Analysis of socio-economic driving forces of cultivated land area and its forecast in the upstream of Han River of China

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Abstract: In recent years, the human driving force of changes in cultivated land area is one of the hotspots in land-use change research. The paper took the Han River in southern Shaanxi of China as study area, and thirteen socio-economic indexes, such as total population, urbanization rate of domicile, per capita GDP during 1995-2015 years, were selected. The main socio-economic factors that affected the change of cultivated land area were sifted by grey relativity analysis, principal component analysis, stepwise regression analysis and STRIPAT model. Meanwhile, the change trend of cultivated land in the next 10 years was predicted by scenario analysis. The results show that, among many related factors, the increase of the proportion of the second industry and the proportion of the third industry can lead to the reduction of cultivated land area with different degree, and the increase of urbanization rate of domicile can induce the increases of cultivated land area. Meanwhile, the increase of cultivated land area is fastest among 8 scenarios when urbanization rate of domicile keeps high speed of growth rate, and the proportion of the second industry and the third industry keep low-speed growth rate.

1. Introduction

In recent years, the study on land use and LUCC is becoming increasingly important in the research field of global environmental change. Among the many types of land use, the change of cultivated land area is one of the hotspots of research [1]. Cultivated land area is an important natural resource, the foundation of agricultural production, and an important guarantee for food security. The analysis of dynamic change law and influencing factors of cultivated land have an important significance on the rational utilization of cultivated land resources, the dynamic balance and regional regulation and control of the cultivated land, realizing the sustainable utilization and development of regional cultivated land, and the coordination of the relationship between the protection of cultivated land and the economic development[1-3].

According to the conclusion of former studies, in term of the driving factors of cultivated land change,
the driving factors that cause the change of cultivated land are mainly embodied in three aspects of nature, humanity and policy [4]. In socio-economic factors, technological progress, urbanization, change rate of population, social development, policy and values will all affect the change of land use. Li et al.[5] studied the relationship between the cultivated land change and socio-economic development in Suzhou by STIRPAT model and correlation analysis. The result showed that the increase of urbanization rate could restrain the reduction of cultivated land area, Meanwhile, Wang [6] and Guo et al. [7] also had similar findings. Zou et al. [8] analyzed the socio-economic driving force of cultivated land change in Nanjing by principal component analysis, stepwise regression analysis and STIRPAT model. The results showed that the increase of grain yield, urban population and the proportion of the second industry will reduce cultivated land area in Nanjing. Meanwhile, it have great practical significance for government to predict scientifically the change trend of cultivated land area in the future. Zhang et al.[9], based on cultivated land during the period of 1996 to 2005 year, forecasted the change trend of cultivated land of 2006-2010 year in Beijing by GM (1.1) model, The results showed that the arable land in Beijing would continue to decrease in the next few years. Cheng et al.[10] forecasted the cultivated land area of 2007-2010 year in Gansu Province by trend moving average method. The results showed that the method can be applied to the prediction of cultivated land area. Wu et al. [11] applied the prediction models of multi-sequence grey correlation and artificial neural nets to predict the cultivated land change in Guanzhong in the future. It was found that, under both models, cultivated land area would show a decreased trend in the future.

In the previous studies, the prediction method such as BP neural network, GM (1.1) model or time series prediction are usually used to predict the change trend of cultivated land area in the future, and there are few papers on forecasting cultivated land change by scenario analysis. Therefore, the paper take the upstream of Han River in Southern Shaanxi as study area, based on the time series of socio-economic indicators and cultivated land area, and analyzed the correlation between cultivated land and socio-economic driving factors and the main driving factors that affect the change of the cultivated land area by grey relational analysis and principal component analysis method. Then, STIRPAT model is used to analyze the relationship between cultivated land area and main driving factors. Finally, based on prediction model, 8 different development scenarios are set up to analyze the change trend of cultivated land area. The results have great significance on the rational use of land resources, the sustainable utilization of cultivated land and the coordination of relationship between protection of cultivated land and economic development. Meanwhile, it can provide reference for underdeveloped areas or ecological protection areas.

2. The study area
Southern Shaanxi province located in the south of Qinling Mountains and north of Basha, which is known as Qinba mountain area, located at E105°30'30" - 111°1'25", N31°42'- 34° 25'40" and located in the middle zone of the southern warm temperate zone to the northern subtropical zone with mild climate and abundant rainfall[12]. The south of Shaanxi Province with 28 counties in three cities of Hanzhong, Ankang and Shangluo, is shown in Figure 1. The total area of Han River basin in Shaanxi is about 62300km², accounting for 65.27% of the total area of Han River basin. In this paper, the Southern Shaanxi section of Han River basin in Shaanxi province, which covers 25 counties, is selected as the study area, with watershed of about 59900km², accounting for 96.56% of Han River Basin in Shaanxi Province [13]. Meanwhile, the Southern Shaanxi is the headstream of Han River and Dan River and water resource of mid-route of south-to-north water transfer project in china.
3. The study data and methodologies

3.1. Data and indexes selection

The original data in this study are from Shaanxi statistical yearbooks (1991-2016), Shaanxi regional Yearbook (2016), Hanzhong Yearbooks (1998-2013), Ankang Yearbooks (1996-2015), Shangluo Yearbooks (2000-2010), and please see reference [14] for detail. Based on previous studies and the characteristics of economic development in Southern Shaanxi, the cultivated land area from 1990-2015 and 13 socio-economic indicators such as the total population, the proportion of non-agricultural population, per capita GDP, fiscal revenue, the per capita net income of farmers and the proportion of the second industry and third industry from 1995 -2015 year, are used in the simulation. The specific indicators are shown in Table 1.

| No  | Socio-economic indexes                  | Data resources                        |
|-----|----------------------------------------|---------------------------------------|
| X1  | Total population(Per)                  | statistical data                      |
| X2  | Urbanization rate of domicile (%)      | Non-agricultural population of domicile/Total |
| X3  | Fiscal revenue(1000 Yuan)              | statistical data                      |
| X4  | Per capita GDP(Yuan)                   | statistical data                      |
| X5  | Total investment in fixed assets (1000 Yuan) | statistical data |
| X6  | Per capita net income of farmers (Yuan) | statistical data                      |
| X7  | Total output values of agriculture (1000 Yuan) | statistical data |
| X8  | Total retail sales of social goods (1000 Yuan) | statistical data |
| X9  | Proportion of the first industry (%)   | The first industry/GDP                |
| X1  | Proportion of the second industry (0 %) | The second industry/GDP               |
| X1  | Proportion of the third industry (1 %)  | The third industry/GDP                |
| X1  | Total grain output(Tons)               | statistical data                      |
| X1  | Total power of agricultural machinery   | statistical data                      |

3.2. Methodologies
3.2.1. STIRPAT model. The predecessor of the STIRPAT model was the IPAT equation of environmental pressure equation, that is, I=PAT, where I is environmental pressure, P is population and A is affluence, T is technology. The IPAT equation thinks that I is the result of driving force of P, A and T, and the changing relationship between I and each of driving force is 1:1, that is, the 1% change of any driving force will cause 1% changes of environmental pressure[15]. Hereafter, the IPAT equation had been restructured and expanded in practical applications. Rose and Dietz represented the equation in a random form, that is, the random regression of population, affluence and technology to analyze the effect of each driving force on environmental pressure, short for STIRPAT model, which is usually as follows [16-17]:

\[ I = aP^bA^cT^d e \]  

(1)

Where, a is the coefficient of model; b, c, d are drive exponent; e is error value. When a=b=c=d=e=1, the STIRPAT model is the IPAT equation. In practical applications, the upper form is usually transformed into logarithmic form for testing the influence of human factors on environment (I), which is as follows:

\[ \ln(I) = f + b \ln(P) + c \ln(A) + d \ln(T) + g \]  

(2)

Where, f and g are the logarithm of a and e in Equation (1), b, c and d are the logarithm of the corresponding driving force in equation (1), which is similar to the elastic analysis in economics.

In practical applications, social or other factors can be added to formula (1) or (2) for analyzing the effect on environment, but the added variables need to be conceptual consistency with the specified multiplication form in the Equation (1) [18].

3.2.2. Research layout. Based on the above socio-economic indexes, the socio-economic driving forces of cultivated land area of Han River in southern Shaanxi will be analyzed. (1) The changing law of cultivated land from 1990 to 2015 year is analyzed. (2) The correlation between cultivated land area and above 13 socio-economic driving factors are analyzed by grey relativity analysis. (3) The main socio-economic factors that affect the change of cultivated land area is selected by principal component analysis, and the influence of multi-collinearity were removed by stepwise regression method. (4) The STRIPAT model is adopted to analyze the causal relationship between cultivated land change and main socio-economic factors. (5) The change trend of cultivated land area in the next 10 years is simulated by scenario analysis.

4. Results

4.1. Analysis of the changing law of cultivated land area

According to statistical data, the changing law of cultivated land area and its annual decline rate of Han River Basin in southern Shaanxi from 1990 to 2015 year is shown in Figure 2.

![Figure 2. The changing law of cultivated land area and its annual regression rate (1990-2015)](image)

As seen in Fig.2, the change of arable land of Han River Basin in Southern Shaanxi mainly experienced three main stages from rapid decline to drastically decreased to be stable and slight rise. There was rapid decreased stage from 1990 to 1998 year with average reduction of 4936.09 hm²/a. It is known that Southern Shaanxi located in the Qinba mountain area, where the nature disasters such as landslides, collapse, debris flow, rainstorm and flood and other natural disasters are easy to occur, the period is the stage of economic development, people were weak in awareness of protecting cultivated
land and environmental, which led to rapid decline of cultivated land area because of frequent occurrence of natural disasters and increasing phenomenon of abusing and abandoning cultivated land. There was sharp decline stage from 1999 to 2003 year with average reduction of 21614.41 hm²/a, and the highest decline rate of cultivated land area was up to 6.33%. This stage is mainly due to the implementation of "the development of the western region in China" and ecological construction that the implementation of "returning farmland to forest" projects. There was stage of stable relatively and slightly rising from 2004 to 2015 year. At this stage, as government recognized that the reduction of cultivated land area would have impact on grain security and social development, the policy of "ecological restoration" was put forward, and the scale of "returning farmland to forest project" had fallen and gradually entered the stage of stable implementation of institutionalization. At the same time, the projects such as land renovation have made and so on. Therefore, the cultivated land area began to be stable and slightly rising.

4.2. Analysis of socio-economic driving forces of cultivated land area

4.2.1. Analysis on correlation between cultivated land area and driving factors. According to the statistical data from 1995 to 2015 years, the correlation between cultivated land area and socio-economic driving factors were analyzed by grey relativity analysis. The results are shown in Table 2.

| No. | X1  | X2  | X3  | X4  | X5  | X6  | X7  | X8  | X9  | X10 | X11 | X12 | X13 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ri  | 0.995 | 0.984 | 0.905 | 0.898 | 0.788 | 0.925 | 0.948 | 0.918 | 0.994 | 0.988 | 0.989 | 0.993 | 0.962 |

As shown in Table 3, the correlation between the cultivated area and the 13 socio-economic driving factors are more than 0.7, which indicated that the change of cultivated land area was greatly influenced by the socio-economic factors.

4.2.2. Sifting socio-economic driving factors. Though there was a great correlation between cultivated land area and driving factors, it is necessary to sift the main socio-economic driving factors because of a high correlation among driving factors themselves. Firstly, the above 13 factors were analyzed by principal component analysis, then Through the load of these factors in the new combination of principal components to evaluate the importance of their influence on the change of cultivated land area by factor analysis. The results are shown in Table 3 and Table 4.

| No. | X1 Total population | X2 Urbanization rate of domicile | X3 Fiscal revenue | X4 Per capita GDP | X5 Total investment in fixed assets | X6 Per capita net income of farmers | X7 Total output values of agriculture | X8 Total retail sales of social goods |
|-----|---------------------|--------------------------------|------------------|-----------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| VC% | 0.894               | 0.968                          | 0.993            | 0.999           | 0.978                             | 0.998                             | 0.991                             | 0.995                             |
| AVC%| 0.366               | 0.213                          | -0.041           | 0.019           | -0.050                            | 0.011                             | 0.062                             | 0.048                             |

Note: “VC” refer to “variance contribution”, “AVC” refer to “accumulated variance contribution”
As shown in table 3 and Table 4, the cumulative contribution rate of the first principal component and the second principal component is 92.135%, and both eigenvalues are greater than 1, so it can fully explain the change of the cultivated land area of Han River Basin in southern Shaanxi. Among the first principal components, the absolute loads of the urbanization rate, fiscal revenue, per capita GDP, per capita net income of farmers, total retail sales of social goods, total output value of agriculture, the proportion of the second industry, the proportion of the third industry and total power of agricultural machinery are above 0.96. Therefore, the change of cultivated land area can be regarded as the level of urbanization and socio-economic development that represent the first principal components. In the second principal components, the absolute loads of the proportion of the third industry is over 0.90, so the second principal component can reflect the influence of adjustment of industrial structure on the change of cultivated land area. Therefore, these driving factors have a greater impact on the change of cultivated land area.

In order to improve the effectiveness of model, the stepwise regression method was used to analyze driving factors that were selected by principal component analysis for eliminating collinearity of driving factors. According to the results, three driving factors of urbanization rate of domicile(X2), the proportion of the second industry(X10) and the proportion of the third industry(X11) were sifted.

4.2.3. Estimation results and analysis of STIRPAT model. The data analysis of model adopts the Least Square. In the econometric model analysis, the Least Square generally faces the problem of the heteroscedasticity of data. Because of logarithmic transformation of original data in the STIRAP model, the relative error is reflected in residuals, and the relative errors often have variance. Therefore, the STIRPAT model itself can better solve the heteroscedasticity. Based on the STIRPAT model and three of main driving factors, the extension model(Ⅰ) is followed:

\[
\ln(I) = f + b_1 \ln(X_2) + b_2 \ln(X_{10}) + b_3 \ln(X_{11}) + g
\]

According to Formula 3, the regression analysis of data was carried out, and model parameters are shown in Table 5.

| Variable                  | Model(I)          |
|---------------------------|-------------------|
| Constant                  | 12.170 (186.847**) |
| X2 urbanization rate of domicile | 0.408(3.142**)    |
| X10 the proportion of the second industry | -0.808 (-5.269**) |
| X11 the proportion of the third industry | -0.726 (-12.480**) |
| Adjusted R²               | 0.940             |
| F-test                    | 105.526           |
| D-W test                  | 1.932             |
| N                         | 21                |

Table5. The parameters of STIRPAT model

Note: in the brackets is t-test, "**" represent significant at 0.01 level, "***" represent significant at 0.05 level.

The fitting goodness of model reaches 94%, and T-test value of all variables reached significant level (\(\alpha=0.01\)), so the fitting effect is quite good. The model had high fitting results. It indicated that the model can explain the relationship between cultivated land change and socio-economic development of Han River Basin in Southern Shaanxi. The specific form of model is as follows:

\[
\ln(I) = 12.170 + 0.408 \ln(X_2) - 0.808 \ln(X_{10}) - 0.726 \ln(X_{11})
\]

Where, I represent cultivated land, X2 is urbanization rate of domicile, X10 is the proportion of the
second industry, $X_{11}$ is the proportion of the third industry.

According to results of model, for influence degree on the cultivated land area, the proportion of second industry $> \text{proportion of the third industry} > \text{urbanization rate of domicile}$. When the urbanization rate of domicile increased by 1%, it would induce that cultivated land area increased by 0.408%, and that is, the urbanization rate of domicile have an positive effect on cultivated land. The results are consistent with above Li [5], Wang [6], Guo[7]. The possible explanation is that the improvement of urbanization level is helpful to promote intensive utilization of land. Besides, in the same conditions, when the proportion of the second industry and the proportion of the third industry increased by 1%, the cultivated land area would decreased by 0.808% and 0.726%, respectively, indicating that economic development and the current adjustment of industrial structure would have negative effect on cultivated land area.

4.3. Prediction of cultivated land area

Based on the results of STRIPAT model, the cultivated land area of Han River Basin in the southern Shaanxi in the next 10 years was forecasted, the specific formula is as follows:

$$I = \exp \left( 12.170 + 0.408 \ln X_2 - 0.808 \ln X_{10} - 0.726 \ln X_{11} \right)$$  \(5\)

Based on historical urbanization rate of domicile, historical proportion of the second industry and historical proportion of the third industrial, the paper simulated the cultivated land of Han River Basin in southern Shaanxi by Equation (5), and fitted the simulated value and historical value. The results showed that fitting effect of model was well, it is shown in Table 7. The maximal absolute relative error is 5.762%, the minimum is only 0.019%, the mean absolute relative error is 1.33%, that is, the mean fitting accuracy reaches more than 98%. Therefore, it is feasible for Equation (5) to predict the cultivated land area of Han River Basin in southern Shaanxi.

![Figure 3. Comparison of simulated values and historical values of cultivated land](image)

According to the “Thirteenth Five-Year Plan” of Hanzhong, Ankang, Shangluo, The economy will keep medium and high-speed growth from 2016 to 2020 years in Han River Basin of Southern Shaanxi, and the proportion of three industries of Hanzhong, Ankang, Shangluo will be adjusted to 12:49:39, 10:56:34 and 10:50:40 by 2020, respectively. In the paper, the mean value of three industrial proportions in Hanzhong, Ankang and Shangluo in 2020 was taken as the three industrial proportion of Han River Basin in Southern Shaanxi in 2020, that is 10.67:51.67:37.67, and the three industrial proportion of Han River Basin in Southern Shaanxi was 14.69:49.53:35.78 in 2015, which can get the average annual growth rate of Han River in Southern Shaanxi by reverse calculation. Considering that the future development model will be transformed from high-speed development to high-quality development, which is aim at reducing the proportion of first industry and increasing the proportion of third industry, and taking the historical proportion of three industries of Han River Basin in Southern Shaanxi as reference. The average annual growth rate of the second industrial proportion that is derived from reverse calculation, is taken as the "low-speed setting", and the mean growth rate of historical second industrial proportion as the "high-speed setting". The average annual growth rate of the third industrial proportion that is derived from reverse calculation, is taken as the "low-speed setting", and the mean growth rate of historical third industrial proportion as the "low-speed setting".
According to “Shaanxi population development plan (2016-2030)”, the urbanization rate will increase to more than 45% by 2020 with an average annual growth rate of 1.2%, and the urbanization rate of domicile will increase rapidly, so the mean annual growth rate of historical urbanization rate of domicile is taken as “low-speed setting”. The Shaanxi provincial urbanization rate of domicile is taken as the “high-speed setting” with annual growth rate of 1.2% of Han River Basin in Southern Shaanxi. For predicting the change trend of cultivated land area from 2016-2025 years, it is assumed that “low-speed setting” and “high-speed setting” of urbanization rate of domicile, the proportion of the second industry and the proportion of the third industry from 2021 to 2025 years are consistent with 2016-2020 years. The specific scenario settings are shown in Table 6 (“Scenario 6” accord with “Thirteenth Five-Year Plan” in Southern Shaanxi).

Table 6. Scenario analysis on cultivated land development of Han River Basin in southern Shaanxi

| Scenarios  | Urbanization rate of domicile | the proportion of the second industry | the proportion of the second industry |
|------------|-------------------------------|--------------------------------------|--------------------------------------|
| Scenarios  |                               | Low-speed                            | Low-speed                            |
| 1          | Low-speed                     | Low-speed                            | Low-speed                            |
| Scenarios  |                               | Low-speed                            | High-speed                           |
| 2          | Low-speed                     | Low-speed                            | High-speed                           |
| Scenarios  |                               | Low-speed                            | High-speed                           |
| 3          | Low-speed                     | High-speed                           | High-speed                           |
| Scenarios  |                               | High-speed                           | Low-speed                            |
| 4          | High-speed                    | Low-speed                            | High-speed                           |
| Scenarios  |                               | High-speed                           | Low-speed                            |
| 5          | High-speed                    | Low-speed                            | High-speed                           |
| Scenarios  |                               | High-speed                           | Low-speed                            |
| 6          | High-speed                    | High-speed                           | Low-speed                            |
| Scenarios  |                               | High-speed                           | High-speed                           |
| 7          | High-speed                    | High-speed                           | Low-speed                            |
| Scenarios  |                               | High-speed                           | High-speed                           |
| 8          | High-speed                    | High-speed                           | High-speed                           |

Based on the above scenarios, the cultivated land area of Han River Basin in Southern Shaanxi is predicted by Equation (5), and the results are shown in Table 7.

Table 7 Prediction of cultivated land area (hm²) in the next 10 years

| Year | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 | Scenario 8 |
|------|------------|------------|------------|------------|------------|------------|------------|------------|
| 2016 | 422643     | 418485     | 418205     | 414091     | 426180     | 421986     | 421705     | 417556     |
| 2017 | 424598     | 416313     | 415858     | 407744     | 431506     | 423086     | 422624     | 414378     |
| 2018 | 426503     | 414124     | 413590     | 401586     | 436630     | 423957     | 423410     | 411220     |
| 2019 | 428361     | 411922     | 411398     | 395610     | 441565     | 424620     | 424080     | 407058     |
| 2020 | 430174     | 409709     | 409279     | 389807     | 446326     | 425092     | 424646     | 404443     |
| 2021 | 431946     | 407487     | 407229     | 384169     | 450923     | 425389     | 425120     | 401047     |
| 2022 | 433678     | 405258     | 405246     | 378690     | 455366     | 425525     | 425512     | 397628     |
| 2023 | 435371     | 403205     | 403227     | 373532     | 459665     | 425515     | 425833     | 394196     |
| 2024 | 437029     | 400790     | 401469     | 368179     | 463830     | 425369     | 426090     | 390758     |
| 2025 | 438652     | 398554     | 399671     | 363136     | 467867     | 425098     | 426290     | 387321     |

As shown in Table 7, without considering major policy changes, major natural disasters, in next ten years, “Scenario 5” is that the cultivated land area would keep the fastest growth when urbanization rate of domicile keeps high-speed growth, the proportion of second industry and the proportion of the third industry keeps low-speed growth. Meanwhile, “scenario1” and “scenario 7” would also promote the slight increase of cultivated land area. “Scenario 4” is that the cultivated land area would keep the fastest growth when urbanization rate of domicile keeps high-speed growth, the proportion of the second industry and the proportion of the third industry keeps high-speed growth.
industry keeps low-speed growth, and the proportion of the third industry keeps high-speed growth. “Scenario 4” that is, if the urbanization rate of domicile show a low-speed tendency. The proportion of the second industry and the proportion of the third industry show a high-speed tendency, the cultivated land area will show trend of the most rapid decline.

The “Scenario 6”, is that the cultivated land area tends to be stable and rise slightly from 2016 to 2022 years, and begin to decrease slightly from 2023 to 2025 years when the urbanization rate of domicile and the proportion of the third industry keeps high-speed growth, and the proportion of the third industry keeps low-speed growth. Based on a more long-term prediction, it was found that cultivated land area will decrease as a whole in the future. Therefore, the “Scenario 6”, which conform to “Thirteenth Five-Year Plan” in Southern Shaanxi, in the long term, is not beneficial for sustainable development of cultivated land area.

5. Conclusions
The paper mainly analyze and forecast the change law and driving forces of cultivated land of Han River Basin in Southern Shaanxi. Firstly, change law of cultivated land area is analyzed, then sifting the main socio-economic driving factors that affect the change of cultivated land area is analyzed by principal component analysis and stepwise regression analysis, and then the relationship between cultivated land area and main driving factors is analyzed by STRIPAT model. Finally, the study set 8 development scenarios to predict the change trend of cultivated land area. The results are as follows.

(1) The cultivated land area of Han River Basin in southern Shaanxi experienced from rapid decline to sharp decline, and then to be stable and slightly increased during the study period. The change of cultivated land area of Han River Basin in southern Shaanxi was mainly affected by socio-economic development, “returning farmland to forest” project and natural disasters.

(2) Based on principal component analysis and stepwise regression analysis, three socio-economic factors that mainly affect the change of cultivated land area, are urbanization rate of domicile, the proportion of the second industry and the proportion of the third industry, and they are selected to simulate the cultivated land area.

(3) The results of STIRPAT model showed that, for influence degree on cultivated land area, the proportion of the second industry > the proportion of the third industry > urbanization rate of domicile. When the urbanization rate of domicile increased by 1%, it would induce that the cultivated land area increased by 0.408%, that is, the urbanization rate of domicile have a positive effect on cultivated land. And in the same conditions, the cultivated land area would decreased by 0.808% and 0.726%, respectively with the proportion of the second industry and the proportion of the third industry increased by 1%.

(4) The scenario analysis showed that, without considering major policy changes, major natural disasters, in next ten years. If the urbanization rate of domicile keep at high-speed development, the proportion of the second industry and the proportion of the third industry keep low-speed development,. When the urbanization rate of domicile keeps at low-speed development, the proportion of second industry and the proportion of third industry keep high-speed development, it would cause the most rapid decline in cultivated land area. Besides, the development of urbanization rate of domicile, the proportion of the second industry and the proportion of the third industry in the “Thirteenth Five-Year Plan” is not beneficial for sustainable development of cultivated land area, in the long term.

(5) Based on study results, urban development and adjustment of industries structure should be accelerated, and the way of economic growth should be changed for effectively restraining the current situation of continuous reduction of cultivated land area. Meanwhile, socio-economic indicators selected in this paper may have some limitations and other factors need to be further studied. And, due to various reasons, the data of social-economic indicators that obtained from Statistical Yearbooks may have some uncertainty, which will also have a certain impact on the research results.

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