

GIS – based DSS for sustainable infrastructures and management of tourism in the Leningrad Region

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ABSTRACT: The paper deals with analysis of a wide-sense role of GIS – based decision support system (DSS). Formalisation of approach towards preparation and realisation of visualisation of tourism infrastructure of Leningrad Region for ensuring stable development of territory is given. The meaning of the GIS – based DSS as a system-forming part of the geocological account (monitoring, management and audit) of tourism infrastructure within the frame of monitoring area and territory is shown.

1 INTRODUCTION

The purpose of the research is making of a technique for the substantiation of selection of terrains suitable for management of recreational activity, reduction of the concrete guidelines on their realization and usage, delimitating of the zonation scheme of objects according to recreation kinds on the basis of analysis of natural-technical environment. The technique runs in a view of a decision support system (DSS) on the basis a GIS technologies.

2 THE LENINGRAD REGION DESCRIPTION

The Leningrad Region occupies a large area in the Northwest of Russia from the Gulf of Finland to Lake Onega (Fig. 1).



Figure 1. Diagrammatic layout of the Leningrad Region districts

The region is one of the most dynamically developing subjects of Russian Federation and consequently is attractive to many of the people. The developing tourism infrastructure, safety and proximity of Saint Petersburg attract tourists, as well as investors to region. The trends of development and monitoring of recreational zones of the Leningrad area are especially attractive in these conditions. The territory of the Leningrad region includes 350 places, attractable for the tourists. The table 1 demonstrates the recent state of infrastructure quality and the tourist load for 2004 in the Leningrad Region.

The table demonstrates that the greatest amounts of means of accommodation now have such municipal formations of the Leningrad Region, as Vyborg, Priozersk and Luga district. Gatchina and Lomonosov are objects of the most interest. There are residences of Russian tsars settle down in their territory.

Development of tourism infrastructures should be friendly for the nature and the people. It provides the geocological analysis of territory of development. Also it necessary to consider recent and perspective design of engineering networks and communication, real-estate market and territories development, localization processes optimization.

3 RELEVANCE OF THE RESEARCH

Increase of population and economical growth of advanced countries entail step-up per capita off-hours, idle time of the social groups and the sociality that averages about 30% of day-time according to several calculations. Consequently, everybody will



aim to realize his off-hours including recreational time (tourism, sport etc.). Therewith town, land, ru-

ral & industrial development decreases per capita potential recreational territories.

Table 1. Number of collective accommodation objects of the Leningrad Region and its saturation points on 01.01.2005. (www.lentravel.ru, the information-statistical collection 2005. Tourism development of Leningrad region in 2000-2004 and the forecast for 2005. The statistical account and the analysis in tourism sphere of Leningrad region.)

Leningrad Region and districts	Total area of the region /district [km ²]	Total population [10 ³ the inhabitants]	Collective means of accommodation (CMA)		Including					
			Number of objects (NO)	Seats of accommodation /Beds (SA/B)	Organisations of a hotel type		Sanatorium and resorts		Organisations of rest	
					NO	SA/B	NO	SA/B	NO	SA/B
Leningrad Region	85,900	1659.90	432	44,422	66	3505	13	1442	353	39,475
Volosovsky District	2680.50	47.10	5	485	1	40	0	0	4	445
Volkhov District	5043.20	54.50	8	410	2	100	1	100	5	210
Volkhov	108.21	50.50	5	329	4	229	1	100	0	0
Vyborg District	7431.20	176.20	85	10,150	16	701	0	0	69	9449
Gatchina			5	267	3	177	2	90	0	0
Gatchina District	2864	114.70	17	2729	2	74	0	0	15	2655
Lodeinopolsky District	4911	39.80	19	721	3	198	0	0	16	523
Luga District	6025	86.70	41	7696	1	68	2	265	38	7363
Podporozhsky District	7705	38.90	7	195	2	58	0	0	5	137
Priozersk District	3597	38.90	109	10,029	4	126	1	350	104	9553
Tikhvin District	822	77.4	12	486	1	150	0	0	11	336

Thus, questions of acquisition of building land, architectural and landscape design, management and development of recent and future recreational areas, making new recreational resources become a very important (Fig. 2). Especially it is a vital question for heavily populated areas like the Leningrad Region.

Organization, operating and developing of recreational zones of tourism and sports objects, and their interplay with residential, industrial, nature protection and other zones is necessary to conduct with allowance for many components:

- the schedules of the area perspective development;
- a geographic setting;

- climatic conditions;
- a level of development of an infrastructure and industry;
- location of the residential districts;
- density of population;
- availability of a cultural-historical value;
- traditions of the population and etc.

Besides many recreation kinds demand availability especial residing conditions: climatic (for example, seaside health resorts), landscape (for example, mounting skiing resorts), circumstance by resources (for example, hunting, fishery). The relevant factors are the transport accessibility, seasonal predilection and potential selectivity of the population on recreation kinds. Seasonal usage only of recreational



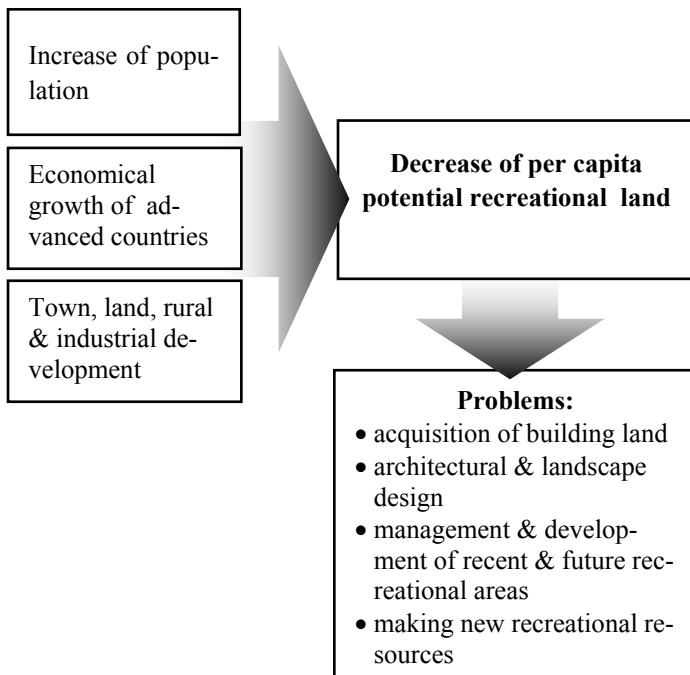


Figure 2. Effectiveness function of geocological analysis within DSS

objects is a great problem for developers and managers of this object in conditions of market economy. Thus, it is necessary to select season compossible recreation kinds with allowance for of psychological comfort and whenever possible by similar modes of operation. In this connection it is necessary to envisage a legible zoning of recreational territories with allowance for time of usage for rest (long-lived short-lived) and duration of work (year-round, seasonal), kinds of strain-relief crystallization, social and age composition of the people. The special attention should be given to a geocological estimation of the territories, which is directional on definition of methods and means of the sustainable development of the recreational zones.

4 GIS-BASED DECISION SUPPORT SYSTEM

4.1 DSS description

Making DSS consists on the three steps:

1. Identification of the existing situation
 - screening existing sources for data (archives, athorities, etc);
 - evaluation of data;
 - examination of existing monitoring systems, data bases, systems of indicators and models with respect to their suitability for the envisaged task;
 - formulation of task to be achieved in order to establish DSS;
 - suggestions for selection of the pilot area;
 - suggestions for the methods to be applied.

2. Implementation and operation of gauging (measurement) system interfacing the DSS
 - gauging of the monitoring bodies;
 - identification of required GIS – layers;
 - interfaces for databases, models nature quality (external load, internal load, critical load), GIS and recorded data.

3. Elaboration of the decision support system.
 - elaboration of models for monitoring and decision making;
 - working out of the DSS consisting of the following modules: data bases, GIS, system of indicators, simulation models, decision-making models, on-line recording of data;
 - testing and validation of the DSS for the selected pilot area.

4.2 GIS function

The recreational zones are large area objects, and consequently demand special means of interpretation and analysis. In this research GIS uses as the basic tool for serving, visualization, processing and saving data. Level-by-level organization of the information reference for GIS is especially comfortable, because enables fast and qualitatively to select, to process and to present a demanded data volume. Each layer represents a separate component of the data or its part. Thus the information on recreational zones is divided into two interdependent kinds: graphic (maps, schemes, figures, case history etc.) and attribute (blocks of the text, table, diagrams, design modules), - also is partitioned on theme layers.

A generally recognized instrument of work with spatially distributed information is geographic information systems (GIS).

The chief advantage of the GIS is the ability to map not only the object's characteristics but also its location in a particular point in the environment of a certain combination of other objects. The systems open widest possibilities of spatial analysis and drawing own maps supplemented by functions of work with databases and preparation of reports and printouts.

The information basis of GIS is electronic maps of a particular town or region. The map objects of a type (for instance, buildings, blocks, streets) are grouped into so-called information layers. The figure 3 demonstrated the key macrolayers of GIS-based DSS which are required for for sustainable quality infrastructures and quantity management of tourism in the urbanized and nature area of the Leningrad Region. Every macrolayer presents a group of thematic layers of homogeneous objects. The landscape layer which is base of the system includes surface relief. The hydrological network contains natural



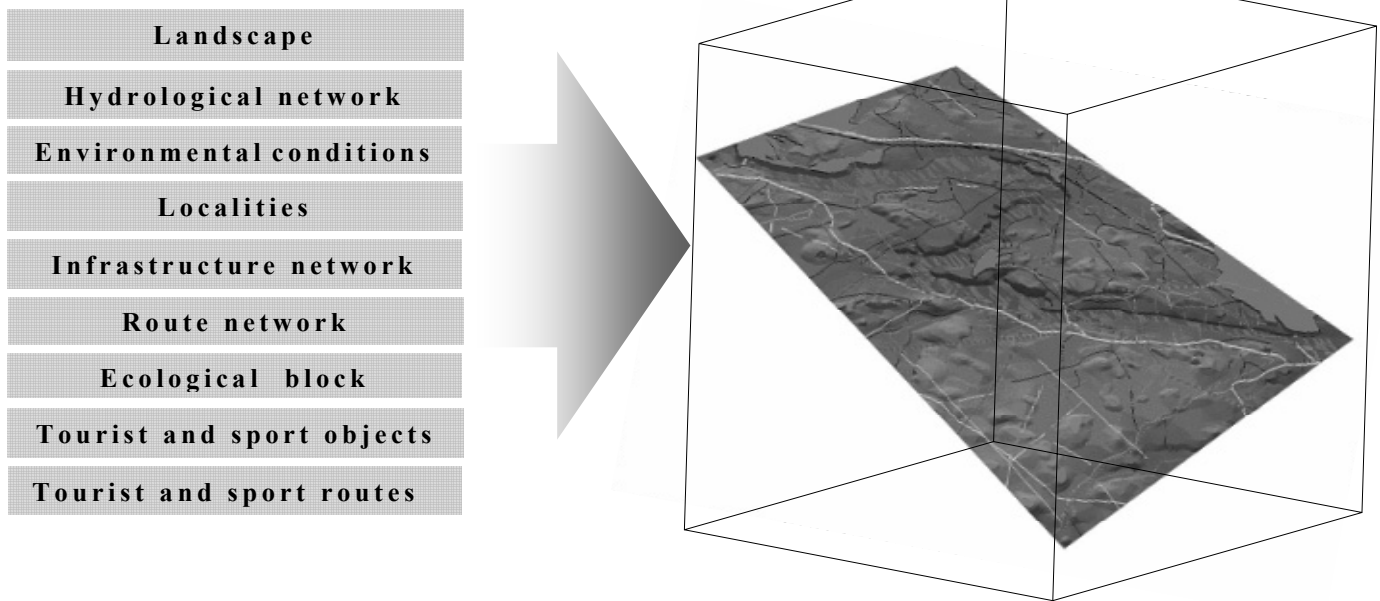


Figure 3. Thematic macrolayers of GIS – based DSS for sustainable quality infrastructures and quantity management of tourism in the urbanized and nature area.

and artificial surface and ground water bodies. Environmental conditions are a very important because they directly influent on type of recreational resource. The most of localities inside recreational areas are a recreational resource or a place of accommodation. Good quality of infrastructure and route networks is sine qua non for negotiability and boosts of the recreational areas. Well-working tourist and sport objects as well as routes are the goal of DSS.

4.3 Some additional GIS possibility of use within DSS

The GIS software makes it possible to solve a widest range of problems:

- drawing of screen maps of various scale, composition, design etc., comparison of maps with tables, texts and diagrams;
- editing of existing graphic objects, creation of user's information layers based on address data;
- work with databases and spatial analysis: all possibilities of standard database management systems;
- thematic mapping and preparation of mapping reports: automatic drawing of maps with visual display of the information for the user supplemented by texts, diagrams, tables.

4.3.1 Satellite investigation

A promising direction of the GIS application is their incorporation as the electronic mapping basis in global positioning systems (GPS). The chief direction of the use of such systems is control

over mobile objects (collection services, mail and messenger companies, transportation of expensive cargoes) and operational management of mobile objects (security companies, public services, ambulance etc.).

4.3.2 Design and maintenance of engineering networks and communications

Large organizations and municipal services need good knowledge of the territory to keep record of "departmental" objects, to provide operative mapping of problem parcels and rational distribution of available resources. The telephone company needs an electronic map of STS location, the emergency-control service must know the locations of the most worn-out sections of heat pipelines, the traffic police needs to know the road signs location. The GIS are the unique basis to which any specific information for the user can be easily attached.

4.3.3 Real-estate market and territories development

Real-estate agencies were among the first ones in business to recognize the importance and efficiency of application of the GIS-technologies. For any real estate object (flat, office, building parcel), its location is one of the most significant factors determining the object market qualities. Developers and realtors should also know the characteristics of the territory around the object: its ecological indicators, traffic location, level of the infrastructure development etc. The GIS make it possible to solve all these



problems: from the real-estate object's location on the map to fundamental analysis of its location.

In outside advertisements the range of GIS application is quite wide: from regular control over pictures on billboards to analysis of competitors' advertisements layout and choice of constructions with the maximum efficiency of advertisements. The GIS make it possible to calculate significant mediametric indicators (GRP) automatically.

4.3.4 Optimization of localization processes

The GIS provide shops, cafes, petrol stations etc. with an opportunity of optimal choice of location based on such data as distribution of the population and labor places, characteristics of traffic and pedestrian flows, location of competitive enterprises etc. It is possible to calculate the potential visitors of each shop, cafe or petrol station and the efficiency of allocation in each of the possible places.

5 CONCLUSIONS

1. Making DSS, development of the technique and comprehensive analysis all spectrum of the involved information allow to receive qualitative and quantitative state estimations of recreational resources, to recommend their rational development directions, to reveal of the main preference of the recreational zone users, i.e. full picture of presence state of recreational zones and an extended forecast.
2. The GIS – based decision support system (DSS) provide the sustainable quality infrastructures and quantity management of tourism in the urbanized and nature area of the Leningrad Region.
3. The GIS – DSS must be made in the frame of the tourism development for North West Russia goal government program.

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