

## FROM FIELD TO MARKET: DIGITALIZATION AS THE KEY TO BUILDING ENTIRE AGRICULTURAL VALUE CHAINS IN RURAL AREAS

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**Abstract:** *This paper explores a novel approach to integrated rural development: constructing entire value chains in rural areas. While integrated rural development has a strong theoretical foundation, past practical attempts have often fallen short. In contrast, this new concept, involving the establishment of secondary and tertiary sectors in rural areas, lacks a formal theoretical basis but is being implemented through China's recent agrarian policies. The implementation of this concept was made possible exclusively by the development of Information and Communication Technology (ICT) and mass digitalization. The research aims to identify and categorize obstacles to previous integrated rural development programs, assess how digitalization can overcome these challenges, and explore the potential of digitalization in creating rural value chains. The methodology involves content analysis of primary and secondary data, comparing and classifying implementation challenges, and examining how digitalization can address these issues. The findings demonstrate that digitalization offers solutions to all identified obstacles. Today, every stage in the field-to-market supply chain can benefit from digital support, bridging geographical gaps and facilitating the spontaneous relocation of economic activities, people, and capital to rural areas due to cost advantages.*

### INTRODUCTION

Integrated rural development refers to a comprehensive and holistic approach to rural development, where various sectors and activities are interconnected and coordinated to achieve sustainable development in rural areas. The idea of integrated rural development stemmed from the knowledge that successful development strategies are always based on a comprehensive approach to diverse and complementary areas and phenomena, while "selectively intervening on a narrow front rarely produces desired development impact" (Brinkerhoff, 1981).

Although very broadly formulated, all previous programs and projects of integrated rural development were until recently limited to improving the lives of rural communities in terms of improving infrastructure, sanitary conditions, environmental requirements, access to schooling and health services, poverty reduction through social programs and the like. A more specific approach to this development concept was only recently (2015) formulated by the Communist Party of China and refers to building entire value chains (based on agricultural inputs) in the area of primary production, that is, in rural areas. The new concept is not theoretically established, it does not even have a specific name. In China it was called literally "the integrated development of rural first, second, and third industries". The central goal of Chinese planners is clear and refers to the development of rural areas based on the synergistic development of all economic activities and the availability of occupations for all structures of the working-age population, instead of only low-skilled farmers.

Despite the obvious advantages, this approach to rural development has not been recorded not only in practice, but it has not been formulated as a separate theoretical concept, that is, there are no scientific works, which include intention to locate the entire value chain in rural areas. The absence of more ambitious goals for the establishment of the secondary and tertiary sectors in rural locations is not a particularly big failure of the planners if one takes into account that even much more modest goals (infrastructure, health service, etc.) were not realized. Namely, all programs of integrated rural development have been assessed as largely unsuccessful by governments, other competent authorities, participants and analysts.

Until the latest achievements in the field of digital technologies, it was not even possible to realize the complex goals of starting economic activities of higher sectors in rural communities, without fulfilling the mentioned elementary conditions. However, the more recent penetration of digitalization into all segments of society allows to jump over some "development steps", to overcome a large number of obstacles to

implementation, and what is the main topic of this research is digitalization as a new possibility to establish other "links" of the supply chain other than agricultural production.

The main goal of the research is to identify and classify problems and obstacles for the implementation of previous programs of integrated rural development, to identify those that can be overcome by digitalization and to identify the possibilities of digitalization in the construction of entire value chains in rural areas.

The research methodology includes:

- content analysis of primary data sources, mainly documents on the results of several dozen projects of integrated rural development, implemented on different continents in developing countries;
- analysis of the content of secondary data sources, scientific works on the results of such projects in developed countries;
- comparison and classification of challenges and obstacles to the implementation of integrated rural development;
- explanation of the development advantages that can potentially be enabled by the formation of the entire value chain in rural areas;
- explanation of the possibilities offered by digitalization for overcoming the identified obstacles of the implementation of integrated rural development in all its forms.

The first part of the article describes and explains the concept and current implementation of integrated rural development, including the new Chinese approach. Its potential development possibilities are described, the challenges and obstacles in implementation are identified and classified. The second part explores and explains the ways in which digitalization offers opportunities to overcome these obstacles.

## **1. THE INTEGRATED RURAL DEVELOPMENT**

### ***1.1. The concept and advantages of integrated rural development***

The concept of integrated rural development in the early 1970s was one of the "most important development intervention strategies used by the Third World governments" (Cohen, 1987). However, it very quickly took an important place in European agricultural policies. Later, the concept gained much broader meaning in the literature, adding non-productive sectors to optimize production. This expanded understanding of this model initiated the development of a whole new, holistic approach, which implies that "any

successful development must take into account the social, cultural, economic, environmental, and geographical realities that shape the lives of people all over the world" (UN, 2004).

Previous rural development programs, both in developed and developing countries, included different combinations of simultaneous development of several sectors. In developing countries, these development initiatives are often prominent due to the pressing need to alleviate poverty, address food security, improve access to basic services, and reduce inequalities in rural areas. In developed countries, these kinds of rural development initiatives tend to emphasize enhancing the competitiveness of rural economies, improving infrastructure, supporting entrepreneurship, and promoting sustainability (Wilson, 2004; Hodge and Midmore, 2008; OECD 2013).

The new, deepened concept of integrated rural development was proposed in Chinese document Guobanfa no. 93 (2015) and was called literally "the integrated development of rural first, second, and third industries". It implies to connect all agricultural production segments more functionally and station as many "links" as possible at the primary production location, i.e., rural areas. The rural development is based on expanding production activities in villages by adding activities from the secondary sector (processing, including development departments - R&D) and the tertiary sector (packaging, storage and warehousing, sales centres, bank branches focused on agricultural financing, even marketing agencies). Some segments of the tertiary sector, such as hobby agriculture and rural tourism based on location specificities, were previously included in the concept of integrated rural development, but not in development of this kind. Mostly, rural tourism projects were implemented as a separate project. These segments of tertiary sector now gaining additional importance due to the multiplication of content and products in rural areas.

The new approach of locating the entire value chain in rural areas offers additional possibilities in these same segments of rural well-being. Below is the author's attempt to identify, explain and classify the advantages of this approach. The advantages are grouped according to the most frequently stated goals of integrated rural development.

- Rural development: Developing the agricultural value chain in rural areas can stimulate economic growth by creating employment opportunities and generating income for rural communities.

- Food security: Strengthening the agricultural value chain ensures a steady supply of food and reduces dependency on external sources, enhancing food security for both rural and urban populations.
- Value Addition: Establishing the entire value chain allows for value addition at each stage, such as processing, packaging, and marketing, resulting in higher profitability for farmers and other stakeholders.
- Empowering Rural Communities: Developing the value chain can empower rural communities by providing them with control over their resources, improving their socio-economic status, and reducing migration to urban areas.

### *1.2. Challenges and obstacles to the implementation*

For the purposes of identifying obstacles to the implementation of this model, we analysed several dozen examples in practice, some of which were analysed based on primary sources (reports), others based on the works of authors who analysed these projects around the world. India has implemented various multi-sectoral rural development programs, such as the Integrated Rural Development Programme (IRDP), launched in 1978, National Rural Livelihoods Mission (NRLM) 2011 (Government of India, 2017), the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) (Ministry of rural development of India, 2005) etc. These initiatives focus on enhancing livelihood opportunities, promoting social inclusion, improving rural infrastructure, and providing social protection to rural communities (Joshi and Rao, 2017; Sarafraz and Manzoor, 2021; Kumar, 2021; Susman, 2021). The Brazilian Program for Sustainable Development of Rural Territories (launched 2003) focused on supporting integrated and sustainable development in specific rural territories. The Chinese Rural Revitalization Strategy (2018), which preceded the concept of integration of three sectors, have broadly set targets of the current multi-sectoral approach. Besides agriculture, health, infrastructure, poverty alleviation, and social welfare, it was included rural entrepreneurship, innovation education, rural tourism and cultural preservation (Guofa No. 12. 2019; Central Document No 1. 2021; Wu and Wen, 2022). The Comprehensive Rural Development Program (CRDP) in South Africa (launched 2009) aims to achieve "social cohesion and development of rural areas by ensuring improved access to basic services, enterprise development and village industrialisation" (Department of PME of South Africa). The Rural Development Board (BRDB), the Comilla Model in Bangladesh (Khan, 1983), and Ethiopia (Cohen, 1987) were also based on integrated

rural development. The Rural Integrated Development for the Eastern Region (PRIDE) Project (Tanzania) implemented in the 1980s. In addition to these nationally designed programs and strategies, the Millennium Villages Project (MVP), launched in several African countries by UNDP in the period 2005-2015 (MPA), was relevant at one time. This is only a small part of the analysed projects in this research.

All of these models were unable to fully achieve its goal in practice! Most of the literature on integrated rural development refers to analyses of "frequent failures of rural development policies in Europe" (Nemes, 2005). Most of the projects produced moderately significant to significant development results, but the effects lasted only until the end of the project. For example, the MFA was analysed in two large-scale studies that were carried out immediately after the end of the project (Mitchell et al., 2018; Sachs, 2018) and both showed that a third of the set goals were achieved, while the investments within the project were so much would bring greater benefit to the countries in the project without any project. Jeffrey Sachs (2018) shows that "the benefits to an MVP site of receiving \$60 per person per year were smaller for the MVP community than if the entire nation had received the same \$60 per person per year". According to Evaluation Steering Committee of mentioned strategy in South Africa, more than a half objective did not achieved, including infrastructure, poverty, sustainable development etc. (Evaluation Steering Committee, 2013). Only China recently established several dozen successful value chains in a few years. In the first year of implementation "all regions have improved the agricultural industrial chain by accelerating the development of agricultural product processing and circulation industries" (National Commission for Development and Reform, 2016). According to the MARA report from 2018 the integration of rural industries led to a 67% increase in farmers' income. By 2018 "more than half of the processing enterprises have built the whole industrial chain value chain by extending forward and backward" (MARA, 2018).

Extensive research and analysis of integrated rural development projects in developed and developing nations have highlighted the primary challenges and barriers hindering their widespread implementation. The most significant challenges for achieving a successful and sustainable application of this model are extracted from the above literature and documents as the most frequently highlighted obstacles. These are:

1. *The project approach* to rural development itself, which limits time and resources to a period of only a few years, which is the duration of



the project. The construction of the entire value chain at the location of production enables the rural community to generate significant income and continuously invest in its own development, guided by the needs of a large number of economic entities from various sectors of the economy;

2. *The problem of coordination*, given that the model includes a large number of very different entities;
3. *Inconsistency between top-down planning and bottom-up participation*;
4. *Weak access to finance* after the completion of the project;
5. *Technology and knowledge gap*;
6. *Market linkages*.

The effective management system in China, coupled with widespread digitalization efforts, has enabled the country to surmount various challenges. In contrast, many other nations are either unable or unwilling to alter their socio-political systems. However, the current state of ICT development has reached a level where it can substantially address prevalent constraints and hurdles in the context of integrated rural development. These identified problems and obstacles, in next section will act as a foundation for evaluating how digitalization can potentially contribute to the efficient functioning of the entire value chain.

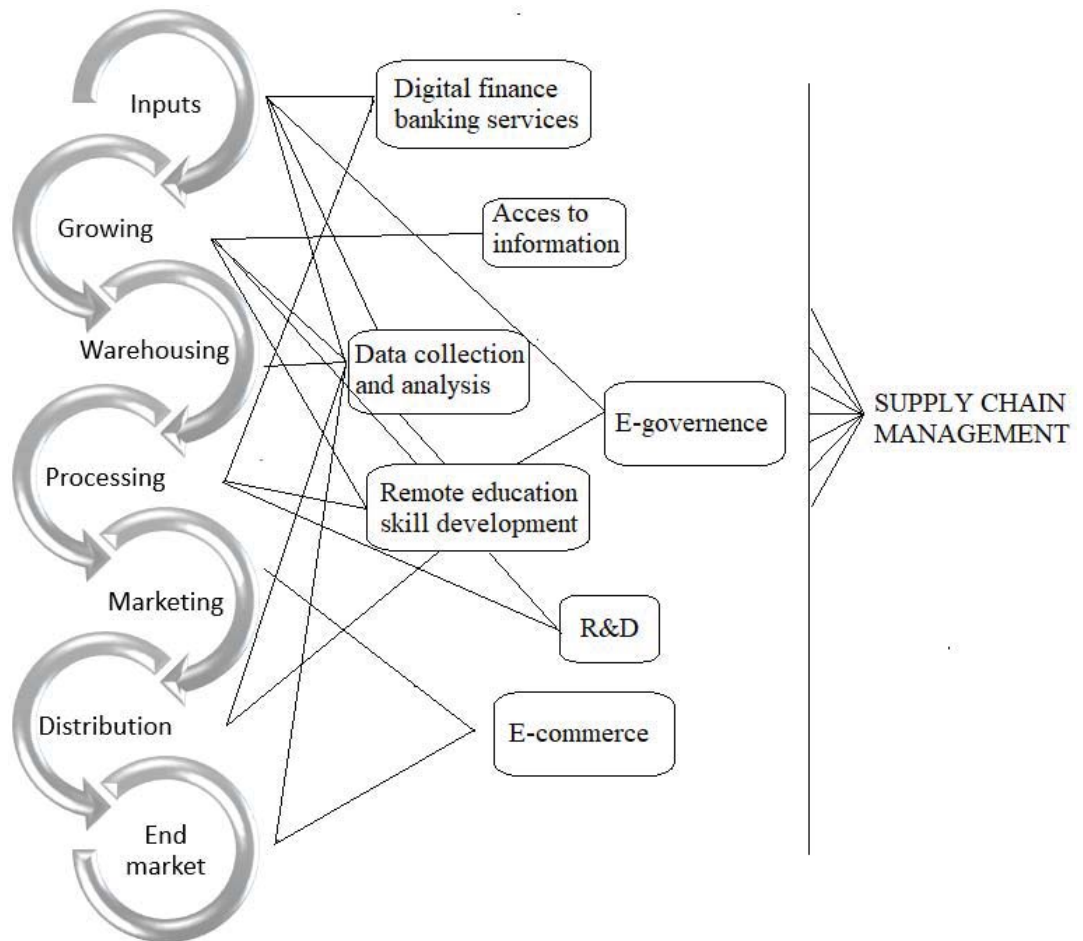
## **2. HARNESSING DIGITALIZATION IN ESTABLISHING RURAL VALUE CHAINS**

Except for the first of the listed problems, the project approach, which can be overcome by establishing additional links of the value chain, other cited challenges arise when implementing any concept of integrated rural development. Recently, with the accelerated development of information technologies, digitalization is emerging as the most efficient way to remove obstacles to integrated rural development and establish longer value chains in rural areas.

The graph illustrates an agriculture value chain, which has been successfully implemented only in several Chinese areas so far. With further advancements and increased use of digital technologies, it is anticipated that this approach will also be adopted in other countries with previous attempts to implement integrated rural development initiatives. The graph demonstrates the different forms of digital support available for enhancing

each stage of the supply chain and strengthening the connections between them.

**Figure 1.** The role of digitalization in managing the agricultural value chain



Source: Authors

### ***2.1. Access to information relevant to agricultural production***

Digital technologies offer farmers valuable information on agricultural practices, weather forecasts, market prices, and pest management. Some platforms provide location-specific data, while others offer broader knowledge applicable to various areas. Specific platforms focus on microlocation data from sensors, aiding farmers with precise insights for better decision-making, leading to increased productivity and efficiency.



Although universal expert information and locational weather forecasts are readily available, sensor-based platforms are still in the experimental phase, mainly limited to test fields in specific projects.

### ***2.2. Data collection and analysis of efficiency of value chain***

Digital data collection and analysis revolutionizes supply chain monitoring, allowing seamless tracking from producers to end users. Quantitative and qualitative data from rural stakeholders inform decision-making processes. Digitalization empowers real-time tracking using technologies like barcodes, RFID, and IoT, optimizing logistics, reducing waste, and ensuring timely deliveries.

With digital tools, inventory management becomes efficient through automated data capture and analysis. Farmers, suppliers, and distributors can track stock levels, expiry dates, and plan replenishment based on demand forecasts, minimizing stockouts and costs.

Furthermore, digitalization captures consumer preferences, market trends, and historical sales patterns, enabling accurate demand forecasting. Farmers align cultivation, suppliers optimize production and procurement, creating a data-driven approach that enhances supply chain efficiency.

### ***2.3. Digital financial services***

One of the problems faced by all multi-sectoral rural development programs in developing countries is the difficult access to financing (Cohen, 1987; MRDI, 1992, 1995; Mitchell et al., 2018; Sachs, 2018; Susman, 2021; Schneider et al. 2021). In the context of rural areas, digital finance and banking services can have a transformative impact by addressing the challenges of limited physical infrastructure and lack of access to traditional banking services. Of particular importance is access to financial resources, that is, loans in the first production stages of both agricultural production and the processing of these products. It is not only about initial capital, but seasonal lending is generally required in this business.

Agricultural finance platforms provide farmers with access to credit for purchasing inputs, equipment, and technology. Digital platforms also facilitate agricultural insurance, allowing farmers to protect their crops, livestock, and assets against natural disasters and market risks.

One of the newer types of digital platforms is online lending platforms and peer-to-peer lending networks, which connect rural borrowers with lenders, including individuals, institutions, and investors. This increases access to

credit for small-scale farmers, micro-entrepreneurs, and rural businesses, allowing them to invest in productive activities, expand their operations, and improve their livelihoods.

#### ***2.4. Market access and e-commerce***

Digitalization offers multiple ways to support market linkages in the agricultural value chain. Digital platforms and e-commerce solutions can bridge the gap between rural farmers and urban or export markets. Digital platforms provide opportunities for rural entrepreneurs and farmers to access broader markets beyond their local communities. E-commerce platforms and online marketplaces can connect rural producers directly with buyers (including services like a rural tourism), eliminating intermediaries and ensuring fair prices. This improves market access and increases income opportunities for rural communities. Mobile Applications provide market information, helping farmers make informed decisions about crop selection and timing of sales. Aggregators and e-commerce platforms enable farmers to reach a broader customer base and facilitate online sales and delivery services. Digitalization also enables traceability systems for product quality assurance and market intelligence tools for real-time insights on pricing and trends.

This segment of digitalization is already widely represented. In all analysed countries there are initiatives and programs of e-commerce. For instance, in India, there are several e-commerce platforms dedicated to agriculture, such as AgroStar, BigHaat, e-NAM (National Agricultural Market), and DeHaat. Rural e-commerce in China exceeds \$50 billion annually (FAO, 2019). In Africa, platforms like Twiga Foods in Kenya and Sokopepe in Tanzania have been established to connect farmers with markets. In Europe, platforms like Agrando in Germany and Agrikol in France provide similar services. Project Agricultural Market Information System in Bangladesh (AMIS) is one of the more successful national programs, although it is not oriented only to e-commerce. It included market data collection, information dissemination, price monitoring, market analysis, policy support, capacity building (Islam and Grönlund, 2007). These platforms can play an important role in the development of value chains in rural areas in the future.

#### ***2.5. Remote education and skill development***

Digitalization enables remote learning and skill development initiatives, which can enhance integrated rural development through educational opportunities and capacity building. Remote education allows access to quality learning without relocation. Online platforms enable virtual classrooms, educational resources, and instruction from qualified teachers. Skill development courses cover various subjects, enhancing employability and contributing to the local economy. Traditionally, rural-to-urban migration has been driven by the pursuit of education and limited prospects for applying that knowledge in rural settings. However, the concept of building the value chain in rural communities opens up a plethora of non-agricultural activities, from biotechnological laboratories to tourism management, harnessing the acquired knowledge and education effectively.

Currently, these digitalization benefits are underutilized in rural areas, with few formal education opportunities available. The one of the most massive example is Digital India, particularly program for agriculture named Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA). The program was initiated by the Government of India, which is one of the prerequisites for durability and consistency. Launched in 2015, by mid-2023, the program has recorded over 70 million registered applicants, and over 45 million certified students, which is a significant number regardless of the size of India's total population (PMGDISHA, 2023). However, it is only about digital literacy. Participants therefore physically go to the centres (of which there are over 430,000) in order to learn how to follow online content. This is therefore not a form of concrete education, but only a prerequisite for its future acquisition through digital platforms.

## ***2.6. E-governance and service delivery***

E-governance offers an opportunity to overcome the lack of mechanisms for administrative coordination of rural and urban communities and inconsistency between top-down planning and bottom-up participation, which is cited as one of the main obstacles to the implementation of any type of integrated rural development.

Digitalization enables efficient and accurate data collection, which is crucial for evidence-based decision-making. By using digital tools, rural development programs can gather data on various aspects, such as agricultural productivity, healthcare needs, education levels, infrastructure gaps, and socioeconomic conditions. This data can then be analysed to identify trends, prioritize interventions, and measure the impact of development efforts.

Digitalization can simplify management processes and service delivery in rural areas. Online portals and platforms can be established to facilitate the application and payment of government services and subsidies. This includes areas such as agricultural subsidies, government crop purchases, health care schemes, social welfare programs and educational grants.

The most successful example is Common Services Centres (CSCs) in India which act as access points for citizens to avail various government services digitally, including healthcare, education, banking, and utility bill payments (Common Service Centres, India). Another example of relatively broad government e-services is Malaysia's Smart Villages initiative which focuses on leveraging digital technology to enhance rural living conditions and economic opportunities (Laidin, 2016).

## CONCLUSION

For several decades, attempts have been made in a number of countries to create and implement strategies for the overall development of rural communities instead of development programs aimed only at improving agricultural production. Projects and programs of integrated rural development were numerous, but mostly included only socio-economic aspects of life in rural communities (infrastructure, education and health). The programs were unsuccessful or partially successful for several reasons that we identified by looking at the primary and secondary sources of several dozens of integrated rural development projects around the world.

The failure mainly stems from the project financing itself, which is limited to a few years, while improvements in the mentioned (non-profit) sectors require continuous investment. Integrated rural development recently received a conceptual solution embodied in the Chinese approach, which includes the construction of entire supply chains in rural areas. Increasing the volume of economic activities, especially those more profitable than agricultural production itself, provides the basis for the independence of rural development from project financing. The implementation of this concept proved to be significantly more successful than previous initiatives.

Other observed obstacles to the implementation of integrated rural development in previous attempts are: the problem of coordination of a large number of very different entities, inconsistency between top-down planning and bottom-up participation, weak access to finance in rural areas, technology and knowledge gap between rural and urban areas, and weak

connection with the market. These problems cannot be eliminated by adding secondary and tertiary sector economic activities.

The rapid advancement of Information and Communication Technology (ICT) has only recently presented opportunities to overcome these challenges. In the modern field-to-market supply chain, each component can benefit from digital enhancements, often through various forms of digital support.

1. The initial link, encompassing inputs, benefits from digital finance for the commencement of the agricultural cycle. E-governance plays a pivotal role in managing subsidies and input supply, while Research and Development (R&D) fosters the development of superior seed varieties and chemical preparations. Digital data collection and analysis facilitate efficient connectivity with other links in the chain.
2. Throughout the agricultural production process, digital platforms provide access to pertinent information such as weather conditions, essential agronomic practices, and product pricing, addressing the comprehensive informational needs of farmers. This aspect of the chain can also benefit significantly from remote education and skill development initiatives and remains intertwined with other components through digital data collection and analysis.
3. The third link in the chain pertains to the storage and distribution of essential agricultural products. Here, digital data and analysis assume critical roles in optimizing efficiency, particularly given the perishable nature of these products.
4. The processing of agricultural products can now be effectively established at the primary production location, thanks to the availability of advanced digital banking services and substantial opportunities in remote education and skill development, empowering rural populations to engage in industrial production. Additionally, R&D continually enhances the quality, safety, and environmental sustainability of agricultural products.
5. Marketing, as a crucial facet of the agricultural value chain, enables farmers and rural residents to better promote both processed and unprocessed agricultural products, as well as services like rural tourism, through e-commerce platforms.
6. The distribution of goods at various stages of processing to specific users is significantly streamlined by the evolution of e-government in terms of procurement of essential products, along with digital data

collection and analysis pertaining to quantities produced, types, and stages of goods processing.

7. Lastly, e-commerce and digital data collection and analysis play pivotal roles in facilitating the placement of food products at all processing stages, as well as rural community services, aligning them with the distinct needs and preferences of end users across diverse geographical locations.

The intrinsic isolation of rural communities and primary agricultural production from the broader economy can now be effectively addressed thanks to the extensive adoption of advanced digital technologies. While ICT does not guarantee rural development, its current level of development is more than sufficient to surmount the primary obstacles encountered in rural community development.

Government intervention is no longer imperative to initiate secondary and tertiary sector endeavours in rural locales, along with their associated developmental aspects. Digitalization has already transcended the geographical isolation of villages in a functional sense. Consequently, the shift of other economic activities, individuals, and capital toward rural areas can occur organically, capitalizing on the conventional advantages of reduced costs.

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