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Research on the Impact and Mechanism of Digital Village Construction on Farmers' Livelihood Resilience

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Abstract: *Strengthening the livelihood resilience of farmers is the focus of consolidating and expanding the achievements of poverty alleviation and promoting common prosperity. Based on the four-stage micro-panel data of the China Household Tracking Survey from 2014 to 2020, a comprehensive index of farmers' livelihood resilience was constructed, and a continuous double difference model was used to investigate the impact and mechanism of digital village construction on farmers' livelihood resilience. The study found that the construction of digital villages significantly improved the livelihood resilience of farmers.*

Keywords: *digital village; Livelihood resilience; Continuous double difference model*

1. Introduction

With the all-round victory of the fight against poverty, China has entered a new stage of consolidating the achievements of the fight against poverty and promoting common prosperity. However, at this stage, the rural residents are restricted by various factors such as their education level, their own skills, natural environment, etc., and the deep-seated vulnerability problem in the livelihood system has not been solved, which leads to their insufficient livelihood development ability and the risk of returning to poverty. Therefore, improving the livelihood resilience of farmers and reducing the risk of returning to poverty are the keys to consolidate and expand the achievements of poverty alleviation. At the same time, with the rise of a new generation of information technologies, such as the Internet, big data and artificial intelligence, digital technologies are gradually integrated with rural production, management, governance and services to boost rural development. Literature studies have shown that digital village construction is helpful to improve agricultural production efficiency, increase rural residents' income and promote consumption upgrading[1][2], the digital village construction has become the new kinetic energy of village revitalization. Then, can the construction of digital villages stimulate the endogenous development power of farmers and further improve their livelihood resilience? The exploration of this issue is not only beneficial to sticking to the bottom line of not returning to poverty on a large scale, but also beneficial to the effective connection between poverty alleviation, rural revitalization and common prosperity.

2. Research hypothesis

The early research is mainly to investigate the impact of external shocks such as natural weather disasters on the livelihood resilience of farmers, and then gradually transfer to human society and the impact of micro individual's own conditions on the livelihood resilience. Since the digital village strategy was put forward, a large number of literatures began to focus on the construction of digital village, which is a new factor affecting the livelihood resilience of farmers. Digital village promotes technology diffusion, promotes agricultural economic growth and efficiency, promotes industrial development, improves social quality, integrates and shares information resources. Digital village construction can enhance external environment development, and then the application of new technologies brought by digital village construction can enable farmers to increase their income and narrow the income gap. Therefore, digital village construction can enhance farmers' buffer capacity; Second, in the process of the diffusion and application of new technologies in the rural areas under the background of digital village construction, farmers will inevitably learn new technologies, integrate into the digital development and network learning of digital village construction, provide education platforms, promote the opportunity of

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re-education and education equalization, reduce the learning cost and improve the learning ability of farmers; Third, the construction of digital villages breaks the space and time limit of communication between farmers, reduces the cost of communication, improves the ability to obtain elements and resist risks, improves happiness and digital literacy, makes the connections between farmers more convenient and frequent, and is conducive to the formation of social trust. In addition, the construction of rural network culture in the construction of digital villages, such as "digital heritage database" and "digital museum", has led the national action, increased farmers' sense of participation, and improved farmers' self-organization ability. In conclusion, the construction of digital villages can significantly affect the livelihood resilience of farmers.

3. Research and design

3.1. Sample selection and data sources

The data used in this paper are from the "China Household Tracking Survey" (CFPS) project of the China Social Science Survey Center of Peking University, China Statistical Yearbook and China Rural Statistical Yearbook. In order to keep the time span of the experimental group and the control group consistent, the data of 2014, 2016, 2018 and 2020 were selected to analyze the impact of digital village construction on the livelihood resilience of farmers. Due to the implementation of the digital village strategy in 2018, this time period just includes before and after the construction of the digital village, which is beneficial to determine the experimental group and the control group. In the process of processing data and selecting samples, firstly, keep the samples of rural household registration; Second, match data at the household and head of household levels; Third, remove the missing and abnormal samples of the main relevant variables.

3.2. Identify strategies and variable definitions

This paper takes the digital village strategy in 2018 as a quasi-natural experiment, using continuous double difference method to investigate the impact of digital village construction on the livelihood resilience of farmers. The traditional difference model has some deficiencies in identifying the processing groups, and the impact of digital village construction on the areas with different degrees of village digitalization is different. Therefore, this paper constructs a continuous double difference model to estimate the impact of digital village construction on the livelihood resilience of farmers.

$$lr_{it} = \partial_0 + \partial_1 dvp_{it} + \partial_2 controls_{it} + \gamma_i + \gamma_t + \varepsilon_{it} \tag{1}$$

Among them, family represents the year, the interpreted variable represents the livelihood resilience of farmers, the core explanatory variable measures the degree to which the processing group is affected by the construction of digital villages, other control variables represent individual fixed effects, time fixed effects, and interference terms of the model. The full text of the article must be typeset in single column.

3.2.1. Livelihood resilience of farmers

According to the buffer ability, self-organization ability and learning ability proposed by Speranza et al.[3] (2014) as the livelihood resilience analysis framework, the livelihood resilience measurement index of farmers is constructed.

3.2.2. Extent of digital village impact

The specific forms of the influence degree of the processing group on the construction of digital villages are as follows: According to the province, the construction results of digital villages are represented by the level of village digitalization. There is no unified measurement method for the level of village digitalization. The method of measuring the level of village digitalization from two dimensions of digital basic conditions and digital construction results, using the method of Linhai et al.[4] (2023) for reference, and replacing the 2018 data with 2019, the entropy weight TOPSIS method is also selected to analyze the degree of village digitalization. For the traditional double difference term, this paper selects one province that has a positive impact on the rural digital level after the digital village construction and the year after 2018 as the processing group. It mainly depicts the degree of influence by digital village construction for the level of village digitization. $dvp_{it} = dv_{pt} \times rd_{p,14-20}$

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$$rd_{p,14-20} = \frac{rd_{p,18-20} - rd_{p,14-16}}{rd_{p,14-16}} \quad (2)$$

3.2.3. Control variables

In order to control other characteristics that affect the livelihood resilience of farmers, according to the existing research, this paper introduces the characteristic variables of head of household (gender, age, health status, marital status, father's education level, mother's education level) and family characteristic variables (family size, insurance status) as control variables.

Table 1: Measurement and Definition of Relevant Variables.

Variable type	Variable name	Variable definition
Livelihood resilience	buffer capacity	Natural capital = land assets
		Human capital = labour force (16-65 healthy families)
		Social capital = access by family members to external funding other than government
		Physical capital = net household property+total value of durable goods owned
		Financial Capital 1= Household Income
		Financial capital 2= household savings
	Self-organizing ability	Trust = average family members' trust in their neighbors
		Satisfaction = average family members' satisfaction with life
		Policy support = cumulative amount of government subsidies received
		Household communication fee = post and telecommunication fee
		Social network = human gift expenses
	learning ability	Information acquisition capability = average importance of family members' information acquisition channels (TV, internet, newspapers, radio, SMS, others to tell)
		Per capita family education status = total family education years/total family population (primary school =6 years, junior high school =9 years, senior high school =12 years, junior high school and above =16 years)
		Education input = household expenditure on education
Rural digital level	Digital base level	Digital infrastructure conditions = internet access
		Digital infrastructure application conditions = internet usage
	Rural Digital Achievements	Rural industrial development = gross output value index of agriculture, forestry, animal husbandry and fishery (100 in the previous year, calculated at comparable prices)
		Income increase = per capita disposable income in rural areas
		Employment rate = number of employees/total population
		Poverty alleviation = number of relief and support institutions for the rural poor
		Cultural Construction and Spiritual Richness = Number of Township Comprehensive Cultural Stations
Control variable	Head of household level	Gender of head of household
		Is the head of household healthy
		Marital status of head of household
		Father's Education (Year)
		Mother's Education (Year)
	Family level	Family size
		Is insurance covered

4. Empirical analysis

4.1. The benchmark regression results

There is a strong correlation between the construction of digital villages and the livelihood resilience of farmers. Causality analysis is carried out using the continuous double difference model. The results are shown in the following table. Table 2 reports the estimation results, which report the average

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treatment effect of digital village construction on farmers' livelihood resilience. Column (1) gives the impact of digital village construction on farmers' livelihood resilience without adding control variables. The results show that the digital village construction significantly improves the livelihood resilience of farmers. With the increase of the intensity of the digital village construction, the average increase probability of the livelihood resilience of farmers is 0.007. Column (2) is added with the control variable. Digital village construction also significantly improves the livelihood resilience of farmers. With the increase in the intensity of digital village construction, the average increase probability of livelihood resilience of farmers is 0.006. The two results are basically the same, indicating that the regression results have certain robustness. Digital village construction significantly improves the livelihood resilience of farmers.

Table 2: Construction of Digital Villages and Resilience of Farmers' Livelihoods.

variable	(1)	(2)
	Livelihood resilience	Livelihood resilience
Degree of impact by digital villages	0.00681***	0.00613***
	(0.00206)	(0.00203)
constant term	0.0319***	0.0322***
	(0.000434)	(0.00242)
Control variable	no	yes
observed value	10387	10387
R2	0.403	0.410

Note: “***”, “**”,“*”represent the significance levels of 1%, 5% and 10% respectively, and the values in brackets are standard errors.

4.2. Parallel trend test

The premise that the results of the double difference estimation meet the consistency is that the treatment group and the control group meet the parallel trend hypothesis after the construction of the digital village, that is, the development trend of the outcome variables in the treatment group and the control group is consistent without policy intervention. If the processing time is not unique, i.e. there are other significant policy effects before the policy starts, the estimated average processing effect may not be the implementation effect of digital village construction. In order to ensure the validity of the parallel trend assumption and the policy point-in-time uniqueness, the validity of the parallel trend assumption is tested. Drawing on the experience of Si Lijuan and Cao Haoyu [5](2022), only the samples before the policy commencement were retained, and the policy commencement time was advanced to 2015 or 2016. As the policy commencement time was false, there was no significant impact of digital village construction on the livelihood resilience of farmers. The results are consistent with the expected results as shown in Table 3. The impact of digital village construction on the livelihood resilience of farmers was insignificant before the policy commencement. Therefore, 2018 is a reasonable time point for the policy, and the model satisfies the assumption of parallel trend.

Table 3: Parallel trend test.

variable	(1)	(2)
	Livelihood resilience	Livelihood resilience
The extent to which virtual villages are affected by digital villages	-0.00153	-0.00150
	(0.00113)	(0.00113)
Control variable	no	yes
constant term	0.0323***	0.0332***
	(0.000653)	(0.00261)
observed value	5196	5196
R2	0.000	0.016

Note: “***”,“**”,“*”represent the significance levels of 1%, 5% and 10% respectively, and the values in brackets are standard errors.

4.3. The robustness test

In order to avoid the problem of sample difference caused by non-random selection in digital village construction itself, this paper uses the propensity score matching double difference method (PSM-DID) to further strengthen the comparability of digital village construction degree, and uses the control variable

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as the covariate for caliper matching. As far as possible, the difference between the characteristics of the treatment group and the control group before and after the construction of digital villages is minimized, and the robustness test of the benchmark regression results of the construction of digital villages is still significant.

Table 4: Tendency Score Matching Double Difference Method (PSM-DID) Robustness Test.

variable	(1)	(2)
	Livelihood resilience	Livelihood resilience
Degree of impact by digital villages	0.00601***	0.00532**
	(0.00229)	(0.00227)
Control variable	no	yes
constant term	0.0317***	0.0313***
	(0.000485)	(0.00273)
observed value	9070	9070
R2	0.415	0.422

Note: “***”, “**”,“*”represent the significance levels of 1%, 5% and 10% respectively, and the values in brackets are standard errors.

4.4. Mechanism testing

The impact mechanism of digital village construction on farmers' livelihood resilience mainly comes from external impact and internal power. The external impact is the impact of the objective environment on the livelihood resilience of farmers, such as the level of rural network construction, intelligent transportation, intelligent water conservancy and information services. However, teaching people to fish is not as good as teaching people to fish, and the idea of "waiting for what is necessary" is the greatest resistance to improving livelihood resilience. Therefore, this paper mainly discusses the endogenous dynamic mechanism of the impact of digital village construction on farmers' livelihood resilience. In view of the fact that the main contents in the construction of digital villages include the construction of rural network culture, the construction of information benefiting the people, the supply of scientific and technological innovations in agricultural villages, etc., these may be beneficial to improving the digital literacy of farmers and their entrepreneurial ability. The digital literacy helps farmers to accept the impact of the digital economy faster, learn and adapt to the development of the digital economy, and broaden the information channels; Entrepreneurship reduces the cost of migrant workers and improves household income, all of which will be beneficial to improving the livelihood resilience of farmers. Therefore, this paper explores the mechanism of the impact of digital village construction on farmers' livelihood resilience from two aspects: farmers' digital literacy and farmers' entrepreneurship. Establish a two-way fixed effect model for empirical analysis.

$$shock_{it} = \beta_0 + \beta_1 dvp_{it} + \beta_2 controls_{it} + \gamma_i + \gamma_t + \varepsilon_{it} \tag{3}$$

Among them, it represents the endogenous power, namely digital literacy and farmers' entrepreneurship. $shock_{it}$ is digital literacy and farmers start their own businesses

Table 5: Analysis of Endogenous Dynamic Mechanism.

variable	(1)	(2)	(3)	(4)
	Digital literacy	Digital literacy	Farmers start their own businesses	Farmers start their own businesses
Degree of impact by digital villages	0.0258*	0.0239*	0.0550***	0.0518***
	(0.0136)	(0.0136)	(0.0196)	(0.0196)
Control variable	no	be	no	be
constant term	0.132***	0.189***	0.100***	0.0432*
	(0.00299)	(0.0161)	(0.00387)	(0.0230)
observed value	6267	6267	10387	10387
R2	0.569	0.572	0.621	0.623

Note: “***”, “**”,“*”represent the significance levels of 1%, 5% and 10% respectively, and the values in brackets are standard errors.

As shown in Table 5(1)-(2), the construction of digital villages has significantly improved farmers' digital literacy; As shown in Table 5(3)-(4), the construction of digital villages has significantly increased

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the number of farmers starting businesses. The above results indicate that the construction of digital villages can improve the livelihood resilience of farmers by improving their digital literacy and the number of farmers starting businesses.

4.5. The impact of digital village construction on the livelihood resilience of vulnerable farmers

The head of household is usually the main economic source of a family, and the vulnerability of the head of household is an important factor that affects the livelihood resilience of farmers. In order to investigate the impact of digital village construction on the livelihood resilience of different household characteristics, this paper conducts research according to the age of the head of household, the gender of the head of household and whether they are insured or not.

4.5.1. Age of head of household

In rural households, households headed by the elderly have significant differences in digital technology mastery, income ability, learning ability and policy perception with those headed by the young. In addition, the elderly face higher disease risk, which will increase the uncertainty of expenditure. At the same time, some of the elderly in rural areas can only participate in farming, farming and other production activities to subsidize the household, but the young have more opportunities, resulting in the elderly's poorer income ability. Therefore, the construction of digital villages is likely to have little impact on the livelihood resilience of households headed by the elderly. Specifically, this paper tests whether the age of the head of household is greater than 65 years old. The regression results are shown in Table 6(1)-(2), which indicates that the construction of digital villages significantly improves the livelihood resilience of non-elderly households headed by households, but has no significant impact on elderly households headed by households.

4.5.2. Gender of head of household

Rural women are more approbated to the positive effect of the Internet on family income and employment, but in the previous literature, it is found that women are not sensitive to digital technology, forming a gender digital divide, so the construction of digital villages is likely to have different effects on households headed by farmers of different genders. The regression results are shown in Table 6(3)-(4), indicating that the construction of digital villages significantly improves the livelihood resilience of female-headed households, but has no significant impact on male-headed households. The construction of digital villages requires the application of digital technology in the economic and social development of agricultural villages. Influenced by the traditional social norms in rural areas, women work at home while men work abroad more. As a result, women have more time to learn and accept the operation of the digital economy, which is beneficial to the formation of digital consciousness. Therefore, the construction of digital villages has significantly improved the livelihood resilience of female-headed households.

4.5.3. The family insured

Table 6: Impact Analysis on Vulnerable Groups.

variable	(1)	(2)	(3)	(4)	(5)	(6)
	the aged	Non-elderly	man	woman	No insurance	Insured
Degree of impact by digital villages	0.00245	0.00632***	0.000212	0.0122***	0.00102	0.00654**
	(0.00610)	(0.00233)	(0.00270)	(0.00389)	(0.00365)	(0.00277)
Control variable	be	be	be	be	be	be
constant term	-0.0385	0.0505***	0.0452***	0.0498***	0.0548***	0.0443***
	(0.0440)	(0.00386)	(0.00498)	(0.00641)	(0.00717)	(0.00381)
observed value	1120	8956	5165	4254	2334	7206
R2	0.489	0.410	0.472	0.465	0.596	0.415

Note: “***”, “**”,“*”represent the significance levels of 1%, 5% and 10% respectively, and the values in brackets are standard errors.

Risks are ubiquitous and inevitable. Accidents often cause huge losses to people. Insurance can prevent life from being changed. The construction of digital villages can provide more information, so that families can better understand the importance of insurance and purchase the types of insurance suitable for their families. Therefore, when the household economy receives a certain external impact, the farmers who purchase insurance have a stronger risk tolerance. As shown in tables 6(5)-(6) of the

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regression results, the construction of digital villages significantly improved the livelihood resilience of households insured, but did not significantly improve the livelihood resilience of households not insured. Therefore, how to improve farmers' awareness of insurance and invest in digital construction is a direction of digital village construction.

5. Conclusions and policy recommendations

The study found that from the perspective of average treatment effect, the construction of digital villages significantly improved the livelihood resilience of farmers. In view of the above analysis, this paper gives the following policy recommendations: First, actively promote the construction of digital villages. Governments at all levels should strengthen the capital investment in rural digital infrastructure, encourage enterprises and social capital to enter the rural digital infrastructure, and promote the construction of digital rural infrastructure through multiple channels. At the same time, through incentives, operators are encouraged to develop products that farmers need, reduce the cost of using information for farmers, and enable farmers to truly enjoy the results of rural digital construction. Second, to further stimulate farmers' endogenous development momentum. On the one hand, the establishment of farmers' digital cooperatives encourages farmers to establish mutual aid networks to jointly solve the problems and challenges in the application of digital technology and enhance farmers' digital awareness. On the other hand, relevant operators help farmers to establish online sales channels, including e-commerce platforms for agricultural products and social media, in order to expand their market coverage and improve product visibility. Promote digital financial services, cultivate social capital in rural communities, and encourage cooperation, mutual assistance and community participation, so that farmers can obtain financial support and invest in agricultural enterprises to promote endogenous motivation. Third, effectively improve farmers' digital skills. Digital skills are the key to improving farmers' livelihood resilience in digital village construction. Governments at all levels should build a digital skills training system, regularly and systematically conduct free digital skills training in rural areas, and consciously tilt to vulnerable groups to mitigate the adverse effects caused by the digital divide in rural areas. In the skills training, digital agriculture training should be provided in particular, including the use of agricultural technology, sensors, drones and data analysis tools to improve the efficiency of agricultural production. At the same time, colleges and universities should give full play to their education and training functions, organize university students to volunteer in rural areas to train farmers in digital skills, and pay regular return visits to solve the problems faced by farmers in digital skills.

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