Study on the Impact of Farmland Transfer on the Welfare of Transferring-out Farmers Under the Background of Rural Revitalization in Shanxi

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Abstract. Under the background of rural revitalization, farmland transfer has become an important way to promote agricultural scale and modern management. While the farmland transfer promotes the concentration of farmland and the transformation of agricultural production methods, what is the impact of farmland transfer on farmers’ welfare? Based on the rural survey data of Xinzhou in Shanxi, this paper used the grey fuzzy comprehensive evaluation method to measure the changes of farmers’ welfare before and after farmland transfer. The study found that the overall welfare level of farmers in three counties of Xinzhou was improved after farmland transfer. The welfare level of farmers was increased by 7.63%, from 0.367 to 0.395. However, the changes in various welfare elements were quite different, and some welfare levels were even declined. After farmland transfer, the welfare distribution gap of farmers transferred out farmland has a tendency to expand.

1. Introduction

By the end of 2018, China’s farmland transfer area was 512 million mu, accounting for 37% of the contracted land area. Although the scale of transfer is on the rise, the increase of farmland transfer area has slowed down since 2014. In addition, the farmland transfer rate in underdeveloped areas such as the central and western regions is far lower than the national average level. At present, there are few studies on the welfare changes of farmers from the perspective of farmland transfer, mainly analyzed the impact of farmland transfer on farmers’ welfare changes using a single indicator or a single type (Chen & Zhai, 2015; Chen et al., 2018), or analyzed the farmers’ welfare change using the multiple regression or the welfare function method (Lin & Jin, 2012; Hou et al., 2016). Based on the contribution and deficiency of the above research, this paper follows Sen’s capability approach theory to analyze the impact of farmland transfer on farmers’ welfare, and then constructed the farmers’ functional activities and its index system; and then uses farmers’ microcosmic survey data and fuzzy evaluation method to measure the welfare changes before and after the farmland transfer.
2. Research Methods

Sen’s capability approach theory pays attention to the limitation and difference in the improvement of people’s situation brought by the same economic conditions because of the differences among people (Sen, 1999). A person’s welfare includes not only the economic aspect, but also the function and ability to reflect its development attribute. Function constitutes a person’s existing welfare, while ability is the real opportunity and freedom of choice. Basu(1987) thinks that the measurement of welfare can skip the evaluation of function and ability, and be based on the evaluation of functional activities. The farmers’ functional activities transferring out farmland identified in this paper, include economy, social security, health, social interaction, employment and ecological environment.

2.1. Fuzzy function setting

Assuming that the farmers’ welfare status is a fuzzy set X, the welfare status (functional activities) of farmers that may change after farmland transfer is a subset W of X, then the welfare function of the n-th farm household is \( W_n = \{ x_n, \mu_n(x_n) \} \). \( \forall x_n \in X, \mu_n(x) \in [0,1] \), \( \mu_n(x_i) \) is called the degree of membership of \( x_n \) to \( W \).

2.2. Membership function setting

Membership function is the basis of fuzzy comprehensive evaluation, and the setting of membership function is also one of the keys of fuzzy comprehensive evaluation.

Set \( x_i \) be the i-th functional subset representing the farmers’ welfare status, \( x_{ij} \) is the j-th evaluation index to measure the i-th function. The evaluation index of farmers’ welfare is \( x = [x_{i1}, \ldots, x_{ij}, \ldots] \). Where \( i=1,2,\ldots,I \), \( I \) is the number of functional activities representing farmers’ welfare, \( j=1,2,\ldots,J(i) \), \( J(i) \) is the number of evaluation indicators in the i-th functional activity. Then, set the farmer welfare membership function as:

\[
\mu(x_{ij}) = \begin{cases} 
0 & \text{if } x_{ij} = x_{ij}^{\text{min}} \\
\frac{x_{ij} - x_{ij}^{\text{min}}}{x_{ij}^{\text{max}} - x_{ij}^{\text{min}}} & \text{if } x_{ij}^{\text{min}} < x_{ij} < x_{ij}^{\text{max}} \\
1 & \text{if } x_{ij} = x_{ij}^{\text{max}} 
\end{cases}
\] (1)

\[
\mu(x_{ij}) = \begin{cases} 
1 & \text{if } x_{ij} = x_{ij}^{\text{min}} \\
\frac{x_{ij}^{\text{max}} - x_{ij}}{x_{ij}^{\text{max}} - x_{ij}^{\text{min}}} & \text{if } x_{ij}^{\text{min}} < x_{ij} < x_{ij}^{\text{max}} \\
0 & \text{if } x_{ij} = x_{ij}^{\text{max}} 
\end{cases}
\] (2)

\( x_{ij}^{\text{max}} \) is the upper threshold value of the index, \( x_{ij}^{\text{min}} \) is the lower threshold value of the index, and the value of the index is between \( x_{ij}^{\text{max}} \) and \( x_{ij}^{\text{min}} \). Farmers’ income and the rest time of household are positively related with the changes of farmers’ welfare, which are positive indicators and applicable to the formula (1); other indicators are negatively related to the changes of farmers’ welfare, which are negative indicators and applicable to the formula (2).
2.3. Determination of weight

The subjective weighting method fully considers the economic significance and practical value of the indicators. However, due to the subjective judgment of experts, it is inevitable to have the disadvantages of subjective prejudice. The objective weighting method is based on mathematical theory and has accurate calculation, but does not consider the practical significance. The calculation results may be inconsistent with the actual situation. Therefore, this paper uses analytic hierarchy process (AHP) and gray correlation method to calculate the weight, and then takes the arithmetic mean value to determine the index weight of the farmers’ welfare evaluation system.

2.3.1. Analytic Hierarchy Process

Based on the analysis of functional activities and welfare indicators of farmers under government intervention in farmland transfer, the factors that evaluate the farmers’ welfare status are divided from top to bottom into target level (O)—farmers’ welfare status, criterion level (C) — farmers’ functional activities, program level (P) — specific indicators of each functional activity.

① Establish hierarchical structure model

Based on the analysis of functional activities and welfare indicators of farmers under government intervention in farmland transfer, the factors that evaluate the farmers’ welfare status are divided from top to bottom into target level (O)—farmers’ welfare status, criterion level (C) — farmers’ functional activities, program level (P) — specific indicators of each functional activity.

② Construct paired comparative matrix

\[
A = (a_{ij})_{n \times n}, \quad a_{ij} > 0, \quad a_{ji} = \frac{1}{a_{ij}}
\]  

(3)

\(a_{ij}\) is the relative weight importance of the i-th factor and the j-th factor relative to the subordinate upper factors.

③ Calculate weight vector and check consistency

For each paired comparison matrix A, the maximum eigenvalue and corresponding eigenvector were calculated according to \(A w = \lambda w\). Consistency index, random consistency index and consistency ratio were used to check consistency.

Consistency index \(CI = \frac{\lambda - n}{n - 1}\), the smaller the CI, the higher the consistency.

Random consistency index \(RI\) can be obtained by referring to the relevant reference table.

Consistency ratio \(CR = \frac{CI}{RI}\), if \(CR < 0.1\), the consistency test is passed.

④ Calculate combination weight vector and check the combination consistency

The combination weight vector of the scheme layer to the target level is calculated, and the combination consistency is checked according to the above formula.

2.3.2. Grey relational analysis

① Determine the reference sequences that reflect system behavior characteristics and the comparison sequences that impact system behavior

The index observation values of the functional activities of the surveyed farmers constitute the comparative series of grey relational analysis, which denoted as \(X_i (i=1, 2, \ldots, n)\), representing n surveyed farmers.

According to the principle of grey relational analysis method, the maximum value of the indicator observation value that is directly proportional to the farmers’ welfare and the minimum value of the indicator observation value that is inversely proportional to the farmers’ welfare are selected as the reference series \(X_0\). Each series has m observation points, construct the evaluation matrix X. \(X_0\) represents the virtual state of the farmers’ welfare when all the evaluation indicators have achieved the optimal value.

② Nondimensionalize the reference and comparison sequences

\[
x_i^*(k) = x_i^k / x_i^0 \quad (i = 1, 2, \ldots, n; \quad k = 1, 2, \ldots, m)
\]  

(4)
Calculate the point correlation coefficient of each comparison sequence and reference sequence at each observation point

$$
\xi_i(k) = \frac{\min \min_{y} |x_i(k) - x_y(k)| + \lambda \max \max_{y} |x_i(k) - x_y(k)|}{\max \max_{y} |x_i(k) - x_y(k)|}
$$

(5)

$\lambda$ is the resolution coefficient, which is generally selected between 0 and 1, usually 0.5.

4. Calculate the relational degree between the comparison sequence and the reference sequence

$$
r_i(k) = \frac{1}{n} \sum_{i=1}^{n} \xi_i(k) \quad (i = 1, 2, \cdots, m; \ k = 1, 2, \cdots, m)
$$

(6)

5. Normalize the relational degree to obtain the weight value of each indicator

$$
a_i = \frac{r_i(k)}{\sum_{k=1}^{m} r_i(k)} \quad (k = 1, 2, \cdots, m)
$$

(7)

3. Data sources

The data in this paper are from the rural peasant household survey in Xinzhou of Shanxi in 2019. Stratified random sampling method was adopted to select Dai County, Xinfu District and Shenchi County for rural survey. 273 sample questionnaires were finally collected, 258 of which were valid.

4. Empirical results and analysis

4.1. Measurement and analysis of farmers’ welfare changes before and after farmland transfer

As shown in Table 1, after farmland transfer, the overall welfare level of farmers increase slightly by 7.63%, from 0.367 to 0.395, which is still lower than the medium welfare level of 0.5. From the perspective of membership degree of farmers’ functional activities, the membership degree of economy, social security, social interaction, employment and environment welfare are increased by 39.59%, 6.24%, 5.84%, 34.66% and 33.87%, while the membership of healthy functional activities is decreased by 18.29%.

4.1.1. Economy. After farmland transfer, the membership degree of farmers’ economy welfare is increased by 39.59%, from 0.258 to 0.359. Although the scale of agricultural production and agricultural income decline after farmland transfer, the non-agricultural income of some farmers is increased, which not only made up for the loss of agricultural income, but also led to the increase of their overall income.

4.1.2. Social security. After farmland transfer, the membership degree of farmers’ social security functional activities is increased by 6.24%, from 0.404 to 0.430. Although the increase of farmland rent income is conducive to the improvement of farmers’ old-age security and medical security, it has a great impact on farmers’ unemployment security.

4.1.3. Health. The membership degree of farmers’ health functional activities is decreased by 18.29%, from 0.442 to 0.361. After farmland transfer, the health welfare level of some farmers deteriorate due to the decrease of leisure time, the increase of labor intensity, the extension of labor time, the bad working environment and the low sense of belonging in the process of non-agricultural employment.

4.1.4. Social interaction. The membership of farmers’ social functional activity is increased by 5.84%, from 0.466 to 0.494. The impact of farmland transfer on the farmers’ social interaction activities is
mainly reflected in the peasant households who move out for non-agricultural employment. Due to the change of work area, they need to establish a new urban social relationship network, which has a negative impact on the original rural social relationship network. However, it has little influence on farmers’ social interaction who still stay in the village or nearby employment after farmland transfer.

4.1.5. Employment. The membership degree of farmers’ employment functional activities is increased by 34.66%, from 0.246 to 0.331. Generally speaking, farmland transfer out is the farmers’ autonomous decision after weighing agricultural benefits and non-agricultural benefits. Overall, farmland transfer has a positive impact on farmers’ employment welfare.

4.1.6. Environment. The membership degree of farmers’ environmental functional activities is increased by 33.87%, from 0.379 to 0.508. It shows that the farmers’ environmental functional activities is improved after farmland transfer. After some farmers transfer their land, they will live and work in cities or towns, and their living environment will be significantly improved. Compared with the situation of land abandonment caused by non-transfer, the ecological environment of farmland may be improved after farmland transfer.

Table 1. Measurement of farmers’ welfare before and after farmland transfer

| Functional activities and indicators | membership degree | before transfer | after transfer | variation | rangeability (%) |
|-------------------------------------|-------------------|----------------|---------------|-----------|------------------|
| 1. Economy                          |                   | 0.258          | 0.359         | 0.102     | 39.59            |
| 1.1 Agricultural income             |                   | 0.238          | 0.163         | -0.075    | -31.51           |
| 1.2 Non-agricultural income         |                   | 0.265          | 0.417         | 0.152     | 57.36            |
| 2. Social security                  |                   | 0.404          | 0.430         | 0.025     | 6.24             |
| 2.1 Old-age security                |                   | 0.382          | 0.427         | 0.045     | 11.78            |
| 2.2 Medical security                |                   | 0.425          | 0.483         | 0.058     | 13.65            |
| 2.3 Unemployment security           |                   | 0.402          | 0.392         | -0.010    | -2.49            |
| 3. Health                           |                   | 0.442          | 0.361         | -0.081    | -18.29           |
| 3.1 Leisure time of householder     |                   | 0.365          | 0.241         | -0.124    | -33.97           |
| 3.2 Health of householder           |                   | 0.374          | 0.328         | -0.046    | -12.30           |
| 3.3 Health of labor                 |                   | 0.523          | 0.436         | -0.087    | -16.63           |
| 3.4 Medical expenses                |                   | 0.437          | 0.362         | -0.075    | -17.16           |
| 4. Social interaction               |                   | 0.466          | 0.494         | 0.027     | 5.84             |
| 4.1 Strong relationship             |                   | 0.509          | 0.431         | -0.078    | -15.32           |
| 4.2 Weak relationship               |                   | 0.420          | 0.583         | 0.163     | 38.81            |
| 4.3 Interpersonal relationship      |                   | 0.481          | 0.429         | -0.052    | -10.81           |
| 5. Employment                       |                   | 0.246          | 0.331         | 0.085     | 34.66            |
| 5.1 Training times                  |                   | 0.169          | 0.375         | 0.206     | 121.89           |
| 5.2 Employment skills               |                   | 0.233          | 0.369         | 0.136     | 58.37            |
| 5.3 Working stability               |                   | 0.306          | 0.245         | -0.061    | -19.93           |
| 6. Environment                      |                   | 0.379          | 0.508         | 0.128     | 33.87            |
| 6.1 Living environment              |                   | 0.409          | 0.526         | 0.117     | 28.61            |
| 6.2 Farmland ecological environment |                   | 0.329          | 0.469         | 0.140     | 42.55            |
| Overall welfare                     |                   | 0.367          | 0.395         | 0.028     | 7.63             |

4.2. Distribution of farmers’ welfare level

As shown in table 2, from the distribution of farmers’ welfare level before and after farmland transfer, the farmers’ welfare membership degree before farmland transfer is mostly distributed between [0, 0.3], and the proportion of farmland was 81.8%, while the proportion of farmers whose welfare level was lower than 0.3 after farmland transfer is 70.9%. The welfare level of some farmers with poor basic conditions
is increased. Before farmland transfer, only 4.6% of the farmers have a welfare level higher than 0.5. After farmland transfer, the number of the farmers whose welfare has exceeded the medium welfare level is 4.9%, increasing by 6.52%. In addition, it should be noted that the poor farmers whose welfare level was lower than 0.1 increased from 1.5% to 2.7%, indicating that the welfare of some farmers is still deteriorated while the overall welfare of farmers is improved.

| Membership degree | Proportion of Farmers before transfer | Proportion of Farmers after transfer |
|-------------------|--------------------------------------|-------------------------------------|
| 0.000-0.100       | 1.5                                  | 2.7                                 |
| 0.101-0.200       | 39.2                                 | 32.3                                |
| 0.201-0.300       | 41.1                                 | 35.9                                |
| 0.301-0.400       | 4.9                                  | 17.3                                |
| 0.401-0.500       | 8.7                                  | 6.9                                 |
| 0.501-0.600       | 4.6                                  | 4.2                                 |
| 0.601-0.700       | 0.0                                  | 0.7                                 |
| 0.701-0.800       | 0.0                                  | 0.0                                 |
| 0.801-0.900       | 0.0                                  | 0.0                                 |
| 0.901-0.100       | 0.0                                  | 0.0                                 |
| Total             | 100                                  | 100                                 |

5. Conclusion
Based on the survey data of farmers in three regions with different economic development levels in Xinzhou of Shanxi, this paper used grey fuzzy comprehensive evaluation method to measure the changes of farmers’ welfare before and after farmland transfer. The study found that, in general, the farmers’ welfare level of in the three counties is improved to a certain extent after farmland transfer. The farmers’ welfare level is increased from 0.367 to 0.395, with a rangeability of 7.63%. After farmland transfer, the welfare distribution gap of farmers transferred out farmland has a tendency to expand.

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