

A Comprehensive Model for Farmland Quality Evaluation with Multi-source Spatial Information

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Abstract: Farmland quality represents various properties, including two parts of natural influencing factors and social influencing factors. The natural factors and social factors are interrelated and interaction, which determine the developing direction of farmland system. In order to overcome the limitation of subjective factors and fuzzy incompatible information, a more scientific evaluation method of farmland quality should be developed to reflect the essential characteristic of farmland. The multi-information used to evaluate farmland quality could be not only derived from remote sensing data, but also derived from spatial data by GIS technology.

According to the existing standard of farmland classification and grading, the study adopted analytic hierarchy process (AHP) to screen variable factors of farmland quality, which could be mapped by spatial analysis technology. The natural influencing factors of farmland quality used in the study included soil organic matter, soil type, soil moisture, soil fertility, degree of land desertification, slope and soil PH. The social influencing factors included farmland use intensity, pollution of soil heavy metal, crop planting scale and location factors. All influencing factors were mapped by GIS or RS technology. Each influencing factors should be normalized to settle the lack of comparability with each other. The Delphi method was used to determine the weight of each influencing factors. The fully covered QuickBird images with high resolution were used to digitize the farmland parcels in the study area. Taking the farmland parcels as basic units, the comprehensive evaluation model for farmland quality was developed, through which the spatial patterns of farmland quality in Shunyi County in Beijing City was analyzed.

The farmland quality in the study area was divided into five levels by the method of density slicing and the references of farmland gradation. The spatial distribution of farmland quality gradation in the Shunyi County was mapped. Results showed that the proportions of farmland quality in the study area were 7.73%, 25.23%, 32.89%, 18.48% and 15.66% respectively. The farmland quality level in the west of Chaobai River was lower than the other region, because of the decrease input of farmland nearby the city. The traditional agriculture dominated in the most villages and towns, of which the inputs of fertilizer were more than the west. The farmland with the first level of quality was loamy soil with rich nutriment, good irrigation and high road density. The farmland quality in the study area was mainly second and third levels, which was the main food grain region of Beijing city. The fourth and fifth level of farmland was easily influenced by urbanization and managed badly, which reduce the quality level of farmland. The spatial distribution of farmland with different quality levels derived from the developed model was basically consistent with the data of the department of Agriculture in the study area. It indicated that the comprehensive evaluation model with multi-source spatial information could map the farmland with different quality level effectively.

Keyword: farmland quality, multi-source spatial information; analytic hierarchy process; Delphi method; comprehensive evaluation model