Economic Analysis on Monetization of Soil Functions

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Abstract On the basis of making clear diversity characteristics of soil functions and multiple characteristics of income, this paper points out that the monetization of soil functions based functional maintenance and change decision process can be regarded as a game process of different utilization methods at the background of different functions. The balance of this game process will determine monetary value of soil functions. After understanding money and monetization concepts, it introduces that measurability and exchangeability of soil functions provide objective conditions for monetization of soil functions. Finally, it discusses that usefulness value of soil functions provide basis for monetization of soil functions.

Key words Soil functions, Monetization, Economic analysis

1 Introduction

At present, the research on monetization of soil functions just starts, so there are many basic problems to be clarified. Using economic method, this paper makes preliminary and tentative discussion on issues concerning diversity of soil functions, multiple characteristics of income, objective conditions and basis of monetization of soil functions. The introduction of monetization concept and economic analysis is to bring the economic thinking and methods into analysis and practice of utilization of soil functions. From the perspective of economics, the utilization of soil functions should follow the principle of "benefit maximization". Like land, soil is also a complex, so its influence and function on economy, society and natural ecology are in many aspects and multi-dimensional. Thus, income itself and income entity brought by soil functions have multiple characteristics, from which we start our analysis.

2 Diversity of soil functions

It is the unconsolidated or loose covering of fine rock particles that covers the surface of the earth. It is the place where exchange of surface material and energy conversion takes place. It forms soil circle with incompletely continuous soil covering land surface. As to spatial location in geographical environment, the soil circle is situated in the closely connected area of lithosphere, hydrosphere, atmosphere, and biosphere. Thus, it is not only the bond connecting natural and geographical elements, but also a central link combining organic and inorganic world[1]. As independent objective natural body, the soil has its own historical development process. In the development process of soil, biology, climate, mother rock, terrain, time and human farming factors play an underestimated role. Since factors of soil formation are different, soil types are various and soil functions are diverse.

Soil functions are determined by material cycle, energy flow, biological evolution and information transmission, so they are inherent features of soil[2]. On the basis of studying soil function and its development, Wu Kening *et al.* made a nearly exhaustive sorting of soil functions. They pointed out that there is still no soil function classification generally recognized. Influential types include: (1) The definition of soil functions in *Federal Soil Protection Act of Germany*: natural function; recording function of natural and humane files; functions related to human utilization. (2) In 2002, European Commission (EC) divided soil functions into production function of grain and other living beings, storage, filtration and conversion functions, habitat and gene pool function, natural and cultural landscape function, as well as source of raw materials. (3) In *the Berlin Digital Environmental Atlas* (BDEA), soil functions are divided into natural vegetation habitat function, agricultural crop production function, buffering and filtering function, water balance adjusting function, and recording function of natural and historic files. (4) *The First Soil Action Plan* for England divides soil functions into 6 types: production function; interaction with water and air environment; biological diversity reservation function; development platform; supply of raw materials, and protection of cultural heritage. In China, there are few relevant researches, and the focus is not on function classification, but just division of soil functions for the necessity of their respective research. Some scholars (Zhao Qiguo, *et al.* 1997) give prominence to soil quality or function quality; some scholars conduct study from the buffering effect of soil on pollution (for example, Hua Luo, 1992); some scholars (Jiang Ming, *et al.*, 2006) discuss single function of simple soil type[3].

In combination with classification of soil functions both at home and abroad, it can be seen that soil functions are diverse and include production function[4], ecological function and bearing function. Production function mainly includes grain production, vegetable production and fruit production; ecological function mainly includes habitat of living thins, nutrient cycle, runoff ad-

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justment, water conservation, gas adjustment, soil protection, climatic regulation, and waste disposal; bearing function is mainly manifested by bearing and storage of independent industrial and mining, urban land and transportation land except rural residential areas and towns. Diversity of soil income lays objective foundation for multiple characteristics of soil income[5].

3 Multiple characteristics of soil income

Research on soil income is favorable for guiding us to conduct further study on monetization of soil functions at a deeper level. Fundamentally, monetization of soil functions provides basis and reference for proper selection of soil functions and reasonable allocation of soil resource. Different soil functions bring different income for soil groups, so the selection process of monetization of soil functions can be considered as a gaming process between different social groups.

3.1 From the perspective of directly sensible degree From the perspective of directly sensible degree, there is apparent income and hidden income. Apparent income is revenue that can be directly sensed, such as economic income revenue and beautiful environment; hidden income is revenue that can not be sensed and has to be shown in indirect way, such as healthy body and mind, social security and social stability. Generally, single soil function brings apparent income and hidden income for a social group. Apparent income includes grain production function, which brings direct economic income for grain producers. Besides, in current conditions, grain production can strengthen ability of producers in resisting against social unrest. Thus, grain production has the feature of social security, but this can not be sensed directly, it belongs to hidden income. Furthermore, single soil function brings different income for different social groups, brings apparent income for some social groups, while brings hidden income for some social groups. For example, to set up green belt in a district, the compensation for land requisitioned is apparent income for original land users, while land price increased indirectly due to land requisition belongs to hidden income.

3.2 From the perspective of social groups On the whole, social groups are divided into three sections, individuals, government sectors and entire society. Similarly, benefits obtained from land functions include individual benefits, government benefits and social benefits. Some single soil function can only satisfy benefits of some social groups; similarly, some single soil function can benefit many social groups at the same time. Take grain production function of soil as an example, individual groups planting grain can reap part of economic benefit and social security benefit; grain production plays an important role in maintaining price level and social stability, so the entire society also can obtain benefit; well control of price level and constant stability of society reinforce legitimacy of government, then the government will be benefited indirectly. For the factory owner, the construction of a factory is incentive; however, for government sector, it can increase tax revenue, investment and employment, even enhance the importance of certain sector, and government sector can be benefited. The original land users can obtain land compensation, so in short term, they are benefit receivers. Those people near the requisitioned land will get negative influence on their income if they do not work in this factory or they are engaged in planting grain crops.

3.3 From the perspective of time Considering the time factor, the benefits of soil function include short-term and long-term benefits. On the condition of changes and maintenance in soil function, different social groups can obtain different short-term or long-term benefits, and the same social group may receive different benefits.

In sum, social groups can be benefited from soil functions. From the directly sensible degree, it includes apparent and hidden benefits; from social groups benefited, it includes individual, government and society; from the perspective of time, it includes short term and long term benefits. Since different benefits have conflicts, it is difficult to realize them at the same time. Such feature will exert direct influence on monetization of soil functions.

From the point of view of the income, due to direct and indirect influence of maintenance and changes in soil functions on benefits of social groups, the decision on maintenance and changes of soil functions based on monetization of soil can be considered as the game of different social groups, and the balance of the game will determine the amount of money allocated to corresponding soil function. This also reminds us of selecting proper view points and standpoints in the process of monetization of soil functions.

4 Monetization of soil functions

4.1 Money and monetization In economics, money is any commodity or token that is generally acceptable as a means of payment for goods and services. It is a product when commodity economy develops to certain stage. As universal equivalent, money functions means of value, means of circulation, means of payment, means of hoard, and world currency. In this study, it generally refers to means of value and means of payment. In other words, in this paper, money is a symbol to indicate value of different soil functions.

Definitions of monetization are various and typical ones are as follows: (1) It refers to the gradual increase of transaction amount with money as medium in economic activities, expressed in the ratio of broad money (M2) to GNP (or GDP), *i. e.* M2/GNP or M2/GDP. (2) Monetization means monetary function as means of exchange is greatly enhanced and filtered into economic fields and sections. With completion of transition process, money will play greater and greater role in economic development. (3) Monetization is the exchange of all commodities and labor services in national economy of a country, as well as the proportion of money in entire production process (including investment and allocation), and the trend of changes in this proportion. (4) Monetization is also the expansion of monetary economic field to non-monetary economic field. (5) Since the generation of money, economic sys-

tem has gradually evolved to blended operation of real economy and monetary economy, and such process is called economic monetization. In this study, the monetization refers to the process of evaluation and changes of soil functions with money as measurement and medium.

From the above analysis, it can be known that monetization of soil functions shall have two objective conditions. Firstly, soil functions can be evaluated and measured. Secondly, soil functions should enter into economic field and participate in economic activities, in other words, soil functions should be exchangeable and transferable. At present, foreign and domestic scholars developed a series of soil function evaluation methods and systems with APF analysis as representative. Although there is still some point to be improved, it realizes evaluation of soil functions to some extent. The real condition shows that rules of transactions have filtered into changes of soil functions to some degree, and have certain degree of exchangeability and transferability.

4.2 Monetization of soil functions As above mentioned, one of definitions of monetization is indicating value of soil functions with symbol of money. Or perhaps, soil functions must have value, and this is the basis of monetization of soil functions. If soil functions do not have value, its monetization process will be entirely imaginary or no practical significance.

There are two difficult problems in discussing value of soil functions. Firstly, soil function is not entity, but just a function or action. Secondly, in China, traditional political economics defines the value as the average human labor condensed in commodities. However, soil functions are generated from various natural and historic factors, so it is slightly far fetched to say soil functions are condensed with average human labor. To solve these two problems, the definition of value in neoclassical economics can be used. It states that value is the measurement of usefulness or utility of commodities. Any thing, as long as able to participate in economic activities and play function in output and benefit, has value.

In this context, on the one hand, soil functions influence output, different soil influences output of crops, for instance; on the other hand, from the definition of value in neoclassical economics, there is no provision that things having value must be tangible. On the contrary, it is the measurement of functions, action and usefulness of things. Soil functions are functions and usefulness of soil, which is consistent with this value definition. Thus, value of soil functions is the basis of monetization of soil functions.

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(From page 5)

distribution range of green food, establish specialty store of green food in the country, and use the form of direct marketing to shorten the transport time for perishable foods[10-12]. Finally, it is necessary to make full use of green food expo and fair to promote green food of Heilongjiang so that more consumers understand green food, to promote green food market, and promote Heilongjiang Province leap from large green food province to strong green food province.

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