Set of Fiscal Algorithms for Land-Use Management and Decision-Making in the Territory of a Municipality

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Abstract — **Using current and available information on the land-use outcomes in the municipality, it is possible to independently analyze development tendencies in the territory and promote planned territory development. Tax revenues can with good reason be considered an important fiscal instrument in territory development planning. Application of this instrument in land-use management decision-making may prevent the so-called urban sprawl and reduce the risk of value decrease of inefficiently used infrastructure and environmental resources. The present research focuses on the application of the developed set of fiscal algorithms in land-use management and decision-making at a municipal level. The set of fiscal algorithms has been developed using the methodological framework for land-use efficiency assessment and the cost-benefit analysis method. The main research results have been substantiated having conducted the analysis of performance of municipalities, including the analysis of experience of the City of Riga in real estate data management. The application of the developed set of fiscal algorithms and the introduction of the specific municipal software module allow analyzing the impact of the changes in land-use objectives and their basic values on cadastral value of real estate objects, the amount of real estate tax and municipal budget revenues.**

Keywords — land-use management; fiscal instruments; algorithms; land-use objectives; real estate tax, the City of Riga.

I. INTRODUCTION

There is a certain link or correlation among land-use objectives, real estate market and its value. On the one hand, land in accordance with its land-use objective is the basis for the economic activity of the population; on the other hand, residents pay taxes for using the land according to a definite land-use objective and depending on its value. UN Economic Commission for Europe (*UN-ECE*) recognizes land and real estate tax as a significant source of revenue for the budget of a public administration entity [1, 2]. Real estate tax has a major impact on the activities of a municipality, ensuring decentralization with regard to land use issues. Research on international practices testifies that tax revenues constitute 70–90% of local municipality budgets. In addition, taxes are not only considered a source of budget revenue, but in a broader sense they are also the instruments of land policies. More specifically, they are fiscal instruments of land-use planning, by means of which land use policies and principles are implemented in the respective territory [3, 4, 5].

A. Fiscal Instruments as Support for Land-Use Management

Fiscal instruments are widely recognized in the world as being significant for the implementation of the land policy. Their application in the municipalities creates a mechanism for the implementation of environmentally friendly and sustainable land policies. Changes in the amount of real estate tax are comprehensible, if the information concerning real estate objects — land, buildings and infrastructure — is objective and transparent.

The paradigm of integrated land-use management determines the need for systematic analysis of the current and potential land-use systems [5-4, 6-192]. Real estate taxation is also considered a fiscal steering instrument. It manifests itself in promotion of manufacturing, provision of the land plots suitable for development, decrease of land speculation, mobilization of the real estate market, and administration of the land use. When planning tax revenue and expenditure on infrastructure development, it is vital to be aware of the current land use and to foresee potential land-use patterns, which can have an impact on the changes in the market value of the real estate [4-177, 5-65].

Numerous case studies have indicated different applications of fiscal instruments; as a result, the evidence has been obtained concerning budget revenue, economic stability, revenue and resource allocation principles, as well as the impact on socio-economic development, environmental protection, and activities stimulating the development of real estate market [7, 8, 9]. Research results demonstrate that in the European context the land price and land-use pattern indices are used in urban sprawl processes, and that real estate tax is imposed as an instrument to determine and change land-use patterns. [8]. Having accumulated real estate transaction prices in data bases, in further research it is possible to obtain empirical evidence on the correlation between land prices and the changes in land-use patterns. Various practices of land value capture have attracted attention of many scholars and have raised discussions on municipal revenue planning and opportunities to finance the development of new local

infrastructure. For this purpose, such approaches as introduction of various betterment levies are studied, and land value capture instruments are identified, summarizing vast international experience, including that of the USA, Japan, China and India [9].

B. Real Estate Tax Revenue: A Case of Latvia

In the period from 1995 to 2011, real estate tax (RET) revenue in Latvia had gradually increased many-fold — from 15 to 98 million LVL, but its proportion in GDP and gross tax revenue was volatile at the beginning of the reporting period, which was related to the changes in laws and regulations. However, after the year 2000 these indices demonstrated a moderate decreasing trend. Although after the changes in the fiscal policy introduced in 2008, the amount of RET revenue was gradually rising. As the state economy has improved in the post-crisis period since 2010, values of the remaining two indices have moderately decreased (see Fig. 1).

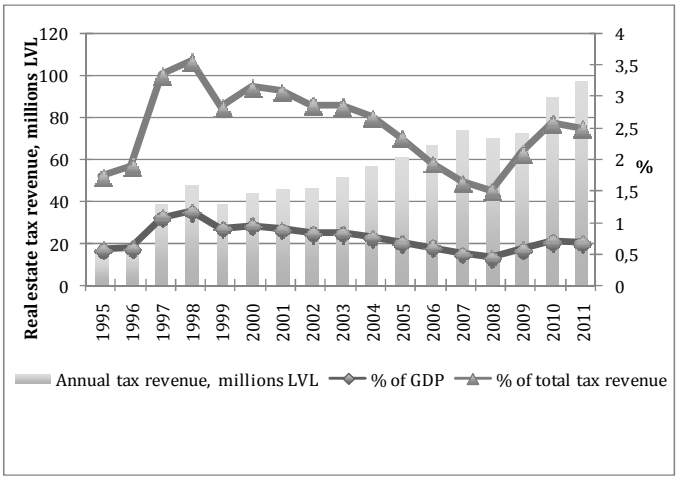

Fig. 1. Real estate tax revenue 1995–2011. *Source:* [10].
Abbreviations: LVL — Latvian currency, GDP – gross domestic product.

In 2011 in Latvia RET revenues per capita were 48 LVL, but revenue per unit of land area (ha) was 15 LVL [11], which in comparison with RET revenues in 2008 grew by 50% per capita and by 36% per unit of land area (ha). However, comparing the amount of RET revenue in gross tax funds of the general budget of municipalities, its amount has been gradually increasing since 2008. The respective figures are the following: 8% in 2008; 12% in 2010, and 14% in 2011 and 2012 [12, 13].

In this respect, it may be concluded that the role of RET as of a fiscal instrument for land-use planning is gradually growing and will also continue to grow in future, especially in the view of the government plans to reduce tax burden on labor in the country and to transfer the authority to determine applicable tax rates for real estate objects to municipalities.

The present article mainly focuses on the RET revenue planning and allocation opportunities in order to substantiate land-use management decisions at a municipal level. The *aim* of the research is to analyze and discuss the application of the developed set of algorithms for land-use management and decision-making in order to facilitate a more efficient use of land resources and the territories occupied by them. As a result of the conducted analysis, the impact of the changes in different land-use objectives on municipal budget revenues has been identified. Moreover, it is suggested introducing a specific software model at municipalities in order to ensure data exchange between RET administration system and the reporting and planning information system of the municipal territory.

II. THEORETHICAL AND METHODOLOGICAL FRAMEWORK

Case studies of contemporary spatial theories, methodology and experience support an integrated approach to the analysis of changes in land-use patterns. Numerous regional studies and their empirical content address the testing of theoretical statements and methodological solutions [14, 15]. In such a way, it is possible not only to comprehend the nature and effects of land-use change, but also to determine socio-economic, environmental and legal contexts of the respective territories, performing the multi-criteria analysis and territorial comparison of the obtained results. Such a comprehensive approach and cause-effect analysis provide substantiation for decision-making and in future for the forecasting of possible changes.

Land-use objectives are spatially characterized by the functional usage of a concrete territory in general and by land-use patterns or categories in particular. Classification of *land-use objectives* (LUO) represents land-use patterns (categories) that are determined in the local spatial plans and basically corresponds to the object segments of real property transactions [16]. In Latvia, a LUO is related to the use of real estate, but it is defined differently in various laws and regulations, as well as official statistics [17, 11]. For the needs of cadastral evaluation, a public institution determines a LUO for a land unit or its part. In such a way, the permitted land-use category is approved. LUO groups, with regard to cost factors, are classified in the following way: (1) lands, the primary function of which is not a construction development, for example, agricultural lands, forestry lands, areas of water bodies, etc. – 01–05 in the classification; (2) building land, for example, private housing development areas, institutional land use areas, industrial land use areas, etc. — 06–12 in the classification. On the whole, 12 LUO groups are determined in Latvia, which in essence correspond to functional usage of the respective territory.

Theoretically, when determining a RET rate and forecasting the amount of budget revenue, among other factors, municipalities should observe the following principles: the principle of efficiency, responsible budget planning, predictability and stability, entrepreneurship support, social responsibility, as well as the principle of territorial development and improvement. Practically, analyzing costs and benefits in the territory of a municipality with regard to tax revenues, a recognized correlation originating from cost-benefit analysis is used [18, 19] in theoretical considerations:

Land Use Efficiency = Outputs / Inputs (1)

Thereby tax revenues are obtained using land areas with respective land use (LVL / ha), and tax revenues and co-financing are spent on the improvement of the infrastructure, which results in growth of capital value of the land (LVL / LVL); return on capital (resources) allocation is obtained as a result of economic activity (LVL / LVL). The outcomes of the economic activity form the basis for tax revenues. In turn, the analysis of *cost-benefit change* dynamic time series, including the analysis of the changes in tax revenues, costs, income level, population welfare and other factors, allows identifying the *changes* in land-use efficiency, in accordance with the LUO determined in the respective territory.

Taking into consideration the above-mentioned function and principles, as well as the information system available to municipalities, including the availability and structure of the data as well as support to RET administration provided by the *Information System of National Real Estate Cadastre* (ISNREC), a set of fiscal algorithms for land-use planning has been developed. The algorithms are to be used in the development of a software module. Module solutions presume the implementation of *geographic information system* (GIS) using the interaction between aggregation of textual and graphical data in ISNREC and tax administration system, in such a way providing the necessary visualization of data series and graphical data. Data exchange between the *Administration System of Real Estate Tax* (ASRET) and GIS of the municipality is ensured in order to provide information on real estate objects located in the territory and on taxes in accordance with requests. Algorithms have been developed using the methodological framework for land-use efficiency assessment to substantiate land management and decision-making processes and to promote better and more effective land use.

III. Data and Results

The ***aim*** of the application of the developed algorithm is associated with the development of land management and decision-making tool, namely, of a software module to substantiate the *impact of the change* in LUO and the change in the basic value of the land on the cadastral value of real estate objects, amount of RET and municipal budget revenues.

Background data of a set of algorithms is formed from the available historical and current ISNREC data, including LUO in accordance with the unified state classification, cadastre report cards, cadastral values of land units, considering the summarized data by territorial units — total cadastral value of land units (LVL), total area of land units (ha), mean cadastral value of the land (LVL / ha) and ASRET data including calculated, payable and collected amount of RET, as well as the data of the *Administration System of Real Estate* (ASRE) of the municipality and the data on population figures in the territorial units.

Following equations are expressed in a simplified form in order to facilitate the perception of the algorithms.

Input data of the algorithm set:

- i = 1, 2,...,n (land units in the respective LUO group, in the territorial unit);
- j = 01, 02,...,12 (LUO groups — regulations of the Cabinet of Ministers define 12 groups, which are further classified into 43 LUO[1] — 4 digit codes;
- t_0,...,t_m (t_0 — the initial reporting date; t_m — the current reporting date, for example, 01/01/2005, ...,01/01/2010,...);
- t_{m-k} (respective preliminary reporting date, e.g., t_{m-1} — the date of previous (previous year) report;
- land units by LUO groups, cadastral code, number ($ZV_{ij}t_0$,...$ZV_{ij}t_m$);
- land plot area by LUO groups, ha ($ZPL_{ij}t_0$,...$ZPL_{ij}t_m$);
- LUO determined for land units, codes (LUO_it_0,...,LUO_it_m);
- land transformation areas attributable to land units by LUO groups, ha ($TRPL_{ij}t_0$,...,$TRPL_{ij}t_m$);
- issued construction permits attributable to land units by LUO groups, address, number ($BA_{ij}t_0$,...,$BA_{ij}t_m$);
- calculated cadastral value attributed to land units by LUO groups, LVL ($KV_{ij}t_0$,...,$KV_{ij}t_m$);
- calculated RET amount attributable to land units distributed according to LUO groups, LVL ($NA_{ij}t_0$,...,$NA_{ij}t_m$);
- amount of RET payable[2] attributable to land units by LUO groups, LVL ($NS_{ij}t_0$,...,$NS_{ij}t_m$);
- cadastral report map status, graphical files (KKt_0,...,KKt_m);
- population in the territorial unit, number (ISt_0,...,ISt_m);
- collected amount of RET in the general budget by LUO groups, LVL ($NI_{ij}t_0$,..., $NI_{ij}t_m$);
- collected gross RET amount in the general budget, LVL ($RETt_0 = \Sigma NI_{ij}t_0$,...,$RETt_m = \Sigma NI_{ij}t_m$);
- gross tax revenue in the general budget, LVL ($NIEt_0$,...,$NIEt_m$);
- general budget revenues, LVL ($PIEt_0$,...,$PIEt_m$).

Output data of the algorithm set:

- *Territorial allocation of the LUO groups*. Visualization of the cadastral report map, marking up the land units, for which different LUO groups have been set, specifying code and cadastral designation (KKt_0,...,KKt_m);
- *Territorial changes in the LUO groups*. Visualization of the cadastral report map, marking up the land units, for which LUO has been changed, in comparison with the amounts indicated on one of the

[1] Data and indicators by 12 LUO groups are more comprehensible; however, 43 LUO may provide a more detailed review, but less transparent visual material. In the process of module development and initialization, it has been discovered that data granularity and visualization influence the programming and data integration opportunities, as well as preparation of reports.

[2] Actual amount of RET collectable considering all tax reliefs imposed.

previous[3] reporting dates, specifying code and cadastral designation ($KKt_{m-k} \Rightarrow KKt_m$);

- *The changes in the land use for construction needs*. Visualization of the cadastral report map, marking up the land units, for which LUO has been changed to building land, specifying code and cadastral designation ($KKt_{m-k} + LUO_{i01-05}t_{m-k} \Rightarrow KKt_m + LUO_{i06-12}t_m$);
- *The substantiation for the LUO change*. Visualization of the cadastral report map, marking up the land units:

a) where the transformation of the land has been performed, specifying the LUO code, cadastral designation and the transformed space ($KKt_{m-k} + ZV_{ij}t_{m-k} + TRPL_{ij}t_{m-k} \Rightarrow KKt_m + ZV_{ij}t_m + TRPL_{ij}t_m$);

b) with the construction permit issued, specifying the LUO code, cadastral designation and address ($KKt_{m-k} + ZV_{ij}t_{m-k} + BA_{ij}t_{m-k} \Rightarrow KKt_m + ZV_{ij}t_m + BA_{ij}t_m$);

- *RET territorial — quantitative and comparative effect*. RET amount per unit of land area, LVL / ha; comparative relation between the amounts at the reporting dates, %:

$$NTEt_m = RETt_m / ZPL_it_m; \quad (2)$$

$$NTEt_{m-k} = RETt_{m-k} / ZPL_it_{m-k}; \quad (3)$$

$$\Delta NTE_{\%} = (NTEt_m / NTEt_{m-k}) \times 100\% \quad (4)$$

- *RET territorial — quantitative and comparative effect within the framework of the LUO groups*. Collected amount of RET in the general budget by LUO groups per definite LUO plot area unit, LVL / ha; comparative relation between the amounts at the reporting dates, %:

$$NTE_{ij}t_m = NS_{ij}t_m / ZPL_{ij}t_m; \quad (5)$$

$$NTE_{ij}t_{m-k} = NS_{ij}t_{m-k} / ZPL_{ij}t_{m-k}; \quad (6)$$

$$\Delta NTE_{ij\%} = (NTE_{ij}t_m / NTE_{ij}t_{m-k}) \times 100\% \quad (7)$$

- *RET burden*. Collected amount of RET per land unit capita, LVL / capita; comparative relation between the amounts at the reporting dates, %:

$$NSLt_m = RETt_m / ISt_m; \quad (8)$$

$$NSLt_{m-1} = RETt_{m-1} / ISt_{m-1}; \quad (9)$$

$$\Delta NS_{\%} = (NSLt_m / NSLt_{m-1}) \times 100\% \quad (10)$$

- *Changes in the collected amount of RET*. RET amount in comparison with the amount at the date of the previously developed report, %:

$$\Delta RET_{\%} = (RETt_m / RETt_{m-k}) \times 100\% \quad (11)$$

- *Changes in RET revenues calculated by LUO groups*. Calculated RET amount by LUO groups in comparison with the amount at the date of the previously developed report, %:

$$\Delta NA_{ij\%} = (NA_{ij}t_m / NA_{ij}t_{m-k}) \times 100\% \quad (12)$$

- *Changes in RET revenues by LUO groups*. RET amount payable by LUO groups in comparison with the amount at the date of the previously developed report, %:

$$\Delta NS_{ij\%} = (NS_{ij}t_m / NS_{ij}t_{m-k}) \times 100\% \quad (13)$$

- *Assessment of RET rebates applied*. RET amount payable comparing to RET amount calculated, LVL; comparative relation between the amounts at the reporting dates, %:

$$PANt_m = \Sigma NA_{ij}t_m - \Sigma NS_{ij}t_m; \quad (14)$$

$$PANt_{m-k} = \Sigma NA_{ij}t_{m-k} - \Sigma NS_{ij}t_{m-k}; \quad (15)$$

$$\Delta PAN_{\%} = (PANt_m / PANt_{m-k}) \times 100\% \quad (16)$$

- *Assessment of the applied RET rebates by LUO groups*. RET amount payable compared to RET amount calculated by LUO groups, LVL; comparative relation between the amounts at the reporting dates, %:

$$PAN_{ij}t_m = NA_{ij}t_m - NS_{ij}t_m; \quad (17)$$

$$PAN_{ij}t_{m-k} = NA_{ij}t_{m-k} - NS_{ij}t_{m-k}; \quad (18)$$

$$\Delta PAN_{ij\%} = (PAE_{ij}t_m / PAE_{ij}t_{m-k}) \times 100\% \quad (19)$$

- *RET portion of the total tax revenues*. The portion of the collected RET of the total tax revenues, %; difference in the amounts at the reporting dates, %:

$$NANt_{m\%} = (RETt_m / NIEt_m) \times 100\%; \quad (20)$$

[3] Territorial changes in LUO groups can be visualized if compared not only to the amounts at the date of the previously developed report, but also to the amounts provided at the eralier date, e.g., $t_m \Rightarrow t_{m-5}$.

$$NANt_{m-k\%} = (RETt_{m-k} / NIEt_{m-k}) \times 100\%; \quad (21)$$

$$\Delta NAN_{\%} = NANt_{m\%} - NANt_{m-k\%} \quad (22)$$

- *RET portion of the general budget*. Collected RET portion of the general budget revenues, %; difference in the amounts at the reporting dates, %:

$$NAPt_{m\%} = (RETt_{m} / PIEt_{m}) \times 100\%; \quad (23)$$

$$NAPt_{m-k\%} = (RETt_{m-k} / PIEt_{m-k}) \times 100\%; \quad (24)$$

$$\Delta NAP_{\%} = NAPt_{m\%} - NAPt_{m-k\%} \quad (25)$$

- *Effective Tax Rate*. Collected RET amount and cadastral value ratio, %; difference in the amounts at the reporting dates, %:

$$ETRt_{m\%} = (RETt_{m} / \Sigma KV_{ij}t_{m}) \times 100\%; \quad (26)$$

$$ETRt_{m-k\%} = (RETt_{m-k} / \Sigma KV_{ij}t_{m-k}) \times 100\%; \quad (27)$$

$$\Delta ETR_{\%} = ETRt_{m\%} - ETRt_{m-k\%} \quad (28)$$

- *Effective Tax Rate by LUO groups*. Collected RET amount and cadastral value ratio by LUO groups, %; difference in the amounts at the reporting dates, %:

$$ETR_{ij}t_{m\%} = (NS_{ij}t_{m} / KV_{ij}t_{m}) \times 100\%; \quad (29)$$

$$ETR_{ij}t_{m-k\%} = (NS_{ij}t_{m-k} / KV_{ij}t_{m-k}) \times 100\%; \quad (30)$$

$$\Delta ETR_{ij\%} = ETR_{ij}t_{m\%} - ETR_{ij}t_{m-k\%.} \quad (31)$$

The analysis of application possibilities of the elaborated algorithms for the development of a municipality software module is being performed in cooperation with ASRE and ASRET software providers and municipality geospatial software developers, as well as in the target groups with many local government experts on the issues of land application planning and tax administration. Therefore, the specification for ASRET data communication for the TP-GIS system (Territory Planning and GIS) is being elaborated. As a result of data exchange, it is planned that the information on real estate objects located in the territory of the municipality and on RET revenues will be made available in the TP-GIS system.

IV. Discussion: A Case Study of Riga City Municipality

Riga City Municipality is the largest local government institution in the territory of the Republic of Latvia, and it has the largest number of the real estate objects. The experience in the development of real estate data administration system and the amount of allocated resources substantiate the choice of this municipality as the best investigation object in compliance with the aims of the present research.

Assessing the efficiency of RET administration and different related performance processes at Riga City Municipality, the management of the existing system should be analyzed, i.e., how tax revenues are calculated and what their characteristic factors are considered, as well as what technological solutions are applied. Therefore, the analysis of RET administration has been initially performed within the framework of the data structure and content of related information systems. RET administration specialists use databases to update the data and to facilitate the routine work. To work with databases, the *resulting standards* have been set, i.e., the regulated rights to individually determine and control the achievement of the resulting indicators of administration [20-117:122]. The particular level managers at Riga City Municipality are responsible for data collection and analysis. They summarize the data on the previous year in their annual presentations. It should be noted that only the data on RET administration operations performed by municipality employees and on the amount of tax collected is provided, as tax revenues are not analyzed by real estate object types and LUO groups.

Therefore, the resulting amounts of the collected tax revenues and their dynamics are general, static, and exclude the analysis of the characteristic factors, e.g., why the amount of taxes collected varies from a land unit to a land unit.

To calculate RET, the cadastral value of the real estate is applied. Determination and classification of LUO are regulated by the regulations of the Cabinet of Ministers [17]. They are required to determine the cadastral value and are registered in the ISNREC. Practically, setting the cadastral value is a time- and effort-consuming, complicated and methodologically governed process. The cadastral value does not directly result from the market value of the real estate. There have been frequent cases, when this value has been set inadequately, without evaluating the real situation, which not only causes the dissatisfaction among the RET payers, but also influences the tax administration. LUO change is regulated by the rules of the Cabinet of Ministers and regulations of Riga City Municipality.

The work of the respective municipality structural units related to the administration of the data on real estate is regulated by the internal normative acts and methodological instructions, which, among other rules, define that RET administration system should comprise topical information, including the data on LUO. The deficiencies of the normative acts should also be observed in cooperation with other institutions. Therefore, the employees should put forward the proposals on the improvement of the system and normative

acts. However, it should be mentioned that the data on LUO is not summarized and analyzed in accordance with tax revenues determined by the land units allocated for Riga administrative territory.

Many structural units of the municipality should perform a lot of work for legitimate and correct determination of LUO. However, the respective work is performed within the framework of the quality management system, regularly improving the processes and services provided, taking into account the feedback received from clients, the proficiency level of the employees, as well as the requirements set in the normative acts. It means that tax administration related performance is assessed annually [21], also in respect to the following research theme-bound aspects:

- Ensuring the efficient information exchange among the structural units of the administration, clients, cooperation partners and society;
- Determining LUO for the needs of the cadastral valuation and portion of the resolutions on LUO of the total number of resolutions, %, record keeping;
- Determining LUO for setting of the privatization value, and portion of the notes/references on LUO issued within the definite period of the total number of notes/references, %, record keeping;
- Providing the forecast calculation of the RET revenue, record keeping of the forecasts and performance work/stages;
- Record keeping of the tax debt collection process and debt creditor requests;
- Analyzing the revenues and installments into the Municipal Finance Equalization Fund;
- Calculating the ratio of the total RET for land, buildings and houses (LVL) and the total forecasted RET, not considering the chargeability rate (LVL), %, record keeping.

Taking into account the existing practice and the statistical performance of the tax administration mentioned above, it should be noted that in the particular municipality tax administration the regular self-evaluation is performed (process evaluation), topical problems are analyzed and assessed, as well as well-grounded decisions are made, which results in the maintenance of the unified record keeping and document management system.

However, the record keeping of the data on the taxable objects, their classification according to the application type, land exploration in compliance with LUO and the allocation of tax revenue based on the real estate type are not performed at the level of municipality; therefore, the tax revenue structure is not studied in accordance with a particular property type.

Having studied the administration of the ASRE, ASRET and TP-GIS systems at Riga City Municipality for the needs of municipality function performance, it can be concluded that tax revenues, as the fiscal instrument for planning of the land application, are not used of full value and in this respect there is no cooperation between RET administrators and territory development (land application) planners. The performed analysis of the respective municipality functions and of the possibilities of their implementation substantiates the introduction of the fiscal algorithm set provided in the form of structured text and spatial information. However, in order to practically implement the developed algorithm set and to approbate the elaborated software module, it is required to overcome a variety of problems. The main problems are the following: the insufficient time series of the historical data for the needs of analysis, disarray in the data of cadastral report maps, differences in the GIS structures and distinct approaches to data administration within the municipality. Therefore, the above-mentioned problems of the municipality would be resolved, as well as the software would be elaborated and tested within the framework of the particular project.

The maintenance of the topical information on land application results at the municipality and the introduction of the fiscal algorithm set would allow *analyzing the development tendencies in the territory at a regular basis and promoting the planned development of the territories*, using the tax revenues as the important fiscal instrument. For instance, it would be possible to perform the analysis of the impact of application of tax rebate and tax rate value on tax revenues by LUO groups and in different territories. Within the framework of the present analysis, the structured textual and spatial information *would substantiate* the local spatial development planning and detailed planning.

V. Conclusions

Having studied the support instruments of land-use management and their application possibilities, as well as having developed and substantiated a set of the fiscal algorithms to monitor land application and to take the corresponding decisions at the municipal level, the authors have come to the following conclusions and suggestions:

- The application of the specific land-use planning instruments substantiates the decisions on land-use management and promotes the development of the real estate market and the increase in the value of land resources.
- The dynamics of RET revenues in Latvia indicates the gradual increase in the influence of this land-use planning fiscal instrument.
- The analysis of the dynamic time series of the changes in input and output allows identifying the changes in the efficiency of land use in compliance with LUO defined for a particular territory.
- A set of fiscal algorithms is developed if applying the methodological framework for evaluation of land-use efficiency and analyzing the performance of the municipality in land-use planning and implementation of fiscal policy.
- The analysis of the application of the developed fiscal algorithm set is performed in relation with the development of RET data presentation specification for the municipality TP-GIS system and the assessment of the data required for the needs of the analysis at a particular municipality.

- By implementing the algorithm set and the specific software module at Riga City Municipality, the deficiencies in data administration systems and problems with the lack of uniformity and immense data would be resolved and the unified approach to data administration would be promoted, by applying the text and graphical information interaction and developing dynamic data series and graphical data visualization for the needs of the analysis.
- Taking into account the results of the present case study within the framework of the specific projects developed at the municipalities in Latvia, it is essential to eliminate the differences in the data structures for the development of software module, to elaborate the unified data administration approach, as well as design and introduce a software module to ensure the performance of the TP-GIS system, which would promote the rational and sustainable use of the land resources and the territories, to which they are allocated in the long-term.

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