Study on the Quantity-quality Conversion of Supplementary Cultivated Lands

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Abstract

As the soul of the land resource, the cultivated land is not only the most basic and irreplaceable production material, but the important base to survive the whole human being, and the important guarantee of the stable development of the society. The double balance of quantity and quality is the key to realize the dynamic balance of the gross of cultivated lands, and to establish scientific cultivated land requisition-compensation balance assessment and certification standard system and the checking and acceptance system of supplementary cultivated lands are the key to really realize the requisition-compensation balance of cultivated lands. The requisition-compensation balance quantity-quality gradation conversion coefficient computation method of cultivated lands is researched in this article, which could help to develop the requisition-compensation balance of cultivated lands.

Keywords: Cultivated land, Requisition-compensation balance, Gradation conversion coefficient

1. Introduction

1.1 Meanings of research intention

The research of the gradation conversion of the quantity and quality of supplementary cultivated lands is very important to guarantee the security of crops, ensure the requisition-compensation balance of the quality and quantity of cultivated lands, protect limited cultivated land resource, realize the harmonious relation between human being and lands, and guarantee the sustainable development of the economy and the society.

The research of the gradation conversion of the quantity and quality of supplementary cultivated lands is the necessary measure to strictly implement the cultivated land compensation system, solve the existing problems such as more requisition and less compensation (Xia, 2006), and good requisition and bad compensation in the requisition-compensation balance of cultivated lands, supervise and urge the construction units to carry out the legal legislation of “one requisition and one compensation”, and ensure the quantity and quality balance of the supplementary cultivated lands and the requested cultivated lands.

The research of the gradation conversion of the quantity and quality of supplementary cultivated lands is the important approach to develop the optimized design, protect the resource of land, realize the harmonious relation between human being and lands, and enhance the intensive level of land resource utilization.

The research of the gradation conversion of the quantity and quality of supplementary cultivated lands and the optimized design of land development could promote the change of the land utilization form from the extensive mode to the intensive mode, which is the powerful guarantee for the sustainable development of the society and the economy.

1.2 Research review

The measures to control the quantity of cultivated lands mainly include the basic farm land protection system, the control system of the land purpose, and the dynamic balance policy of the cultivated land gross. But in fact, in the economically developed regions, the reserve resources are always very deficient, and to balance of the cultivated land gross will certainly influence the urbanization, the industrialization and the development of the economy, but if to continually push the urbanization and the industrialization, the policy of the dynamic balance of gross may be a mere scrap of paper (Ho, Samuel P.S, 2002). At the same time, for the research of the cultivated land gross balance, the quantity balance is the main aspect at present, and some difficulties and problems still exist. To realize the comprehensive balance management of quantity-quality and establish the provincial cultivated land requisition-compensation balance system as quick as possible has been the urgent request of the society for the sustainable development. The cultivated land gradation conversion quantity-quality system is the hot content in the research of lands at present.

1.3 Research technical route

The research utilizes many methods such as the mathematical statistics to induce and analyze the relationship between the indexes such as the cultivated land utilization and the crops production capacity, and discuss the influences of the land development projects on the quantity and quality of cultivated lands and the social environment.

This research constitutes the quantity-quality gradation conversion coefficient of supplementary lands, and establishes the evaluation technical standard of the supplementary cultivated land gradation. The research process emphasizes the link among various parts, and ensures the systematical character and rationality of the whole research. The main technical route is seen in Figure 1.

2. Theoretical analysis of the gradation conversion of supplementary cultivated lands

To realize the target of "requisition-compensation balance of cultivated lands", except for the theoretical reference should be opened out, the measures and systems should be studied. According to the technical process of quantity-quality gradation conversion of cultivated lands should follow following theories, i.e. the land shortage principle, the sustainable development principle, the intensive utilization principle, the maximum salary of limited factor principle, and the productivity dynamic balance theory. Based on above theories, according to relative laws and requirements about the supplementary cultivated lands, following principles should also been followed.

2.1 Principle of quantity-quality double balance

As viewed from the view of long-term crops security, the requisition-compensation balance of cultivated lands at present should be based on the premise that the quantity is not changed, and the excuse of compensating high-class cultivated lands is not allowed to reduce the compensation of the quantity of cultivated lands.

2.2 Principle of crops comprehensive production ability balance

The main target to implement the requisition-compensation balance of cultivated lands is to ensure the comprehensive production capacity balance of crops, and the comprehensive production capacity of crops should be the base and reference of the conversion when converting the quantity and quality of supplementary cultivated lands according to the gradation (Tang, 2006, P.8-20).

2.3 Principle of objectively reflecting the farmland power difference

The cultivated land requisition-compensation balance gradation conversion research is based on the research of farmland classification, and the research result should objectively reflect the difference of the crops production capacities of different-level lands.

2.4 Principle of dominant factor

The factors influencing the quality of cultivated lands include the water condition, the light and heat condition, the quality of soils, the climate environment, and artificial utilization. This research should follow the principle of dominance, and select main influencing factors influencing the quality of cultivated lands, and comprehensively utilize relative new theory, new technology and new method about economic science and natural science, and ensure the science and rationality of the quality evaluation technical standards of supplementary lands.

2.5 Principle of technical and economic rationality

In the land development optimized design of supplementary cultivated lands, the local practice should be referred, and the land development engineer measure and many biological and chemical measures about soil improvement must accord with the technical level which could be achieved at present or in recent term, and when the technical and economic conditions are reasonable, the class of supplementary cultivated lands should be properly enhanced (Wang, 2001, P.62-64).

2.6 Principle of comprehensive benefit maximization

The land development project should improve the quality of land, enhance the crops production capacity, bring economic benefit, and differently influence the ecological environment and the social life.

3. Gradation conversion coefficient of supplementary cultivated lands

3.1 Modeling of indexes and standards

Based on large numerous of mathematical analysis experiments, this research could reflect the relation between the farmland crops production capacity and the farmland utilization index by the stratified sampling method, and accordingly confirm the model of the relation between the standard crops output and the farmland utilization index.

3.1.1 Stratified sampling selection of samples

(1) The concept of stratified sampling

The stratified sampling is also called as the classified sampling, and this sampling organization form first stratifies the various units according to certain sign, and then samples many sample units in various layers according to stochastic principle, and composes one sample by the sample units in various layers. Suppose that the collectivity contains N units, and the collectivity is divided into K layers, and the unit amount of the i'th is Ni (i=1, 2,…,K), so N1+N2+…+NK=N. Stochastically sample the sample units ni from the collectivity Ni, so the samples n are n=n1+n2+…+nk.

(2) The principal of sampling selection

When studying the stratified sampling process, following basic principles should be followed.

a. Adopting the result data of the provincial farmland gradation

The farmland gradation result of China is developed from bottom to up, and various counties and cities' farmland gradation result contains detailed high, middle, and low outputs sample survey data.

b. Representative principle

First, the county and city samples selected in various layers should evenly cover various second-class space range as more as possible, and could represent the land utilization index and the good, middle, and bad level of standard crops output in the second-class region. Second, the final sample data selected in various counties and cities should reflect the high, middle, and low level of the crops production capacity of this county or city.

c. Principle of difference

The difference requirement of the sample unit sigh in the layer is relatively smaller, and the difference requirement among layers is relatively bigger.

3.1.2 Selection and elimination of samples

(1) Establishing the basic database of sample information

By sampling and selecting, the database software could record the county and city second-class region, the unit number, the sample point area, the land code, the output of appointed crops, the standard crops conversion coefficient, the output of standard crops, various appointed crops natural indexes, various appointed crops land utilization coefficients, natural quality indexes, natural attribute of unit, land quality, and land gradation information in each sample data (Yun, 2005, P.44).

(2) Eliminating the data of abnormal samples

Some abnormal samples exist in the initial sample information database, which could be eliminated by the index standard deflection reflecting the variability of sample data S_i. The elimination standard is $y_i \notin (\bar{y} - 2S_i, \quad \bar{y} + 2S_i)$, i.e. the variability exceeding $\pm 2S_i$ is unacceptable, and needs to be eliminated. In the elimination process, the stratified elimination of abnormal samples is adopted, i.e. first taking each provincial second-class region as a sample collectivity, and then eliminating the abnormal samples exceeding the reasonable variability region, and finally collecting relative information to the total sample base to test and eliminate again.

3.1.3 Stratified sampling statistics of samples

(1) Average value

The computation formula of the average value of sub-samples in each layer is

$$\bar{y}_i = \frac{1}{n_i}\sum_{j=1}^{n_i} y_{ij}$$

Where, y_i is the average value of sub-samples, n_i is the amount of sub-samples, and y_{ij} is the j'th sample in the i'th layer.

The computation formula of the total average value of samples is

$$\overline{y} = \frac{1}{N}\sum_{i=1}^{N}\overline{y_i}$$

Where, $\overline{y}$ is the estimation value of the total average values, N is the total stratified amount, and $\overline{y_i}$ is the average value of the sub-samples in the i'th layer.

(2) Standard deflection

The computation formula of the sample standard deflection of various layers is

$$S_i = \sqrt{\frac{1}{n_i - 1}\sum_{j=1}^{n_i}(y_{ij} - \overline{y_i})^2}$$

Where, S_i is the standard deflection of the i'th layer, and other symbols have same meanings with above symbols.

The estimation value of the total standard deflection is

$$S_{\overline{y}} = \sqrt{\frac{1}{k - 1}\sum_{j=1}^{k}(y_{ij} - \overline{y})^2}$$

Where, $S_{\overline{y}}$ is the estimation value of the total standard deflection, and k is the amount of total samples, and other symbols have same meanings with above symbols.

3.1.4 Establishment of the model

By utilizing the data in the sample database, taking the utilization index of sample unit as the explanation variable, and taking the standard crops output as the explained variable, both factors are modeled and analyzed regressively. The database analysis in various regions indicates that the linear model in various computation models is the best one and most accords with the practice in the actual test. The linear model is

$y = ax + b$ (r, R^2)

Where, y is the output of standard crops (kg/mu), and x is the utilization index.

From the model statistics, the correlative coefficient r of the linear model denotes the correlative tendency between the output level of standard crops and the farmland utilization index, and the judgment coefficient R^2 of the model denotes the reliability degree that the change degree of the standard crops output (y) could be explained by the change of the farmland utilization index (x).

Solve the first-order derivative to x in the model, $dy/dx = a$, and the slope of the fitting line is a, i.e. theoretically, adding the utilization index of one unit equals to that the standard crops output increases a kg/mu. Therefore, the potential crops increase production by enhancing the unit utilization index could be predicted. In the same way, the linear model could be used to compute the corresponding theoretical crops production capacity of different utilization gradation cultivated lands. By above linear model, the relation table and the gradation conversion coefficient table about the farmland utilization index and the standard crops output could be respectively obtained, and the interval of the crops production capacities could be computed, which could be used to compile the cultivated land requisition-compensation balance gradation coefficient table.

3.2 Conformation of relative parameters of supplementary cultivated land gradation and assessment

Before evaluating the gradation of supplementary cultivated lands, the relative parameters designed in the evaluation process. These relative parameters include the standard cultivating system and appointed crops, the supplementary cultivated land evaluation index region, the evaluation factor system and weights, the accounting rule, and the appointed crops output ratio coefficient (Bai, 2002).

3.2.1 Confirmation of the standard cultivating system and appointed crops

(1) Confirmation of standard cultivating system

The standard cultivating system should be confirmed according to the farmland gradation result of various regions.

(2) Confirmation of standard crops and appointed crops

The standard crops and appointed crops should be confirmed according to the farmland gradation result of various regions.

3.2.2 Division of supplementary cultivated land gradation evaluation index areas

According to the farmland gradation result, the dominance factor principle, and the regional difference principle, the province could be divided into the evaluation index region.

In the same evaluation index region, the evaluation factor system and weight selected by the evaluated supplementary cultivated lands are consistent to the appointed crops output rate coefficient.

3.2.3 Confirmation of the supplementary cultivated land gradation evaluation factor system and weights

According to the farmland gradation result and the "Farmland Gradation Rules", the evaluation of the supplementary cultivated land gradation should adopt the factor method.

(1) The basic principle establishing the evaluation factor system

Because the factors influencing the quality of cultivated lands are corrective, and information are superposed each other, so it is not necessary to consider all factors when evaluating the quality of cultivated lands. The evaluation index should include the factors which are related with the quality of cultivated lands, and could really reflect the quality connotation of cultivated lands.

a. The principle of dominance

When selecting the evaluation index, the factor mainly analyzing the quality of cultivated lands should be mainly analyzed according to the sorts and function differences of various factors influencing the quality of cultivated lands.

b. The principle of stability

The quality of cultivated lands is decided by a series of factors together, and the evaluation of the cultivated land quality must comprehensively consider the influence of these factors. When selecting the evaluation factor, those factor influencing the stability of the cultivated land productivity in the long term should be selected, and the changeable factors should not be the evaluation indexes.

c. The principle of maneuverability

The indexes should be simple, so concrete indexes with strong microcosmic character should be selected, and they are easy to be measured, collected, picked, and compared (Bibby J.S, 1969). Those selected indexes should be fit for the method of multi-factor comprehensive evaluation in the evaluation system of this research.

d. The principle of directness

The evaluation indexes should include those factors which could directly influence the quality of cultivated lands, and the indexes indirectly influencing the quality are not considered at this moment.

(2) Confirmation of the evaluation factor system

According to the farmland gradation result, ten evaluation factors including the landform, the grade of farmland, the water table, the efficient land stratum depth, the quality of land, the section structure, the content of organic materials, the value of PH, the irrigation guarantee rate, and the soil drainage are the gradation evaluation factors of supplementary cultivated lands (Huang, 1998, P.34-38). In addition, the limitation factors selected according to the local practice include the rock outcrop degree, the depth of obstacle layer, and the degree of salinity. Not all limitation factors are fit for all places, and they are only distributed in the regions with special conditions, for example, the cultivating lime soils and the cultivating purple soils influenced by the rock outcrop degree are only distributed in the part of lime rock regions in Shaoguan, and the quantity of lime land (with the lime-harden layer) and the white-eel mud land (with white-slurry land layer) influenced by the obstacle layer is rare, and the acidity-sulfate land, the salty land, and the salty-acid land influenced by the salinity degree are distributed in part of coastal lands.

4. Conclusions

Based on the farmland gradation result, this research adopts the stratified sampling method to analyze the relation between the farmland crops production capacity and the farmland utilization index.

By utilizing the data in the sample database, taking the utilization index of sample unit as the explanation variable, and taking the standard crops output as the explained variable, both factors are modeled and analyzed regressively. The database analysis in various regions indicates that the linear model in various computation models is the best one and most accords with the practice in the actual test. The linear model is

$y = ax + b \ (r, R^2)$

Where, y is the output of standard crops (kg/mu), and x is the utilization index.

By computing the gradation conversion coefficient based on the model, the cultivated land requisition-compensation balance quantity-quality gradation conversion coefficient table could be compiled.

This article also utilizes the gradation conversion result to perfect the land development project design criterion, and the main contents include (1) the conformation of the relative parameters such as the supplementary cultivated land gradation evaluation, (2) the evaluation method and approach of the supplementary cultivated land gradation.

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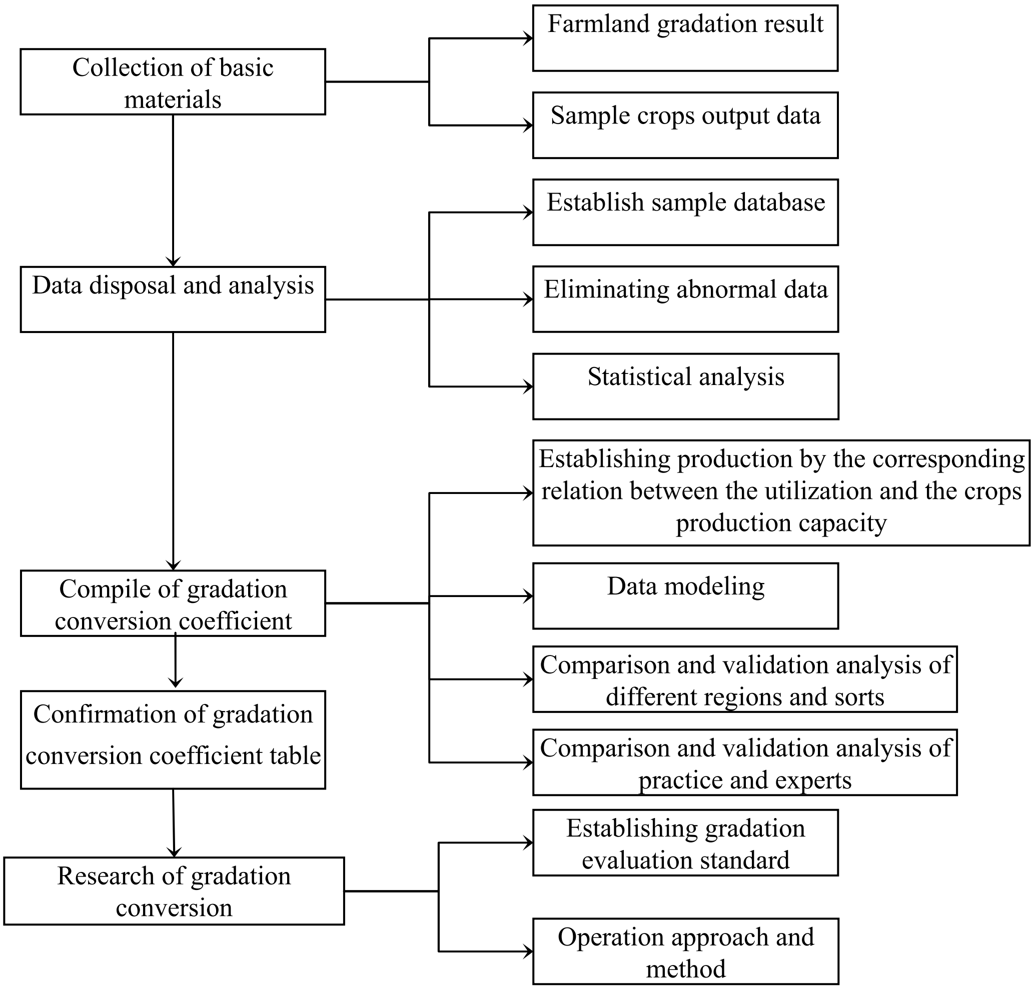

Figure 1. Technical Route of the Cultivated Land Requisition-compensation Balance Gradation Conversion Coefficient Research