Multipurpose resource inventory in Far East of Russia *(economical aspect)*

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Abstract

The analysis of the approaches used by conservation, management and sustainable development of all types off forests shows that a small progress has been made in preparing of comprehensive inventorying and monitoring. At the same time on the level of the concrete application of necessary programs is facing a series of obstacles, which need to be overcome. A multipurpose resource inventory (MRI) is designed to collect and analyze data from some existing federal datasets. A pilot project aims to provide a more comprehensive estimate of extent of land under conservation management; to identify gaps in existing conservation area networks and highlight the need for increased allocation of temperate forests for protection and conservation. Most of such information are used a number of resource agencies (Forest and Hunting Services, Service of Zapovedniks and Nature Parks, Environmental Committees, etc.). To improve the state of existing forest inventory the special program was initiated. Program designing focusing on issues and options related to the process of defining economical goals, regional policies and inventory. The preparatory work based on the provisions of program principles as demand-driven processes, which recognize that local priorities and constraints change. Within project activity all forest inventory and monitoring estimates were accompanied wildlife surveys and landscape quantification. The development and conduct of inventory and monitoring systems coordinated to ensure data compatibility. The results of inventories were by analyzed, maintained and presented using GIS technologies (PC ARC/Info software).

1 Setting up a problem

The challenges of the existing global ecological problems make for the search of the urgent and efficient ways of their solution. Undoubtedly, the preservation of global diversity, the slowing-down of the pace of forest degradation, the minimisation of the anthropogenic influence on the preserved nature territories require the involvement of the essentially new information technologies in the process of decision-making on the nature conservation issues. At the same time a pressing necessity exists to use complex methods for the assessment of the nature resources potential, especially for the vast forest territories that still occupy most of Earth's dry land (Mitchell and Hagenstein 1992, Zlotin and Yasny 1992, Kondratyev 1992, Voronkov and Turkevich 1993).

The global problems are to be solved on the territory of the specific regions, and it is very important that the decision-makers could receive complex information for the purposes of regional planning. Nevertheless, even when there is a relatively sufficient knowledge of the different components of the nature or resource potential on a given territory, in actual practice, the decisions are often governed by the priorities that have little in common with the real value of the forest resources. The reason for this lies in the extreme complicity of the assessment procedures for the investigated nature objects (systems) and the insufficient reliability of the results obtained by traditional methods. The "one-sided" character of the information that is officially collected by the main resource agencies and organisations also does not contribute to the progress in this area (Teplyakov 1997).

Other practical difficulty resides in the fact that each resource and nature conservation agency has its own mechanism of the assessment of resources, which, correspondingly, implies obtaining of a specific set of parameters and criteria. However, their activities do not guarantee that complete information is collected that would be sufficient for a comprehensive analysis and for making an optimal decision. Very often the same information is collected by different agencies, regional and federal structures, public and state organisations.

In the recent decade the emphasis has shifted greatly towards the inexhaustible use of nature resources. As a result, the resource conception in forestry is replaced by the sustainable forest exploitation that is able to take the best account of the social, cultural, environment-forming, and environment-protecting functions of the forest (Moiseev and Pisarenko 1996, Kozhukhov 1997, Strakhov 1997a, b, Shubin 1997). However, despite the crucial importance of this approach for the long-term sustenance of nature systems, more often the economical interest still remains the most important factor in choosing the variant of the territorial development.

In the 1990-ies, the Multipurpose Resource Inventory (MRI) attracted a great attention as a promising ap-

proach in the scientific investigations, practical undertakings, and international projects (Lund 1997). Using the Multipurpose Resource Inventory for the assessment of several kinds of resources, which is most suitable for the forest territories, it is possible to make a more objective assessment of the significance of different components. However, as the experience of many countries shows, it is very difficult to put into practice the main idea of this method, which lies in the inventory conducted simultaneously for the needs of many users (it is of no importance whether they will be governmental agencies or private forest companies) (Grumbine 1992, Noss and Cooperrinder 1994, Bocharnikov et al. 1996).

2 Evaluation of modern situation, urgency and need of economical assessments

Taking into consideration the international obligations of Russia on the preservation of biological diversity, the need to obtain the reliable assessments of the nature resources potential of the forest territories and in accordance with the Concept of the sustainable development of the country, the independent non-state organisation Scientific-Research Centre for Forest-Dependent and Aboriginal People (SRC FDAP) has developed a special project financed by WWF-Russia. Its main goal is to develop an original algorithm for obtaining an integrated economical assessment of the forest territories of the Russian Far East.

Far East of Russia belongs to the territories where the most diverse forest formations have preserved which have their typical structure, vegetation composition and biodiversity level. A specific feature of this territory is that in the south-western part of this region, in Primorye (Fig. 1), many forest ecosystems posses floristic and faunistic elements that are characteristic of different geographical zones: Arctic and taiga zones, forests of temperate and subtropical zones (Kolesnikov 1966, Bocharnikov 1996).

On the territory of the Russian Far East a large number of endemics have been registered: over 21 % local mammals (or more than 5 % of all terrestrial fauna of Russia), over 14 % nesting birds (almost 5 % of all ornithofauna of Russia); 66 %

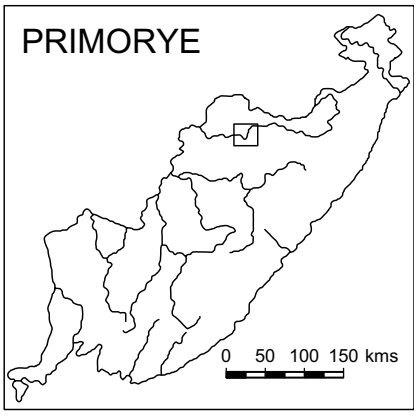

Figure 1. The south-western part of the territory of Far East of Russia.

reptiles (more than 10 % of all reptiles of Russia); over 55 % amphibians (or more than 15 % of all amphibians of Russia). One third of 18,000 species of higher plants are relicts, out of them the representatives of 16 families, 200 genera and 800 species of vascular plants occur only in the southern part of Far East. Therefore, the total biodiversity level is the highest on the territory of North Asia (Voronov et al. 1997).

In modern conditions the economical and social problems on the territory of Siberia and Far East have become of profound concern. For this reason very often the situations occur when it is necessary to determine which most economically suitable variant can be used on a specific territory. In fact, the most frequently used alternatives are the use of a forest site for commercial timber-cutting; complex nature management (collecting non-timber resources, commercial hunting, recreation, etc.) or organisation of a specially protected nature territory (SPNT).

When the strategy for preservation of the biodiversity in Sikhote Alin was developed, the optimum location of the existing and planned SPNT was evaluated (Bocharnikov, Krasnopeev, 1997). The creation of new SPNT and the correction of the borders of the existing SPNTs is possible only when there is a strong and objective justification of the economical appropriateness of them. It is necessary to develop a simple and practical algorithm of the economical assessment of forests to obtain a full picture of different variants of nature use.

Taking into consideration the recommendations prepared on IUFRO 4.02 meetings (the Monte Verita Conference on Forest Survey Designs and Assessment of Non-Timber Resources, Ascona, Switzerland 2–7 May 1994; the International Conference on Multiple Resource Inventory & Monitoring of Tropical Forests, Seremban, Malaysia, 21–24 November 1994) where the advantages of using **GIS** for practical analysis of spatially distributed data were clearly demonstrated and it was decided to implement an automated computer algorithm of economical assessment.

It is known that in order to make the needed changes in Russia regarding the ownership on the nature resources, it is first of all necessary to conduct their objective inventory and additional economical assessment. On the basis of data obtained it is necessary to develop sophisticated regional information systems for the control of the condition and dynamics of the nature resources potential within the frame of individual nature resource systems, regions, territories and republics (Baklanov 1992, Giryaev 1995).

The main structure of forest management in Russia has been in existence without any significant changes for more than 60 years, and its main element has been supporting the main industrial enterprises on cutting, export and processing of timber (Kozhukhov 1997). However, starting with the middle of this century, many times in Russia practical efforts were made to organise complex commercial enterprises**,** having state or public ownership on means

of production for the exploitation of the forest resources. During the years of their existence the experience of obtaining integrated assessments and prognosis for complex forestry and hunting management was accumulated (Kucherenko 1979, Kukuev 1997).

In the 1990-ies a cardinal change in the system of nature resources exploitation and management resulted in a practical uselessness of the existing departmental methods of the resources assessment and procedures of monitoring of the environment state. The need for developing a new plausible procedure, which could adequately provide, on the basis of a complex approach, obtaining comparative assessments for choosing a scenario for the territorial development of any forest site, became evident.

Besides, to get the reliable assessment on the existing resources, the volume of timber production, its prime costs and market potential of the forest goods, it is necessary to actively involve the local population in the inventory making. Obtaining such data is even more urgent now, when the Soviet system of planned economy has stopped its existence, and the new market mechanisms have not been fully formed yet. For this reason a large-scale sale of cheap nature resources of the country is observed.

Practically, it was assumed that a mechanism would be obtained that would allow to avoid the duplication of the efforts of different departments. At the same time it would allow to obtain regularly reliable data, to cover the "gaps" in data collection and processing; to reduce significantly the cost of the monitoring and inventory operations.

3 General algorhythm of economical assessment of forest resources

There are three most common concepts of the assessment of nature resources: expenditure, rental and combined ones. In the first case, the notion of economical assessment is connected with the expenditures invested in the development of resources; the second approach is based on differential rent that was calculated in the Soviet period as a difference between the value of the production obtained from the exploitation of the nature resources and the normative level of individually given expenditures for its production. In the combined approach the economical assessment of nature resources means the value of the annual profit from their exploitation, i.e. both the expenditures and the effect from the exploitation of the resources.

The choice of the methods of assessment depends on the goals, object and time period of the assessment. If it is necessary to calculate an optimal territorial scenario three almost polar assessments are chosen: the extensive exploitation of timber resources on the industrial scale, the inexhaustible use of the maximal number of forest components and the lack of exploitation in case of SPNT.

When comparing such variants, the most acceptable is the modified rental approach with a use of integrated cost estimations, including both the profits and the expenditures from all the components of the utilised nature resources. The value of such assessment by the economical content represents the net present value that depends on the resources taken into account, on the chosen scenario of forest land use and on the time period of the exploitation assessment.

As a cost-determining basis for evaluation of the production it is suggested to use both home market and export prices on the real forest production. It is planned to make calculations in the interval price estimations on the basis of practically accessible volumes of production with further organization of data into a "transparent" information system in order that it would be possible in future to correct the main indexes of the economical assessment.

It is fundamental that the division should be done into three main categories of timber and non-timber resources: economically available, exploitational, and potentially suitable for exploitation. Such division is made based on the accepted methods: state of the market, modern economical situation, availability of roads and infrastructure, processing capacities, peculiarities of nature management and other factors (Procedure.. 1991).

The potential resources include all the biological harvest that is formed under the influence of the forest productivity, climatic factors, crop capacity and other natural factors. The exploitational resources include the volume of resources that may become a real object of man's efforts**.** The economically available resources encompass a part of the exploitational resources that can be obtained, processed and sold at a profit level sufficient in the modern conditions.

At this stage the economically available resources must become an object of study. The suggested formula for the assessment is:

$$R = \sum_{t,i=1}^{T,I} \frac{(pti * Vti - Cti - Zt)}{(1+E)^t} + \sum_{t,j=1}^{T,J} \frac{(ptj * Vtj - Ctj)}{(1+E)^t}$$

where

R integrated assessment of resources with a chosen scenario of use;
T period of assessment;
E coefficient of discounting;
i index of production obtained from timber resources;
j index of production obtained from non-timber resources;
t year of resource use;
pti cost estimation of a unit of i-production obtained from timber resources in t-year;
ptj cost estimation of a unit of j-production obtained from timber resources in t-year;
Vti volume of i-production obtained from timber resources in t-year;
Vtj volume of j-production obtained from timber resources in t-year;
Cti total expenditures on obtaining, processing and transportation ofVti of i-production obtained from timber resources in t-year;
Z expenditures on forest restoration works in t-year;
Ctj total expenditures on obtaining, processing and transportation ofVtj of j-production obtained from non-timber resources in t-year.

The volume of i-production obtained from timber resources in t-year was calculated using the next equation:

$$Vti = \alpha im * kim * Fmt$$

where

Fmt economically available stocks of timber resources of m -*kind* planned for exploitation in t-year;

im proportion of economically available stocks of timber resources of m -*kind* felling within i-production;

kim coefficient of conversion of economically available stocks of timber resources of m -*kind* into i-production.

Economically available stocks of timber resources of m -*kind* planned for exploitation during all period of assessment are:

$$\sum_{t=1}^{T} Fmt = \gamma m * Qm,$$

where

Qm total stocks of timber resources of m -*kind*;

m coefficient of conversion of total stocks of timber resources of m -*kind* into economically available ones.

The volume of j-production obtained from non-timber resources in t-year:

$$Vtj = \beta jn * ljn * Hnt$$

where

Hnt economically available stocks of non-timber resources of n -*kind* planned for exploitation in t-year;

jn proportion of economically available stocks of non-timber resources of n -*kind* felling within j-production;

ljn coefficient of conversion of economically available stocks of non-timber resources of m -*kind* into j-production.

Economically available stocks of non-timber resources of n -*kind* planned for exploitation in t-year:

$$Hnt = Snt * hnt * \lambda nt$$

where

Snt total area occupied by non-timber resources of n -*kind* in t-year;

hnt biological productivity of an area unit of n-resource in t-year;

nt coefficient of conversion of total stocks of non-timber resources of n -*kind* into economically available ones.

4 Methodical basis for inventory of forest resources

Rational management of forest resources and forest landscapes requires distinguishing the elements that would practically reflect the important properties of the forest, implementation of quantitative measures of diversity that would provide a full picture of its functional properties, which is necessary for practical work. The forest taxation and forestry accepted in our country are a form of systematised reflection of different aspects of forest communities and forest landscapes. Such notions as forest type, habitat type, types of trees, condition of trees, diameter class, age, bionitet class etc. are directly reflect the peculiarities of forest resources, and lately, diversity indexes (Isaev et al. 1997, Golovikhin and Kukuev 1998).

In fact, the components used for the assessment of the timber resources are universal, because the main calculations on a possible "calculated timber-cutting area' are based on standard forestry data the same for all the territory of Russia, and the procedure of choosing timber for exploitation is officially stated in the corresponding documents, first of all in Instruction on organisation of forest management in the unified state forest fund of the USSR (1986) and its revised versions, up to Forest Code of the Russian Federation (Moiseev 1974, Polyakov and Nabatov 1992, Kukuev 1997, Romanov 1997).

In the project proposed, the materials on forest management for Primorskii Krai for 1986–1997 have been chosen as a documentary basis for the practical algorhythm of forest assessment. During the last three decades, forest management works were conducted on a regular basis (usually once in every decade) in each state forestry enterprise on Primorskii Krai territory using a standard forestry procedure (Instruction on... 1986, 1995).

With a support of a joint Russian-American project (**ERT**) earlier, in 1995–1997, on the basis of the primary forestry materials (plans of forest-plantations, description of wood vegetation) a database (DB) "Forests of Primorye" was created (Krasnopeev, Bocharnikov, 1997). The total information array of DB includes the description of about 500 thousand forest **sites** on an area of over 11.5 mln hectares of Primorskii Krai territory.

In the forestry practice of Russia the projects of federal forestry management by state organs are developed on the basis of forestry data, in which the original characteristics of forest plantations are used for the calculation of planned exploitation indexes, their restoration and protection on the territory of forest enterprises. A high level of data and procedure standardization allowed to create rather easily a corresponding information system. A further perfection of the user's interface and BD structure in the project implemented is aimed at that the program block could be widely used by different users, especially in the calculation by use of the main automated algorhythm of economical assessment.

Usually the integrated resource assessment is proceeded by the calculation of different components, and the general assessment is obtained by use of summarizing of individual assessments taking into account their weight, if the parameters investigated are not connected with each other by complex functional dependence. The dynamics of the accumulated timber stocks is calculated by the bionitets of forestry enterprises; all other "**usefullnesses**" of the forest are calculated more often in free form by different departments and organizations (Procedure of detection... 1987, Methodical instructions... 1988, Petrov 1996, Vorobyev and Vekx 1997). There is also a practical instruction on the assessment of non-timber forest resources in the southern part of Far East (Solovei et al. 1996).

The main idea of modern practical assessment of a forest site lies in establishing a strict connection between the existing in the estimated time marketing possibilities for the kinds of production and raw materials on an estimated site and the necessary inventory procedures. Thus, based on the practical side of **realisation** of the production that is in greatest demand, the number of the assessed kinds of resources is reduced to the minimum. Usually for the southern part of Far East these are 2–3 kinds of coniferous and deciduous trees, not more than 5–6 kinds of herbal and food materials; 1–2 kinds of furs. More detailed calculations are made when preparing a business plan for a specific enterprise or for an expert assessment of the damage.

The calculations on commercial game animals that are important for the sustenance of the life level of local people were made within the group "non-timber forest resources". Data obtained as a result of field studies, mapping of hunting lands and questioning of the local hunters are organized into a special DB**.** Standard relation tables allow to keep data obtained from different sources indicating their reliability and the time when they were obtained. The created user friendly interface of the program makes it possible even for a non-prepared user to work easily with data. The built-in editor allows to make corrections, additions and to remove some non-correct or out of date data. The system of **cross queries** helps to get necessary data and calculations promptly, presenting them in a **chart form**.

5 Conclusion

During the last 5 years in the USA a special system of forest inventory and monitoring based on special programs (Talent-Halsell.., 1994). The net of permanent sampling sites embraces all the country. Each sampling area represents a complicated hierarchical structure of smaller sampling areas the end use of which varies: inventory of tree, bush and grass levels, soil, soil invertebrates, etc. Probably, based on these approaches monitoring systems in the developed countries can be developed (Pavinen et al. 1994).

Other possible future development of monitoring is **high resolution** organization and processing of field observations data. Even now everywhere in forest management, biological studies and monitoring GPS are widely used for **choosing the sites** for field observations. This method is most promising for the assessment of different biodiversity components. But we can surely say that in Russia different assessments of the forest territories will be mainly done on the basis of mass data on forest management.

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