Article

Coupling and Coordination Analysis of Digital Rural Construction from the Perspective of Rural Revitalization: A Case Study from Zhejiang Province of China

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Abstract: Taking the development level of digital village construction in the Zhejiang province of China as the research object, this paper analyzes the current situation of digital village construction in Zhejiang and the relationship between financial development and technological innovation. Firstly, the digital village construction evaluation index system is built, which includes 6 first-level indicators and 18 s-level indicators, and then the comprehensive value to measure the development level of digital village construction in Zhejiang is calculated by the entropy method. Secondly, using the coupling and coordination model, the relationship among digital village construction, financial development, and technological innovation is discussed. The numerical results show that indicators such as infrastructure, beautiful villages, and digital economy play a greater role in the development of digital villages, accounting for 38.22%, 22.89%, and 18.55%, respectively. The continuous improvement of the financial development level, from 17.25% in 2016 to 39.98% in 2019, has an important impact on the construction of digital villages.

Keywords: digital rural construction; rural revitalization; coupling and coordination analysis; index system

1. Introduction

In today’s China, the digital transformation of the real economy is accelerating, and the digital economy is becoming an important driving force for economic transformation. In 2019, China’s digital economy was among the top in the world in terms of scale and growth rate, accounting for 36.2% of GDP [1]. COVID-19 has a huge impact on the world economy, and the digital economy has also become an important force to hedge the impact of the epidemic, help resume work and production, and achieve economic recovery. As China’s digital economy moves toward a new historical node, the construction of digital villages is not only an effective connection for poverty alleviation, but also a strategic direction for rural revitalization [2]. Since the 18th National Congress of the Communist Party of China, the Chinese government has attached great importance to the construction of rural informatization. In May 2019, it was clearly pointed out that the digital villages were the application of networking, informatization, and digitization in the economic and social development of agriculture and rural areas. In 2021, “No. 1 Central Document” clearly stated that the digital rural construction project should be implemented to promote the modernization of agricultural and rural development, and this strategic plan also marked the urgent advancement of digital village construction from the exploration to in-depth stage. The construction of digital villages currently is urgent to comprehensively upgrade the level of rural information infrastructure, to promote the digital transformation of production and living infrastructure including water conservancy, highways, and electricity, and to expand the application of the Internet of Things technology in agricultural and rural scenes. Its content includes building a digital agriculture, rural areas, and farmers
collaborative application platform to promote digital applications in production management, circulation marketing, industry supervision, public services, and rural governance. At present, Zhejiang is committed to the development of these aspects, which is also of great significance for accelerating the construction of digital villages and enhancing the inclusiveness of digital economic development. In the future, digitalization will become the strongest engine for development, and the construction of digital villages in Zhejiang will be shown to the world as a window example, that will further give the world an answer with Chinese characteristics for the construction of the world’s villages.

The concept of digital villages has achieved more and more attention in the world. The concept of smart villages has been proposed in some countries for a long time, but the connotation of the two is not clearly distinguished. The basic idea of smart villages in India was to integrate the resources and strength of the community from all aspects and combine it with information technology to provide the community with services such as safety, transportation, health, and social governance [3]. Pinto-Correia et al. [4] proposed that rural areas are undergoing a process of multi-functional transformation. These driving forces, including rural consumption and protection, urgently need a new relative balance. In Indonesia, the smart villages were defined as an innovative development form under the national development planning system, through the strengthening of rural human resource development, in which the use of information technology to promote the efficient development of various economic sectors is used to achieve sustainable urban and rural development [5]. The EU’s smart villages initiative is driving improvements in the lives of rural residents. Scholars thought that smart agricultural technology must be given priority to effectively develop a smart rural system [6]. A case study of Poland put forward that the construction of smart villages is directly dependent on the specific land structure of a certain region, which can greatly affect the possibility of smart development of a region [7]. Stojanova et al. [8] investigated the construction of smart villages in 6 different EU Member States and provided key policy findings and recommendations for future research.

According to the existing literature, rural development mainly focused on rural revitalization, such as land spatial reconstruction [9], rural e-commerce [10,11], rural tourism [12], and so on. Some scholars devoted themselves to investigate very novel points. For example, Kamruzzaman et al. [13] conducted a study on the relationship among rural group mobility, carbon dioxide emissions, and social exclusion. In the aspect of digital economy, the main research is based on the application of digital economy to construct the relevant index system and measure the development status of digital economy. However, the practical application of digital technology in agriculture and rural areas is less studied. China’s Information Center of the Ministry of Agriculture and Rural Affairs constructed 6 first-level indicators, 15 s-level indicators, and 20 third-level indicators, including development environment, environmental support, production informatization, management informatization, rural governance informatization, and service informatization, when evaluating the development level of digital agriculture and rural areas in counties across the country [14]. In addition, digital rural construction mainly includes research on implementation paths and countermeasures or empirical conclusions of regional project research. Guo et al. [15] analyzed the practice of digital village construction in Beijing and provided countermeasures and suggestions for the development of digital villages. Li et al. [16] interpreted the planning path and implementation results of German rural digitization projects under the framework of integrated development through a rural digitization practice case in the Lipp region of East Westfalen, Germany. In combination with the key tasks of the next stage of digital rural development in China, researchers proposed several relevant suggestions. Su et al. [17] measured the overall and sub-dimensional levels of farmers’ practical participation from the perspective of digital rural construction. They still explored the phased characteristics of farmers’ practical participation, internal and external driving factors, and their differences in influence. In the early years, the research of sustainable rural development focused mainly on the development of agriculture [18]. With the changes of time, it began to develop into the progress of rural urbanization, agricultural
technology [19], new rural finance [20], etc. Now, digital village construction will be a new direction to break through the sustainable rural development, and it will balance the mechanism of various interests. A new generation of information and digital technology are being transformed into new production enterprises and governance’s tools, providing unprecedented opportunities to promote sustainable rural development.

The rapid development of science and technology has brought opportunities to the construction of digital villages. Therefore, it has become a hot topic on exploring the construction of digital villages and building a harmonious home in recent years. However, many investigations on digital rural construction mainly focus on the national macro level or the micro level of a small scope, and the index system of many digital rural construction is not comprehensive enough, with some of the construction indicators such as farmers’ participation or rural ecological environment being ignored. Moreover, few articles have studied the internal mechanism between digital rural construction and other systems. Therefore, it is beneficial for the high-quality development of digital villages to excavate the coupling and coordination relationship among multiple systems.

In order to make up for the deficiencies of existing research, this article will expand the construction of digital villages from the following aspects. Firstly, this research builds an index system to measure the development level of digital villages based on the goal of digital rural construction. This index system innovatively incorporates the two influencing factors of human and environment and examines the development level of digital villages in more detail from multiple angles. It is worth mentioning that many concepts have only been put forward in recent years, such as beautiful villages, etc. Therefore, the research is very novel and the available data years are relatively short. Secondly, considering the relationship between digital villages and other influencing factors, the level of rural financial development and technological innovation in Zhejiang is calculated. Finally, we thoroughly explore the coupling and coordination effects of Zhejiang’s digital rural construction, financial development, and technological innovation to improve efficiency and achieve sustainable development of the three. At the same time, this can also provide a useful recombination for the construction of the world’s digital villages.

The remainder of the paper is organized as follows. Section 2 gives the research framework of this article. Section 3 presents the research methods. Section 4 discusses the data processing and numerical results. Finally, Section 5 concludes the research and gives policy suggestions.

2. Research Framework

2.1. The Connotation of the Digital Villages

The rural revitalization strategy was first proposed in China in 2018, and it vowed to fully construct digital villages by the middle of the century in 2019. Digital rural construction is an endogenous process of agricultural and rural modernization development and transformation with the application of network, information, and digitization in agricultural and rural economic and social development, as well as the improvement of farmers’ modern information skills [21]. Digital villages deeply integrate big data with rural ecological revitalization, and promote the digitization of ecological resources, efficient environmental governance, intelligent green production, and comprehensive revitalization of the villages.

2.2. Area Selection

In this article, we take Zhejiang as an example and investigate the coupling and coordination relationship among digital rural construction, finance, and technology. Zhejiang consists of 11 prefecture-level cities, which are divided into five regions: eastern Zhejiang, southern Zhejiang, central Zhejiang, western Zhejiang, and northern Zhejiang. Zhejiang has carried out the development strategy of digital villages and accelerated the construction of digital villages. It has set an example in improving rural infrastructure, transforming rural governance mode, building beautiful villages, and cultivating farmers’ digital literacy.
According to the 2020 report of the Information Center of the Ministry of Agriculture and Rural Affairs, the development level of digital villages in Zhejiang was in the leading position in China with the development level at 68.8% [14]. Zhejiang will shoulder the responsibility of fully displaying the “important window” of the socialist system with Chinese characteristics in the new era and highlight the advantages of Chinese characteristics with the practice of the province. Taking Zhejiang as the research object and going deep into the county areas will show the advancement of digital rural construction and affect the development direction of digital rural construction in the whole country. From this point of view, it is of special significance to study the digital rural construction in Zhejiang. The specific map is shown in Figure 1 below.

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2.3. Construction of Digital Villages Index System

Based on the above connotation and construction goals of digital villages, we refer to the index system of the Information Center of the Ministry of Agriculture and Rural Affairs [14] and add the characteristics of the development of digital villages in Zhejiang (Zhejiang Rural Revitalization Report 2019). We construct the evaluation index system of digital villages, which includes technology agriculture, wise farmers, beautiful villages, digital economy, infrastructure, and rural governance. The relationship between indicators has been listed in Table 1, and there are 6 first-level indicators and 18 s-level indicators.
Table 1. Index system of development level of Zhejiang digital villages.

| Objective                  | First-Level Index                  | Second-Level Index                                      | Unit                  | Variable |
|----------------------------|------------------------------------|--------------------------------------------------------|-----------------------|----------|
| Technology agriculture     | Total power of agricultural machinery | Ten thousand kilowatts                                  | X1                    |          |
|                            | Contribution rate of agricultural technology progress | %                                                      | X2                    |          |
|                            | Rural electricity consumption      | Billion kilowatts                                       | X3                    |          |
| Wise farmers               | Per capita disposable income of rural residents | Yuan                                                   | X4                    |          |
|                            | Number of farmers trained          | Ten thousand people                                     | X5                    |          |
|                            | Number of rural cultural auditoriums constructed | People                                                | X6                    |          |
| Beautiful villages         | Scalar amount of agricultural chemical fertilizer application | Ten thousand tons                                     | X7                    |          |
|                            | Coverage rate of rural household waste classified | %                                                      | X8                    |          |
| Digital villages           | Number of rural public toilets     | Thousand seats                                          | X9                    |          |
| Digital economy            | Rural service industry output value | 100 million yuan                                        | X10                   |          |
|                            | Online retail sales of agricultural products | 100 million yuan                                      | X11                   |          |
|                            | Number of Taobao Villages          | Number                                                 | X12                   |          |
| Infrastructure             | Total length of rural delivery lines | Kilometer                                              | X13                   |          |
|                            | Population rate of farmers meeting drinking water safety standards | %                                                      | X14                   |          |
|                            | Number of agricultural IoT bases   | Seats                                                   | X15                   |          |
| Rural governance           | Video surveillance coverage in rural public areas | %                                                      | X16                   |          |
|                            | Rural general practice grid coverage | %                                                      | X17                   |          |
|                            | Comprehensive disclosure level of the three rural affairs | %                                                      | X18                   |          |

(1) Interpretation of the indicator of technology agriculture

Technology facilitates the high-quality development of agriculture and improves the efficiency and competitiveness of agriculture, which is the fundamental driving force for digital villages. Considering the quantifiable indicators, technology agriculture indicator selects three second-level indices of the total power of agricultural machinery, the rural electricity consumption, and the contribution rate of agricultural scientific and technological progress. The full application of technology to agriculture has made it a qualitative leap, laying a solid foundation for the construction of digital villages.

(2) Interpretation of the indicator of wise farmers

Farmers are the main participants in the practice of digital village construction and play a decisive role in the construction of digital villages. Their scientific and cultural level, ideological and moral level, etc. will affect the construction of digital modernization in the countryside. Therefore, the smart farmer indicator selects three second-level indices of the per capita disposable income of rural residents, the number of farmers trained, and the construction of rural cultural auditoriums. Among them, the construction of the rural cultural auditorium is a new landmark of the rural cultural spirit of Zhejiang, which has strengthened the integration and innovation of traditional folk culture and modern civilization.
(3) Interpretation of the indicator of beautiful villages

A good ecological environment is a valuable asset in rural areas, and it is also a part that cannot be ignored in the process of rural revitalization. The beautiful village indicator selects three second-level indices of the scalar amount of agricultural chemical fertilizers, the coverage rate of rural household waste classified, and the number of rural public toilets. As an important birthplace of beautiful village construction, Zhejiang has continued to promote the “toilet revolution” in recent years, implement rural domestic waste classification and other work, and has always adhered to a green and coordinated rural development model. Therefore, the indicator of the beautiful villages is a very competitive indicator in the study.

(4) Interpretation of the indicator of digital economy

The indicator of digital economy selects the output value of rural service industry, the online retail sales of agricultural products, and the number of Taobao villages as three second-level indexes. The output value of rural service industry reflects the optimization of rural industrial structure. Rural e-commerce is an important part of the digital economy. It is the product of the deep integration of rural economy and e-commerce and plays a positive role in promoting the development of rural economy, solving farmers’ employment and entrepreneurship, and promoting industrial development. In addition, Zhejiang has more than 1700 Taobao villages, ranking first in China [22]. Zhejiang rural e-commerce development continues to maintain a rapid trend, which is an important carrier of urban and rural integration development. Thus, the rapid development of the digital economy is also an important indicator for the construction of digital villages in Zhejiang. The rapid development of the digital economy in Zhejiang is also an extremely competitive indicator in the digital village.

(5) Interpretation of the indicator of infrastructure

The infrastructure indicator selects three second-level indices of the total length of rural delivery lines, the population rate of farmers meeting drinking water safety standards, and the number of agricultural IoT bases. Once the infrastructure lags, it will certainly restrict the construction and development of the village. Rural transportation, post- and telecommunications, drinking water safety, and backward Internet of Things infrastructure will hinder the construction of digital villages. At present, the rural 5G base stations in Zhejiang are also being built, which will better build a new generation of digital infrastructure network, contributing to the optimization of digital rural construction.

(6) Interpretation of the indicator of rural governance

The rural governance indicator selects three second-level indices of the video surveillance coverage in rural public areas, the rural general practice grid coverage, and the comprehensive disclosure level of the three rural affairs to reflect the level of rural governance ability in digital rural construction. Rural revitalization cannot be separated from safe villages. Full coverage of video surveillance in rural public areas is conducive to providing a good public security environment in rural areas. Transparency in rural affairs helps to stimulate rural supervision and management. Grid governance in rural areas takes grid as the unit, establishes management and service teams, applies information management, extends service functions to the end, and maintains social harmony and stability from the source. During the COVID-19 epidemic, Zhejiang implemented the management through big data investigation and grid, giving full play to the huge role of grid in epidemic prevention and resumption of work.

3. Methodology

3.1. Internal Mechanism

Financial development and technological innovation are the two indispensable elements to accelerate rural revitalization. On the one hand, the strategic framework of financial development to help rural revitalization has been initially established, including
the continuous improvement of the rural credit guarantee system with agricultural credit guarantee companies as the leader, agricultural-related guarantee companies as the support, and village-level mutual guarantee organizations as the supplement. In addition, industrial and commercial capital is accelerating to attract more and more outstanding enterprises to settle in beautiful villages and participate in rural revitalization. Financial development also has a direct impact on technological innovation, and with the continuous improvement of the institutional environment, the promotion of scientific and technological innovation is more and more obvious. This article selects the balance of agriculture-related loans and the balance of farmers’ loans to measure the indicator of financial development level. On the other hand, technological innovation can drive rural revitalization actions, especially the construction of digital villages. A number of digital technologies and industries, such as mobile payment and digital factories, are accelerating the layout of rural areas. Digital villages from conceptual design into reality, rural production, and lifestyle is setting off a digital revolution. In this article, the number of patent applications and the number of patent grants are selected to comprehensively measure the ability of technological innovation.

The links among the three systems of financial development, technological innovation, and digital villages are very complex. The coupling and coordination analysis has the advantage of being able to deal with the complex relationship among multiple systems. Therefore, we can investigate the complex relationship among the three systems by this method. The coupling of this article refers to the phenomenon that the financial development level, technological innovation ability, and digital rural construction of Zhejiang influence each other through various interactions. The coupling degree is studied to understand the degree of interaction between the three systems. The higher the degree of coupling coordination among the three systems, the higher the efficiency of the system operation will be, and the vigorous vitality will be maintained. On the contrary, if the systems are not coordinated, stagnation or regression may occur. Based on this, this article will study the coupling and coordination relationship among the three systems to provide useful reference for realizing the coordinated development of a digital rural construction system. Refer to Figure 2 for the specific three-dimensional internal drive mechanism.

Figure 2. The coupling mechanism of finance, technology, and digital villages.

3.2. Determination of Index Weights

(1) Data Standardization
In order to eliminate the effects of different units of variables and different data sizes, we first standardize the data.

For indicators that are superior to the larger, the data has a positive effect, and the calculation formula is as follows:

\[ r_{ij} = \frac{x_{ij} - \mu_{i} n(x_{ij})}{\max(x_{ij}) - \mu_{i} n(x_{ij})} \]  

(1)

For indicators that are better for small ones, the data has negative power, and the calculation formula is as follows:

\[ r_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \mu_{i} n(x_{ij})} \]  

(2)

Note that the normalized results may be equal to zero, therefore the following transformation is necessary:

\[ r_{ij}^{'n} = r_{ij} \times 0.99 + 0.01 \]  

(3)

(2) Entropy Method
It is well known that the entropy method has the advantage of assigning weights based on the amount of information transmitted by the indicator itself. In addition, the entropy method also has the function of weakening or strengthening the attribute parameters with different values. That is, the contribution of attributes with little difference in value to the comprehensive index is weakened. The contribution of attributes with large difference in value to the comprehensive index is strengthened, so that all kinds of information can be reflected more comprehensively. We then give the formula of entropy.

When there are \( m \) indicators and \( n \) evaluated objects, the entropy of the \( i \)th indicator is defined as:

\[ H_i = \frac{1}{\ln n} \sum_{j=1}^{n} p_{ij} \ln p_{ij} \]  

where \( p_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}} \) is the probability of the \( j \)th evaluated object under the \( i \)th indicator.
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    r_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})}
\]

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When there are \( m \) indicators and \( n \) evaluated objects, the entropy of the \( i \)th indicator is defined as:

\[
    H_i = -\frac{1}{\ln n} \sum_{j=1}^{n} f_{ij} \ln f_{ij}, i = 1, 2, \ldots, m
\]

(4)

where \( f_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}} \), let \( f_{ij} \ln f_{ij} = 0 \), if \( f_{ij} = 0 \).

(3) Index Weights

\[
    w_i = \frac{g_i}{\sum_{j=1}^{n} g_{ij}}, i = 1, 2, \ldots, n
\]

(5)

where \( g_i \) is the difference coefficient of the \( i \)th index, that is \( g_i = 1 - H_i \). The difference coefficient of each index reflects the difference of each index in each year.

3.3. Coupling and Coordination Models

Based on the study of coupling degree calculation in Liu [23], we consider the calculation formula of coupling degree of three systems, and the coupling degree function is as follows:

\[
    C^t = \sqrt[3]{\frac{u_f^t \times u_n^t \times u_d^t}{u_f^t + u_n^t + u_d^t}^3}
\]

(6)

where \( C^t \) is the coupling degree in the \( t \) year, and \( u_f^t, u_n^t, u_d^t \) represent the efficiency of three subsystems of finance, technology, and digital villages, respectively. The coupling degree can only judge the degree of interaction between systems but cannot describe the degree of coordinated development between systems. Therefore, the coordination degree model
should be added on the basis of the coupling degree model. Using this model can provide in-depth analysis of the three-dimensional synergy situation. The coupling coordination degree is expressed as follows:

\[
D^t = \sqrt{C^t \times T^t}
\]  

(7)

\[
T^t = a \times u^t_f + b \times u^t_u + c \times u^t_d
\]  

(8)

where \(D^t\) represents the coupling coordination degree of the total system in the \(t\) year. \(a\), \(b\), and \(c\) are three undetermined parameters, representing the contribution degree of the subsystem to the total system. In this article, taking \(a = b = c = 1/3\), we define the three dimensions of the coordinated development of the relevant evaluation criteria as shown in Table 2 below.

Table 2. Evaluation criteria of coupling coordination degree.

| Coupling Coordination Degree | 0.000–0.199 | 0.200–0.399 | 0.400–0.599 | 0.600–0.799 | 0.800–1.000 |
|------------------------------|-------------|-------------|-------------|-------------|-------------|
| Completely uncoupling        | Almost uncoupling | Low coupling | Moderate coupling | High coupling |
| Dysregulated decline type (Unacceptable interval) | Intermediate transition type (Rivalry interval) | Coordinated lifting type (Acceptable interval) |

4. Data Processing and Numerical Results

The data in this article are from the Zhejiang Statistical Yearbook, Zhejiang National Economic and Social Development Bulletin, Zhejiang Natural Resources and Environment Statistical Yearbook, and Zhejiang Rural Revitalization Report. According to the evaluation index system of digital rural construction, this article selects data from 2016 to 2019 in consideration of research objectives and data integrity. We use linear interpolation to supplement the missing data, and apply the entropy method to calculate the weight of each index. The comprehensive development level of each subsystem is obtained, which is shown in Tables 3–5 and Figure 3. The results show that the indicators of infrastructure, beautiful villages, and digital economy play an important role in the development of the system. Then, the coupling and coordination degrees of the three systems are calculated respectively. The results are shown in Table 6.

Table 3. Index weights of digital rural construction.
Table 4. Comprehensive evaluation results of digital rural construction.

| Year | Technology Agriculture 0.62 | Wise Farmers 15.70 | Beautiful Villages 22.89 | Digital Economy 18.55 | Infrastructure 39.22 | Rural Governance 4.02 | Results (%) |
|------|-----------------------------|-------------------|--------------------------|----------------------|----------------------|----------------------|-------------|
| 2016 | 0.8229                      | 0.0057            | 0.0258                   | 0.2377               | 0.0508               | 0.0258               | 7.64        |
| 2017 | 0.7561                      | 0.0073            | 0.0297                   | 0.2612               | 0.0743               | 0.0340               | 9.09        |
| 2018 | 0.7421                      | 0.0096            | 0.0372                   | 0.3706               | 0.1545               | 0.0406               | 14.41       |
| 2019 | 0.7153                      | 0.0102            | 0.0431                   | 0.4872               | 0.1887               | 0.0422               | 18.01       |

Table 5. Comprehensive evaluation results of finance and technology.

| Year | Financial Classification Indicators | Results (%) | Technology Classification Indicators | Results (%) |
|------|-------------------------------------|-------------|--------------------------------------|-------------|
|      | Balance of Agriculture-Related Loans 24.55 | Balance of Farmers' Loans 75.45 | Number of Patent Applications 24.16 | Number of Patent Grants 75.84 |
| 2016 | 0.6721                              | 0.0100      | 0.7419                               | 0.0317      |
| 2017 | 0.7532                              | 0.0552      | 0.6756                               | 0.0100      |
| 2018 | 0.8506                              | 0.1169      | 0.7400                               | 0.2928      |
| 2019 | 1.0000                              | 0.2045      | 0.9185                               | 0.2959      |

Figure 3. Development level of digital villages, finance, technology, and comprehensive value.

Table 6. Coupling coordination degree of digital rural construction from 2016 to 2019.

| Year | C | D |
|------|---|---|
| 2016 | 0.9216 | 0.3727 |
| 2017 | 0.9342 | 0.3899 |
| 2018 | 0.8976 | 0.5203 |
| 2019 | 0.9293 | 0.5638 |

As can be seen from Figure 3, the subsystem of digital rural construction, the subsystem of financial development level, and the comprehensive development level of the three all show a steady upward trend. However, there are two stages of decline in the technology innovation, including 2017 and 2019. The technological innovation ability increased rapidly from 17.08% in 2017 to 46.37% in 2018, achieving a qualitative leap, while it basically remained slightly declined in 2019. The level of financial development continues to strengthen, and it has almost linear growth trend. Digital rural construction slowly fluctuated, among which there was a relatively obvious growth from 2017 to 2018.

Through the research on the development of digital rural construction, financial development level, and technological innovation ability in Zhejiang, the financial development...
level played a leading role in the overall system development for four years. The development was rapid and stable, and played a direct role in the digital rural construction and the improvement of technological innovation ability. The growth of technological innovation accelerated in 2018, showing a strong upward trend. The comprehensive development level of the three systems is consistent with the rising trend of digital rural construction. Therefore, the overall development needs to rely on the development of digital rural construction.

As can be seen from Table 6, the coupling degree among the three subsystems increased and then decreased slightly, reaching a low point of 0.8976 in 2018, but it was still a high level of coupling. However, the degree of coordination is generally low. This is because when the results of several comprehensive development levels are low, the pseudo-result of high coupling degree will occur. Therefore, from the perspective of the degree of coordination, the period from 2016 to 2019 generally contains two stages. From 2016 to 2017, it was in a state of slight imbalance, and from 2018 to 2019, it reached a state of dysregulated decline with almost uncoupling. From the general situation, it showed that 2018 was an important time point of improvement and the degree of coordination continued to rise, and the implementation of rural revitalization strategy was effective. This phenomenon is also due to the fact that the Ministry of Agriculture and Zhejiang jointly signed the cooperation agreement on rural revitalization demonstration province, making Zhejiang the only one in China. The joint construction has promoted the continuous emergence of fresh Zhejiang experience in the field of rural revitalization from then on.

According to the above methods, the development results of digital rural construction at the county level in Zhejiang are shown in the Figures 4 and 5 below.

Figure 4. Coupling and coordination degree of digital villages construction in 2016.
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According to the above methods, the development results of digital rural construction at the county level in Zhejiang are shown in the Figures 4 and 5 below.

**Figure 4.** Coupling and coordination degree of digital villages construction in 2016.

**Figure 5.** Coupling and coordination degree of digital villages construction in 2019.

Figures 4 and 5 compare the changes in the degree of coupling and coordination of digital village construction in prefecture-level cities in 2016 and 2019. Although none of the cities in Zhejiang has reached a high degree of coupling, the construction of digital villages has developed significantly after several years. Central Zhejiang was low coupling in 2016, while it reached a moderate coupling situation in 2019. Wenzhou, located in southern Zhejiang, was almost uncoupling, while it reached low coupling in 2019. The plains-dominated northern and eastern Zhejiang, except for the island counties and cities of Zhoushan, all have reached the moderate coupling stage. However, the digital village construction infrastructure in western Zhejiang, which is located in a mountainous and hilly environment, is backward. The topography of the county also has a great influence on its rural construction and development, so it should be developed according to local conditions.

In summary, the overall construction of digital villages in Zhejiang is still between the low and moderate levels, and its coordination needs to be further improved.

### 5. Conclusions and Policy Suggestions

This article constructs the evaluation index system of digital rural construction from multiple perspectives and comprehensively. Through calculation, it shows that the indicators of infrastructure, beautiful villages, and digital economy play an important role in the development of the system. At the same time, these indicators are also very competitive that distinguish Zhejiang from other regions. Based on the coupling coordination degree model, the results of Zhejiang are obtained as follows: First, in rural revitalization, the level of financial development occupies a relatively important position, and the influence of regional innovation is constantly strengthened. Then, the comprehensive level of development mainly depends on digital rural construction. Finally, the three systems of digital rural construction, financial development, and technological innovation have changed from an almost uncoupling stage to a low coupling stage. As digital village construction continues to strengthen, coordination degree will also rise. In the future, with the gradual deepening of rural revitalization strategy and digital rural construction, as well as the gradual development of rural finance and science and technology, high-quality coordination among the three systems will surely be achieved.

Based on the conclusions, we propose the following four specific suggestions. First, improve rural infrastructure conditions and accelerate the digital and intelligent transfor-
formation of rural infrastructure such as water conservancy, roads, electricity, logistics, and 5G to support the application of information technologies such as the Internet of Things and big data in rural construction. Second, digital rural construction should increase the forms and channels of loans for farmers and enterprises. Use digital technology to promote the popularization of financial services in rural areas, and promote the use of mobile banking in rural areas. Third, foster and strengthen new forms of digital economy such as rural e-commerce, smart logistics, village broadcasting, cloud farming, and rural areas with distinctive features. Finally, adhere to the concept of innovative, coordinated, green, open, and shared development, give priority to ecology, and build beautiful villages.

The above conclusions put forward meaningful theoretical and policy suggestions. The existing literature on digital rural construction rarely explores the influence of other systems, and the definition of digital villages seldom includes people and rural ecology. In this article, Zhejiang, as an example of the study, has good demonstration effect, and the multi-system coupling method compensates for the previous single element research method. At the same time, wise farmers and beautiful villages are also included in the digital rural index system, which can evaluate the development level of digital rural construction more scientifically and reasonably. Therefore, this article is an academic supplement to the existing research. In the next step of research, digital village construction in poor areas should be considered. Due to data limitations, longer-term data will be obtained in the future with the promotion of digital rural construction. Combined with the ideas of this article, it can provide a definite direction for the construction and development of digital villages.

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Abbreviations

GDP Gross Domestic Product
COVID-19 Corona Virus Disease 2019

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