

# Comparative analysis of forest lands cadastral appraisal estimated with regards to wood and food resources

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**Abstract.** Cadastral appraisal of forest fund is one of the topical challenges of modern natural resource management. The paper delivers comparison of different approaches to cadastral appraisal of forest lands. The authors suggest a uniformed model to compare objectively and choose the most effective use of parcels.

## 1. Introduction

Forest lands prevail in the structure of Russian land funds [2, 3]. However, their use is inefficient, which leads to both profit loss and forest damage caused by lack of funding. Cadastral appraisal of forest lands plays an important role in efficient forest use and forest taxation. In Soviet time cadastral appraisal was conducted according to all-union standards, which was convenient if a country's economy is centralized. In market conditions, the Russian forest funds appeared to be in a tricky position – on the one hand, private ownership of forest land has not been permitted [5], on the other, logging industry has started developing intensively on the state lands. Thus, a forest user has no right to choose the optimal way to use forest land, and the state cannot collect full statistical data on economic efficiency of logging and its basic parameters, which makes general condition of the industry vague and unclear. All mentioned above proves that cadastral appraisal of forest lands in Russia is a challenging task that needs special approach. Market value comparison, which is used for other land categories, cannot be applied since there is no forest land market due to the absence of private forest land ownership. Cost approach does not take into account the quality of obtained forest resources. There is the last approach left – income approach that has been developed by Russian legislators for 15 years.

The first attempts to apply the income approach were made in 2000. The RF government developed a Guideline for economic assessment of forests [9] that determined a basic assessment concept: resource cost is income minus expenditure. It was for an appraiser to determine income and expenditure, which made the procedure unclear.



In 2002 a new Guideline for cadastral appraisal of forest lands was approved [6]. According to it, cadastral values were to be defined by discounting flows of money in three levels: federal constituent entity, regional forestry and a forest ranger station. The classical Faustmann model was a source of basic concepts to appraise forest lands [1]. However, the fact that the model had been developed for forest owners with all their rights and responsibilities was not taken into account.

In 2010 the Guideline was abolished to provide more effective legal framework, but nothing was introduced instead. Nowadays there is a specific indicator of cadastral value (SICV) [8] which is unified for a whole constituent entity of the Federation (Federal subject). This indicator does not differentiate land areas according to their quality, which makes it useless. Thus, it is not studied in the research.

For some decades forest has been regarded not only as a wood source but also as a source of non wood forest products (NWFP) or as an area used for recreational purposes. Therefore, it is NWFP that is studied in the article. The guideline [6] suggests appraising NWFP resources by rent capitalization. Such approach is quite vague: it may be difficult to determine a capitalization rate, since it changes from lumber company to lumber company and also depends on forest growth conditions. Another factor that makes such approach doubtful is the fact that a significant part of NWFPs is obtained from forest for non-commercial, personal use. Thus, such forest use cannot be regarded as business, and the capitalization rate can hardly be applied in this case.

Moreover, the Guideline [6] implies using this way of appraisal only for forest lands producing NWFP. NWFPs are not implied being gathered from areas meant for clear cutting, thus integrated cadastral appraisal of such areas is not provided in the guideline. It may be explained by the fact that discounting method and capitalization method of forest resources appraisal give incomparable results. For example, the cadastral value of blueberry-birch forest in Leningradskaya oblast based on mushroom resources can be three times higher than the cadastral value of the same area based on wood resources appraisal. Therefore, these appraisal results can hardly be compared and united for integral assessment. However, development of multifunctional cadastral appraisal is still one of the modern challenges of land management. It is necessary to take into account all possible ways of forest use, and find balance between them while making cadastral appraisal of an area. The results of cadastral appraisal should be the base for choosing the most efficient forest use of an area.

The aim of the research is to align forest appraisals made according to different methods, which would make it possible to compare them and to determine the most efficient and sustainable way of using particular forest area.

## **2. Objects and research methods**

The data to study is mensuration description data of 259 compartments of 11 units of “Pesochinskoye” district forest ranger station of “Curort lesopark” forest-park, St. Petersburg [7]. A forest park refers to urban protective forests. However, the species content and forest growth conditions refer to taiga biogeocenosis.

To compare incomes from clear cutting and MWFP (we chose mushrooms for calculations: cepe, milk mushroom, orange agaric, aspen mushroom, annulated boletus, rough boletus, sharp agaric, russula) we should make evaluation by unified methods. We suggest changing capitalization approach to average annual specific NPV. Thus, it is necessary to estimate income obtained from different forest services and goods for a particular period then discount it and divide it by the period.

Firstly, let us define a period. Income from clear cutting is received at any one time at the end of cutting cycle. However, over mature stands should be cut in the moment of evaluation. It is reasonable to consider a period as period before the end of cutting cycle plus a period of one cutting cycle. Let us take a period of 60 years for deciduous species and 80 years for coniferous ones. It should be noted

that while changing continuous cutting to a certain limited period, the value is lost to a certain extent. However, preliminary estimation showed that the loss will not exceed 10%. Moreover, the current prices can hardly be taken into account to calculate costs in more than 60 years.

Let us use mensuration description to estimate the income from forest harvested mushrooms. According to the Guideline [4] on NWFP appraisal, there is a relation between a forest type and an average annual mushroom yield in forests of Russia's North-West. The data show only the average yield from areas with the same forest growth conditions, that is why the yield value is quite low. We should underline that appraisal of every unit can hardly be implemented in this case, since the average values can not reflect a yield capacity of this or that compartment. Thus, an average unit yield will be taken as the most reliable for further cadastral evaluation.

To estimate total income from mushroom yield, it is necessary to multiply mushroom yield capacity by income from one kilo of particular mushroom species and by mushroom season period. The mushroom season period, as it is described above, equals the number of years before cutting plus one cutting cycle for a dominating wood species. The fact that mushroom yield is low during the first 10 years after clear cutting should be taken into account. Industry profitability is taken as 34% [10]. To bring cost values to the estimated period, let us discount the obtained value of total income. According to Russian agricultural ministry's regulation, the discounting rate is 0.02. Let us divide the obtained value by mushroom season period and we have a specific average annual cadastral value of a unit with mushroom yield. When the unit estimations completed, it is possible to evaluate the average cadastral value for a whole research object.

The general formula of calculation is as follows:

$$P_{cad}^{mush} = \frac{\sum_1^i P_i^{mush} W^{mush}_i \cdot t}{(1+d)^t} + \frac{\sum_1^i P_i^{mush} W^{mush}_i \cdot (T-10)}{(1+d)^{(t+10)(T-10)}}}{t+T},$$

where

$P_{cad}^{mush}$  – specific average annual cadastral value, ruble/ha;

$i = 1 \dots 12$  – species of gathered mushrooms;

$P_i^{mush}$  – income from one kilo of mushrooms, ruble/kg;

$W_i^{mush}$  – average annual mushroom yield capacity, kg/ha;

$t$  – period before the end of cutting cycle for main wood species, years;

$T$  – cutting cycle, years;

$d = 0.02$  – discounting rate [6].

To make further comparison and choice of alternative forest use, the average annual cadastral value was estimated for the same period without clear cutting:

$$P_{cad}^{mush} = \frac{\sum_1^i P_i^{mush} W^{mush}_i}{(1+d)^{(t+T)}}$$

To estimate the cadastral value with regards to wood cutting, we use the same discounting method:

$$P_{cad}^{wood} = \frac{\frac{P_{hardw} W_{hardw}}{(1+d)^t} + \frac{P_{hardw} W_{hardw}}{(1+d)^{tT}} + \frac{P_{softw} W_{softw}}{(1+d)^t} + \frac{P_{softw} W_{softw}}{(1+d)^{tT}}}{T+t},$$

where

$P_{cad}^{wood}$  – specific average annual cadastral value, ruble;

$P_{hardw}$  – income from 1 m<sup>3</sup> of hardwood timber production is taken as 1272 ruble/m<sup>3</sup> according to the average 7-year cost [11] and the profitability of 6% [12];

$W_{hardw}$  – stand of hardwood timber per hectare, m<sup>3</sup>/ha;

$P_{softw}$  – income from 1 m<sup>3</sup> of softwood timber is taken as 1475 ruble/m<sup>3</sup> according to the average 7-year cost [9] and the profitability of 6% [12];

$W_{softw}$  – stand of softwood timber per hectare, m<sup>3</sup>/ha.

### 3. Results and discussion

The research resulted in average annual specific cadastral values for each unit with regards to different ways of forest use: only timber production, mushroom production with clear cutting and mushroom production without clear cutting. As a result, the average annual specific cadastral value with regards to mushroom production with clear cutting on all compartments is 29 ruble/ha, without clear cutting – 75 ruble/ha.

The average annual specific cadastral value with regards to timber production is 208 ruble/ha. Taking into account complementary forest yields (timber and mushroom yields), the average annual specific cadastral value increases up to 231 ruble/ha. With the average productive period of the units being 89 years, the cadastral value with the complimentary forest use for the whole period is 20,559 ruble/ha vs 18,512 ruble/ha of the cadastral value without mushroom yield. Thus, the average cadastral value should increase by 2,047 ruble/ha or 23 ruble/ha annually.

While making forest land cadastral appraisal, it is advisable to use average annual parameters rather than general cadastral values, since the average values are easy to compared. To calculate the charge for forest use, the cadastral value is of little importance since the charge value can be controlled by an adjusting factor.

Further research is to be focused on other NWFPs, such as tree biomass components (fir-needles, foliage, tanner's bark, and birch bark), birch juice, oleoresin, berries and herbal medical products and starting materials. Integration of the cadastral values with regards to different ways of forest use will allow us to assess true cadastral value of forest as a natural resource.

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