ESTIMATION OF LEVEL OF PERFORMANCE FUNCTIONS FORESTS RADIOACTIVELY CONTAMINATED TERRITORIES

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Forest resources are an integral part of economic, social and ecological development of the state. Making decisions as for the change and improving the system of forestry and the mechanism of management of it should be based on the results of comprehensive evaluation of implementation their functions by forest fund. The research is based on application of integrating estimation method to economic objects. The main functions of forest resources include productive, socio-economic, protective and preserving function. The method of evaluation of lamas their functions is developed, which is based on the method of integral evaluation and regulation of performing indicators implementation of specific functions. System of indicators is selected, which reflect the performance of the forest resources of each determined function. It was ascertained that degree of execution of their functions by forests of the four most radioactively contaminated districts of Zhytomyr oblast as one of the worst-affected by Chornobyl Nuclear Power Plant disaster differs significantly. This applies especially to provisional and protection functions.

Key words: forest resources, radioactively contaminated forests, functions of forests, integral evaluation of the functions by forests.

JEL Codes: Q23, Q51.

1. Introduction

Forest ecosystems play an essential role in providing ecological and socio-economic equilibrium of society. However, in the current conditions forest resources require economically profitable and ecologically safe management by public authorities. Making decisions as for the change and improving the system of forestry and the mechanism of management of it should be based on the results of comprehensive evaluation of implementation their functions by forest fund. Such evaluation will enable to identify problems of industry and to rank them by priority solution. According to this, substantiation of method of evaluation of performance their functions by forests and directly making such an estimation have both theoretico-methodological and practical values. Besides, this universal method, which can be adapted to the specific conditions, should be considered as organizational-managerial innovation in the sphere of forest use and reforestation.

Investigation of problems of balanced development of forests is becoming more topical among academic economists. Among these researchers are identified such as: A. I. Derebot (analysis of essence of timber complex and its ecological and
economic problems) (Derebot, 2012), R. G. Dubas (investigation of problems of formation of forest sector of Ukrainian economy with due consideration of international practices) (Dubas, 2011), V. P. Krasnov (investigation of state forests and tendencies of changes of forest funds of Zhytomyr oblast) (Krasnov, 2013), I. Lytsur (study of ecological and economic problems of dimensional management of Ukrainian timber complex) (Lytsur, 2010), M. H. Shershun (study of issues of Ukrainian timber complex reformation) (Shershun, 2012), A. Malinowski (study of special aspects of forest management on radioactively contaminated territories of Ukraine) (Malinowski, 2007), R. I. Trynko (study of the role of forests in socio-economic development of regions) (Trynko, 2011) and others.

The aim of the study is to investigate the performance of problems radioactively contaminated areas of Zhytomyr region by forests and their basic features. The basic research tasks include: 1) classification of showings that indicate degree of execution of their functions by forests; 2) application of suggested method of qualitative assessment of the degree of execution of their functions by forests by the example of radioactively contaminated districts of Zhytomyr oblast; 3) identification of current problems of forest use.

2. Methods of investigation

The method of integral evaluation is the basis of conducted research. Among the requirements to results of integral evaluation should be allocated: 1) comparability and correlation of indicators related to different functions; 2) considering only the key indicators which most completely characterize implementation their functions by forest funds; 3) providing the possibility to evaluate general level of implementation of forests one or another region or Ukraine in general all functions; 4) universality of method is in the ability to adopt to the specific features different forest areas and regions.

Most indicators of degree of implementation of forests their some functions are not correlative and comparable because of different units of measurement. To overcome this problem is possible by making their valuation, result is the placement of indicator values range from 0 to 1. Normative indicators are calculated by following formula (Vitlinskiy, 2004):

$$k_{ij}^+ = \frac{p_{ij} - p_{i \text{ min}}}{p_{i \text{ max}} - p_{i \text{ min}}}, \quad k_{ij}^- = \frac{p_{i \text{ max}} - p_{ij}}{p_{i \text{ max}} - p_{i \text{ min}}}$$

(1)

where: $k_{ij}^+$, $k_{ij}^-$ – normative coefficients of $i$- indicators for $j$- region, which have in accordance positive and negative component; $p_{i \text{ min}}$ – the minimal value among all other regions of $i$-indicators; $p_{i \text{ max}}$ – the maximum value among all other regions of $i$-indicators; $p_{ij}$ – the actual value of $i$-indicators for $j$-region at the moment of investigation.
Generalized evaluation of the degree of execution by forests the investigated regions is based on the generalized integral coefficient:

\[ R_j = \frac{1}{n} \sum_{i=1}^{n} k_{ij}, \]  

where \( n \) – number of performing indicators of the degree of execution by forests for \( j \)-region their functions.

3. Data and Results

Based on the analysis of modern approaches to grouping functions of forests (Food and Agricultural ..., 2006; 2010; Millennium Ecosystem ..., 2005) the authorial list of functions is developed, which is adapted to the peculiarities of the national forest fund and forest management. Industrial, social-economic, retaining and protective functions are included. The very level of performance of these functions should determine state policy in the sphere of forest management and reforestation.

The first stage of evaluation of the execution by forests their functions is the allocation and calculation of indicators, which reflect how effectively forests of radioactively contaminated territories fulfill entrusted to them functions. For this you must first define the system of goals, the achievement of which involves each of the selected above functions and their quantitative description. The main goal of production function is to provide population with products of the forest use. Due to the law of increasing demands, we can assume that demand for forestry products is growing, including the needs of population other countries. Forest production is divided into three categories: 1) primary production, which liquid timber belongs to, including round wood and firewood for technological needs, which is intended for further processing, as well as firewood intended for heating; 2) secondary products, which includes products of proceeding of liquid and the part of saw logs (lumber, and wood-fiber boards, construction made of wood); 3) The products of indirect forest management, which includes wild fruits, nuts, mushrooms, berries, herbs, woody juice. Implementation of production function of forests implies their ability to produce a primary product type of forest management, especially liquid timber.

As part of production of by-products, production and providing forest functions are provided. Due to the fact that compared to manufacture of wood, production of byproducts of forest management is immaterial, the volume of production should be considered within the framework of providing features such as providing people with food. Evaluation of performance of forest production function is offered to implement on the base of volume of production basic forest products - liquid timber.

Forests of Zhytomyr region suffered the most from radioactive contamination, particularly Yemilchynskyi, Luhyny, Narodychskyi, Olevskyi and Ovruchskyi areas.
Suggested method of estimation of degree of execution by forests their functions is applied on the example of these regions. The data table 1 shows that the amount of workpiece of marketable timber by forestry all without exception contaminated with radionuclide areas during the 2008–2012 is growing. The most notable this tendency is seen in Lugynskyi and Narodyckyi regions, in which the volume of harvesting the timber annually is increasing, accordingly on 8.11 and 7.94%.

Table 1. Dynamics of indicators’ level of performance of production function on radioactively contaminated regions of Zhytomyr region by forests

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>Provision of liquid timber, ths. m³</th>
<th>The average annual growth rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td><strong>Yemilchynskyi</strong></td>
<td>140.90</td>
<td>138.40</td>
<td>159.00</td>
</tr>
<tr>
<td><strong>Luhynnskyi</strong></td>
<td>74.00</td>
<td>63.50</td>
<td>100.70</td>
</tr>
<tr>
<td><strong>Narodychskyi</strong></td>
<td>101.00</td>
<td>90.10</td>
<td>118.60</td>
</tr>
<tr>
<td><strong>Olevskyi</strong></td>
<td>315.60</td>
<td>328.60</td>
<td>370.10</td>
</tr>
<tr>
<td><strong>Ovruchskyi</strong></td>
<td>269.00</td>
<td>262.60</td>
<td>307.00</td>
</tr>
</tbody>
</table>

The volume of marketable wood per 1 ha of forest plantations, m³/ha

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>The volume of marketable wood per 1 ha of forest plantations, m³/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
</tr>
<tr>
<td><strong>Yemilchynskyi</strong></td>
<td>3.21</td>
<td>3.15</td>
</tr>
<tr>
<td><strong>Luhynnskyi</strong></td>
<td>2.80</td>
<td>2.41</td>
</tr>
<tr>
<td><strong>Narodychskyi</strong></td>
<td>2.07</td>
<td>1.84</td>
</tr>
<tr>
<td><strong>Olevskyi</strong></td>
<td>2.25</td>
<td>2.34</td>
</tr>
<tr>
<td><strong>Ovruchskyi</strong></td>
<td>2.52</td>
<td>2.46</td>
</tr>
</tbody>
</table>

Another characteristic of the performance of production function by forests is their productivity. As an indicator of productivity of forest plantations is reasonable to use the index which reflects the volume of produced wood (primary production) per unit area of forest. The largest volume of provision of liquid wood is typical for three Ovruchskyi forestry and two forestry enterprises of Olevskyi region. At the same time the maximum volume of wood calculating per 1 ha of forest plantations is observed in Yemilchynskyi area’s forestry (3.83 m³). Slightly smaller this index is in Luhanskyi region, but average annual growth rate is higher in 1.5 times than in the SE “Emilchinskyi forestry.”

Average stock of wood is a generally accepted indicator of productivity of forest plantations, which reflects the potential volume of logging. The research used a relative measure of wood’s reserves – the primary source of basic products of forest management – to forest’s areas. This index reflects the amount of wood calculating per 1 ha of forests. As of 2010, the volume of wood stock on 1 ha of forest plantations, which are at the disposal of forestry of Yemilchynskyi district, made 202.7 m³/ha, Luhanskyi region – 214.1 m³/ha, Narodyckyi area – 265.4 m³/ha, foresters of Ovruchskyi and Olevskyi areas – 231.1 and 198.4 m³/ha. In total by three mentioned indicators it is impossible to give a definite answer about the forests, of which exact areas perform production function best, and which – worst.

Taking into account the difficult socio-economical and financial situation of population of wooded regions, the vast majority of which belongs to the rural popula-
tion, the function of providing the population with byproducts of forest management now plays a significant role in the lack of quality of food and its imbalance. Indicators, which reflect the effectiveness of provision of wild berries, wild fruits, nuts, mushrooms will be determined as the value of productivity – volume of provision of by-products on 1 ha. The levels of above indicators and the nature of their dynamics are reflected in the table. 2. According to the data table, sideline products were not gathered in the forestries of Yemilchynskyi and Luhynskyi in 2011. This activity is not typical for forest management in Narodichskyi region. The significant is reduction of volume of provision by forestries of Ovruchskyi and Olevskyi areas.

Fluctuations of actually available volumes of by-products of forest management in terms of years are usually caused by natural and climatic conditions. During 2008–2011 years an extremely unfavorable weather conditions in the Zhytomyr region was not observed. This gives reasons to believe that the current amount of berries, fruits, nuts, mushrooms shouldn’t differ much in dynamics. As a result, we can conclude that by-products of forest management are harvested by population rather than by forestry enterprises. A significant drawback of this is that population usually consumes or sells berries, fruits, nuts, mushrooms without proper analysis, which is required for these types of food, which is collected in the territories polluted with radionuclide.

In conditions of increasing demand for recreation services both from the citizens of Ukraine and from foreign tourists, the full implementation by forest fund the function of ensuring with recreational resources will improve public health and create the basis for formation the economical effects and providing socio-economical development of country in general, preserve cultural heritage and local flavor of forested regions. In context of analysis of recreation resources the forests serve two functions, which include providing population with recreational resources and the provision of recreational services. However, to carry out a full assessment of implementation by Ukrainian forests these functions is impossible, due to the lack of information about the amount of tourists visiting certain regions, and because of collecting data about the area of recreation and health forests is made once in 5 years.

Management of any object that provides continuous monitoring is impossible without complete and reliable information about it. So now we can talk about the lack

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>The average annual growth rate, %*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
</tr>
<tr>
<td>Yemilchinskyi</td>
<td>0.00</td>
<td>751.71</td>
</tr>
<tr>
<td>Luhynskyi</td>
<td>0.00</td>
<td>379.00</td>
</tr>
<tr>
<td>Narodychskyi</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Olevskyi</td>
<td>0.00</td>
<td>1707.66</td>
</tr>
<tr>
<td>Ovruchskyi</td>
<td>102.98</td>
<td>4231.46</td>
</tr>
</tbody>
</table>

Note: * – average annual growth rate is calculated for the period 2009–2001 years
of attention from the public authorities to potential of forests (including Zhytomyr region) in the sphere of provision the recreational services, which can be a source of additional cash inflows and the basis for creation new jobs for population of certain regions.

In basis of evaluation of the implementation by forests providing functions population with recreational resources is offered to put the share of recreationally-healthy forests in the total area of the latest. As at 2000, the share of recreationally-healthy forests in their total area in the woods (reporting to the State Agency of forest resources) of Yemilchynskyi area has made 5.6%, Luhynskyi – 5.7%, Narodychskyi – 0.25%, Ovrutsky – 1.1%, Olevskyi region – 4%. On the one hand, such low values of indicators in all areas are explained by relatively high levels of radioactive contamination of forests. However, as it mentioned earlier, it is found out that the current level of radiation of cesium-137 was reduced almost in half. It means that a significant area of forests that earlier was qualified as contaminated with cesium isotopes, today is not included to the following, that gives ground to review the functional purpose of areas, covered with forest vegetation.

As mentioned above, within the protective function the national forests primarily protect agricultural lands from wind and water erosions. In order to evaluate performance by forests the investigated regions with protective function the agricultural lands from erosion processes, the indicators of proportion weight were used, indicators of deflationary dangerous agricultural land and share of land, covered by water erosion in their total area. In investigation the data of recent survey is used in 1994 of deflationary dangerous ground almost proportionally increased, this enables making the comparative analysis of radioactively contaminated areas in Zhytomyr region based on the data of 1994.

Within the studied areas of Zhytomyr region the most negative is the situation in Narodychyi and Ovrutskyi areas. In these areas, the proportion of soils, which are exposed to water erosion was 0.5 and 8.5% respectively. Instead, agricultural lands of Yemilchynskyi, Luhyny and Olevskyi areas are almost not influenced by the water erosion. As for deflationarily dangerous lands, their specific weight in total area of agricultural lands in Emilchynskyi region is 6.3%, in Luhynskyi – 3.4%, in Narodychskyi - 14.3, in Ovrutskyi – 10.5%, in Olevskyi region – 12.7%.

Within the framework of performance by forests the socio-economical function extremely important for population of wooded regions is to provide its employment in the forestry. In the basis of evaluation the degree of implementation of last function is the number of employees, which falls 1 ha of area, covered with forest vegetation. Currently, almost the same tendency to reduce this indicator is observed in investigated regions. In the process of immediate evaluation of completeness of performance their functions by forests it is important to get the result both as a whole by all the selected features and by individual subfunctions. It will enable you to create a set of conclusions which serve as a basis for acceptance of administrative decisions in the sphere of forest management. Also in this case, it will be possible the comparative analysis of forests of different regions and highlight the most efficient and produc-
tive, management mechanism, which should be considered as the benchmark for other regions.

Among the objectives of this study one of the main is the selection of current problems in forest management (including on the basis of evaluation of performance by forests their functions) and on the basis of the obtained results - the formation of forest management measures. In such a way, the developed recommendations will concern the future. Therefore, identified problems should cover the closest period of time to the present, 2012 (in the absence of data – 2011).

The data table. 3 shows that the best production function perform forests of Ovrutskyi region, Zhytomyr region, the value of integral coefficient of degree of execution which functions are 92% more than in Olevskyi area. At the same time, there is a significant dissipation of level of performing the functions depending on the indicators and the lack of a clear leadership of separate district area. This is because leadership of areas by one indicator is in the context of production function accompanied by low levels of the coefficients, by other indicator – by index.

Table 3. The results of integrated evaluation of degree of execution by forests their core functions in 2012

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Normalized coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emilchynskyi</td>
</tr>
<tr>
<td>The coefficient of degree of execution production function by forests</td>
<td>0.44</td>
</tr>
<tr>
<td>The coefficient of degree of execution providing function by forests</td>
<td>0.49</td>
</tr>
<tr>
<td>The coefficient of degree of execution protective function by forests *</td>
<td>0.87</td>
</tr>
<tr>
<td>The coefficient of degree of execution socio-economic functions by forests</td>
<td>0.00</td>
</tr>
<tr>
<td>Integrated coefficient of degree of execution by forests their functions</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Note: calculation is based on data of 1994; taking into account almost equal value tendency to decrease the number of employees on 1 hectare of forests within all regions, this indicator is defined at zero level.

Instead, within the performance of providing function significant leadership is allocated by forests of Olevskyi area, while the outsider is straightforward Narodychskyi region. Low degree of fulfillment these functions are also typical for Ovrutskyi region. These results are explained by very small part of forests of recreational and healthy purposes due to the high level of contamination the last two regions of Zhytomyr. Forests of Luhynskyi regions perform protective function most
completely. The predictable is reverse link between the level of implementation production and protective functions by forests of Ovrutskyi region: providing the highest level of preparation of raw materials causes to reduction of forests’ ability to resist the erosion of agricultural soils. In general, the least ability to perform the basic functions is characterized by forests precisely of Ovrutskyi region.

4. Conclusion

1. Forming the system of measures to restore and for the most efficient use of forest resources requires identifying current problems, which are typical for specific areas covered with forest vegetation. Systematization of such problems is reasonable to carry out on the results of comparative evaluation of degree the execution their basic functions by forests. In the methodology of such an assessment method is proposed to put an integrated evaluation with determination the partial standardized coefficients in.

2. Method of assessment of the degree of execution of their functions by forests on radioactively contaminated territories is based on integrated assessment method. Its use allows comparative appraisal of showings-indicators of the degree of execution of their functions by forests on grounds of standardized coefficients computation. Standardized coefficients reflect how efficient is performance of functions by forests in each district in comparison to other districts.

3. Main showings-indicators of execution of their functions by forests are: procurement of merchandisable wood, volume of merchandisable wood on 1 hectare of forest (production function), provision of byproducts, recreation resources produce to population (provisional function), ratio of deflationary dangerous agricultural lands and lands that are affected by water erosion (protection function), assurance of employment of rural population in forestry sector (socio-economic function).

4. Among the most radioactively contaminated areas of Zhytomyr region are Emilchynskyi, Luhynyi, Narodychskyi, Ovruchskyi and Olevskyi areas. The highest level of performance its functions is typical by forests of Luhyny area. Almost the same results of evaluation are typical for forest resources of Žemilchynskyi and Olevskyi regions. Instead, the forests of Ovrutskyi region perform their functions the worst.

References


**MIŠKŲ FUNKCIJŲ ĮGYVENDINIMO VERTINIMAS RADIACIJA UŽTERŠTOSE TERITORIJOSE**

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Žytomyro nacionalinis agroekologinis universitetas

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**Santrauka**


Reikšminiai žodžiai: miškų ištekliai, radicija užteršti miškai, miškų funkcijos, integruotas vertinimas.

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