

COMPLEX MAPPING OF NATURAL RESOURCES FOR MAKING GIS-REGION WITH USE OF SPACE DATA

Vladimir A. Sushchenya

State Scientific-Research and Production Center "Priroda", Russia

Tatiana V. Semakova

Administration of Arkhangel'sk oblast, Russia

Abstract

Complex thematic mapping of natural resources of the region with use of space data is carried out on the base of analysis the territory's needs and concludes by thematic maps series. Maps from these series contain the newest and actual data about natural resources and environment what promotes the increasing capacity of GIS-program as an instrument for information support of management organizations for preparing and solving urgent problematic decisions.

1. Introduction

The Arkhangelsk Region (oblast) is one from the largest regions of North having the territory in 587.4 thousands sq. km with the population of 1571.1 thousands men. It includes the Nenents autonomous district (okrug), 20 districts (raion), 7 cities of regional subordination, 1 city of district (okrug) significance and 6 towns of district significance uniting on the whole 300 centers of territorial management. There are more 1400 large enterprises on the territory of region. The complicated natural-zonal and climatic conditions, the specific of geographical situation form the transport system with the land, air, marine and river subsystems of communications and connections. The intensive utilization of natural resources and environment deteriorates the ecological situation, and sets a problem of its improvement. Moreover, the region with great activity co-operates with the neighboring territories of subjects of the Russian Federation and foreign countries. All this has been the prerequisite that's why the region 'matures' for solving the tasks to speed up the informatization and to make the geographic information system (GIS-oblast).

Customer of work is the Administration of Arkhangelsk Region which developed the scientific program of the informatization of region and combines it with the actual from 1992 program of complex studying and mapping of natural resources on the base of space data. The intergovernmental agreement between the Administration of the Arkhangelsk Region and Norway on rendering the scientific and technical aid by the Norwegian side in the field of the information technologies has been concluded.

The 'Priroda' State Center has been charged to carry out these works; it is the organization which has gained the considerable methodological and technological experience on the collecting and digital processing the territorial data obtained on the base of space data; these works are carrying out in co-operation with other organizations. The tasks which are solved by the Administration in connection with the realization of plans on making GIS are so complicated and varied that the structural reorganization of the information service of the region has been required. It has led to making in the Administration the new structure - the Center of Information technologies (CIT) which has assumed all the functions for further developing, extending and accompanying the technical project of GIS on making the regional information system of management as well as a for solving many other tasks of informatization of the region.

Financing and carrying out works are planned by the phases. At the first phase works are financed from the local budget, in the future the attraction of means is expected from the federal budget. For this aim draft of agreement between the Arkhangelsk Region and Federal Service of Geodesy and Cartography of Russia has been developed. In order to establish the direction of volumes and kinds of works; the plan of the technical measures on making the first turn of the Arkhangelsk oblast' GIS on 1995-1997 also has been co-ordinated.

The works on developing and making GIS of management carried out in the region conventionally can be divided on the following phases.

2. Preliminary works on making GIS

The agreement on the complex inventory of the natural resources with the use of space data has been signed by the Administration of the Arkhangelsk Region with the 'Priroda' State Center. This agreement is the base for preparing the information data bases on the state of environment of the region: all the vast data on the main natural resources and the state of environment are collected and processed with the use of materials of space photo surveys (by interpreting, working out the information parameters and making the series of the thematic natural-resource maps on the common mathematical base). At present the adjustment of the natural-resource maps on the common standard topographical base at the scale of 1:500 000 on all the territory of region is completing. The author's models of the thematic maps after reconciling, editing and evaluating by experts are transformed into the digital computer data bases for making the information layers of the electronic versions of the thematic maps and - in prospect - the computer maps in the use of the ARC/INFO applied software and the satellite data. At the given moment the experimental works on digitizing 5 thematic maps (vegetation, soils, quarterary deposits, natural-fodder areas, land use) have been carried out at the margins of the sheet of trapezium at the scale of 1:500 000.

In the course of this phase the susceptibility of the regional and department services to the information technologies has been examined. The show-hall of the computer technologies has been established in CIT of the Arkhangelsk Region; the requirement to software and hardware are worked out and improved, the tasks on making a number of workstations are prepared in this continually active show-hall.

The examination of the united technology of making the information system with the organization of the conceptual interface for training the beginner users of the different AOCs and mastering the new technique by them acquires great significance at this stage.

3. Making the regional data bases

The problem of forming and managing the data bases - the information problem to which the great attention is given. For this aim the analytical division has been established in CIT; it determines the structure of information and the ways of its actualization in reference to solving the tasks which face the information system. The great amount of information about the natural resources of the region is preparing at present on the base of space data by making the thematic maps and their electronic versions with the participation of the 'Priroda' State Center and the departmental services. At present the works are carrying out to analyze the versions of hardware and software of the different workstations of the departmental structures and the personnel of management with aim of forming local and branched nets. The following factors: reliability, technical characteristics, prospects of development are taking into consideration at the given

phase. Simultaneously with arranging the local net the examination of connecting up the information complex to the RELCOM and REMART international nets is carrying out.

4. Selection of methods and means of mapping

The logic of developing the territorial information systems leads to the necessity of using the stored data with taking into consideration their spatial control that is making the data bases with the use of the mathematical-cartographic models. For these aims the series from 20 names of maps at the scale of 1:500 000 is making; it allows to carry out the account and inventory of the natural resources with the attributive and cartographic data. Mapping and digitizing data are carried out simultaneously with editing and verifying them including interpreting the space photographic images with the use of the ARC/INFO software. At present the information layers of 5 thematic maps characterizing the land resources: soils, vegetation, fodder areas, quarternary deposits and land use - have been processed. The structure of thematic classifiers, their conjugation and intercomplementness for forming the open system in form 'inquire' is formed. The preparation of the digital models and electronic versions of thematic maps is worked out on the InterPro workstation in MicroStation environment. Making and introducing such integrated information systems pursue the following aims and tasks: 1) formation of the united GIS-oblast as an independent territorial administrative - economic complex of support of control for the management of natural resources; 2) support of the information base for the realization of functions of managing the regional economy; 3) support of information backing the process of management based on the reliable data necessary for planning and controlling the processes of development of the region.

5. Principal functions and tasks

The principal purpose of the GIS-oblast is to support the realization at the qualitative level of the following functions in the structure of management of economy of the region: preparation of the registration certificates for the funds of the territory; inventory and account of the natural resources; differentiated account of the land use; management of the data bases by the object of property; graphical representation of the real state of the infrastructure of the territory; analysis and control of the social development of the regional districts; formation of the maps of functional usage of territory; formation of the sectoral schemes of development of territory; presentation of the valued characteristics of different resources of the territory; managing the map of ecological zoning; making maps of the ecological risk; forming the district plans; solving the tasks of social monitoring; tax policy; management of the budget.

5. Structure of information

For presentation of the Arkhangelsk Region as an object of management the information system contains the following subsystems each of them is supported by the corresponding structural subdivisions.

1. System area 'management' (Upravleniye):

- 'finances and budget' - Financial Department;
- 'economy and forecasting' - Economy and Forecasting Committee;
- 'infrastructure' - Industry, Transport, Communications and Road Construction Committee;
- 'agriculture' - department of Agriculture;
- 'State property' - Committee of State-property Management ;
- 'external relations' - Division of External Economic Relations;
- 'execution of decisions' - Personnel of Head of Administration.

2. System area 'Population' (Naseleniye):

- 'labour resources' - Department of Labour, Center of Employment;
- 'social protection' - Department of Social Protection;
- 'education' - Department of Education;
- 'protection of health' - Division of Health;
- 'support of rights' - Department of Internal Affairs;
- 'Zags' - Registry Office.

3. System area 'Territory' (territoriya):

- 'town planning' - Committee of Construction and Architecture;
- 'land-property' - Committee on Land Reform;
- 'forest resources' - Department of Forests;
- 'ecology' - Committee on Ecology and Natural Resources;
- 'mineral resources' - Association 'Arkhangelskgeologia'.

The said list contains the principal subdivisions of the Administration of the Arkhangelsk Region which are storing thematic information on base of which the corresponding algorithms of its processing are projected. In the future in the support of certain rules of access the system can include the structures which are external in respect to Administration; the said structures have the initial information which is necessary for forming the administrative decisions. They are statistics board, the tax bodies, the banks etc.

In connection with the fact that works on introducing the automated methods of processing data are carrying out practically in all structural subdivisions of Administration it is necessary to make the new system with taking into consideration these facts; in no case this system doesn't infringe their autonomy and the rights on their disposal information that belongs to them. All the relations in GIS must be founded on the base of the intersystem agreements.

7. Information exchange

In support of process of management the structural subdivisions exchange the information both between themselves (the horizontal connections) and with the corresponding subdivisions of other levels of management (the vertical connections).

The analysis of relations shows that many structural subdivisions have the vertical connections of the departmental subordination and are obliged to present the information on this line. It forces to consider the system of information support of management of the region as one from the levels of information support of the Russian Federation on the whole.

Today can consider 5 levels of the information system: Federal, Arkhangelsk Region, Cities and districts of Arkhangelsk Region, Local Soviets, Enterprises, organizations.

Separately mark the following flows of information:

- organizational - instructional information, supporting both horizontal co-operation of the structural subdivisions of Administration and co-operation of Administration with the local bodies, the examination and execution of decisions;
- information, forming the legislative base of activity of Administration; this is the special kind of information which is common for all the levels of management that forces to put it on the particular place in the scheme of information co-operation.

The 'Territory' subsystem supports the account and control of management of the natural, material and human resources (as well as settling) for the efficient development of the region; it executes a number of following functions: 1) evaluation of the funds of territory; 2) control and

regulation of used funds; 3) formation of the sectoral schemes of development of territory; 4) formation of the maps of functional zoning of territory; 5) formation of the forecasting maps and the maps of ecological situations and risk; 6) formation of the business plans of usage of territory; 7) construction monitoring; 8) ecological monitoring; 9) territorial cadastre; 10) sectoral cadastres (water, land, minerals etc.); 11) renewal of the residential and non-residential funds of territory; 12) settling etc.

The funds of territories - the main (basic) component of the information system of the region for aims of management; its compounds are used in forming other subsystems. Basic aims of form of collecting, storing and filling the information - the operative and auxiliary maps which are making with the account of data of standard topographical basis as the spatial element of control executed at the first stage of the works.

The 'Population' subsystem supports the execution and development of the following functions on the base of map of settling: 1) evaluation of the demographical capacity of territory; 2) evaluation of the requirements in the social and cultural provision; 3) public forecast; 4) provision of employment; 5) formation of the maps of the structure and size of population; 6) account of the payments and services; 7) formation of the forecast etc.

The 'Management' subsystem in its turn consists of the sections: 1) infrastructures; 2) subjects of the business activity; 3) sources of the budget and the finances.

The order of access of separate organizations of management to the funds of programs of GIS and data bases is differentiated with the division of functions on the lower, middle and upper levels. In the receipt of detailed data of the lower level the said order is sanctioned, paid. Moreover, the organization which is competent in managing data and bears the juridical responsibility for the quality of the said data gives (pays) the sanctions on access. In the receipt of data of the middle level the said order is free, but with the obligatory notification of the operating center (CIT) about the accomplished exchange by data and programs for adding payment.

In the receipt of the information - reference data of the upper level the said order is free, free of charge.

Only the general scheme of presentation of the exchanged information realized by technology of GIS is given in this section.

It is known that the GIS-oblast contains many data bases, moreover, the account, revision and management of the most detailed (lower) level of information are carried out in its each unit of originators of the source data bases.

The region-wide exchange by data within the framework of the projected GIS is planning to carry out through the telecommunication medium in the co-ordinated formats and forms according to the standardized records on the mutually advantageous base.

In the end the structure of such integrated GIS in prospect consists of the following components: 1) telecommunication exchange by data; 2) means of integration of the heterogeneous data; 3) system of the information-analytical service; 4) geoinformation system; 5) system of the automated units of the data banks - the primary information sources.