Research on the Dynamic Evolution of Farmers' Urbanization Based on Logistic Model: A Case Study of Shiquan County

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Abstract—Orderly promoting the nearby urbanization of farmers and improving the degree of urban integration is one of the development goals of new urbanization, and it is also an important measure to promote the construction of smart towns and the high-quality development of county towns. Based on the background of county urbanization, this paper takes Shiquan County as an example to analyze the dynamic evolution characteristics of rural and urban farmer urbanization through questionnaire data and logistic model. The research shows that the urbanization of farmers depends on the joint action of their own factors and social factors, showing the law of penetration, integration and migration. The distance from the center of the county is about 10 kilometers, which shows a two-way integration feature; the distance from 20 to 50 kilometers shows a one-way flow into the county; and the distance from 50 kilometers shows a one-way flow into the nearby key town or adjacent county city, which all follow the distance decay law. To sum up, measures such as improving the urban community system, increasing the proportion of tertiary industry, completing public service facilities and comprehensive skills training for farmers can be taken to accelerate the urbanization speed of farmers and accelerate the construction of smart cities.

Keywords-logistic model; Farmer; urbanization; dynamic evolution; Smart city

1 INTRODUCTION

With the proposal of the new urbanization strategy, scholars realize that they should not only pursue rapid economic development or rapid population flow, etc., but should pay more attention to the happiness experience and high-quality life of urban residents. From a material point of view, as a floating population, farmers' work income and living environment in cities have affected the quality of life of farmers[1]. From a spiritual level, farmers, as "strangers", have a sense of insecurity and loneliness about living alone in the city, which indirectly affects their perception of happiness[2]. Farmers often choose to integrate into cities for the purpose of improving employment opportunities and pursuing a higher quality of life, which also promotes the trend of urban-rural integration[3]. The development of the county-level urban and rural industrial system, the gradual improvement of infrastructure, and the increasingly better ecological environment have promoted the rapid growth of short-distance urban-rural integration[4]. Similarly, the construction strategy of smart cities and smart towns has brought many advantages to farmers living in cities, such as: refined urban management and intelligent basic public service facilities such as education, medical care, business and entertainment. It not only facilitates the life of farmers and improves the convenience of residents, but also enables

ICICA 2022, December 02-04, Chongqing, People's Republic of China

DOI 10.4108/eai.2-12-2022.2328044

farmers living far away in cities to contact their families in real time, enriching the spiritual life of farmers. In summary, as the main personnel of urban settlement, how to effectively absorb farmers, ensure the continuous improvement of farmers' integration and happiness in the process of integration, and promote the construction of new urbanization and smart cities in a reasonable and orderly manner has become one of the hot spots for the high-quality development of county towns.

Relevant research on urban-rural integration at home and abroad, involving sociology, demography, psychology and management[5-6]. Rural urbanization is the concrete embodiment of social mobility in the process of spatial encounter, collision and continuous integration, and in material, life and emotional aspects[7-8]. The degree of agglomeration in urban centers, the phenomenon of dislocation of job and housing space, the allocation of public resources and the level of public services have gradually become important factors in measuring the urbanization of farmers[9-10]. In terms of research content, scholars have less research on the interaction between factors affecting the urbanization of farmers. However, In terms of research area, scholars have less research on urban-rural integration at the county level. From the perspective of research, there is no in-depth connection between the development of smart cities and smart towns and the urbanization of farmers.In summary, this paper takes Shiquan County, Ankang City as an example, analyzes the dynamic evolution characteristics of farmers' urbanization in Shiquan County based on questionnaire survey method and logistic model, quantifies the interaction between the self-factors and social factors of farmers' urbanization, summarizes and analyzes how to improve the urbanization rate of farmers, and puts forward suggestions and countermeasures for the development of county towns and smart township construction.

2 DATA SOURCES

Taking the key towns and villages where farmers gather in Shiquan County as the research area, questionnaires were distributed from March 2022 to April 2022, and collected, sorted, counted, and calculated. A total of 500 questionnaires were distributed, and 469 were actually recovered, with a recovery rate of 96.27%. The research area of this paper - Shiquan County, located in the west of Ankang City, Shaanxi Province, north of Qinling Mountains, south of Ba Mountain, located in the hinterland of Qinba, the shore of Han Water, with a total area of 1525 square kilometers, is an important water conservation area of China's south-to-north water diversion and an important power energy base in the west, and is also a national all-round tourism demonstration zone, with talent attraction. Through reading literature, local chronicles and other materials, we find that farmers in the county have frequent urban-rural migration, and it is typical to study the integration of farmers into urban space. As a national all-round tourism demonstration area, this area is rich in tourism resources, equipped with more intelligent public service facilities, and conforms to the characteristics of typical smart townships, so Shiquan County is used as a case to study the urbanization of farmers nearby and urban integration.

3 RESEARCH METHODS

Based on the research of existing scholars, this paper divides the factors affecting farmers' urbanization into two categories: self-influencing factors and social influencing factors. Among

them, self-factors include psychological identity, distance between family and city, children's education, living habits, urban survival pressure, self-development ability, generational differences, etc.; Social factors include economic income, psychological exclusion, institutional alienation, urban public facilities, urban inclusion, urban security, and urban comfort. With the help of logistic statistical model, this paper quantitatively analyzes the interaction between the above two types of factors affecting farmers' urbanization, in order to provide guidance for promoting farmers' urbanization and improving farmers' happiness and quality of life.

In the process of integrating farmers into urban space, they first need to engage in certain work in the city and use work as a platform to obtain urban survival resources [11]. Secondly, the influencing factors and social influencing factors of farmers work together to determine the infiltration, migration and retention of farmers in urban social space. In order to explore the random dynamic change process of the interaction between osmosis force and repulsive force caused by self-factors and social factors, a logistic statistical model is introduced to represent the trade-off relationship between repulsion force and penetration force. As shown in Figure 1:

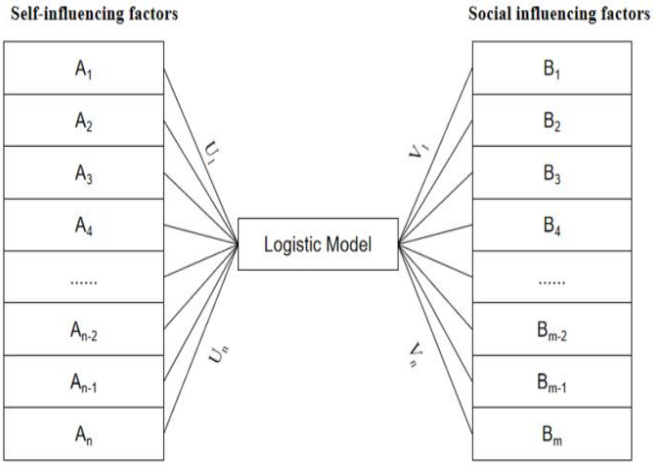

Fig. 1 Model diagram of factors influencing rural urbanization

Therefore, assuming that in the process of urban integration of migrant workers, the normalized weights of the impact factor of A…A_N are $u_i(i = 1,2 \dots)$, and $u_1 + u_2 + \cdots = 1$. The normalized weights of the impact factor of B…B_M are $v_i(i = 1,2 \dots M)$, and $v_1 + v_2 + \cdots = 1$. The specific values of the corresponding factors and social factors of the farmers themselves are defined as $a_i(i = 1,2 \dots N)$ and $b_i(i = 1,2 \dots M)$. At the same time, the random functions of penetration and repulsion force are as follows:

$$\mathrm{I(i)} = \begin{cases} 1 & osmosis\ force \\ 0 & Repulsive\ force \end{cases} \tag{1}$$

Formula (1) represents the variable selection model of self-factors and social factors, and the interaction ratio of penetration and repulsion force with the help of logistic model is as follows:

$$\Pr\left((I(i) = 1|a, b, u, v\right) = \frac{exp\{u^T a + v^T b\}}{1 + exp\{u^T a + v^T b\}} \tag{2}$$

$$\Pr\left((I(i)=0|a,b,u,v\right)=\frac{1}{1+exp\{u^{T}a+v^{T}b\}} \quad (3)$$

Formula (2) is the proportion of peasant groups in urban penetration, and formula (3) is the proportion of repulsion received by peasants in cities. The interaction between osmosis force and repulsive force determines the dynamic change process of farmers in urban and rural space, and the force has the following properties: when the difference between osmosis force and repulsive force is greater than a certain threshold, farmers will infiltrate into the central area of the city; When the difference between osmosis and repulsion is less than a certain threshold, farmers leave the city and move to the suburbs or townships; When the difference between osmosis and repulsion is within a certain threshold, farmers have a temporary state of stability in a certain space in the city, that is, a state of stay. Among them, the difference between penetration and repulsion mainly depends on the degree of efforts of farmers themselves, and the threshold mainly depends on the level of urban development and the size of the city.

4 EMPIRICAL ANALYSIS

4.1 Dynamic evolution analysis of peasant urbanization infiltration and migration in Shiquan County

According to the above formulas (2) and (3), the weights u、v corresponding to the parameters a_i and $b_i$of the logistic model are assigned respectively, and the following data is obtained: ai=[0.15,0.18,0.12,0.15,0.08,0.15,0.17], bi=[0.10,0.15,0.12,0.18,0.15,0.18,0.12].

Through the preliminary survey data and weight assignment calculation, the spatial network infiltration, transition and stay status of farmers in Shiquan County and surrounding key towns were obtained. The conclusion is as follows:

As shown in Figures 2 and 3, within the county area of Shiquan County, due to the attraction and radiation of the county center, the urban and rural population migration shows the characteristics of gathering from the periphery to the center. The countryside around the county seat of about 10 kilometers has become a community-type settlement area after the transformation of the new countryside, and although the residents are farmers, their lifestyles and work forms have been civilized, and farmers move between the countryside and the city in both directions according to the seasons or living needs; People from villages and market towns between 20-50 kilometers from the county seat will flock to the county seat, mostly young and strong workers working or starting businesses in the town, as well as elderly groups who help their children accompany their children to school; The population of areas 50 kilometers away from the county seat will gradually migrate to nearby cities or market towns, and integrate into key towns or neighboring cities.

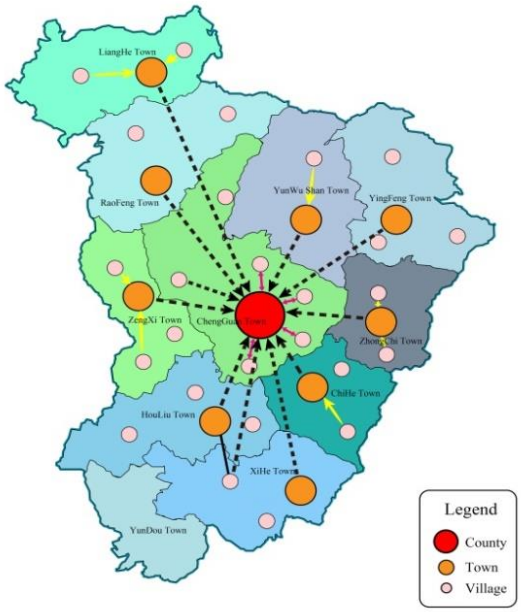

Fig.2 Dynamic diagram of urban and rural population migration in Shiquan County

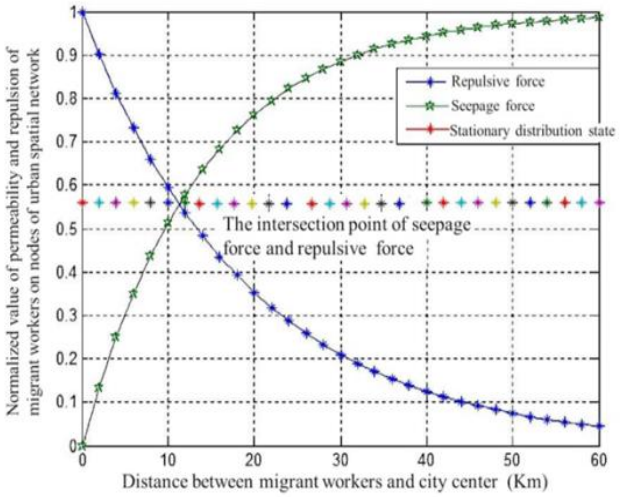

Fig.3 Dynamic evolution of peasant osmosis and repulsion in Shiquan County population migration in Shiquan County

4.2 Analysis of influencing factors of rural urbanization in Shiquan County

With the help of logistic statistical model, this paper explores the interaction relationship between the two major types of factors affecting farmers' urbanization, and finds that among the mutual factors, with the development of county urbanization, the influence of social factors is constantly increasing, the county community system is diversified, education, medical care, health and other departments are complete, and the pace of rural urbanization is accelerating. In particular, it should be pointed out that the new urban and rural family forms in rural areas 10 kilometers away from the county seat are more common, as shown in Table 1, and their family members are mainly service industry personnel, self-employed, private owners, etc. The way these people work is to work in the county by private car, with separate work and residence.

Table 1 List of types of occupations of farmers in Shiquan County

Type of occupation	Frequency	Percentage (%)
Ordinary part-time workers, service industry personnel	151	35.8669
Self-employed, non-formal workers (private owners, petty traders)	201	47.7434
Skilled workers (skilled workers)	34	8.0762
Managers	15	3.5629
Others	20	4.7506
Total	421	100

In the context of smart city and smart township construction, it can be found that the proportion of skilled workers and managers is gradually increasing through the statistics of farmers' identity information. Informationization, networked re-education and training and other channels have improved farmers' skills and their own comprehensive quality, which has greatly strengthened the penetration of farmers' urbanization, and the proportion of skilled workers and management personnel has gradually increased.

5 CONCLUSION

By studying the spatial evolution of urban farmers in Shiquan County, it can be found that in the process of new urbanization in the county, the urbanization of farmers depends on the combined effect of their own factors and social factors, and the increase of urban tertiary industry, the improvement of infrastructure and public service facilities, and the strengthening of urban tolerance are all conducive to rural urbanization. The construction of public service facilities in smart cities, such as the facilitation and informatization of infrastructure such as education, medical care, and transportation, will accelerate the integration of farmers into cities.

To promote the construction of smart townships in Shiquan County, we must not ignore the problem of nearby urbanization of farmers. To guide farmers to urbanize nearby, it is necessary

to continuously adjust and improve the structure of the service industry and broaden the channels for farmers to integrate into urban space. Improve the equalization and informatization of public facilities in county urban communities, with a view to building smart towns and promoting the pace of new urbanization. At the same time, it is also necessary to pay attention to the physical and mental health and quality of life of farmers, and improve the sense of integration and well-being.

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