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Article

Bridging the urban-rural information gap: A case study of digital rural construction in Yunnan Province

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Abstract: As one of the key initiatives promoted by the Chinese government, precision poverty alleviation aims to lift information-blocked areas out of poverty and ensure their sustainable economic development. Yunnan Province, characterized by its combination of old, young, border, and poor areas, is the province with the most diverse types of poverty, the widest poverty coverage, and the deepest poverty levels in the country. Yunnan has carried out anti-poverty work in tandem with the national efforts for 42 years in a planned and organized manner, ultimately achieving the goal of zero absolute poverty. In this process, digital rural development has played a very important role. Based on the current experience of digital construction in developed regions, completing regional digitalization requires meeting the needs of information resources, information environment, and information supply and demand. Through keyword search, text analysis, and field visits, we summarized the factors considered by local governments in policy formulation. We also attempted to map out the path for rural governments to build digital villages. With the ultimate goal of bridging the urban-rural gap, the study of digital rural development in Yunnan will provide an effective case.

Keywords: information gap; TF-IDF extraction algorithm; digital rural development

1. Introduction

The concept and practice of modern digital governance originated in economically developed regions, driven by the paradigm shift in digital technology and economics during the digitalization process (Nadiia et al., 2016). Traditional regional digital governance requires a vast amount of data resources, hardware infrastructure, and talent reserves as its development foundation. This ensures that digital governance can continuously evolve and secure ongoing financing for development. The Kuznets curve reflects how "creation" and "destruction" accompanying economic development alter social and economic structures, impacting income distribution (Martínez-Navarro et al., 2020). In the early stages of economic development, income distribution tends to become more unequal as the economy grows.

The issue of the digital divide exacerbating wealth disparities is particularly pronounced in the impoverished rural areas of Yunnan Province, China. Analyzing from the Kuznets Curve Theory, the overall poverty in Yunnan will cause a gap in overall social development compared to more developed regions for a period of time. At the same time, the digital industry has a relatively obvious agglomeration effect. After proposing digital construction, Yunnan Province has primarily focused on the provincial capital, Kunming which accounts for 27.58% of Yunnan's GDP. Meanwhile, the overall level of rural digitalization is low, and the progress and results

are not very satisfactory. The development of agricultural and rural digitalization is notably unbalanced and insufficient. Additionally, due to the lack of sufficient funds in rural local governments, infrastructure development is lagging (Xing and Lu, 2010). The uneven terrain of Yunnan Province leads to high road construction costs and long travel times, causing transportation inconveniences. These factors present significant challenges for village and town governments in Yunnan Province when promoting rural digitalization.

Therefore, without government intervention, economically backward regions will inevitably experience an "information gap" with economically developed regions. This "information gap" amplifies the "economic gap", leading to further widening of regional development disparities (Alp and Baycan, 2024). At present, research on reducing the information gap is mainly focused on more developed rural areas. There is little research on digitalization in poor rural areas, and the government is only one factor. Reducing the wealth gap is one of the key initiatives promoted by the Chinese government, putting significant performance pressure on local governments in Yunnan Province. The absence of strong enterprises in rural areas results in a lack of market and research and development capabilities for digital construction (Tang and Yang, 2011). However, at the same time, local governments in Yunnan have received substantial special grants. How to lift information-blocked areas out of poverty and ensure their sustainable economic development has become a crucial issue that rural governments must address in policy formulation and implementation.

This research lies in explaining why Yunnan Province is able to promote the construction of bridging the information gap and the role it plays in the construction. Therefore, we chose to text through documents. We would look at the problems that the government is trying to solve in the construction from the government's point of view. We collected 42 government reports from March 2020, when the Yunnan Provincial Government issued its first policy on digital rural development, to December 2023. We attempted to identify and summarize the characteristics and processes of digitalization in towns and villages Through keyword searches and content comparisons of the literature. Afterwards, in order to confirm the results of the construction, we made field visits to 12 rural digitalization in the area. We conducted field visits and finally summarized the policy effects based on the current state of digital construction and provided an outlook for the future.

2. Research background

In urban areas of mainland China, digital communication has become an indispensable part of daily life. With the further development of information technology, digital management has been widely applied in eastern cities. Digital technologies and industries represented by 5G, industrial internet, the Internet of Things (IoT), big data, cloud computing, and AI technology have been integrated into government governance (Hassan and Awad, 2018). However, compared to traditional industries, these governance methods require significant investment and personnel development, with stringent infrastructure requirements. Therefore, the digitalization experience of cities cannot be simply transferred to rural areas.

The crucial challenge to overcome is to summarize and innovate the experience of digital governance, combine it with the local needs of rural areas, and truly bring the fruits of the technological revolution to underdeveloped regions in the process of achieving digital rural construction.

Compared to developed regions, these areas generally have lower education levels, limited information exchange, and industries primarily focused on primary agricultural products (You and Nie, 2024). These factors lead to weaker competitiveness in rural regions, with residents having less knowledge of electronic tools such as mobile phones computers (Agustin et al., 2022). Ultimately, this results in an information disadvantage in competition, making it difficult to ensure economic self-sufficiency.

From our summary, we can conclude that villages and towns in Yunnan Province will face the following challenges: lack of infrastructure construction; lack of specialized talent; low acceptance of digitalization among residents; and inability to provide supporting information services. In both text analysis and interviews, digital governance repeatedly emerged as a construction goal. Therefore, we also include digital governance as one of the requirements for digital rural construction.

3. Keyword search

3.1. the TF-IDF extraction algorithm

Term Frequency (TF) refers to the number of times a term appears in a target text. A term that appears frequently in a text is not necessarily a keyword, due to the presence of synonyms and substitute words in natural language. Therefore, an adjustment factor is needed to determine the commonness of a term—Inverse Document Frequency (IDF) (Chen et al., 2020). The size of IDF is inversely proportional to the commonness of a term. After obtaining TF and IDF, the product of the two values is the TF-IDF value. The higher the TF-IDF value, the more important the term is in the text (Ao et al., 2020; Sun et al., 2018; Wang et al., 2021).

3.2. The formula

Using Python, it is very convenient to obtain the frequency of word occurrences (term frequency).

$$\mathrm{TF}_{ij} = \frac{n_{ij}}{\sum_k k_j} \tag{1}$$

In Equation (1), n_{ij} represents the number of times term *i* appears in document *j*, $\sum_k k_j$ represents the total number of terms in all above documents.

$$\mathrm{IDF}_i = \log \frac{|D| + 1}{\left|\{j: t \in d_j\}\right| + 1} + 1 \tag{2}$$

In Equation (2), IDF_i represents the frequency of term *i* in the general language corpus. Both the numerator and the denominator in Equation (2) are incremented by 1 to smooth the result and prevent interference from terms that do not appear in the general language corpus.

3.3. Calculation results and analysis

3.3.1. TF-IDF extraction results

After analyzing the 42 government reports, the keywords are ranked by frequency as follows:

Digital rural areas, Rural Revitalization, Information Technology, Agriculture, Rural Areas, Network Facilities, Smart Logistics, Digital Economy, Ecological Protection, Network Culture, Smart Party Building, Governance Capabilities.

The specific values are not disclosed as we have not obtained government permission for public release.

3.3.2. Analysis of results

Analyzing the keywords against each other, we find that the keywords basically coincide with the title of the first policy document issued by the Yunnan Provincial Government. It shows that each lower level local policy is basically formulated around the initial document when formulating the policy. To the higher level documents for the specific implementation of the content of the supplement.

Through further interviews with government officials, we learned the elements of the local government to realize rural digitalization. We drew a **Figure 1** based on the contents of documents and interviews.

Figure 1. Schematic diagram of digital village construction.

Note: SG: Specific goal.

The core lies in solving the "information gap" in rural underdeveloped areas. According to the existing statistical research, the digital gap and poverty have strong spatial autocorrelation, which is directly proportional to the degree of spatial agglomeration, which means that when the information gap is enlarged, the poverty of the local area will be worsened, and with the bridging of the information gap, the

poverty of the local area will be alleviated. Therefore, according to the analysis of modern digitalization governance, the solution to the information gap will be mainly from three aspects.

1) Digital infrastructure development

Modern digitalization development is inseparable from the construction of related hardware facilities, electricity, communication lines, offline server groups, data source construction has been a matter of urgency, but compared to profit-oriented commercial investment, investment in underdeveloped rural poor areas is not a rational choice, therefore, the construction of information roads need to be regulated and planned by the government.

2) Intelligent logistics

Collecting information and transforming it into usable resources is one of the goals of modern digitization, and information can be transformed into useful economic resources by means of digital crawling and digital cleansing. For economically underdeveloped regions, the volume of data is small and the complexity of information is low, so it is more suitable to collect the data to the more developed data centers for processing, and at the same time, according to their own needs, release the request to the upper level data nodes, which will reduce the need for professional and technical personnel, and thus reduce the burden on the local economic policy.

3) Network culture construction

For reasons of economic development, rural populations are often at a disadvantage in terms of access to and awareness of modern information. This reduces the results of digital construction because there is a lack of self-motivated groups that can apply and publicize the government's construction. Therefore, it is necessary to publicize the application of digital construction results to the needy. At the same time, the document issued by Yunnan Province also highlighted the need to prevent the spread of negative information through Internet channels. In particular, it points out the need to prevent children and teenagers in rural areas from becoming addicted to the Internet, and to keep illegal and undesirable information away from children and teenagers in rural areas. The practice of digitized rural construction in Yunnan.

4. Field visits

4.1. The actual situation

Among the underdeveloped regions in China, Yunnan, with the characteristics of being the old, the young, the poor and the marginalized, is the province with the largest number of types of poverty, the widest area of poverty and the deepest degree of poverty in the country. Yunnan and the whole country to fight against poverty at the same time, planned and organized anti-poverty work for 42 years, and finally synchronized to achieve the goal of zero absolute poverty population, in this process, digital rural construction has a very important role.

The reasons for the seriousness of Yunnan's poverty situation can be summarized as geography, ethnicity and industrialization. Yunnan is located in the southwestern border of China, and shares borders with Myanmar, Laos and other Southeast Asian countries. At the same time, most of the western part of Yunnan is situated in the Hengduan Mountains, with steep terrain, while the central and western part is located

in the Yunnan-Guizhou Plateau, with similarly high mountains, and the southern part of the country, which has relatively gentle terrain, is a tropical rainforest (Li and Hua, 2020). So the cost of infrastructure construction, such as transportation and communications, is far higher than that of the plains. Yunnan has a large number of ethnic minorities, most of which retain their own culture and customs, which makes it necessary to combine the poverty alleviation in the region with changes in local customs, resulting in the implementation of policies faced with the lack of cooperation of personnel, language difficulties in communication and so on. Third, Yunnan has a relatively low level of industrialization, with tourism and agriculture as the main industries, and low value-added production, resulting in poor local finances. As of the end of 2018, Yunnan is one of the six provinces with more than a million people in poverty, and is also the province with the largest population in poverty, and is one of the five provinces with a poverty incidence rate of more than 4%, which is much higher than the national poverty incidence rate of 1.7%, and the depth of the poverty area of the "three districts and three continents" of the Nujiang Prefecture, where the poverty incidence rate is close to 15%.

4.2. Mechanisms of rural digital rural construction

From the current experience of digital construction in developed areas, the completion of regional digitalization needs to satisfy the information resources, information environment, information supply and demand, and at the same time, in order to achieve the ultimate goal of poverty alleviation, poverty alleviation in rural areas need to pay attention to the ability to transform information into value, as well as the sustainable development of big data information, only to complete the breakthroughs in the core competence of the two points, in order to sustainably promote the completion of the transformation of digitalization of rural areas and have self-economic bloodshed capacity. Only by accomplishing these two core ability breakthroughs can we sustainably promote rural areas to complete digital transformation and have the ability to create blood for their own economy.

4.2.1. Information resources

Information resources, as one of the important economic resources, has become an important basis for the government to make decisions, the rural poor population due to the information gap, their own government enterprises and individuals have objective barriers to the acquisition and utilization of effective information, resulting in the implementation of information technology construction in the rural underdeveloped and poor areas, the difficulties

4.2.2. Information environment

The overall information infrastructure in rural areas is weak, and due to the constraints of economic development, the popularity of digital terminals is relatively low, and the equipment and psychological awareness of digitalization are limited. After the visit, Yunnan Province has provided special funds for the construction of informationization infrastructure in poor areas, so there is no problem of constraining the construction funds in regular poor areas. Though the precise poverty alleviation has been completed, compared with the people who have been living in digital cities for a long time, the information terminals owned by the people from rural poor areas

and their knowledge of informationization are necessarily limited to simple and basic use, and there are serious obstacles to the flow of information, which is one of the reasons why the digitalization construction is opposed and not cooperated with by the local people in some areas.

4.2.3. Information suppliers and demanders

First, information providers are the producers of information and those who clean and integrate it.

The demander of information is often the rural government, rural enterprises or individuals. The lack of information suppliers and demanders is undoubtedly fatal to rural digitization, which will lead to the lack of internal dynamics of rural digitization.

4.2.4. Analysis of the mechanism of policy operation

Through interviews and consultations with those involved in the front line of poverty alleviation, we have compiled a list of ways in which the government hopes to achieve this. In order to make the construction of digitalized rural areas truly realize the development of productivity, it is necessary to make use of the policy and the market to build a complete and sustainable rural information market, and to strengthen the ability to transform information into productivity.

In order to cope with the situation of single access to information in poor traditional rural areas, the core is to broaden the channels and methods of access to information, which should be implemented gradually, from traditional digital media such as radio and television, to gradually guide individuals or rural enterprises in need to use mobile terminals such as computers and cell phones, and gradually guide local people to understand the changes in modern communication technology and gradually accept the development of new types of digitalization from the demand side of the market. digitalization development. From the supply side, it is necessary to guide the platforms that can provide more sales channels to help expand sales channels in poor rural areas, and secondly, local people should be guided to provide online knowledge and consumption information, so that each household can be connected to the terminals of digitalization to help the poor.

The second is to realize the efficient transformation of rural information and production. As a matter of fact, because the less developed rural areas often have a unitary productivity structure, mainly in agriculture, but agriculture is not the core cause of poverty; the core cause also lies in the supply and demand sides. First of all, due to geographical constraints or personnel and planting technology is not developed, resulting in their own output is limited; secondly, due to the single market model, the traditional bazaar has not been able to meet the demand for modern high-speed information exchange, and because agriculture needs time to plant crops, the results of the output and the market demand is naturally asynchronous, so the ability to accurately grasp the predictions of the agricultural information has a higher demand. With the use of intelligent logistics, can greatly expand the scale of the rural agricultural trade market, from supply and demand is not right to “on-demand to find supply” or “supply and demand booking”, so that the rural sales and market can be guaranteed to reduce the lack of market leading to This will ensure that the marketing channels and markets in the countryside are guaranteed, and minimize the situation of

agricultural products suffering losses instead of great harvests due to insufficient markets.

In the end, the best way to relieve people in poor rural areas of their fear of or resistance to digitization is not through teaching and guidance, but through mature market-oriented operation, which can practically improve people's lives. This requires policymakers to tailor their policies to the needs of specific regions, capitalizing on their strengths and avoiding their weaknesses. Undoubtedly, the level of local governance also puts forward higher requirements, so the provision of accurate and reliable data to the local government has also become a necessary task to realize digital governance. The specific process is shown in **Figure 2**.

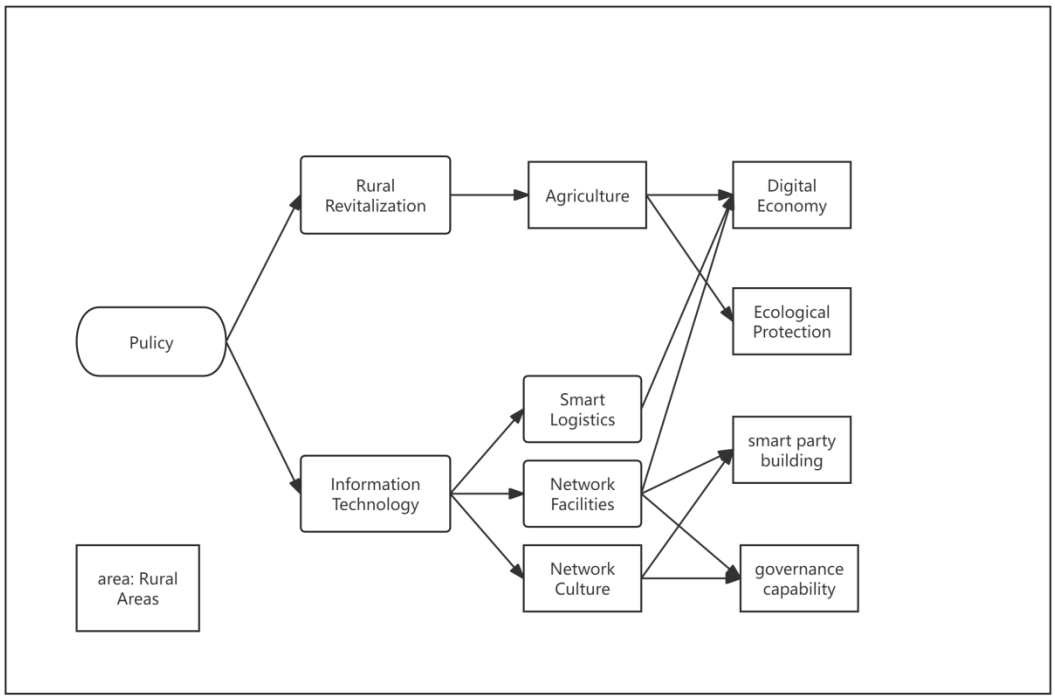

Figure 2. Flowchart of digital village construction.

4.3. New technology breaks through the digital divide

At present, with the continuous development of new digital technology, digital technology is integrated in large and medium-sized cities, and at the same time, because the digital infrastructure requires a high amount of financial and human resources investment in the early stage, which has led to the fact that the "digital divide" between urban and rural areas continues to widen.

In order to cope with this real problem and solve the development problems of underdeveloped rural areas, it is necessary to have a more complete and accurate grasp of the overall situation of the countryside, and with the development of technology. This problem has been technically broken through.

In the interview, the staff used land surveying as a case study to tell us how new technology can improve agricultural production. At the same time, they also said that the traditional model of poverty alleviation has a big problem in filing information of local geographic information personnel. The government is also expanding the information on the actual situation of rural areas while implementing the digital village

construction. This will facilitate the government's management and judgment. At present, the new technology is mainly used in geographic information exploration, soil research, meteorological research, etc., the use of drones, meteorological satellites and other modern high-tech means can effectively play a digital poverty alleviation convenience; second, the data archived in the nearby big data centers for processing, from the point of view of financial efficiency, can be used in developed areas have been completed to carry out the data storage and computing, at the same time, due to the development of modern e-government, the data storage and computation, the data storage and computing (Chen et al., 2018). At the same time, due to the development of modern e-government, the formulation and handling of government affairs can be completed in other places, reducing the financial pressure of less developed regions (Kassen, 2021). For regions with advanced information technology, it is possible to collect more regional government affairs and local information, so that the further completion of the data integration can enrich the relevant contents of the database and make preparations for the potential investment in the future. Third, the completion of the modernization of rural development can open the way for the network of e-commerce, to help the countryside to open up a new demand market, can encourage local residents to further develop production to meet a greater number of needs, not only to increase the local income of the countryside, but also to enable urban residents to enjoy more fresh and high-quality agricultural products, in the rural revitalization plan to form a positive interaction. Fourth, the expansion of rural cultural resources, "the old, the young, the poor" and other areas with their own unique cultural characteristics, can use the Internet to publicize, to a certain extent, linked to the use of tourism and cultural needs of the surrounding towns.

Due to the digital divide makes the gap between urban and rural areas further widened, resulting in information "disconnection", the gap between urban and rural areas is not only manifested in the economic gap, but also manifested in the inhabitants of the cognitive existence of a huge information gap. If you can not well bridge the gap between urban and rural areas, will lead to further increase the gap between urban and rural productivity. On the contrary, if you can make extensive and effective use of modern communications equipment, modern agricultural technology, as well as modern digital market to complete the entire process of agricultural production digitization. Need to do this, there is no way to do without an accurate grasp of the local water and heat conditions, climate conditions and other factors, there is no way to do without the support of modern big data technology, will be similar to the conditions of the database into a comprehensive analysis, can greatly expand the development of agricultural information technology. At the same time, rural digitalization can provide local people with more horizons, allowing local people not only limited to local development, can be more intuitive impression of the development of other areas of the city, providing more possibilities for the development of local people.

5. Conclusion

Digital rural construction serves China's proposed rural revitalization plan. It is a concrete manifestation of that plan. The core of the digital rural construction policy

lies in tapping the potential of social productivity and reflecting the original complicated information efficiently and intuitively to the people who need it. The revitalization of rural areas will be guided by both agricultural policy and IT policy. Based on the above reasoning, the digital rural construction policy can be divided into two parts: improving agricultural production and building information technology. Then, corresponding solutions are proposed for different purposes. However, the samples in this study are specific. The underdeveloped economy of Yunnan Province may weaken the role of enterprises in digitalization. Therefore, it would be more meaningful to be able to compare it with better developed rural areas.

From the experience of current practice, the digitalized rural construction has had a greater impact on the traditional mode of governance, and a lot of misuse has occurred, especially in rural areas. But there is still a distinction between the specific implementation of government policies and the formulation of policies. Although site visits were included in this study, there may still be a large gap between the actual construction and the expected situation. The difficulty in recognizing the effect of the policy has also led to financial waste in policy implementation by local governments. Digitization for the sake of digitization has resulted in a waste of valuable local finances. It is also difficult to summarize the process of digital rural construction into a common general formula, which makes the policy implementation of digital rural construction face a lot of practical difficulties. However, with the growing maturity of digital construction and the increasing number of successful cases, it shows the great potential of digital rural construction in the revitalization of poverty-stricken villages. Finally, we want this study to provide reference and advice for other governments in similar situations.

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