Mountain soil characteristics and agricultural economic growth based on high-resolution remote sensing images

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Abstract
The land is the most basic support condition for agricultural planting in our country. For the development of the rural economy, strengthening the use of land and the transformation of land is essential. The rational use of land for transformation in rural areas is an important way to promote rural economic development. Soil water plays a very important role. Moreover, soil moisture is also an important data for agricultural scientists to conduct research on agricultural economics and hydrology. Strengthen the protection and attention to soil water so that the water in the land can be recycled and used reasonably. At present, the remote sensing method is mainly used for soil moisture measurement. Especially the development and perfection of GIS have made the estimation of the content of water molecules in the soil more accurate. Regarding the land situation in impoverished mountainous areas, it is necessary to improve the availability of cultivated land by strengthening scientific and technological means, as well as the coordinated development of the transformation of cultivated land’s functional form and spatial form. In this way, the functionality of the arable land can be well utilized, and at the same time, the land can be consolidated and optimized through spatial transformation. So that some scattered land can be gathered through spatial transformation, thereby increasing the aggregation of cultivated land.

Keywords High resolution - Remote sensing image - Soil characteristics - Agricultural economy

Introduction
Since the founding of New China, our country has vigorously developed its economy and made great progress in our country’s economy and society. With the economic development and the acceleration of the urban pace, there has been a very large gap between the population of our country’s urban and rural population, especially the poor mountainous areas. Especially in recent years, many rural young people have chosen to work in cities. This inevitably led to a reduction in the number of people in the vast rural areas. In many rural areas, only the elderly and children are left behind. Most young people choose to go out to work in the cities (Jansson and Tas 2014). This situation inevitably caused a large amount of arable land in these areas to be deserted. Many lands in rural areas have been abandoned due to a lack of personnel for planting. In addition, some enterprises built factories in the countryside and occupied a large amount of arable land for farmers. In addition, the complex terrain conditions in some mountainous areas are not conducive to large-scale farming, etc., which has led to a large amount of waste in some areas of our country, and the development of agricultural planting and rural economy has been severely restricted. The land is the most basic support condition for agricultural planting in our country (Babaei et al. 2005). For the development of the rural economy, strengthening the use of land and the transformation of land is essential. The rational use of land in rural areas for transformation is an important way to promote rural economic development. Therefore, strengthening the transformation of land use in rural areas, especially in poor areas, is very important for the growth of the local rural economy and the quality of agricultural products. Significance is of great significance for promoting sustainable economic development in rural areas and reducing the gap between rural and urban areas (Kajimoto 2010). The quality of rural land also directly affects
the quality of agricultural products. Therefore, the maintenance and conservation of the land in rural areas is strengthened to make the land more suitable for planting a large number of crops and to increase the annual output of crops grown on the land (Alavi 2004). It plays a very important role in strengthening rural economic construction and increasing farmers’ income levels. Moreover, in rural areas around cities, many lands are used to build factories and facilities. This has also resulted in a large extent of rural land, especially arable land. Reduction and waste, so reducing the amount of arable land converted into construction land will also contribute to improving the rural economy and increasing farmers’ income.

**High-resolution remote sensing image research**

For rural land protection, it is necessary to fully understand the size of water molecules in the land. If the land is too dry, it is not conducive to the growth of crops, so the effect of soil water is very large. Moreover, soil moisture is also an important data for agricultural scientists to conduct research on agricultural economy and hydrology. It is also an important aspect to strengthen the protection and attention to soil water so that the land water can be recycled and used reasonably. At present, the main method of soil moisture measurement is remote sensing (Jian et al. 2018). Due to the development of modern information technology and science and technology, for soil water monitoring, it mainly collects values such as the content and flow of soil moisture through sensor systems and computer data. Through this advanced information and scientific technology to monitor and measure the water content in the soil, we can effectively perceive the water content in the soil so as to be more conducive to taking corresponding measures to keep the water content in the soil at an excellent level. Using this method to measure soil moisture content can also provide experts and scholars with certain theoretical data. Many areas now use this method for monitoring soil moisture content. Especially the development and perfection of GIS have made the estimation of the content of water molecules in the soil more accurate (Rienberg et al. 1996). Therefore, this technology has also been widely used in real life. In addition to accuracy, the soil moisture data obtained through remote sensing has the advantages of a relatively large soil area that can be monitored, a relatively fast-value transmission speed, and a relatively low cost of using remote sensing methods. Therefore, soil moisture is being monitored in many areas of our country so that areas that frequently experience drought can be prevented and controlled as soon as possible (Menyaileo 2008). When obtaining the value of soil moisture by remote sensing, multiple sensing systems in the sensor also measure the location of soil moisture. Thereby, it is possible to distinguish the color of the soil and the temperature of the soil more accurately. However, when the measurement is performed, it is sometimes restricted by factors such as weather and sunshine, which will cause a certain deviation in the measurement result (Beiranvand et al. 2014). Therefore, when scientific analysis of the measurement data is performed, the measurement rate in this case should be improved. The microwave sensor will not be affected by weather such as sunshine and can monitor the land conditions 24 h a day, which is also a unique advantage of microwave remote sensors. Therefore, in recent years, the application of microwave remote sensors in soil moisture measurement has gradually become widespread.

**Research on the characteristics of mountain soil**

The water content in the soil is closely related to the plant coverage on the soil surface and the protection of the land. Soil moisture plays a very important role in the planting and growth of plants on the land. At the same time, plant growth and planting coverage will also restrict and control the moisture content in the soil to a certain extent, so it is important for the maintenance of soil moisture. In other aspects, it is necessary to strengthen the coverage of plants on the land (Sarfi et al. 2015). Relevant data studies have shown that scientific and reasonable use of land can protect the water in the land surface, the nutrients in the land are gathered due to the accumulation of water, which is more conducive to planting crops. And if the loss of water in the land is relatively fast, it will take away other nutrients in the land, causing nutrient loss and reducing the yield of planting (Jiang et al. 2005). In addition, strengthening the protection of soil moisture can increase the penetration and retention of rainwater in the soil, thereby protecting the soil moisture content. It is found after analyzing and researching the land moisture content in the Loess Plateau of my country. The combined action of human factors and natural environmental factors will have a great impact on the composition of water in the land. The water content of the land has an important relationship with the use of the land. Because of different ways of using land, the hydrological content of the land will be different (Menyaileo and Hungate 2005). In addition, if some water storage equipment is built on the land, it will help protect the moisture content of the land.

**Status quo of agricultural economic growth**

At present, in the vast rural areas of our country, the source of farmers’ income is mainly from farming. However, because the land in these areas is wasted in use, the income of farmers is low. First, due to the geographical constraints of rural areas, the resources and facilities in these areas are relatively small and many areas rely on the weather to grow crops. Second, because agricultural production in these areas is relatively simple. It is mainly based on planting some common crops so that agricultural income cannot be increased through a variety of planting methods (Sarfi and Yazdi-Moghadam 2016).
And because these areas are restricted by topographical conditions and natural resources, traditional artificial planting is the main way to cultivate the land and the equipment used is also very simple and primitive. Modern machines cannot be used in this area, resulting in the lack of scientific facilities and equipment in these areas, the production capacity is greatly restricted. Third, when planting crops, it is affected by many factors such as weather, geographical environment, and market conditions. These factors have great uncertainty, and therefore, there are also great fluctuations in the prices of agricultural products. Fourth, because farmers have relatively few sources of income, the vast labor force in the countryside has given up on crop planting and chose to work in cities to increase their income (Jong et al. 1974). To a certain extent, the land in the countryside cannot be used well. The phenomenon of staying behind in the village is very obvious.

In terms of targeted poverty alleviation, our country places the main targets of poverty alleviation in poor mountainous areas. Therefore, these areas are also key areas for poverty alleviation in our country. Through the implementation of poverty alleviation policies by the state, the economy of these areas has been improved to a certain extent, but due to geographical and natural environmental constraints, the problem of land has greatly restricted the development of the rural economy. First, the increase in construction land has caused many arable lands to be occupied, which has greatly reduced the area of arable land and the amount of arable land has dropped significantly. The second is that arable land has been largely abandoned. In these poverty-stricken areas, the main labor force is the elderly, teenagers, and children and there is a serious shortage of labor in the rural areas. As a result, some land is abandoned, and agricultural production is seriously damaged (Chernoff 1973). Third, although our country has made great efforts in land use in recent years, the amount of land has increased significantly, but because these lands have not been maintained for a long time, the quality of these lands is not high, and it is difficult to improve crops. Fourth, due to the rapid development of industry and services, and the relatively slow development of agriculture, farmers’ enthusiasm for farming land has declined. Most farmers adopt extensive management methods and use large amounts of chemical fertilizers and pesticides, which results in the destruction of the ecological environment of the land to a great extent.

Materials and methods

Data acquisition

This article uses ECVSMC Essential Climate Variable Soil Moisture data set for data collection and analysis. Invert the data with an active microwave scatterometer. The formula of SWI is

\[
SWI_{m(n)} = SWI_{m(n-1)} + K_n \left( ms(t_n) - SWI_{m(n-1)} \right)
\]

(1)

\[
K_n = \frac{K_{n-1}}{K_{n-1} + e^{\frac{(v_n - v_{n-1})}{2}}}
\]

(2)

Data preprocessing

The calculation formula using ArcGIS software is

\[
NDVI = 0.008 \times (DN - 128)
\]

(3)

\[
NDVI = DN \times 0.004 - 0.1
\]

(4)

The DN value of each unit is converted into the corresponding NDVI value, and the NDVI data set is assembled according to some boundaries. This study is mainly divided according to the four seasons of the year, spring, summer, autumn, and winter. The calculation method of NDVI data is as follows:

(1) The maximum synthesis method: the NDVI value is based on the maximum value of the first ten days, the middle ten days, and the second ten days of each month (Kim et al. 2012). This method eliminates the influence of environmental factors such as weather and sunshine and makes the value of NDVI more accurate. The calculation formula is

\[
NDVI(i) = \max_{1 \leq j \leq 3} NDVI(i,j)
\]

(5)

(2) Average method: according to the annual value obtained by NDVI and the seasonal value of the four seasons of spring, summer, autumn, and winter, the NDVI of each month corresponding to the 12 months of the year is calculated average of. This method can exclude the impact of certain special months on the data (Setudehnia 1972). The calculation formula is

\[
NDVI(i) = \frac{1}{n} \sum_{j=1}^{n} NDVI(i,j)
\]

(6)

Measurement of transformation of mountain agricultural land use

The measurement of land use transformation can be carried out from the functional service form and the spatial form. The functional service form mainly refers to the three functional
service forms of production service, life service, and ecological service; the spatial form mainly refers to the spatial pattern and spatial quantity (Ciais et al. 2013). Through the analysis of a large number of literature materials and research data of relevant experts and scholars, this research mainly uses the collection of relevant data to understand the value quantum table of the ecological service function of cultivated land and proposes the value of the national cultivated land ecosystem unit grade service value. See the details Table 1 shows.

In the calculation process, the direct value method can be used to calculate the relevant formula. When calculating by using the Delphi consulting method, the specific weight calculated by the Delphi method is obtained by consulting the data proportion (Kolari et al. 2006). The weight calculated by the direct value method is basically similar. Since the experts consulted in the Delphi consultation method have a relatively large impact on the data, the third round of expert consultation was carried out. The final weight values are as follows, as shown in Table 2.

## Results

### Distribution characteristics of soil moisture SWI at a different time and space scales

The monthly average soil moisture SWI value changes in the Loess Plateau region from 1992 to 2013 are shown in Figs. 1 and 2 and Tables 3 and 4.

### Table 1 Service value per unit area of the national cultivated land ecosystem (yuan/year·ha)

| Service function type          | Equivalence factor | Value per unit area | For example                        |
|--------------------------------|--------------------|---------------------|-----------------------------------|
| Food production                | 2                  | 884.8               | Production of corn and wheat      |
| Raw material production        | 0.2                | 88.6                | Production of cotton, linen, and clothing |
| Gas regulation                 | 0.6                | 442.5               | Oxygen, nitrogen, carbon dioxide, etc. |
| Climate regulation             | 0.88               | 787.6               | Regulate the temperature and humidity in the air |
| Water conservation             | 0.7                | 530.8               | Concentrate moisture              |
| Soil formation and conservation| 1.47               | 1291.8              | Organic matter and nutrient content |
| Waste disposal                 | 1.65               | 1451.3              | Wastewater, waste, and various fertilizers and pesticides |
| Biodiversity conservation      | 0.72               | 628.3               | Multiple resource materials       |
| Pleasant landscape             | 0.02               | 8.9                 | Beautiful rural scenery and farm travel |

### Table 2 Weight determination based on the Delphi consulting method and the right value method

| Index                                                   | Delphi consultation method | Entropy method | Weighted mean |
|---------------------------------------------------------|----------------------------|----------------|---------------|
| Major crop yields per land                              | 0.139                      | 0.071          | 0.105         |
| Agricultural value added                                | 0.118                      | 0.068          | 0.094         |
| Multiple crop index                                     | 0.034                      | 0.071          | 0.052         |
| Per capita agricultural income of rural residents       | 0.061                      | 0.069          | 0.065         |
| Proportion of the number of people employed in a plantation in rural areas | 0.021                      | 0.071          | 0.046         |
| Per capita food guarantee rate                          | 0.135                      | 0.068          | 0.103         |
| Cultivated land nitrogen and phosphorus index           | 0.023                      | 0.068          | 0.047         |
| Chemical control area ratio                             | 0.022                      | 0.065          | 0.044         |
| Cultivated land ecological service value index          | 0.118                      | 0.066          | 0.093         |
| Cultivated land patch fragmentation                     | 0.038                      | 0.068          | 0.054         |
| Cultivated land patch aggregation degree                | 0.045                      | 0.068          | 0.057         |
| Distribution density of slope farmland per unit area    | 0.011                      | 0.071          | 0.041         |
| Newly added cultivated land area                        | 0.064                      | 0.066          | 0.065         |
| Per capita arable land area                             | 0.157                      | 0.071          | 0.114         |
| The ratio of cultivated land in a plain valley area     | 0.027                      | 0.044          | 0.035         |
From 1992 to 2013, the average change of soil moisture in the three seasons of the year: spring, summer, and autumn. The details are shown in Fig. 3.

It can be seen from Table 5 that compared with the years from 1992 to 2000, the soil moisture content in the three seasons of spring, summer, and autumn from 2007 to 2013 was relatively large (Alavi 2007). Moreover, through the changes and comparisons between the values, it can be found that the coefficient of variation of the values in spring is larger than those in summer and autumn, which also shows that there will be greater variability in the water content of the land in spring (Dixon et al. 1994). The specific situation is shown in Table 6.

The average soil moisture changes during the period from 1992 to 2013 are shown in Fig. 4. It can be seen from this figure that the spatial pattern of the water content in the land in the Loess Plateau has changed greatly.

It can be seen from Table 5 that during the 8 years from 1992 to 2000, the land moisture in the Loess Plateau has decreased and the land moisture in the Loess Plateau has increased in the past few years from 2007 to 2013 (Ezampanah et al. 2018a). Figure 5 can clearly see the situation in areas where the land moisture is rising. See Table 7 and Fig. 5 for details.

### Table 3 Distribution area ratio of soil moisture content in each month of the Loess Plateau from 1992 to 2000

| Month value | 0–10 | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 | 70–80 |
|-------------|------|-------|-------|-------|-------|-------|-------|-------|
| 3           | 13.99| 26.98 | 20.13 | 25.57 | 11.78 | 1.62  | 0.00  | 0.00  |
| 4           | 3.03 | 28.08 | 28.28 | 25.16 | 11.78 | 3.63  | 0.11  | 0.00  |
| 5           | 0.11 | 14.18 | 33.11 | 27.47 | 17.82 | 6.95  | 0.41  | 0.00  |
| 6           | 0.00 | 6.15  | 22.75 | 28.68 | 29.48 | 10.17 | 2.73  | 0.11  |
| 7           | 0.00 | 0.92  | 8.56  | 17.72 | 28.38 | 35.52 | 8.66  | 0.31  |
| 8           | 0.00 | 0.11  | 1.52  | 7.76  | 12.08 | 20.43 | 51.92 | 6.25  |
| 9           | 0.00 | 0.11  | 1.62  | 9.06  | 16.01 | 34.32 | 33.91 | 5.04  |
| 10          | 0.00 | 0.61  | 7.66  | 17.92 | 19.12 | 36.33 | 17.41 | 4.92  |
| 11          | 0.00 | 1.42  | 14.48 | 25.96 | 33.61 | 19.63 | 4.94  | 0.00  |

### Table 4 Distribution area ratio of soil moisture content in each month of the Loess Plateau from 2007 to 2013

| Month value | 0–10 | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 | 70–80 |
|-------------|------|-------|-------|-------|-------|-------|-------|-------|
| 3           | 0.00 | 9.57  | 28.08 | 48.38 | 11.88 | 2.12  | 0.00  | 0.00  |
| 4           | 2.32 | 21.84 | 30.69 | 31.38 | 11.28 | 2.53  | 0.00  | 0.00  |
| 5           | 0.00 | 19.33 | 28.77 | 28.68 | 16.31 | 5.85  | 1.02  | 0.11  |
| 6           | 0.00 | 5.24  | 27.88 | 26.77 | 26.47 | 9.47  | 3.93  | 0.31  |
| 7           | 0.00 | 0.61  | 8.46  | 24.86 | 18.52 | 33.71 | 12.79 | 1.12  |
| 8           | 0.00 | 0.21  | 3.53  | 11.78 | 19.93 | 21.94 | 35.32 | 7.36  |
| 9           | 0.00 | 0.11  | 1.32  | 6.85  | 12.38 | 22.24 | 40.86 | 16.31 |
| 10          | 0.00 | 0.31  | 3.63  | 9.16  | 14.88 | 30.29 | 29.29 | 12.49 |
| 11          | 0.00 | 0.82  | 6.65  | 13.89 | 29.89 | 34.92 | 13.89 | 0.00  |

Comparison of SWI characteristics of soil moisture in a typical section of a plateau

In order to make the spatial change of land moisture more intuitively visible, different samples were selected to analyze the land moisture situation. Figure 6 shows the details of the selected eight sample strips. Figure 7 shows the details of land moisture, plants, and precipitation in the elevation distribution area.

Figure 8 shows in detail the conditions of land moisture, plants, and precipitation in the E109 transect.

Figure 9 shows in detail the conditions of land moisture, plants, and precipitation in the E113 transect. Special attention is paid to the significant changes in the NDVI value of the transects after the country implemented the project of returning farmland to forests (Ezampanah et al. 2018b).

Figure 10 shows in detail the conditions of land moisture, plants, and precipitation in the N36 transect. From Fig. 10, it can be found that this transect has the most areas and the greatest changes in natural and geographical conditions.
Analysis of vegetation cover changes under soil moisture changes

Figure 11 shows in detail the differences in the changes of SWI and NDVI in the Loess Plateau. Figure 12 shows in detail the changes in different spatial patterns of SWI and NDVI in the Loess Plateau.

Figure 13 shows in detail the decrease in land moisture and increase in plant coverage in the Loess Plateau.

Analysis of vegetation cover changes under the conditions of precipitation and soil moisture changes

Table 8 shows in detail that the precipitation in the central part of the Loess Plateau has increased significantly, while the precipitation in the western and northern parts of the Loess Plateau is still significantly lower (Hobbie 1996).

Fig. 1 Spatial variation of the average monthly value of SWI in the Loess Plateau from 1992 to 2013.

Fig. 2 Changes in SWI in the Loess Plateau during the year (a: 1992–2000, b: 2007–2013)
Table 5 Distribution area ratio of soil moisture content in each season of the Loess Plateau from 1992 to 2013

| Season   | Period   | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 | 70–80 |
|----------|----------|-------|-------|-------|-------|-------|-------|-------|
| Spring   | 1992–2000| 23.15 | 34.11 | 26.37 | 12.89 | 3.53  | 0.00  | 0.00  |
|          | 2007–2013| 15.28 | 30.98 | 39.14 | 11.78 | 2.83  | 0.00  | 0.00  |
| Summer   | 1992–2000| 0.61  | 7.46  | 15.78 | 28.58 | 38.24 | 9.17  | 0.21  |
|          | 2007–2013| 0.61  | 8.96  | 25.77 | 20.94 | 32.08 | 11.08 | 0.61  |
| Autumn   | 1992–2000| 0.21  | 4.83  | 15.51 | 16.81 | 20.44 | 42.26 | 0.00  |
|          | 2007–2013| 0.21  | 3.43  | 876   | 17.52 | 36.83 | 25.76 | 7.56  |
**Discussion**

**Agricultural economic growth strategy based on the transformation of cultivated land functional form**

**Use science and technology to innovate the technological system**

Through research and analysis, it can be seen that in some areas of our country, the agricultural economic growth has been stagnating or even retreating (Amini 2006). In this case, it is necessary to improve the rural economy in these areas by strengthening science and technology, such as using modern machinery and equipment to promote agricultural production and increasing the output value of crops per acre of land, which will promote the rural economic development.

**Learn from and introduce international advanced agricultural production technologies**

Because some areas of our country, especially the impoverished mountainous areas, are restricted by geographic location, when the land is cultivated, traditional machinery and equipment are still needed to work. Under this circumstance, it is possible to absorb foreign advanced farming methods (Högberg et al. 2001). For example, when arable land is operated in a hillside, one can learn foreign advanced science and technology and plant some new products and varieties (Menyailo et al. 2002). This is a kind of protection of the land quality of the hillside. At the same time, it is necessary to teach farmers some professional planting techniques and apply advanced science and technology to planting in mountainous land so as to improve the backwardness of agricultural production in these areas.

**Take the characteristic agricultural development route**

In some mountainous areas, due to the diverse characteristics of the land structure, the topography and topography of some areas also have great differences (Wang et al. 2005). This requires proper planting according to the characteristics of the land, for example, planting in some hillsides. Tea and tobacco are used to increase the scope

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**Table 6** Statistical characteristics of SWI seasonal variation in the Loess Plateau

| Season | Period      | SWI Minimum | SWI Maximum | SWI Average | Standard deviation | Coefficient of variation |
|--------|-------------|-------------|-------------|-------------|--------------------|--------------------------|
| Spring | 1992–2000  | 8.18        | 59.49       | 28.69       | 10.85              | 37.81                    |
|        | 2007–2013  | 11.35       | 57.82       | 30.56       | 9.34               | 30.55                    |
| Summer | 1992–2000  | 15.27       | 75.89       | 47.27       | 10.66              | 22.54                    |
|        | 2007–2013  | 16.26       | 78.85       | 46.11       | 11.87              | 25.74                    |
| Autumn | 1992–2000  | 18.07       | 69.77       | 50.18       | 10.91              | 21.77                    |
|        | 2007–2013  | 18.09       | 76.8        | 54.62       | 11.44              | 20.94                    |
| Annual | 1992–2000  | 14.49       | 65.83       | 42.32       | 10.19              | 24.07                    |
|        | 2007–2013  | 16.37       | 69.62       | 43.67       | 10.25              | 23.46                    |

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Fig. 4 Annual average SWI spatial change in the Loess Plateau (1992–2000 (a), 2007–2013 (b))
of agricultural planting so that the land can grow a variety of agricultural products (Stampfli 2000). Make agricultural planting more in line with local land characteristics and topography so that these mountainous areas can develop their own characteristic planting to increase rural economic income.

Control the number of labor force and improve the quality of labor force

Since the labor force in the rural areas of our country is mainly the elderly, young people, and children, the quality of the labor force is generally weak. In this case, if we want to increase the income of the rural economy, we must increase the quality of the labor force so that the labor force can receive the training of advanced scientific and technological knowledge (Ito et al. 2020). Therefore, in order to improve the quality of the labor force in the rural areas, the state and the government must issue a series of incentive measures to enable young laborers to return to the village for modern agricultural planting and agricultural operations and to carry out agriculture

| Table 7  | Distribution area ratio of average soil moisture content in the Loess Plateau in 1992 and 2013 |
|----------|----------------------------------------------------------------------------------------|
|          | 10–20 | 20–30 | 30–40 | 40–50 | 50–60 | 60–70 |
| 1992–2000 average | 1.22  | 11.78 | 26.67 | 37.63 | 19.53 | 3.23  |
| 2007–2013 average | 1.12  | 9.67  | 25.66 | 35.62 | 23.35 | 4.64  |

Fig. 5 Changes in the annual value of SWI in the Loess Plateau from 1992 to 2013

Fig. 6 Corresponding points of 8 soil moisture transects in the Loess Plateau
through modern scientific and technological means and technical methods.

**Agricultural economic growth strategy based on the transformation of cultivated land spatial form**

Continue to carry out land consolidation and improve the agglomeration of cultivated land

To carry out land consolidation in mountainous land to increase income and production of these lands requires a certain degree of transformation of the land so that some slopes and mounds can be more suitable for planting crops. On the one hand, it increases the area of land used. On the other hand, it can also make scientific and reasonable application of land resources (Millar et al. 2017). This is also an important aspect of improving the rural economy, increasing farmers’ income, and protecting the rural ecological environment. Through land consolidation and land reclamation and rational use of land, the use of land can be scientifically and rationally distributed, which is the basis for the economic use of land. In order to increase the availability of land, the agglomeration of cultivated land has been significantly improved.

**Clarify the property rights of resources and ensure sufficient arable land for agricultural production**

In order to ensure that the amount of land can continue to increase, it is necessary to clarify the property rights of the land and implement a responsibility system to protect the land use to the greatest extent. In some poor mountainous areas, most of the young villagers no longer engage in land
planting work. The property rights of the land in the village are not clear, so the land is cultivated extensively (Jaff et al. 2015). After the land resource property rights are clarified, the land can be self-protected when it is cultivated by itself so that the quality of cultivated land can be effectively protected.
Combination of multiple measures to strictly protect the amount of cultivated land

In some areas of our country, the amount of arable land in poor mountainous areas has not been able to be effectively guaranteed (Stampfli and Borel 2002). Therefore, the protection of the amount of arable land in poor mountainous areas has been strengthened so that the amount of arable land in these areas will no longer decrease. It is necessary to implement a variety of methods and measures to jointly protect.

Intensive and cooperative development of agricultural production

Intensive and cooperative production methods are more conducive to the rational use and development of land and can increase the output efficiency of land planting. In the development of intensive and cooperative management methods, it is necessary to use modern science and technology and methods to rationally use and develop the land so as to gather and develop some separate and scattered land cultivation, thereby making some rural
lands in mountainous areas scattered. The phenomenon is fundamentally governed.

**Agricultural economic growth strategy based on clever dominance**

Optimize and adjust the structure to ensure the versatility of cultivated land

Carry out a series of optimization adjustments to the functions of the land, organically combine the functions of the land with the product configuration of crops so as to expand the scope and field of farming land in rural areas, and strengthen the investment in labor and agricultural production machinery and other equipment and facilities (Tremblay et al. 2018). By increasing the investment in land, the land and its ecological environment can be well protected so that the land resources in the countryside can be optimally allocated and used so as to achieve an efficient increase in production within a limited land area the goal of.

**Coordinated development of function transformation and spatial transformation of cultivated land**

In addition to protecting the functionality of arable land, it is also necessary to coordinate the development of land functionality and spatial transformation, that is to say, to ensure the production of arable land and the functionality of ecological
environment protection, as well as the replacement of land and land consolidation (James and Wynd 1965). And other measures to achieve spatial transformation so as to achieve the purpose of the harmonious development of land function transformation and spatial transformation.

Multi-industry integrated development, other industries feedback the improvement of agriculture

Increasing rural economic income and realizing land function transformation and spatial transformation are the two most important aspects (Vedrova 2005). At the same time, in order to better develop the rural economy and make the rural economy and the urban integrated economy develop together when vigorously developing the rural agricultural economy, it is necessary to develop a variety of agricultural activities based on the rural geographic location and scenic characteristics to increase farmers’ income, such as the development of agricultural tourism and other activities in some beautiful rural areas, on the one hand, can increase farmers’ income, and at the same time, the good ecological environment in the countryside can be utilized and developed to a large extent. Through the development of tourism activities such as rural tours and farmhouses with increasing farmers’ income, the efficiency of rural land use can also be greatly improved.

Conclusion

Regardless of the land situation in impoverished mountainous areas, it is necessary to improve the availability of cultivated land by strengthening scientific and technological means and carrying out coordinated development of the transformation of cultivated land’s functional form and spatial form. In this way, the functionality of the arable land can be well utilized, and at the same time, the land can be consolidated and optimized through spatial transformation. So that some scattered land can be gathered through spatial transformation, thereby increasing the aggregation of cultivated land. It is convenient to use modern machinery and equipment for farming and improve the efficiency of farmland yield per mu, which can better promote rural economic growth.

Declarations

Conflict of interest

The author declares no competing interests.

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