THE INFLUENCE OF GEOPHYSICAL MEASUREMENTS APPLICATIONS ON LAND USE ATTRACTOR

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Abstract: Exogenous and endogenous factors determine the rational method of spatial planning, which is related to determination of the optimal planning functions. The attractor in the sense of land use is the place where the data describing land conditions attract its optimal use. The study presents considerations leading to determination of space use function attractors on the basis of exogenous and endogenous factors applied and by means of including the analysis of exogenous factors obtained from geophysical measurements. Inclusion of geophysical measurements results into the process of searching for land use attractors will contribute to better modeling of spatial processes and relations as well as decrease the number of decision errors made by planners in the spatial planning process. Determination of planning functions' attractors may be important for changing the development trends of spatial processes and contribute to a change in practice of organization of the space covered by planning

1. Introduction

Civilization development and the increase of social needs require development of new fragments of space, and, as a consequence, continuous modification of land already developed. The land use status changes under the influence of the needs related to human existence, which causes allocation of agricultural and forest land for urbanization. As a consequence the paper aims at presenting considerations leading to defining factors determining the development of space use function attractors based on the example of construction function.

The factors originating from the environment can be called exogenous while those related to the unit itself – endogenous [2]. Features of space such as terrain morphology, water conditions, soil fertility and load capacity of soil determine the specific land use attractor. Currently the planning decisions concerning space development are most frequently based on those features.

Results obtained from land surface surveys by noninvasive methods are used in a variety of areas including road construction, environment protection and archeology. As a result of those surveys the image of electric conductivity is obtained and after its interpretation the answer to the interesting questions such as: positioning of caverns, zones and directions of waters and contaminations migrations, places containing covered remains of war activities (e.g. blinds), places qualifying for archeological excavations, graves, walls or historic objects, is provided. All those components may influence attractors of land use. As a consequence it is proposed to supplement the planning works with analysis of subsurface elements as determined through

application of noninvasive methods to achieve space development in line with land use attractor.

2. The notion of attractor

Phenomena consisting of millions or billions related elements are difficult to grasp with human mind. Even o god knowledge of those elements does not secure insight into the entire phenomenon unless higher sorting categories are established. Today specialists in a variety of fields use such categories. One of them is the model proposed by theoreticians of deterministic chaos. The "attractor" – a term meaning the focus of all forces present in the system – is the central category of their description. The attractor, in the general systems theory, is the area or point in a certain space of states towards which the system aims and around which it stays in the time scale of any magnitude. The attractor can be defined as the grouping of trajectories in the phase space that is a state towards which the system aims. The attractor also organizes the dynamics of that system [3 , 7].

In terms of economies any large concentration or intensity of economic processes currently registered mainly in memories of large computer networks servicing banks and financial exchanges only is an attractor. The attractor is a mechanism of positive feedback related to capital mobility. It is an experimentally confirmed rule of intensification of economic processes in those places where they already are intensive, which appear from graphic presentations of data in the form of graphs and tabulations illustrating statistical consequences of billions of financial transactions per day. Inevitably all surpluses of people cash generated flow towards the attractors. [5].

Lorenz dealt with the theory of atmospheric phenomena. His studies aimed at long-term weather forecasting. Using computer simulations, he tried to project the development of atmospheric phenomena, which lead to stating that weather is a highly unstable system the trajectory of which is very strongly dependent on the initial values of parameters characterizing it and that it may depend on very minute disturbing factors (butterfly effect). Applying the attractor to meteorology, it can be interpreted in the following way: each individual trajectory represents the weather on a given day and it is never known which trajectory will apply on a given day. The attractor as a whole can represent the climate of a given area or a country [6].

The human senses and brain set sensual impressions in order by giving them the specific meaning and attributes using all components of a specific set. That model is also useful for understanding of creative thinking. Our memory structure changes during creative thinking. The structures of notions applied so far start collapsing, disturbances occur, the nervous stress and the number of mistakes increase. After a period of chaotic activity a sudden organization occurs based on a new, altered pattern. That is the new attractor that appeared in the brain of a given person as a result of development of cognition, inflow of information that did not fit the old pattern and a period of loosening of that pattern. An analogy with phase transformations observed in physical, chemical and biological processes here is clear although in case of thinking in notions it is difficult to make quantitative measurements and calculations. The brain operates according to a single attractor. As a consequence of a change in operational parameters, its dynamic state jumps to another attractor. A person solving a problem starts searching for new solutions, which involves changing the attractor in the nervous system. In that case the new pattern of brain operation can be called the attractor [6].

The forms of land use ending the process of the best adjustment of space use function to its characteristic features are also attractors. The attractor in the sense of space use is a place where given characteristics of land attract its optimal use, that is the best use in a given place and time. If a certain use is optimal in case of given space characteristics then, as a consequence, that space will be developed in that and not any other way. It happens

independent of the other use that was assigned to that area erroneously. The attractor here should be understood as attraction in a specific direction that is aiming at a specific planned function.

3. Description of studies

It was assumed that endogenous characteristics cause development of specific space use functions.
The land use attractor, such as the construction function, is influenced mainly by such features of the space as land morphology, water conditions, soil value characteristics and land load capacity [1, 4]. In this study those elements were investigated using point valuation method for four classed where points were spaced by the interval of 10 (table 1).

Type of feature	I suitability class	II suitability class	III suitability class	IV suitability class
Slope of land	1-5%	5-8%	8-12%	12-20%
Number of points	40	30	20	10
Water level distance from land level	>3m	3-2m	2-1m	<1m
Number of points	40	30	20	10
Fertility class of agricultural land	VIZ-V	V-IVa	IVa-II	II-I
Number of points	40	30	20	10
Load capacity of soil	$19{,}62*10^4 N/m^2$	$14{,}72*10^4 N/m^2$	$9{,}81*10^4 N/m^2$	$<9{,}81*10^4 N/m^2$
Number of points	40	30	20	10

Table 1: Assessment of endogenous characteristics using the point valuation method

As a result the zones of possibilities for using the land for construction function were obtained (fig. 1). Areas within the points range of 160-120, where the space is qualified for construction function without limitations in buildings' erection and for all forms of development are the land use attractor.

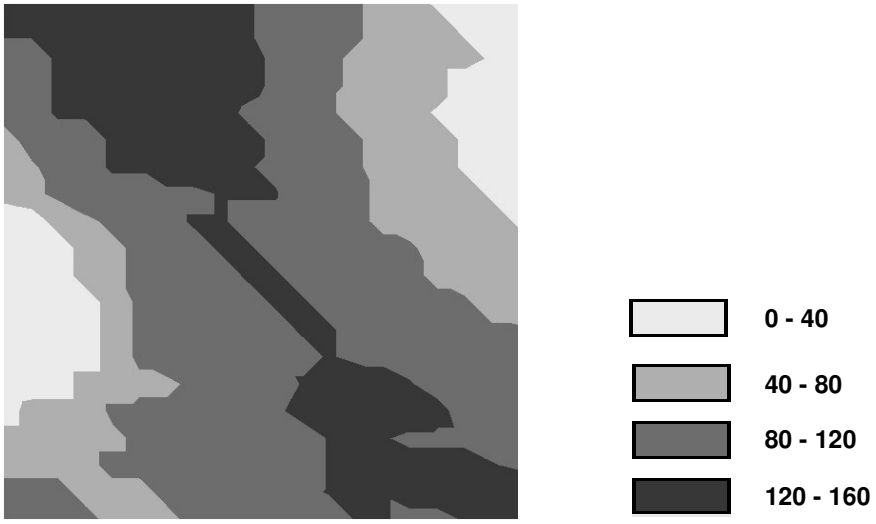

Figure 1: Land use attractor without subsurface elements analysis

For the points range of 120-80 the area can be used for construction function but with limitations concerning development with large and medium buildings as well as small buildings with cellars. Areas with the points score within the range of 80-40 can be used for construction but such construction would require additional outlays to improve the building conditions (e.g. drainage, reinforced concrete foundation, piles). That can also lead to exclusion for location of medium and large buildings and buildings with cellars. The remaining land scoring 40-0 points is unsuitable for development by construction.
In the second stage of the study the information concerning positioning of subsurface elements in the analyzed area. Three area underground objects (void, sandwater and cavern) were identified that changed the land use attractor significantly (fig. 2). The construction area of land use attractor in places where a subterranean element such as sandwater was identified changed to unsuitable for development by construction (fig. 2 area A). Identified void extended the area unsuitable for development by construction (fig. 2 area B). Also the area above a cavern was identified as unsuitable for development by construction (fig. 2 area C).

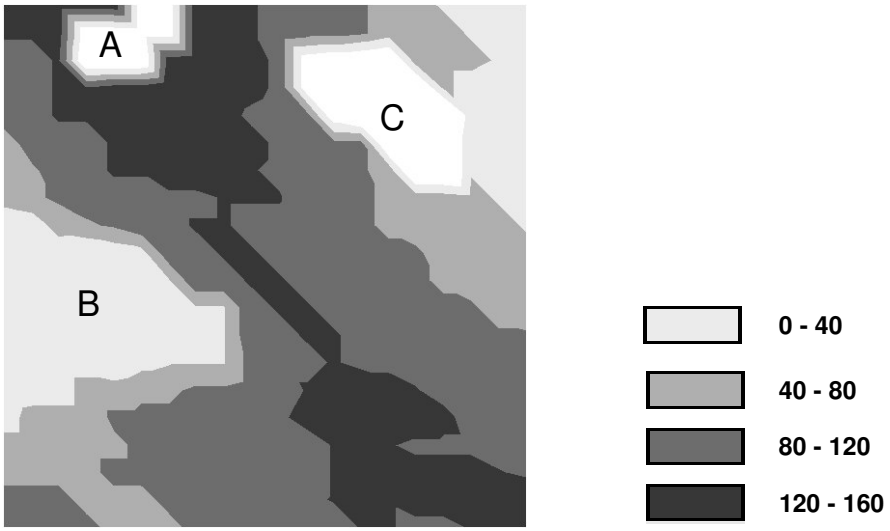

Figure 2: Land use attractor with subsurface elements analysis

Revealing new relations caused acquisition of new knowledge that should be used. In this case revealing new land use attractors should contribute to a change in development of the planning space. Application of the results of geophysical studies at the spatial planning stage will provide comprehensive information and lead to optimum solutions in the process of physical development plan formulation. Examination of subsurface space could become one of the factors influencing planning solutions It is proposed to include the results of subsurface studies into the process of spatial planning for better modeling of spatial processes and relations.

4. Conclusions

Considering results of geophysical studies supporting the search for the optimal space use method was the practical goal of the study on land use function attractors. Determination of the planning functions' attractors can have a significant influence on a change in the spatial processes development trends.
The plan should represent a sequence of targets related to the space taking into account its optimal development. As a consequence it can be stated that in the process of shaping the

spatial phenomena appropriate analyses and assessments of information obtained from land subsurface studies will play a role providing guidelines for the planning process.
The current legal system in Poland applicable to space development causes that human power shapes the space. Aiming at limiting the excessively vast powers of the planner in decisions concerning space development various studies, analyses and polls are used. Using the results obtained from geophysical surveys should become another application components limiting the scope of mistaken decisions taken by the planner.
Spatial planning is a kind of projecting space transformations. The physical development plan is a reflection of that projection. The results obtained can provide information on development of the planning functions during practical work involved in development of the physical development plans. They may also contribute to changes in the existing development trends related to the search for optimal planning solutions by including results of subsurface analyses of the land obtained by means of noninvasive methods.

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