New Indicator System for Evaluation of Land Use Efficiency

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Abstract

The rational use of land resources and land use monitoring have become topical nationally and globally. To evaluate the results of the implemented land-use policy measures, specific indicators revealing underlying changes in the qualitative and quantitative content should be used. *Topicality* of the paper is related to the knowledge of land use and land management within the framework of the socio economic and political aspects; spatial development planning experience; problems in determining of the development indicators of the spatial development areas; deficiencies of the real estate market and their impact on land use efficiency results, etc. *The aim* of the paper is to explore and discuss the indicator system for evaluation of land use efficiency and support of decision-making to promote the land use in better and more efficient way. A systematic, logical and comparative analysis of the existing approaches for substantiation of a decision-making process in relation to the determination of indicator sets is used for the research. The scientific research *methods*: the logical-constructive, the graphic, the monographic, the analysis and synthesis, the historical approach method, the sociological research method – the analysis of documents and collecting of information, the collation and grouping and other research methods.

Keywords
Land use efficiency, Evaluation, Indicator system, Criteria, Indicator sets

Introduction
Introducing land-use-related institutions is just one of the ways to diminish problematic land use traditions and promote sustainable land management. To ensure a sustainable land management practice, land use measures should be evaluated systematically. The key aspects of ensuring land use sustainability can be found in the *implementation* of the provisions of the land legislation (Auziņš and Kāpostiņš 2012) i.e. the administration and monitoring of land use, well-coordinated collaboration among the parties involved in land management, and the multifunctional analysis of land use results based on selected criteria and indicator sets.
For the purpose to get an insight on level of land use and spatial development in a territory and perform comparative analysis, the relationship among social-economic, environmental and institutional factors is examined and specific criteria and indicators selected. Thereby, it is possible to assess the extent to which the land use is equitable, acceptable, legal, productive, monitored, and accessible to the local society. The authors hypothesize that a land use benefits society if the relevant system for evaluation of land use efficiency is provided. According to the evaluation framework, the aim of the system of efficiency indicators is to support a decision-making in *land use management*. This aim prescribes the application of various indicators that characterise the land use efficiency (LUE).
The indicator system is created and is applicable for an analysis of the socio-economic and environmental aspects of changes in LUE as well as for the monitoring of land usage in general according to the functional land use set for a particular territory. The system is designed to promote the land use in better and more efficient way for providing the commercial and public goods as well as to balance both private and public interests. The application of the indicator sets may lead to decision-making on future land use considering the functional goals of a stakeholder. A developed system of appropriate indicators may be used at different land management levels.
The study focuses on analytical assessment of applicable indicator system for evaluation of LUE on the basis of systems and modelling approaches. Therefore, *the purpose of the study* is to show and discuss the developed indicator system in relation to a methodological framework.
The paper is structured as follows. First, the paper provides a theoretical framework of the study and literature review, which covers key issues and comparative analysis of existing approaches in relation to study context. Subsequently follow the description of research methodology and presentation of the indicator system, as well as the provision of main study results and discussion on the interpretation of indicators and outcomes of the expert

assessments and the further development of indicator system. The conclusions summarize key findings of the study and give implications for future research.

1. Theoretical Framework and Literature Review

Efficiency as an economic term of sustainable development prescribes necessity to use the human and environmental values in the way to promote the socio-economic development that would *increase constantly* the efficiency of use of available resources in the public benefit without endanger to resource renewability (Auzins and Vanags 2011). The efficiency concept is ambiguously defined in economic theory. However, "efficiency" relates to a *relative estimation* of either the conscious action of a person or the outcome of a process that shows the ratio of both the achieved effect and the resources consumed to achieve this effect.

Land use process can be seen as efficient while it is not compared with either some similar process or some other period of time. Accordingly, the LUE is comparable indicator and applicable for increasing of the efficiency. LUE refers to both an indicator of an achievable goal and an indicator of consumable resources. On the one hand, an efficiency indicator denotes the success of an actor that faces some land-use-related activity in achieving the previously set goals – a result-oriented approach. On the other hand, an efficiency indicator denotes the usefulness and possible optimisation of the resources consumed to achieve these goals – the process-oriented approach.

Therefore, LUE as an economic category in its general form refers to the function, which includes both the land use effect (a result) and consumed resources to achieve this effect. However, the evaluation of LUE is related to the identification of its *dynamics – qualitative changes* in the land-use process – by *comparing* the changes in both the effect and the consumed resources. Here, if the obtained effect increases more than the resources consumed do, efficiency increases. If the resources consumed to produce the effect increase over the changes in the effect, then efficiency decreases. Efficiency remains constant if the obtained effect changes proportionally to the changes in consumed resources. Generally, efficiency may be calculated using the equation below:

$$\Delta E = \Delta Rz / \Delta Rs, \quad (1)$$

where

ΔRz – changes in effect, comparing the land use-related activities;

ΔRs – changes in resources consumed to produce the effect.

LUE is often defined as the amount of land that is required to produce a unit of product or service. Using land more efficiently involves using smaller areas of land to produce the same product or service. Therefore, the economic meaning of land use is reflected, which only partly comply with the principles of sustainable land use.

Exploring the theoretical aspects of efficiency in relation to land use, it is proposed to assess its socio-economic, environmental, and institutional meaning. Several scientifically justified solutions (Dunkerley 1983, Smyth and Dumanski 1993, Valentin and Spangenberg 2000) and the results of the performed analysis show that the coincident influence of *socio-economic, environmental* and *institutional* factors and the *linkages* between them enable the determination of criteria and development of an indicator system specific to the evaluation of LUE. *Institutional arrangements* as crucial necessity to promote rational land use is also widely studied and argued (Auzins 2004, Auzins and Vanags 2011).

It is observed that the methods used to evaluate LUE are insufficiently analysed in the scientific literature. However, methods of evaluating spatial development, assessing land use typology, calculating the economic value of land resources, selecting usable indicators and determining relative weights, as well as other methods, are listed in many scientific publications (SRDA 2011, Beinat and Nijkamp 2010, Saaty 2006, Kuyler 2006, Chen et al. 2007, Joerin et al. 2001, Taromi 2011).

The core of the evaluation of LUE points to the necessity of increasing efficiency, providing the useful usage of land resources for the public benefit. The American economist Heyne (2009) proposes an approach and argues that *efficiency depends on evaluations*, that the determination of a process' efficiency is related to the value of its results and costs to its appraiser. Therefore, in essence, the application of *integrated evaluation methods* provides opportunities to use *specific and weighted* efficiency indicators in calculations.

Various scientific publications point to the *integrated approach* for substantiation of a decision-making process in relation to the determination of applicable indicators for the evaluation of sustainable development (Bossel 1999, Valentin and Spangenberg 2000, Farrow and Winograd 2001, Zavadskas et al., 2007, Sakalauskas 2010). In this way, the indicators track *numeric information,* which helps to explain land use changes during a specific time period.

Examining existing evaluation approaches and techniques, it is concluded that there are few studies on the subject of this paper in a scientific literature. Evaluation of LUE as essential procedure to the revision of general land use planning and land use regulations based on regional scale is recognised in China (Chen et al. 2007). Obviously, relevant problems regarding the usage of land resources explain both topicality and needs to proceed with the

evaluation and monitoring measures in regional context in this country. Therefore, 24 evaluation indicators were designed for multiple efficiency determination from the aspects of society, economy, ecology, and environment. Spangenberg (2004) proposes integrated scenario approach for reconciling sustainability and growth, thereby selecting two groups of sustainability indicators, i.e. dimensional and interlinkage ones. An input to rural sustainability indicators by land use modelling approach is presented when identifying the indicators that are related to land use change (Farrow and Winograd 2001). The results of this approach provide information to policy-makers in a form consistent with the spatial information used in the monitoring process, but does not meet the LUE domain.

2. Methodological Framework

The methodology of the research is chosen to best reflect the outcomes of the study, thus it is closely related to the purpose of the study. The socio-economic, environmental and institutional objectives and its linkages are set for evaluation of LUE as a result of the systematic and comparative analysis. Mainly historical and logical approaches are employed for identification of three different land management levels (LML), considering diverse functional goals of each level. Accordingly, the proposed indicator system is designed to support the decision-making at the national, municipal and land-user levels by applying diverse the evaluation criteria and indicators.

The hierarchy of the three-level indicator system (see Figure 1) follows the inductive-deductive data analysis of each element of the system. The first level of the indicator system is developed after analysis of the multi-dimensional evaluations of sustainable development and weighted by applying the expert assessments at municipal level in Latvia. The second level of the indicator system is concerned with evaluated criteria that form appropriate indicator sets in third level of the system. The efficiency indicators are selected in the result of both empirical availability studies and investigations of relevant data sets.

The realisation of the system for evaluation of LUE enables the creation of multiple indexes as integrated indicators on the basis of multi-criteria analysis. Thereby, an evaluation process follows the hierarchical evaluation approach by obtaining both the values and weights of specific indicators and using Analytic Hierarchy Process (AHP) as main method to determine the land use efficiency.

To develop and use the indicator system for examination of the cause-effect relationships, the input-output-outcome framework (see Figure 2) is proposed. This framework is provided on the basis of an input-output modelling approach used in several public management studies.

The novelty of the research involves the comprehensive and integrated evaluation approach, including socio-economic, environmental and institutional dimensions by using efficiency domain to support the decision-making in land use management.

3. Indicator System

A selection of applicable indicators for the evaluation of LUE makes it possible to describe the following: *made inputs*, the indicators of consumed resources (natural, human, material and financial), and *achieved outputs,* the output indicators that show the degree to which land use objectives have been achieved. *Land use objectives* spatially characterise the functional use of the territory. Thereby, they are effectuated by land-use planning and implementation system in a country. In Latvia, like in both other Baltic countries and in more advanced European spatial planning practices, the land-use planning follows the "bottom-up" approach and points to the responsibilities of local governmental level – municipalities.

The following indicators may specify the relationship between inputs, outputs and achieved objectives: *economic efficiency*, the utilisation of inputs to achieve outcomes (the comparison of input indicators, output indicators, and outcome indicators), and *effectiveness*, the impact of outputs on the level of achieved objectives (outcome indicators). "Economic efficiency" is also denoted in various publications as "quantitative efficiency", suggesting its nature. However, "effectiveness" rather indicates functionality and quality in the efficiency domain. Accordingly, *LUE* may be related to the impact of outputs on the satisfaction of inhabitants' needs and expectations as well as on the quality and availability of services, using the land resources in the most efficient way possible. This approach points to the *rationality assessment* of the sustainable usage of land resources rather than the *directional assessment* of territorial development. Therefore, expressively featuring, the "compass" may be replaced by the "road map" for the purpose of both substantiation decisions and making decisions in the field of land use management.

According to the study context, the system of selected indicators enables the summarisation of complex information, such as information on either the efficiency of multi-functional land use in a specific territory or the description of different levels of land management. An assessment of influencing factors of LUE, a determination of criteria to be evaluated and the development of an indicator system for the evaluation of LUE are based on the identification of potential resources: *human resources* (number of inhabitants, employees), *land resources* (area of land, amount and

breadth of resources) and *material resources* (fixed assets, infrastructure investments). As shown in several studies, this approach involves a *capital model*, the most common of which is the three-capital model, which includes human capital, natural capital, and produced capital. Sustainable development according to a *capital approach* is described by the guidelines of the United Nations and other prominent organisations in 2003 (United Nations et al. 2003). The guidelines define "sustainable development" as development that ensures that the national wealth per capita does not diminish, with the stocks of produced, human, social and natural capital composing this wealth.
The hierarchy of the indicator system, which can be used for the evaluation of LUE, is proposed in Figure 1. This system has been developed according to previously analysed factors influencing efficiency and its linkages. In the paper the hierarchical form of the indicator system is presented, but the study includes also its expanded form, which contains specific indicators and its units of measure.
Therefore, the three-level system includes 3 factors and 3 linkages, which are divided into 24 criteria to be evaluated. These *criteria* illustrate the impact of the factors and the interaction of the land use objectives. The *indicators*, which have been gathered over a specific period of time and analysed at the given LML, are classified into input indicators and output indicators as well as into outcome indicators (see Figure 2). *Input indicators* describe the investments of effects and resources. *Output indicators* describe the actual ratio of both land use effects and investments. *Outcome – efficiency* indicators describe the comparisons of obtained output indicators over different periods of time as well as the comparisons of both the predicted results and the actual results. *Impact indicators* describe the qualitative changes in a society and an environment as a result of land usage, thus reflecting *outcome – effectiveness*. The overall conformity of both the outcome indicators and the impact indicators to the land use objectives reflect either qualitative or functional efficiency, commonly known as *effectiveness,* and create a basis for decision-making regarding future land usage.

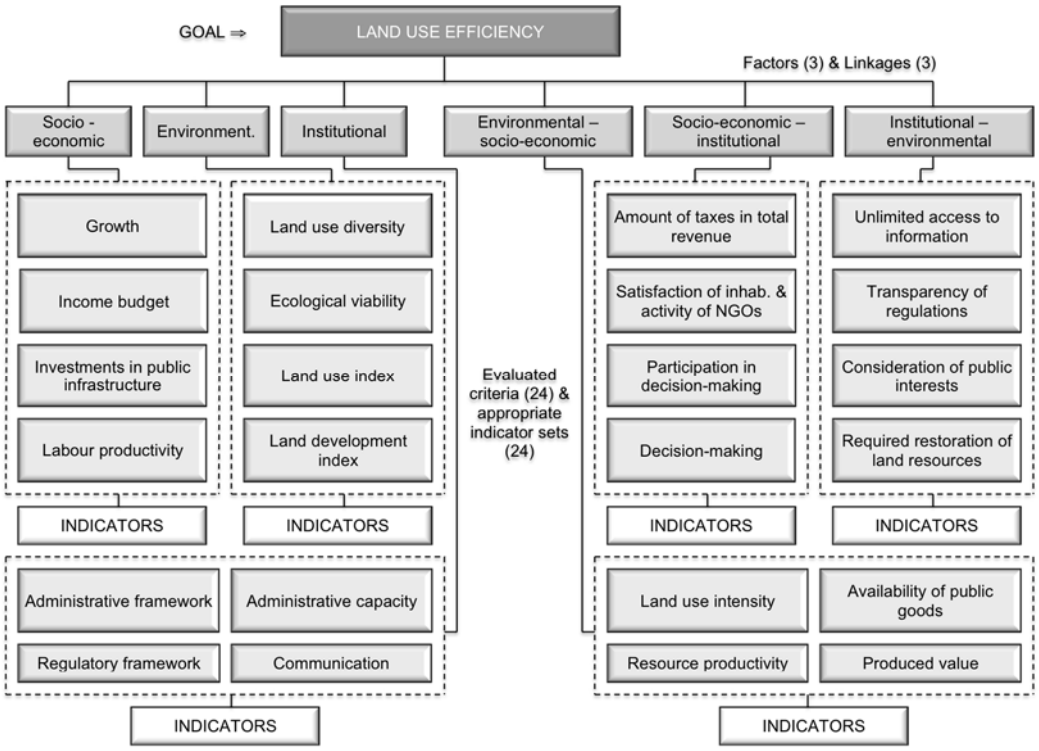

Figure 1: Hierarchy of proposed indicator system for evaluation of LUE

The indicator system includes indicators, which can be used at different LML. This differentiation is showed in the expanded form of the indicator system. Depending on the level of obtained outcomes, it is possible to determine a critical margin, *threshold*, past which an immediate decision, *response,* is made.
The *resulting indicators* are identified and applied for the evaluation of LUE due to the need to measure the achievement level of previously set land use objectives, the possibility of improving land use management procedures, and the necessity of providing the information for a society on investments and achievements using the land resources available. However, an appropriate model is needed to develop and use the indicator system to

examine the cause-effect relationships. The theoretical aspects and the results of several public management studies (European Commission 1997, Pollitt and Bouckaert 2004 and 2011, Vanags and Vilka 2005) inform an input-output-outcome framework proposed in Figure 2.
The model in Figure 2 presents the framework for the evaluation of LUE based on the socio-economic, environmental and institutional situation under study, as well as identified problems and defined needs for solving these problems in a particular territory. When determining the land use objectives, it is necessary to adjust them to the needs of inhabitants. The collection and introduction of the survey data of inhabitants in the indicator system allow clarifying the quality of institutional environment as well as the level of inhabitants' awareness, satisfaction, and participation, considering the processes of land use and development.

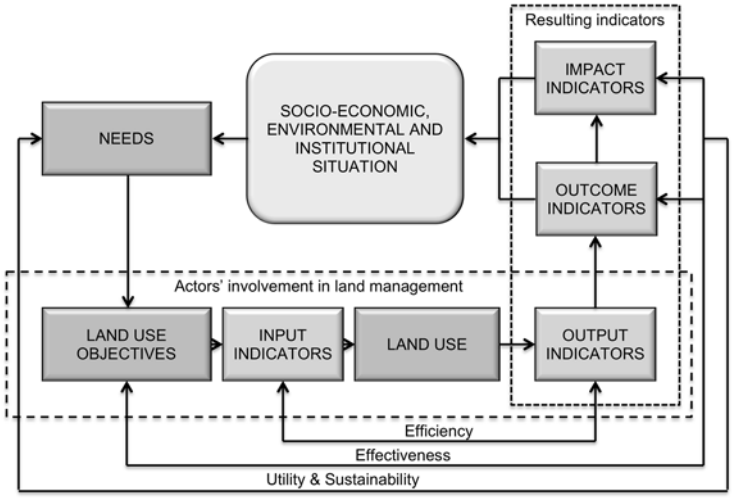

Figure 2: Input-output-outcome framework in land use management

The competences of actors involved in land use management contain the publicly responsible actions, when setting land use objectives, necessary resources for land usage, and land-use-related procedures, as well as when obtaining and gathering the output indicators. Both the outcome indicators and the impact indicators point to the effects occurring in a society and indicate the necessary solutions for the improvement of socio-economic, environmental and institutional conditions. The efficiency is determined if comparisons of both inputs and outputs are made, but the effectiveness is determined if comparisons of both the set of land use objectives and achieved outcomes are made. The extent to which the achieved outcomes make it possible to satisfy the needs of a society points to the utility and sustainability of the land use management system.

4. Results and Discussion

4.1 Application of the indicator system

The developed indicator system can be applied for evaluation of not only the state-owned and municipal lands, but also the private ownerships. Therefore, the land-users can assess the best possible allocation of resources and expect the best possible outcomes of using and developing appropriate territories. An analysis of the evaluation results may show, in addition to changes in the inputs or outputs of land-use-related resources, the changes in land-use-related resource outcomes, such as changes in the ratio of productivity to the costs of these resources, when observing dynamic data sets. Furthermore, the efficiency indicators along with the GIS offers and the assessments of experts / inhabitants on possibilities to use land resources in better and more efficient way would provide more balanced justification for making decisions rather than just the enumerating of both achieved effects and consumed resources in the territory.
From a practical point of view, the system's indicators may be used according to the context and level of a research, as well as considering the availability of actual data. The determination of aggregated indicators (indexes) arises from the simultaneous impact of land use-influencing factors and a set of selected indicators to evaluate the particular criteria. In order to evaluate LUE by choosing selected groups of indicators, it is possible to form the indexes. However, the system is designed for determination of LUE considering the multiplicity of land use and various dimensions of efficiency. The *index of LUE* can be determined by applying the method of linear weighted

sum after the calculation of efficiency values and determination of the relative weights of selected indicators. Therefore, a relatively simple index would clearly illustrate the differences of LUE in various territories, but a wider range of indicators applied to solve specific tasks in relation to the evaluation of land use and decision-making in land use monitoring.

4.2 Assessment and interpretation of indicators

Possible grouping of selected indicators, thus creating the indexes, including the comprehensive index of LUE at the given *LML*, indicates to the flexibility of the system. Therefore, it is feasible to select and use in calculations the most suitable groups of indicators for a research, which from the experts' point of view would be useful in the initial implementation period of the system. Accordingly, the indicators should be selected if considering their significance and availability of actual their values.

The evaluation of LUE at *national level* shows general development tendencies in the territory of the country by using aggregated and integrated indicators. Thereby, it makes possible to justify the strategic decisions in land management, to improve the land policy guidelines and goals, and to make decisions on priority directions of the development of economic sectors. Accordingly, at the national LML are used such indicators as GDP per capita, GDP per unit of investments and Value Added that is produced by economic sectors per capita, assuming that the functionally appropriate areas of land are used for the sector. As a result, the LUE is measured in terms of *growth* (see Figure 1).

The evaluation of LUE at *municipal level* reflects main land use and development tendencies in the territory of a local municipality by using the indicators, which characterise the performance of municipal functions. Thereby, it makes possible to justify the decisions of land-use planning and implementation, to improve the binding regulations of the local government and to solve the cross-border problems if co-operating with neighbouring municipalities, as well as to make decisions on priorities of land use patterns and its changes in particular areas of the administrative territory. Accordingly, at the municipal LML the *income budget* from the land resource usage per inhabitant is assessed, which in turn is used for improving the public infrastructure. The *investments in public infrastructure* are evaluated as value sum of made investments per inhabitant of a local municipality.

The evaluation of LUE at *land-user level* in a sufficiently comprehensive way shows the land use-related tendencies in the territory that is managed by a land-user by applying the indicators, which relate to either the entrepreneurship activities or the maintenance of a household. Therefore, it makes possible to justify the decisions regarding the land use in better and more efficient way if either doing business in a specific area or maintaining and developing the household. Accordingly, at the land-user LML the *labour productivity* is evaluated as value sum of produced goods and services per employed human resource if using proper areas of land. Similarly, also other criteria and indicators of the system are evaluated and applied.

The evaluated criteria of the "group of institutional factors" (see Figure 1) do not involve the indicators that can be applied at the land-user level. It follows from the functional goals of this LML. However, the evaluation of the "land use diversity", the "ecological viability", the "resource productivity", the "produced value per area unit", the "availability of public goods", and some other criteria comply with the functional goals of all three levels and involve the appropriate to them indicators.

The application of the efficiency indicators in decision-making at different LML is explained if the functional goals, the input indicators, the executed functions and activities, as well as the achieved outcomes of each level assessed. Therefore, the impact indicators have to be identified and assessed, because they together with the outcome indicators lead to the qualitative evaluation of LUE – to the changes in level of both the effects and resources (Δ) or determination of marginal values.

The expanded form of the indicator system includes a *threshold* of the indicators at appropriate LML. This refers to the reaching of a critical margin that is reflected by the obtained value of an indicator and causes a necessity to make a decision as response to further actions. For instance, if evaluating the "land use diversity" it is recognised that the share of forest area in the total area of land reached a critical ratio, immediate decision on afforestation is made. The determination of thresholds should follow the land use and spatial development plans as a result of interaction between LML. Similarly, if evaluating the "land use intensity", it is possible to ascertain the share of either built-up area or vacant space in the total area of land, as well as to determine the ratio of both built-up area and vacant space. But, if evaluating the time spent and the costs in making decisions, it is possible to recognise the critical margin of average time spent and costs in decision-making. Thereby, the negative externalities can be prevented, the costs of real property transactions diminished, and the institutional environment improved. However, the determination of thresholds for certain indicators is not useful. For instance, if evaluating the "communication" or the "participating in decision-making" one can state – the more constructive and active is the process, the better for the society.

4.3 Results of expert assessments

As it is argued in a previous research (Williamson et al. 2010, Auziņš and Kāpostiņš 2012), the municipal LML is considered as managerial level in sustainable land use and protection of valuable land resources for the public benefit. The study on evaluation of LUE at municipal level was conducted during the autumn of 2012. The aim of the study was to gather and analyse the expert assessments about the needs and possibilities to evaluate the LUE in the territory of appropriate municipality of Latvia. 84 respondents – official land-use planners of 119 municipalities of the country were questioned (response factor – 71%). The outcomes of the expert assessments indicate to the integrated indicator sets to be used in evaluations. The respondents indicated to the distribution of the indicator sets considering their relative significance if the indicators are used for the developing of appropriate indicator system. The distribution of the integrated indicator sets shows: the socio-economic indicators – 47%, the environmental indicators – 33%, and the institutional indicators – 20%.

A weighting of multiform indicators can be regarded as main challenge of an evaluation process. In the research of multi-criteria analysis the subjective and objective methods are used to determine the relative weights. Subjective methods include the establishing of weights on the basis of experts' experience. The experts can determine the relative weight of each element (indicator) within a system through the pair-wise comparisons, using the AHP method (Saaty 2006). Thereby, the matrices of comparable indicators are set and the numerical values of indicators' weights calculated, i.e. normalised the evaluations of priority vector. Objective methods include the establishing of weights on the basis of actual and "entirely objective" data sets, which characterise the indicators. However, before to use the objective methods, the applicable data sets must be collected and systematised. AHP method can be used together with an entropy method (Chen et al. 2007). Therefore, the average weights of the indicators are determined and used in calculations.

According to the hierarchy of developed indicator system (see Figure 1) and the LML, the matrices of pair-wise comparisons are formed and the relative weights of applicable indicators are determined for evaluation of LUE. Using the results of the expert assessments and evaluating the integrated indicators of the first level of the indicator system for matrix A (X_i), its relative weights are calculated as follows: socio-economic (X_1) $\alpha_1 = 0{,}235$; environmental (X_2) $\alpha_2 = 0{,}165$; institutional (X_3) $\alpha_3 = 0{,}10$; environmental – socio-economic (X_4) $\alpha_4 = 0{,}20$; socio-economic – institutional (X_5) $\alpha_5 = 0{,}1675$; institutional – environmental (X_6) $\alpha_6 = 0{,}1325$. However, these values have to be revised if the mentioned methods are applied and the relative weights are calculated for all the system simultaneously.

Conclusions

The study proposes that the application of the specific techniques for the evaluation of LUE in practice may lead to the sustainable usage of valuable resources for the public benefit. The indicator system besides the socio-economic indicators includes also environmental and institutional indicators that lets consider into evaluations the integrated objectives of environmental acceptability and institutional justice.

The efficiency domain is widely described and applied as an economic category. It is primarily defined by the economic theory. However, considering the sustainability aspects in usage of the valuable land resources and analysing the theoretical aspects of efficiency in relation to land use, it is proposed to assess its socio-economic, environmental, and institutional meaning. The application of efficiency indicators for evaluation of LUE points to the rationality assessments and the necessity to support a decision-making process using and renewing the land resources in long-run period.

The review of the previous research on the evaluation instruments that are used for evaluation of land-use-related activities show the lack of comprehensive and integrated approach for evaluation of land use. Therefore, the application of institutional indicators is not identified for assessing the performance and changes of normative and administrative framework.

Observing the Latvian experience due to the implementation of local land use plans and municipal development programmes, it can be concluded that there does not exist a common land use policy that would prescribe an evaluation methodology and indicator system to provide appropriate evaluation procedures and promote efficiency measures for assessment and monitoring of land usage. As recently performed expert assessments show, over 90% of assessed local municipalities lack and require specific techniques for the evaluation of land use efficiency, which indicates the necessity of introducing a set of selected socio-economic, environmental and institutional indicators. Moreover, although general guidelines for the development of local municipal programmes are provided, over 80% of assessed local municipalities lack an indicator system referring to the monitoring of territorial developments.

The implementation of the proposed indicator system will provide potential outcomes – the identification of development tendencies in specific territories – the assessments of possible future responses against decreases in the

value and renewability of land resources. Therefore, the support system for decision-making towards the best and most efficient land use must be introduced, and the response to needs and land use objectives must be effectuated.
The study includes an expanded form of the indicator system, which contains specific indicators and its units of measure, however only the hierarchical form of the system is designed in the paper. The results of expert assessments are presented after study on evaluation of LUE at municipal level, which was conducted in the Republic of Latvia. An evaluation process and the identification of dynamic changes of indicators', if applying the indicator system, are not described in the paper.
The paper calls for the efforts towards organising evaluation processes and analysing the outcomes leading to the substantiation of binding decisions using the proposed indicator system. It is acknowledged in the study that the land use evaluation results will lead to the expected benefits and will likely indicate needed corrections in selection of applicable indicators and evaluation procedures. Therefore, the development and constructive activities of an expert group play a meaningful role in the systematic organisation of the evaluation process of LUE. Accordingly, the evaluation process should be organised due to project-based approach at all LML.
The findings of the study suggest the indicator system for comprehensive and multisided evaluation of LUE. The hierarchy of the indicator system has been developed according to previously analysed socio-economic, environmental and institutional factors influencing efficiency and its linkages. Therefore, the system can be applied for measuring the sustainable land development components, including the institutional ones in appropriate territory. The indicator system is designed to identify changes in integrated efficiency indicators instead changes in effects and resource indicators if observing dynamic data sets. The input-output-outcome framework is developed to be used in land use management and to ensure the continuous improvements of the indicator system. New indicator system, obtained during the scientifically applied research for evaluation of land use efficiency, has a significant role for sustainable development of the regional planning.

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