it is necessary to create conditions for the development of enterprises, including the provision of jobs, which will be able to stop further migration. The effective implementation of the smart village concept offers such opportunities, especially through the use of modern technological and communication solutions, which could be an attractive factor, especially for young people. It should be stressed at this point that before the pandemic, a migration from urban to rural areas was observed in Poland. However, this concerned rural areas close to urban agglomerations, i.e., city-adjacent rural counties. The research shows that between 1989 and 2018, 4.9% of the population moved to the rural areas. The positive balance of internal migration continued for most age groups, with the exception of those between 20 and 40 years of age. This phenomenon is referred to as the spreading of cities, which changes their territorial extent and function [59]. From the longer post-pandemic perspective, changes in consumption and production patterns can be expected. This will also influence the increase in the proportion of remote working and highlight the importance of quality of life and forms of mobility. It could create new opportunities for sustainable growth in rural areas, particularly those close to and well-connected with metropolitan centers.

Some rural communes do not benefit from the advantage of an attractive location, or are too small and do not have sufficient resources to effectively provide public services. In this situation, cooperation between communes is a viable solution to reduce the costs of service provision and improve service quality [60]. To jointly perform public tasks, the

communes may form a union. As a rule, the establishment of such a union is voluntary, and they are usually established to carry out tasks of a community purposes. These include, among others, those concerning water supply and sewage disposal or waste management. The need to execute these tasks stems from the fact that some communes have too little potential to perform these tasks independently, or from the fact that cooperation will reduce costs while improving management. Cooperation between local authorities is, therefore, defined as a set of activities that achieve a specific result [61]. The source literature identifies three basic spheres in which local government units cooperate: [62]

- Cooperation regarding administration and satisfying citizens' collective needs in the field of administration, providing services related to municipal services, health services, education, public safety, social care, communication, environmental protection, culture, sport, and tourism.
- Cooperation regarding economic development, increasing the level of competitiveness in the economy and achieving economies of scale related to investment location, the development of strategic plans, and spatial planning.
- Cooperation related to protecting the interests of the local community, protecting the rights of local government units, and lobbying in the region, the country, and the international arena.

In accordance with the register of intercommunal unions kept by the Minister of the Interior and Administration (30 September 2021), a total of 315 unions were registered (including those related to waste management, environmental protection or communication). However, it is worth mentioning that their total number is not synonymous with the number of those in operation. For formal and legal reasons, the register includes all of them, even those that were liquidated (e.g., after completing the task for which they were established). The cooperation of communes aims to increase the efficiency of service provision and also contributes to rationalising public expenditure while taking care of the environment.

#### 4. Digital Transformation as an Example of Implementing the Smart Village Concept

Despite the fact that communes fulfil a fixed catalogue of tasks, more and more often, both the changing expectations of their stakeholders and their own initiative result in them undertaking other challenges, which appear alongside the economic development. They operate in a commercial environment, competing for businesses and inhabitants with the scope and quality of their public services. Today, the demands on communes are increasing, both from persons wishing to locate a business in the area or those who choose it as a place of residence. For some time, electronic services have been an important area of activity for local authorities in this respect. They improve and speed up numerous activities and save time and funds. In order to be able to deliver these services effectively, local authorities need to implement a digital transformation.

The issue of a digital transformation in the activities of local government initially meant the use of the Internet in the provision of services by public administration bodies. The terms e-government, e-public services, and e-governance have been used to describe these activities [63]. Initially, the scope of services was limited to the most fundamental services, which did not require much commitment from both the office and the stakeholder. At present, the scope of the digital transformation of public administration is expanding as a consequence of the increasing use of digital technologies [64]. The spread of information and communication technologies (ICT) results in the expectations of inhabitants and entrepreneurs increasing with regard to the scope of public services that are available electronically. However, as access to the Internet is already relatively common, this means that local governments are able to provide a number of services in this way without fears of excluding a significant part of citizens, who only a few years earlier did not have access to the internet, or an appropriate level of digital competence. The experience of the COVID-19 pandemic has further reinforced and accelerated the digitisation of a significant portion of the services provided by local governments to their residents [65].

The digital transformation of local government is understood as the entirety of the transformations taking place in local government with regard to services, processes, local government resources and competences, using digital technologies. These transformations should be carried out for the following purposes [66,67]:

- Improving the accessibility and quality of public services;
- Supporting strategic and operational decision-making processes and streamlining the work of the office;
- Increasing the transparency of local government;
- Involving residents in the life of the local community.

These transformations aim to achieve sustainable development goals [68,69]. Digital transformation represents the innovation of local government, the co-production of public services, a way of improving the transparency of local government and creating public value [70].

In the local government units, the digital transformation may include: processes of providing social and technical infrastructure services, the technologies used, the type of services offered, and the flow of information within the office and between the local government administration and its clients. As a consequence of the digital transformation occurring in the economy and society, the tasks of local government and the way that they are performed will also change. As a consequence of the necessity to adapt to economy 4.0, local government units will shift from the direct execution of tasks to performing a management function consisting of indicating the desired development directions [71].

Under the conditions of a rapidly changing environment and emerging challenges, local governments are obliged to carry out new tasks to enter the path of smart growth. In accordance with the principle of the presumption of competence of the commune, it is mainly this level of local government that is responsible for taking action to make the functioning of local communities smart. The communes are already taking educational measures to disseminate skills in the use of ICT devices and technologies. In addition, local governments have been tasked with cyber security and making inhabitants aware of how to protect themselves against online threats. There will also be significant changes in the existing tasks in the communes. A great example is the management of schools. Changes are necessary in terms of adapting the educational offer to the rapidly changing expectations of the market and making the system more flexible in relation to the need for employees to requalify (sometimes several times) during their careers. Other changes in this area will include the introduction of modern curriculum content and teaching methods (including remote learning) using modern technologies and shaping skills and competences adequate to the needs of the changing economy (automation, computerization, language competences, Economy 4.0).

Certain changes are and will be taking place in the performing of public tasks by local governments (the use of other technical means and the need to perform tasks related to digital transformation in cooperation with other entities). The service delivery process will be carried out using artificial intelligence, the internet of things, robots and blockchain technology [72].

Communes are also facing various challenges related to digital transformation. They are mainly connected with the low awareness and poor competences of local government bodies, officials, inhabitants and entities co-creating the local government community [73]. Other obstacles relate to the functions performed by the local government, the scope of its tasks, and the specificity of the tools and the methods used to meet the needs of inhabitants and economic entities. Among other challenges that accompany the implementation of digital transformation are those relating to the organizational culture of local government units as well as technological and financial barriers.

Digital transformation constitutes one of the most significant areas for the implementation of the smart village concept. On the one hand, it concerns the application of innovative and intelligent solutions in the process of providing public services. On the other hand, it is a response to rapidly changing operating conditions, which consequently implies a process of proactive adaptation to the environment. Another, equally important, argument is that the digital transformation of local government is the result of the interests and growing expectations articulated by the inhabitants. In this way, they participate in decision-making processes regarding the territory they inhabit and articulate their needs, which is one of the key elements of endogenous development.

#### 5. Public Services in Rural Areas—Trends and Their Outcomes

Public services include a set of public goods that no one can be excluded from using. When using these goods, none of the new consumers shall, in principle, infringe the rights of the others. The level of public service provision is, therefore, expected to be of a certain quality, regardless of the number of users [74].

The area of public services refers, among other things, to the wide range of activities and the fulfilment of tasks by the commune self-government units. In accordance with the classification used in the UK public sector, the following distinction can be made [75]:

- 1. Universal services provided to everyone, including services related to the environment in which we operate, i.e., refuse collection, street sweeping;
- 2. "On-demand" services, which include renovation services, counseling and primary health care;
- 3. Services for authorized persons, whose users must meet certain criteria set by the relevant public authorities (examples of services in this group are: social assistance, benefits, shelters for the homeless, social housing);
- 4. Rationed services, i.e., based on available resources, e.g., nurseries for children, housing, housekeepers, multiple forms of social and health care;
- 5. Compulsory services, the provision of which is intended to protect or enrich individuals and the general public, e.g., school education, health and food standards, some social services;
- 6. Preventive services, including health care, public safety, community development, services for young people.

With reference to the presented British catalogue of public tasks (services), similarities can be noticed with those implemented by Polish commune self-governments. Therefore, the British classification of public tasks should be considered as a starting point for the implementation of modern trends in the field of social participation in the process of providing public services in Poland.

One of the modern trends in the delivery of products and services is cocreation. This concept implies the involvement of the final recipients of goods or services as stakeholders in the process of their creation [76]. The concept of co-production is now in the mainstream of contemporary innovative public management and assumes that inhabitants engage their own time and effort in producing public services that they themselves will benefit from. Co-production is an important element in the context of a public sector that is in a process of reform, that is not innovative enough and that is looking for more efficient ways of functioning [77]. An example of the implementation of these assumptions is the involvement of the inhabitants of the village of Piaseczna Górka in Świętokrzyskie Voivodship. As part of the initiative "Prevention of local flooding in Piaseczna Górka", a rain garden was established on a public plot [78]. Its function is to store and, at a later stage, filter meteoric water. Rain gardens absorb much more water than regular lawns. In addition to their primary function of infiltration, they also increase biodiversity through increased numbers of birds and beneficial insects. Furthermore, they are a visually attractive flowerbed and have a positive effect on the aesthetics of public spaces. The main objective of the initiative was to increase meteoric water retention and prevent local flooding. Given the priority of protecting the climate and the environment, this measure should be regarded as offering a "double" benefit. Between 2017 and 2018, at the initiative of the Association of Piaseczna Górka Residents, two other projects were implemented alongside the rain garden. One of them was the installation of seven solar lamps equipped with LEDs. As they are characterized by high light sensitivity, they can work continuously at low light

levels for up to 12 h (switch on at dusk, switch off at dawn). They are safe and resistant to weather conditions. Another activity (carried out on the initiative of and together with the informal group Regionalists) was the establishment of a self-service outdoor library. This type of undertaking was intended to support the idea of reading and bookcrossing and to provide the inhabitants with an opportunity to interact with culture. This is because there is no formal center in this town dedicated to the implementation of social services in the indicated area.

In addition, rural inhabitants have their own group set up on social media. This is also where they communicate their needs, local news such as public consultations or other events relevant to the residents. It facilitates the exchange of views or information between inhabitants and allows for residents to quickly and effectively adjust the planning of activities to inhabitants' expectations.

Another example of smart activities is the application implemented in the municipality of Poniec (in the Wielkopolskie Voivodship), which, using augmented reality, allows for one to virtually see, on the screen of a smartphone, what a particular place looked like in the past. The initiative was launched by Fucco Design and the Association for Entrepreneurship Support of Gostyń County. Funded by the Rural Development Programme (through Local Action Group "The Land of forests and lakes" in Leszno) [79]. The augmented reality (AR) is about enriching the real environment with computer-generated content, which is mainly supplemented with graphical content. "Augmented Reality" can be identified as a combination of real and virtual worlds, with real-time interaction, allowing for freedom of movement in three dimensions [80]. Among other things, the implementation of this project has contributed to the expansion and provision of educational services.

The reasons for the development of the co-production concept include the following:

- The improvement in public services by exploiting the knowledge of users and their networks;
- The need to provide public services that are better targeted and more responsive to their audience;
- The potential to use co-production as a means to reduce costs;
- The opportunity to create synergies between government and civil society.

This way of providing public services is also directly in line with the smart village concept, which, besides innovation, also emphasizes the issue of gaining public support for the implemented changes and increasing inhabitants' participation in decision-making processes and actions.

It should be noted, however, that the possibilities for the development of a given area, apart from the involvement of the local community and the aforementioned participation of inhabitants, are also significantly influenced by the spatial structure. An unfavourable structure reduces the competitiveness of rural areas and prevents them from achieving their full development potential. For example, too much fragmentation of plots can adversely affect the structure of socio-economic functions. In these areas, the implementation of processes related to smart village implementation may be postponed. However, the digitisation of spatial data can improve the situation.

In terms of the digitalization of spatial planning, in a number of communes in Poland have already provided examples of how modern technology can contribute to spatial management. Interactive maps of Warsaw that consider the planning acts that were undertaken constitute a good example. Warsaw, due to its character (the largest urban commune in Poland; the capital of the country; the main seat of many economic and scientific entities) is "predestined" to implement such solutions and they are, in fact, expected to show the development directions in this respect for other local governments. Therefore, since 2016, i.e., since the entry into force of the resolution amending the act dated 14 April 2016 on the suspension of sale of real properties of the Treasury Agricultural Property Stock and Amendment of Certain Acts [81], spatial planning in rural areas has become increasingly important in the context of real estate transactions [82]. Undoubtedly, the digitization of existing and future spatial plans in rural areas will not only rationalize the spatial development process but also improve the marketing of agricultural property [83].

From the perspective of the implementation of the commune tasks carried out in rural areas, the most important in this aspect are the spatial development plans. The progressive digitalization of the dataset in this respect will enable more efficient decision-making, which, consequently, will have a positive impact on the effectiveness of the public service delivery process.

One of the pioneers in implementing the new smart village concept in the area of public services is the municipality of Michałowo in Podlaskie Voivodship. A new model of rural hospice has been established in this area. It is part of the delivery of public social services, with a particular focus on social services. This is because the Prophet Elijah Foundation runs a free Home Hospice. The Foundation is also building a residential hospice. As part of a newly introduced social innovation, there is a network of carers who help to organize cultural events. The Foundation is also the leader of an innovative project that is funded by the European Commission "To give what is really needed" [84]. This is a program of home care for dependent persons and support for their carers in rural areas.

The innovation of this project consists in creating a network of people helping at different levels. These will include activities carried out both by neighborhood and informal groups, as well as by public sector bodies and NGOs. A mechanism that was set up and operates in this way will meet real health needs and provide the opportunity to flexibly adapt care to the needs of the residents. By design, the model is so universal that it can be easily replicated in other parts of rural Poland and Europe. However, community integration and the important role of the local leader(s) must be taken into account.

Over 75% of employees in rural areas in Poland derive their income from nonagricultural sources and have no relationship to a farm. Contemporary rural areas in Europe and Poland mainly need to create good-quality non-agricultural jobs and improve the quality of life of rural inhabitants. At present, only about 22% of the rural population works in agriculture. At the same time, the share of non-agricultural sectors is increasing. In terms of economic activity and the sectoral structure of employment, the population in rural areas is gradually becoming similar to the population in urban areas [85]. However, the development of non-agricultural functions, which require larger areas of compact land, including the development of entrepreneurship, which leads to the creation of new jobs and thus increases the commune's sources of income, is difficult or even impossible when plots of land are too fragmented. As the research indicates, spatial structure a basic determinant of the successful implementation of smart village concept solutions. In regions with a particularly disadvantaged spatial structure, improvements are often a prerequisite for smart growth and can lead to a boost in knowledge and innovation [86].

Specific challenges in rural areas can, therefore, include the following: centralization of services, unemployment, investment in infrastructure development, job creation, changing the spatial structure of rural areas and developing mechanisms for financing local communities [87]. The Polish Ministry of Agriculture plans to support "smart villages" under the LEADER approach and under the intervention on infrastructure in rural areas. Using LEADER, the aid will be particularly targeted at the areas left after State Agricultural Farms, which are marginalized areas with the problems that accumulate in marginalized rural areas (structural unemployment, low mobility resulting from poor connections with larger urban centers, low accessibility to public services, including a wide catalogue of advisory services). The Plan will also include infrastructure investments in the field of water and sewage management. These include domestic wastewater treatment plants and water retention. In addition, procedures are also to be implemented to support revitalization measures for small rural towns. These activities will focus on developing public spaces in accordance with the requirements of spatial order, including an increase in the proportion of green areas and increased retention. Support will also be provided for the renovation of or improvement in historic facilities, serving the preservation of cultural heritage. Moreover, undertakings in the field of promotion and information on local traditions, including cooking, local products and tourist attractions, will be implemented.

#### 6. Limitations to the Development of the Smart Village Concept

In addition to the benefits and examples of good practice that are presented, it is also worth noting the experience implementing the concept of smart villages and the limitations that occur in this process. The greatest difficulties in the implementation of the smart village concept occurred in the outermost areas due to the insufficiency of their endogenous development potential. These areas have more limited access to resources and markets compared to suburban areas. Significant differences exist in relation to social structures and socio-economic characteristics. In the majority of cases, they are characterised by low communication accessibility, a negative migration balance, and the low educational level of the inhabitants [86,88].

Research conducted in Poland at the regional level has identified several important barriers to the implementation of the smart village concept, including the following [76]:

- Low engagement or awareness of inhabitants hindering the creation of smart communities and a low level of openness to change in rural communities;
- Difficulties in creating innovative projects and raising funds for these projects,
- Low communication accessibility and poorly developed transportation and communication networks,
- Lack of network cooperation and transfer of innovations from scientific and research institutions to business practice.

The age structure of the inhabitants of the local community is also not without significance. This determines the possibility of implementing individual measures or projects. The foundation of the smart village concept is IT technology, and factors related to the progressive ageing of the population and the migration of young people to urban areas mean that some areas may have problems with direct access to the technology. Seniors are becoming more familiar with new technologies; however, in rural areas, they are often deprived of this opportunity due to health constraints, etc. [89]. Therefore, it is recommended that local governments, in cooperation with their partners, identify their needs. The need for a dedicated Smart Social Services Village plane to emerge from the smart village concept may be a cause of further analysis and research. The need for social care is gaining in importance, not only in Poland but also in other countries. It is one of the needs reported under social assistance, which, as a task for the communes, is carried out by them. However, the forms of this assistance generally focus on financial support and the assistance of carers, although they are limited in time (up to a few hours per week). The authors believe that a smart village should also aim to ensure care for persons who, due to age or health constraints, are deprived of support or care by their closest family members and need assistance.

The article itself also has some limitations. Due to the novelty of the subject, there are not many reliable results regarding the implementation of the smart village concept to provide public services. The emergence of such results will enable an empirical verification of the benefits of implementing public tasks with the use of intelligent solutions. Future research could also find the most effective ways of delivering local public services in rural areas.

#### 7. Conclusions

Instability in the energy market causes many threats to all entities operating in the modern world. These challenges also concern the public sector and are mainly manifested in an increase in its operating costs. Rising costs provide an incentive to look for solutions aimed at reducing them. In terms of the implementation of local public tasks, these opportunities are offered by the idea of a smart village. In this aspect, this is treated as a way of using modern solutions that reduce energy costs. Innovative technical and organizational solutions applied at the local level are aimed at more energy-efficient management in the implementation of public tasks.

A smart village is a concept in which measures implemented in accordance with this concept, based on the use of modern tools, techniques and technologies. These aim to:

- Provide a higher quality of life;
- Offer wider access to and raise the standard of public services;
- Reduce the negative impact on the environment.

The implementation of this concept and its defined elements is based on meeting the needs of the local community and on using its potential for this purpose. This means that there is no universal model for each unit. A smart village will implement solutions that are tailored to its economic, social, cultural, and natural conditions. Thus, a smart village could not develop if not for the inhabitants. They are the main initiators and recipients of the proposed activities. It is the community of smart villages, integrating and cooperating with each other, that determines the direction of their community in the pursuit of sustainable development. The opportunity to speak out and participate in actions and decisions is, therefore, important in terms of potentially better tailoring legislation to social needs, but also from the perspective of the democratic state. It increases the general public's willingness to take an interest in public affairs. This makes them co-responsible, which, in practice, means they seek information, stimulate local initiatives or ensure that they are properly formulated and funded. In this concept, grassroots activities can have a significant impact not only on local and regional, but also national development. The solutions adopted under Polish conditions (especially the aspect of providing social services) can also be implemented in other countries.

**Author Contributions:** Conceptualization, Ł.S. and A.M.; methodology, Ł.S. and A.M.; validation, Ł.S. and A.M.; formal analysis, Ł.S. and A.M.; investigation, Ł.S. and A.M.; writing—original draft preparation, Ł.S. and A.M.; writing—review and editing, Ł.S. and A.M.; visualization, Ł.S. and A.M.; supervision, Ł.S.; project administration, Ł.S.; funding acquisition, Ł.S. and A.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** This work has been supported in part by University of Agriculture in Krakow and Warsaw University of Life Sciences—SGGW (science fund).

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.

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