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USING OF ANALYTIC HIERARCHY PROCESS ON EVALUATING THE AFFECTING FACTORS IN THE VALUE OF FARMLANDS

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Abstract

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In this study, in the valuation of farmland Analytic Hierarchy Process (AHP) was applied. This method was used as an alternative method to the method used on evaluating the affecting factors of the value of farmland. It has been given the weights to the affecting factors of the value of farmlands and these weights have helped to determine the objective value by attach to income method which is the classical method. In this study, it was regarded the width, kind, income, yield, shape, distance from settlements and road of the land. These factors, which were analyzed with AHP using the evaluation of the experts, can be taken into account on the valuation of farmlands.

Keywords: AHP, Farmland, Farm Appraisal

Introduction

The subject of real estate appraisal which is an important role carrying out the activities of public always up to date. In addition, rural real estate is both a life style and economic power for people who live rural area. In other words, the agricultural lands which are the main material of the agricultural sector bring social status as well as being livelihood for rural population due to be production resource. Agricultural lands are an endless, not easily bought and sold and the specific qualities, so the particular market is not available for agricultural lands. However, the agricultural land appraisal is needed for the important issues such as expropriation, land consolidation, taxation, credit, inheritance. There are more valuation methods in the science of appraisal and the method should be determined according to the purpose of appraisal and the type of commodity.

There are applied to the four basic method in agricultural appraisal; income method, market method, cost method and quantitative method (Conneman, 1983; Rehber, 2008). Although agricultural land is valued according to Income Method in many countries because it is the revenue real estate continuously, the valuation is technically possible according to the market method. The method to be used should be determined according to the purpose of valuation, the features of property and legal regulations. In the valuation process, some difficulties have occurred in collecting and analyzing data and it is needed specific process. Especially in agricultural valuation, collecting data is an important problem owing to the natural structure of agriculture and not registering in agricultural enterprises. Therefore, the valuation process should be done systematically.

The price of farmland is determined by many agronomical, geographic, demographic and economic factors (Huang et al., 2006; Sklenicka et al., 2013). In terms of agricultural use, the factors frequently observed as significant determinant of farmland price are farm size, soil quality, water supply, farm returns, land rents, land markets and agricultural subsidies (Lloyd et al, 1991; Bastian et al., 2002; Awasthi, 2009). Guiling et al. (2009) confirmed a positive effect of the size of local population on land prices. Lisec and Drobne (2009) found the influence of the natural amenities and recreational activities on the farmland market. Naydenov (2009) emphasized a significant negative relationship between land price and distance to the capital city in Bulgaria. Stewart and Libby (1998) also described the role of the quality of the infrastructure and of accessibility, especially proximity to a highway. Sklenicka et al. (2013) found that the most power-

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ful factor in explaining the land price was proximity to a settlement and other the powerful factors were municipality population, travel time to the capital city, accessibility of the parcel and natural soil fertility.

Environmental, social and economic characteristics emerged depend on criteria and location of real estate are described as the factors affecting value. Economic and spatial characteristics of a city and region are always factors that to be regarded estimating the market value of real estate. The most important issue in the valuation is to be done a comprehensive analysis. The reason is that one real estate is affected from other real estate or the factors surrounding it. Environmental analysis is the factor to be regarded as much as a specific feature of real estate in the valuation. To determine the degrees of influence of these factors affecting the value is necessary for determination of an objective value.

Real estate valuation is defined depending on the potential and location of real estate (Lahoz, 2007). In other words, a parcel value is directly related to the features of parcel in respect of location (Frizzell, 1979). Agricultural land valuation is a complex process (Bible and Hsieh, 1999). In the agricultural land valuation, to be capitalized to today the income which will obtain in the future according to income method is not enough to determine real value. There are positive or negative factors affecting the value. To be regarded environmental, structural, social and economic factors for agricultural lands which are the subject to valuation and to be reflected to the value provide determination of the correct value. The evaluation of these factors is used econometric, statistical and mathematical methods. There are used such as Multiple Regression Analysis (Isakson, 2001) and Hedonic Price Model (Vasquez et al., 2002; Huang et al., 2006; Vyn, 2007) in previous studies.

Due to the increasing economic development of the countries and to the increasing complexity of the appraisal problems, it becomes more and more necessary to make better and more accurate valuations. There have developed new alternative methods which perform well in common appraisal contexts, in order to find a solution for appraisal problems (Melon et al., 2008). Analytic Hierarchy Process (AHP) is one of the new methods. To determine the weights of the factors affecting value it is possible to apply AHP which is the method providing the availability of quantitative and qualitative factors in the deciding process

Today, it is widely used in big decision makings and in the environmental, commercial, energy, transportation etc. evaluations (Khan and Faisal, 2008). Bender and his friends (1997) use AHP approach in the selection of real estate, Bellver and Mellado (2005) and Melon et al. (2008) use AHP approach for determining which factors are more important in decision-making process in valuation of agricultural land.

Materials and Methods

In this study, AHP which is used in solution of complex problems and is method of decision-making was used in evaluating factors affecting the value of agricultural land. AHP allows its models in a hierarchical structure which shows relationships between complex problems of decision-makers, the main objective of the problem, criteria and sub-criteria for problem, and alternatives to the problem. The most important feature of the AHP is that decision making can include his or her both objective and subjective thoughts in decision process. Namely, knowledge, experience, individuals' thoughts and premonitions are combined in a sensible way in this method (Saaty, 1980; Bender et al., 1999). AHP is applied in diverse area such as education, health, transport and marketing. Nevertheless, it is not used sufficiently in the agricultural land appraisal.

AHP is based on one to one comparison of the both factors effecting the decisions and decision points of these factors in terms of values of importance on a hierarchy of decision using a pre-defined analog scale. A comparison matrix of size nxn is formed for showing the levels of importance according to the factors in a specific logic. Scale of importance, scoring scale with 9, is being used in table 1 for the mutual comparison of the factors. Normalization process is being made by dividing the sum of the column of an element comparison matrix. Weights are obtained by normalized factor divided by the number of matrix (Prato, 2008).

The formation of the factor weights and scores in the realization of the objective conditions has an attribute to be reconciled accordance with the opinion of experts from related disciplines (Özügül, 2004). Therefore people with expert opinion were applied for determining of the scores in an objective way in this study. Individual decisions or group decision can be applied in differences between factors. 'Combining individual judgments' can be used because it is difficult to bring together individuals' decision in the group (Saaty, 1989). Arithmetic mean is used in technique combining individual judgments in this study.

$$CR = \frac{CI}{RI}$$

CR = The rate of consistency
CI = Consistency index
RI = The random index

If the calculated value of CR is smaller than 0.10, comparisons made by the decision maker are consistent. If the calculated value of CR is bigger than 0.10, either there are

calculation error or comparisons made by the decision maker are not consistent (Saaty, 2000).

Results and Discussion

Comparison matrix was formed with the factors thought to affect the value of agricultural land. Appropriate points according to the importance in valuation were given by creating a comparison matrix between the factors in Analytic Hierarchy Process. Points were determined with of the average of expert assessments of 4 people. At scoring it was used "Measure Scale" which was developed by Saaty.

Some factors (transport facilities, irrigation facilities, land market, population) were removed from the analysis as a result of the being not consistent of analysis which is made according to the 11 factor within the comparison matrix given above. Comparison matrix obtained from as a result of this was given in Tables 1, 2 and 3.

Table 1
Fundamental Scale for Paired Comparison

Values of importance	Definitons of value	Explanation
1	Equal importance	Status of both factors being of equal importance
3	Moderate importance	Status of 1. Factors are more important than 2. Factor
5	Strong degree importance	Status of 1. Factor is very important than 2. Factor.
7	Very strong degree importance	Status of 1. Factor has an strong importance than 2. Factor.
9	Extreme importance	1. Factor has an absolute supreme importance than 2. Factor.

Reference: Saaty, 1980

Table 2
The Value of Cross-Comparison Matrix Affecting the Values_1

	The width of land	The kind of land	Land income	Land productivity	The form of land	The distance of settlements	The distance of road	Transport facilities	Irrigation facilities	Land market	Population
The width of land	1										
The kind of land		1									
Land income			1								
Land productivity				1							
The form of land					1						
The distance of settlements						1					
The distance of road							1				
Transport facilities								1			
Irrigation facilities									1		
Land market										1	
Population											1

Table 3
The Value of Cross-Comparison Matrix Affecting the Values_2

	The width of land	The kind of land	Land income	Land productivity	The form of land	The distance of settlements	The distance of road
The width of land	1	1/9	1/7	1/7	1	1/9	1/7
The kind of land	9	1	1	3	9	1	1
Land income	7	1	1	1	3	1/5	1
Land productivity	7	1/3	1	1	7	1/5	1/4
The form of land	1	1/9	1/3	1/7	1	1/6	1/6
The distance of settlements	9	1	5	5	6	1	1
The distance of road	7	1	1	4	6	1	1

As seen the comparison between the width of the land and other factors, it is equally important of width between itself and form of land, 1/9 times important in comparison with wealth of land, 1/7 times important in comparison with land income, efficiency of land and distance the road, and 1/9 times important in comparison with distance to settlements. The kind of land is equally important to itself, land income, the distance of settlements and the distance of road. It is more important 9 times comparison with the width of land and the form of land and 3 times comparison with land productivity.

Factor weights were obtained by taking the sum of each row and divided by the number of factors in comparison of the normalized matrix factor. When seen the distribution of the general measures, the importance of the land width is 2.3%, kind of land is 21.7%, land income is 13.3%, land productivity is 10.6%, land shape is 2.9%, distance from settlements is 28.4%, and road distance is 20.7%. It was determined that according to the factor weight, the most important factor is the rate of 28.4% the distance from settlements and the second important factor is the rate of 21.7% kind of land so the land is irrigated or dry.

In the consistency measurements, the matrix D is obtained multiplied by factor weights (W) and the comparison matrix (Figure 1). The proportion of D matrix values and factor weights (W) are E values. The arithmetic average of the sum of E values is the maximum eigenvalue. Maximum eigenvalue is used in The Consistency Index (CI) calculation. The rate of Consistency Index (CI) and Random Indicator (RI) is Consistency Rate (CR).The Random Indicators get following values depending on the compared number of factors; RI value is 1.32, because 7 values were regarded in analysis.

The Consistency Rate (CR) were calculated as 0.068 and compared matrix is consistent because it is lower than 0.10 (Tables 4 and 5).To be consistent compared matrix indicates that the affecting factors of value can be used in valuation of agricultural land. The weights of factors were obtained from coefficients regulated based on expert opinions can be used in GIS program to constitute value map.

According to this study results, the most important factor of farmland value is distance from settlement. Sklenicka et al. (2013) also found the most significant factor behind the spatial volatility of farmland prices is proximity to a settlement. There is higher value of farmland near to settlements. The main reason behind this increase in farmland value is interested by conversion of farmland for non-agricultural uses. This is in accordance with findings of Drozd and Johnson (2004) and Sklenicka et al. (2013). Distance from settlements and road affects the value significantly when considering proximity to row materials and increase or decrease in the cost of production. These factors describe also the concept of the amenity of land.

Table 4
Comparison of Normalized Factor

	The width of land	The kind of land	Land income	Land productivity	The form of land	The distance of settlements	The distance of road	Total	W
The width of land	0.0244	0.0242	0.0148	0.0098	0.0303	0.0299	0.0307	0.1640	0.0234
The kind of land	0.2195	0.2198	0.1056	0.2101	0.2727	0.2717	0.2193	1.5187	0.2170
Land income	0.1707	0.2198	0.1056	0.0700	0.0909	0.0543	0.2193	0.9307	0.1330
Land productivity	0.1707	0.0725	0.1056	0.0700	0.2121	0.0543	0.0548	0.7402	0.1057
The form of land	0.0244	0.0242	0.0348	0.0098	0.0303	0.0462	0.0373	0.2070	0.0296
The distance of settlements	0.2195	0.2198	0.5280	0.3501	0.1818	0.2717	0.2193	1.9903	0.2843
The distance of road	0.1707	0.2198	0.1056	0.2801	0.1818	0.2717	0.2193	1.4491	0.2070

Table 5
The calculation of the consistency rate

$\sum E$	$\lambda (\sum E / n)$	CI $(\lambda-n) / (n-1)$	CR (CI / RI)
52.819	7.5456	0.0909	0.068

Small parcels and big parcels have different features (Torrel and Bailey, 2000). Thus the width of land is an important factor. The demand of larger parcels for agricultural use is explained due to the agronomic methods and mechanization that are used easily (Gonzales et al., 2004). To be irrigated or dry of the land is important because it affects yield and net income. Land productivity and income have great importance in terms of income value. Sklenicka et al. (2013) also confirmed that land size and land productivity are significant factors for farmland prices. The form of land is not properly so it adversely affects the value, because it brings additional cost during the processing of land and it is an undesirable situation.

Some factors which are transport facilities, irrigation facilities, land market, population were removed from the analysis as a result of the being not consistent of analysis. However, Sklenicka et al. (2013) observed a positive influence of population size on an increase in farmland prices. They interpreted their result in terms of speculation on the conversion of farmland to buildable land.

It is possible the value of farmland is determined by many different factors. These factors may change according to the purpose of valuation and depending on the relationship of factors with each other.

Conclusions

Expressed the factors that affect the value of the real estate mathematically greatly helps valuation objectively real estate. Creating a model in the valuation of real estate and transferring this model to information system will provide standardization in valuation activities. The development of a standard in the valuation provides great convenience stakeholders of valuation activities. Because people who valuation, real estate owners and related corporations or institutions consider various damages in the valuation of real estate. Such damages occur in condemnation activities that is the highest area of the valuation of agricultural land in Turkey. According to the Condemnation Law, the factors that affect the value is expressed as 'other objective measures will be effective in the determination of the price' and this expression causes problems in the valuation activities, because it consists uncertainties. The factors affecting the value added to the value of land through AHP method will solve this problem, not be ignored using income method in the valuation of agricultural land according to the Condemnation Law. Objective value is determined when the weights that were calculated for the factors affecting the value added to the value of land through AHP method. It is possible to use GIS in this process and the effects of factors on the value can be seen on the map. In this manner, benefit from GIS provides great convenience for ensuring systematic structure which save information about agricultural land and add the factors affecting to the value of agricultural land.

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