Development of Land Valuation System

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SUMMARY

Land has always played a crucial role in life of human community. Difference in position, fertility or natural resources make some locations and land parcels more desirable than the others. System of land valuation provides control of real estate market and can also be used for both transaction and ownership taxation. Taxation of land has many benefits. Properly calculated tax rate helps efficient use of land. Best land locations must be available to users who can make the best use of land and maximize its benefits.
According to current law, transaction taxes on market of real estate in Croatia are calculated from market value. However, market value is calculated from the value of transaction, not from valuation. Some kind of land valuation system in Croatia would be a great tool for better planning and decision making on land use.
Land valuation is a process of assigning values to land locations. In order to perform a land valuation, many objective and subjective valuation factors must be considered and modelled. Especially for agricultural areas the physical factors are of crucial importance and have the strongest influence in their market value. In order to test some premises regarding land valuation, a DTM for whole territory of Croatia was loaded into a spatial database and some physical factors were calculated offline and stored together with it. With that, prototype system with basic functionality was developed. Already in this phase its functioning can significantly improve current procedures in land taxation, with a possibility of further extension.

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1. INTRODUCTION

Nowadays, every modern country needs to have some kind of land valuation system, regardless if it's made in purpose of land market support, land taxation or land consolidation. In order to perform a land valuation, many objective and subjective valuation factors must be considered and modeled. Land quality with physical factors such as type of soil, aspects, rain expectancy and location can contribute, but do not determine how much land in an open market worth is. To determine land value, beside land quality, many other factors must be considered - legal constraints, intended use of land, state of local economy, etc (Dale and McLaughlin 1999).

This paper intends to examine land value determination of agricultural areas using GIS. This has been made with spatial analyses of different physical factors which are the most important for rural areas valuation. Choice of these factors and their combinations greatly determines reliability of system.

In many European countries, various land and/or real estate valuation systems have been established, dependent on their purpose. Unfortunately, no land valuation system exists at the moment in Croatia. As in other former communist countries, land was in Croatia for long time assumed as worthless and gift of nature. Large cooperative farms on state owned land had neither market nor any other value assigned, and there was no need for valuation or gathering some land use data. Recently, some initiatives and projects for collecting land use data based on satellite imagery started on national level, which are resulting with some datasets suitable for spatial analyses.

According to current law, transaction taxes on market of real estate in Croatia are calculated from market value. However, market value is calculated from the value of transaction (Official Gazzete 69/97). Statistics on made transactions are stored in the local tax offices. Officers are authorized to make individual valuation for transactions with market values significantly different from the statistic estimated one. Implementation of land valuation system could automates large part of this process, and make it more transparent.

2. METHODS

Land valuation is a process of assigning values to land locations. Land value has to be determined in process of buying, selling, leasing or taxing it or when there is a need to calculate assets held by an individual or business (Dale and McLaughlin 1999). Three most commonly used methods of valuation are: sales comparison, income capitalization and cost approach method (Mastelić Ivić 2004). Choice of method is greatly determined by property

type and the purpose of valuation (Dale and McLaughlin 1999). Mentioned methods are most suitable for valuation of built-up land and professionals are still irreplaceable in a process of appraisal. However, fast and efficient information system could be a big help in the process.

3. DATA MODEL

As in cadastre, basic unit of land valuation system is land parcel. In order to achieve the best possible integration, nation's fundamental spatial datasets (cadastral, topographic ...) should be developed on similar models (Ryttersgaard 2001). Land parcels data stored in some kind of State Cadastral database would be easy to integrate with other datasets in order to make valuation system. Many other legal constraints greatly determine land value, for example intended land use or district borders, and they should also be modeled and included in the system.

Another important aspect of land valuation model is elevation data, which should be a part of topographic database. Elevation data can provide input for calculation of 3D spatial orientation and slant for a chosen parcel or set of them thereby broadening user's perception of its value. Additional datasets can be introduced (land market value regions) to, combined with previously gathered data additionally enrich the user's perception of a certain part of the land (Figure 1).

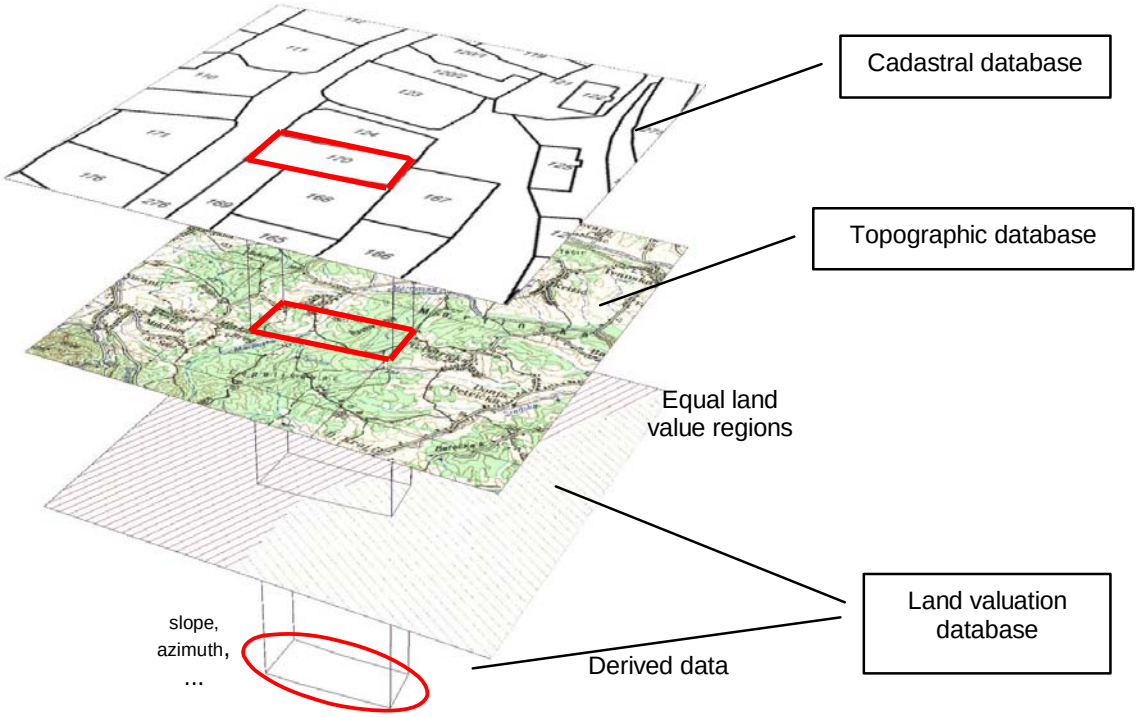

Figure 1. Land valuation system concept

All of the mentioned datasets should be managed and updated on national level, with clearly defined data model and connection possibilities. From those datasets is possible, and fairly simple, to combine data from these databases in order to derive some new data.

4. TEST IMPLEMENTATION

Test implementation of land valuation system were made using Oracle10g SDBMS. Three databases were created. Two of them played the role state handled database systems – cadastral and topographic. Third database was used for storing additional datasets with other valuation factors (types of soil, areas under forests, roads, etc).

For establishing cadastral database, prototype of Cadastral district called"Šuma Striborova" was used. This dataset is modeled according to project made on Faculty of Geodesy for State Geodetic Administration (Roić et al. 2005). For these testing purposes this data was stored as SDO_GEOMETRY object type:

```
SDO_GEOMETRY(2003, 1000001, NULL, SDO_ELEM_INFO_ARRAY(1, 1003, 1),
SDO_ORDINATE_ARRAY(5390078.25, 4904332.12, 5390071.77, 4904305.53,
5390092.54, 4904303.33, 5390093.17, 4904309.22, 5390093.88, 4904313.22,
5390094.58, 4904316.83, 5390095.29, 4904319.26, 5390095.99, 4904321.07,
5390097.09, 4904323.03, 5390098.35, 4904324.99, 5390100.38, 4904327.12,
5390078.25, 4904332.12))
```

The data used for the DTM was acquired from the SRTM (Shuttle Radar Topography Mission). Whole territory of Croatia is covered by 23 files which are 1 x 1 degrees in size with resolution of 3 x 3 arc seconds. So initially we had a total of 38.9 million points (including overlapping areas from neighboring data files). In order to improve performance and to avoid unnecessary and possibly faulty calculations the data set had to be cleaned from points in the sea and points outside of the area of interest. So finally the data set contained 9 million points. Coordinates were modeled as spatial object, but elevation data was stored as an attribute:

```
SDO_GEOMETRY(2001, 8307, SDO_POINT_TYPE(13.666833, 44.314, NULL),
NULL, NULL),69
```

DTM model is stored in WGS84 coordinate system. Croatian cadastral data lies in several different coordinate systems based on Bessel 1841 ellipsoid. In 2004, Croatia has adopted a new SRS, called HDKS (Croatian State Coordinate System). For transforming data into this system, function SDO_CS.TRANSFORM was used (Figure 2).

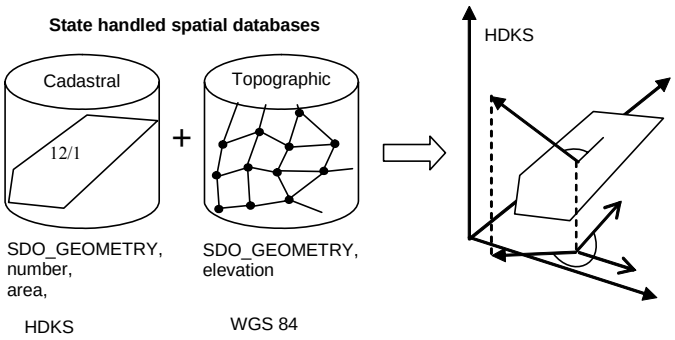

Figure 2. Coordinate systems

Cadastral and county district areas were loaded as SDO_GEOMETRY object, and stored in previously user defined SRS (Figure 3).

Figure 3. Cadastral/County boundaries

Formed system already in this phase has ability to answer to questions about some important valuation factors. For example: Which areas are ideally oriented for some specific land use?

```
select count(A.point) from dtm.dtm A, cadastral_metadata.rsu C where
C.id_area=335487 and
sdo_anyinteract(A.point,SDO_CS.TRANSFORM(C.geometry,8307)) = 'TRUE';
```

Spatial query for Cadastral district "Odranski Obrež" was performed. Result can be represented in a numerical way (Table 1) or spatially mapped (Figure 4). Combination of these types of queries, and proper assignment of different "weight" for each valuation factor, can give a good estimation of land worth.

requirement	Area (%)
azimuth 120°-240°, slope up to 30°	30
azimuth 150°-210°, slope up to 30°	11

Table 1. Aspects value analysis

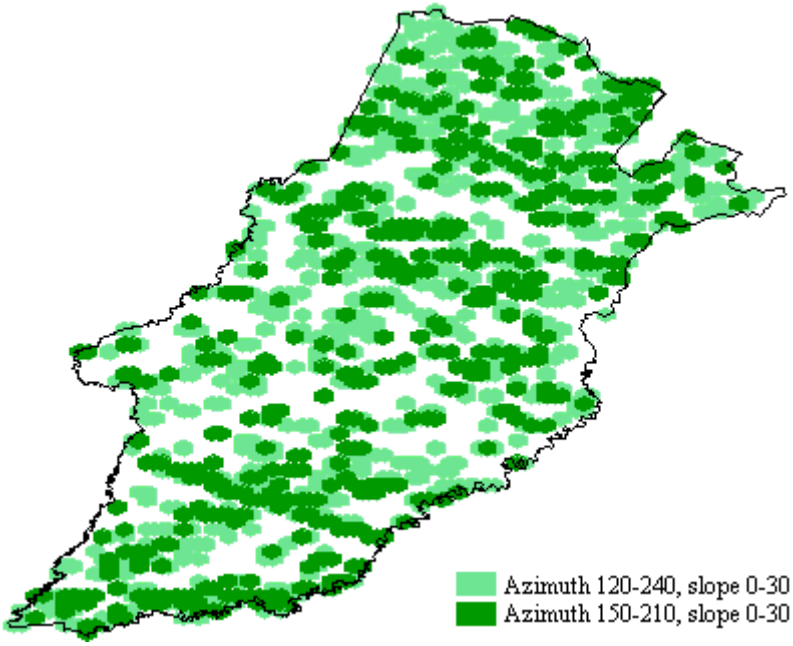

Figure 4. Mapped aspects value analysis

In order to make a good estimation, many other land valuation factors which may affect a land parcel value have to be modeled and mathematically expressed (Yomralioglu 2004).

5. CONCLUSION

Major advantage of establishing this type of GIS based valuation system is that this system can be started on national level (of course, with limited functionality in this first phase) without a big investment in acquisition of data, because all the required data can be extracted from existing state handled topographic and cadastral datasets.

Furthermore, model used for this GIS system can be utilized as a basis for bigger and more comprehensive system defined with more valuation factors, which can play crucial role in classifying land, estimating highest and best land use and discovering essential trends.

Next step in implementation land valuation system would be detailed classification, determination and assignment of ”weight” factor for each valuation factor performed on national level, which would simplifying process of more detailed land value estimation for smaller areas of interest.

Land valuation system enhanced with information about market of real estates, could evolve into a new valuation system, which could be used for purpose of market support or control. Modern trends in land taxation as well as in the real estate market, which require land value related information to be easily accessible and transparently justifiable could and would be followed by implementing such a system. The spatial DBMS technology has proven to be appropriate for supporting such a large scale system in data processing, storage and distribution.

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BIOGRAPHICAL NOTES

Hrvoje Tomić works as a university assistant at the Chair of Spatial Information Management on Department of Applied Geodesy, University of Zagreb, Croatia. He is now PhD student and his research interest are in GIS, SDI, DBMS, land management. Hrvoje Tomić has parcitipated on several projects.

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