Ecological Communication

Economic Availability of Forest Resources in Russia: An Analytical Assessment

Alexandr G. Tretyakov[1] and Igor G. Mayorov[2]

[1]Federal State-Funded Organization Saint-Petersburg Forestry Research Institute (SPbFRI), Saint-Petersburg, Russia

[2]MIREA - Russian Technological University, Moscow, Russia

ABSTRACT

The topic of the availability of forest resources is especially relevant for Russia, given the volume of the existing potential of these resources, distributed over a huge area of the country. The purpose of the article is to substantiate the possibilities of using the economic availability of forest resources in the practice of forestry in the Russian Federation. The article presents an analysis of the application of tools based on the economic availability of forest resources. It presents the classification of the forms of forest resources availability and analysis of possible situations that may occur assessing the economic availability of forest resources. The authors analyzed various methods of assessing the economic availability of forest wood resources, formed a criterion of economic availability and considered various conditions of economic availability. The results of calculations of economic availability assessments for the Vilegodskoe forestry located in the southeastern part of the Arkhangelsk region, according to which 19.1% of the analyzed plots were recognized as economically unavailable, are presented. The analysis of the characteristics of economically unavailable forest wood resources in the studied object has been carried out. Proposals have been developed on the spheres of the possible use of the toolkit for the economic availability of forest wood resources. The economic availability of forest resources can be widely used in the forestry practice of the Russian Federation in the areas of pricing and forest exploitation optimization. Its application will increase the level of payments for forest resources, due to the withdrawal of excess profits of loggers, and will also ensure the formation of more realistic forest plans.

KEY WORDS: AVAILABILITY ASSESSMENT OF FOREST RESOURCES, CRITERIA OF ECONOMIC AVAILABILITY, FOREST RENT.

INTRODUCTION

The availability of forest resources is a major factor in the volume of logging. Russia accounts for more than 20% of the world's forest areas, but its share in the global production of round wood is almost 4 times lower than this indicator. One of the current results of the existing level of forest resources economic availability is the low share development of the harvesting permissible volume in mature and over-mature forest stands (allowable cut), which in (2020) in the Russian Federation amounted to slightly more than one quarter (25.12%), while out of 83 constituent entities of the Russian Federation where there is a possibility of felling in mature and over-mature stands, in 21 constituent entities the development level of the allowable cut was below 5% (including in 12 subjects it was equal to zero).

The concept of natural resources availability is widely used in scientific research, characterizing the existence of opportunities for involving them in economic circulation, which presupposes the availability of resources identified by modern exploration methods that are technically accessible and economically viable for development. Natural resources availability encompasses the complex of relationships related to the operation of natural objects, the development of technological progress, the economy, and society. In the case of different mineral resources, issues of exploration and technical capabilities of exploitation play a significant role. When considering the availability of forest resources, other factors come to the fore. For example, the Alberdi et al. (2016) considers environmental (e.g. protected areas), social (e.g. recreational areas) and economic (e.g.

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profitability) constraints when defining inaccessible forest wood resources (Alberdi et al. 2016; FAO 2020; Medeiros et al. 2021).

The FAO documents indicate both legally protected areas and other reasons as reasons for unavailable for harvesting, such as: physical conditions and terrain, such as steep slopes; remote locations and limited access through lack of infrastructure (roads, etc.) and transport and other factors, such as low productivity, poor stand quality, lack of commercial species, etc (FAO 2020). According to the authors, the forest resources availability has two main forms, which take into account the legislative (institutional form) and economic (economic form) conditions. These forms act as absolute restrictions on the development of wood and non-wood resources. Each of the forms has its own availability criteria and each is influenced by its own factors, which differ both in the nature and mechanism of their impact on the forest resources availability.

The various forms of availability discussed above may be taken into account in these two main forms. For example, the ecological form of availability is taken into account in the institutional, through legislative restrictions that have an ecological character, and various social factors (historical, religious and cultural significance of individual forest areas, energy infrastructure (power grids, pipelines), recreation areas) have a limiting effect on logging for the basis of legislative documents regulating the implementation of social activities (Alberdi 2021).

The institutional form of forest resource availability is based on existing regulatory legal acts (legislation), the various regulations on forest management, which take into account environmental and social aspects, constitute external restrictions on the possibility of involving resources in economic circulation and reduce the potential amount of economically available resources. Therefore, institutional inaccessibility of forest resources should be considered as a synthesis of restrictions reflected in the legislation on the use of forests of different origins (environmental, social causes, institution of ownership, etc.) and taken into account in the management decisions on the involvement of forest resources in economic circulation. It should be noted that institutional restrictions may be absolute, prohibiting forest use in the considered forest area, and relative, narrowing the possibilities for the implementation of certain types of forest use, for example, a ban on clearcutting in forests located in water protection zones (Alberdi 2021; Medeiros et al. 2021).

In case of a prohibition of clearcutting in plantations, the economic availability assessment of forest resources in them is carried out taking into account the additional costs of selective cutting. The economic form of availability determines the possibility of harvesting forest resources, focusing on the economic conditions of forest management, which take into account both individual resource and territorial (logistical) factors, as well as general economic factors that affect the economic availability of forest resources in general.

MATERIAL AND METHODS

At present, there are many definitions of "economic availability (economic unavailability) of forest resources", which differ in approaches to its definition. Analysis of scientific publications allows us to single out a whole set of different interpretations of this concept, according to which the economic availability of forest resources is determined by: establishing the characteristics of the plantations, which determine their economic inaccessibility; the limit level of costs, for the implementation of links between facilities, formed taking into account objective economic and natural conditions of development and ensuring its profitability; qualitative and quantitative condition, as well as territorial location, ensuring during its development the necessary minimum level of profitability; forest resources of positive forest rents; forest resources, the development of which is possible provided that the value of forest rents equals or exceeds the standard value of forest reproduction, conservation and protection (Sokolov 2014; Petrov 2016; Moiseev 2017; Mokhirev et al. 2018a; Pozdnyakova et al. 2018).

Approaches based on the use of plantation characteristics, without cost estimates, were designed to identify areas potentially attractive for exploitation for various purposes, such as justification of the feasibility of logging in particular forests, the formation of calculated forestry, the preparation of management decisions, including in the field of transport network development. For example, when determining the economically accessible design forest area, the researchers propose to exclude certain economically unattractive categories of plantings, such as mature and over-mature forest plantations, with wood reserve ranging from 50 m3 to 100-150 m3; plantations with a high proportion of species that are not in demand on the market, for example, softwood species; plantations with a low percentage of commercial timber yield; deconcentrated logging fund - small areas of mature forest, remote at a considerable distance from the existing road network, so that the construction of even temporary roads does not pay off due to the use of the wood on them (Suhodolov et al. 2012).

Spenser (1986) proposed a method for assessing wood availability based on the use of seven taxation indicators: stock of growing forest, area of the plot, average diameter, height, sawmill stock, percentage of rejected trees, removal distance. Examples of the use of comparative assessment approaches in assessing the economic attractiveness of a forest plot are the establishment of a "class of economic value", formed based on scores of indicators of specie-quality characteristics (the ratio of species in the plot/quarter; average stock per hectare; average trunk volume in the bark; age group; type of forest growing conditions) and the formation of rating commodity and transport assessments of wood resources.

The term "transport accessibility of resources", which characterizes the limitation of forest development due to underdeveloped transport infrastructure, is widely used in practice and this accessibility is assessed based on the proximity of the forest areas under consideration in relation

to the existing logging trails and branches (Pochinkov 2015). In the practice of logging, transport accessibility is considered as the most important criterion for the availability of forest resources, and is often identified with the concept of accessibility of forests, including their economic availability (Pilli and Pase 2018; Chumachenko et al. 2018; Verkerk et al. 2019; Ghajar. 2021). The use of the term transport accessibility as an accessibility criterion was also used in world practice. For example, when classifying the world's forest lands into accessible and inaccessible categories, American researchers used a distance of 10 km to forest infrastructure, including waterways (rivers) (Brent et al. 2008).

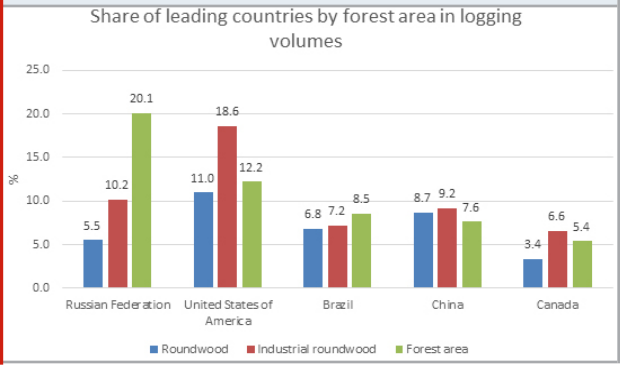
At the same time, the criterion equal to 30 km was applied to the USA (Brent et al. 2008). However, the transport inaccessibility of forest resources can be seen as a form of economic unavailability, as if the resources were profitable to develop and there are no legal restrictions on their use. Considering the transport inaccessibility of forest resources, two forms were distinguished: high costs of transporting wood and the lack of transport infrastructure. In the first case, these high costs acted as an economic constraint that is limited to the economic availability of forest wood resources, in the second case the lack of transport infrastructure was assessed as a temporary constraint.

This limitation was eliminated within the time frame necessary for carrying out an appropriate set of measures to create the required road network for the development of forest bases. In this case, the efficiency of forest roads construction, which predetermined the reality of their creation, was justified by the financial results from the development of the existing economically available forest resources, which ensured the appropriate profitability of logging production, taking into account the required costs for maintenance and construction of forest roads (Tretyakov 2014). That is, the accessibility of economically available resources in remote forest areas predetermined the possibility of their transport development in the future. In assessing the availability of European wood resources, researchers, along with Environmental and social restrictions, have taken into account economic constraints, using various factors that may influence the profitability of logging. Accessibility (distance to roads, elevation, and terrain), slope and soil condition, as well as the extent and annual growth of plantings were used as such factors (Alberdi et al. 2020).

RESULTS AND DISCUSSION

The gap between the forest area and the volume of business wood harvested is less significant for Russia, but it was still almost twice, which was much worse than the ratio of the indicators considered for other leading forest countries with the largest forest areas in the world (Figure 1; FAO 2020). To a decisive extent, this situation was a consequence of rather low average values of forest fund characteristics of the Russian Federation (the average tree volume, an average stock of forest stands per hectare, average site class of plantings), which predetermine both the low level of forest resources economic accessibility and the high importance of the problem of assessing this availability and developing a system of measures to improve it (RAS 2019; Alberdi et al. 2020).

Figure 1: Share of leading countries by forest area in logging volumes in 2020 (Global Forest Resources Assessment 2020: Main report)



The presented methods, based on the use of only qualitative and quantitative characteristics, make it possible to identify forest resources characterized by the most favorable operating conditions, which will positively affect the economic results of their development, but these methods do not take into account the impact of various market factors (prices of forest products, the cost of production factors, etc.), which affects the level of reliability of the results obtained. For example, classifying soft-leaved plantations as economically inaccessible resources was unlikely to be legitimate if there are processing plants in close proximity to them that focus on the consumption of low-quality wood. The remaining approaches to the definition of "economic availability of forest resources" were based on the profitability of their use and were distinguished by the choice of criteria for economic accessibility (relative or absolute indicators) as well as by the set of factors taken into account in its definition (Alberdi et al. 2020).

One of the approaches to determine the economic accessibility of wood focuses on providing the standard level of profitability of logging (Sokolov 2014; Mokhirev et al. 2018b). However, in the conditions of the Russian Federation, when the mechanism of forest land lease is used, this indicator does not take into account additional costs incurred by the entrepreneur under the lease contract related to reproduction, protection and conservation (Bespalova et al. 2019). Considering the above, the authors refer to the economic availability of forest resources as an assessment of the efficiency of their development and involvement in economic turnover on the basis of the economic criterion of availability, determined based on the qualitative and quantitative state of resources, their territorial location, the conditions for transportation, processing, and reproduction of forest resources, the organizational and technological level of production, the state of markets and sectoral institutional characteristics (Dayneko et al. 2021).

Based on this, the following determine the economic accessibility of forest resources:

1. Results of forest inventory work describing the

qualitative and quantitative condition of forest resources;
2. Forest infrastructure (actual and planned);
3. The level of wood processing depth, which is determined by both the technologies used and the level of complexity of raw material utilization, which depends on the business process management system and the level of forest sector combination;
4. Market conditions that determine the price level of forest products depending on the supply-demand ratio;
5. Industry institutional environment, including innovative development programs, regulatory and regulatory frameworks.

Economic relations between the forest owner (the State) and forest users (tenants, other legal entities, citizens) related to the use and reproduction of forests form the essential basis for the category of economic availability of forest resources. This essential economic relationship was formed by the involvement of forest resources in the management field, one of the conditions of which was to ensure the balance of interests of all actors in forest relations. However, this balance of interests should take into account the environmental impact of these economic processes (Sukhorukova and Pogorely 2017; Tysiachniouk et al. 2021).

Given the existing mechanism of forest leasing, when the forest user is assigned to carry out various forest works, the most adequate was the use as a criterion of economic availability of forest resources - equal or exceeding the value of forest rents of the standard cost of reproduction, conservation and protection of forests. Forest rent refers to the net income generated at the time of forest resources development and calculated as the difference between the market price of final forest products and the total costs of their production, taking into account the receipt of regulatory profit per capital (while the costs of production do not take into account payments for forest resources). The presented criterion for the economic availability of wood resources was most in line with the principles of sustainable forest management, which provides economic opportunities for forest reproduction after logging. The selection and approval of the criterion of economic availability of forest resources was a central issue in the planning of their development, it determined the potential volumes and structure of the forest sector (Sukhorukova and Pogorely 2017; Tysiachniouk et al. 2021).

It should be noted, however, that this criterion of economic availability was formed from the position of the owner, in this case the state, and reflects the potential possibility of involving these resources in the economic turnover, at zero value of their cost. Their actual use by business entities was possible only with consideration of payments of forest resources which they pay to the state. Based on the above, the following conditions of economic availability of forest resources can be defined by the system of inequalities as a criterion of economic availability of wood resources: Forest resources are recognized as economically unavailable based on the existing conditions characterizing the current organization of forest resources development in terms of technology, technology, economic relations, forest market conditions, etc (Tysiachniouk et al. 2021).

$$r < 0 \quad (1)$$

where r- is forest rent per unit of resource.

Forest resources are recognized as economically available only if they are developed from the perspective of the owner (in which case the value of forest rents will be positive but does not include the costs of forest reproduction, conservation, and protection).

$$r < 0 \quad (2)$$

Forest resources are recognized as economically available according to the conditions of their development and reproduction from the position of the owner.

$$r - Cn > 0 \quad (3)$$

Where Cn is the standard cost for the reproduction, conservation and protection of forests per unit of resource. Forest resources are recognized as economically available by the conditions of their development and reproduction from the perspective of the business structure

$$r - Cn - Cr > 0 \quad (4)$$

Where Cr is payment for forest resources.
Formulated values of the differences between rent and cost can serve as a basis for economic assessments of forest wood resources. Based on the presented approach, calculations were made to estimate economically available forest wood resources for the Vilegodsk forest district located in the southeastern part of the Arkhangelsk region, the territory of which was a typical example of a multi-forest region in which long-term forest exploitation was carried out. Calculations of economic availability assessment were based on forest survey data, which contained information on 9855 plots assigned to final cutting (Tysiachniouk et al. 2021).

The initial structure of the sample information used in the calculations included:
— area,
— forest-forming species,
— economic management (type of felling, type of reforestation),
— in strata - species section,
— average height,
— average diameter,
— class of marketability,
— stock per hectare.

As additional parameters defined in the context of quarters based on cartographic materials and GIS data, such parameters as tax rate (removal distance) the distance of plantations from the existing forest infrastructure are established. The total information, taking into account the species composition of the plots, contained 30521 positions,

for each of which the average diameter, the average tree volume, and the stock for each of the species were taken into account during the commoditization of reserves. More than 85% of the plots were assigned to clearcutting, on which 81.3% of the forest stock was concentrated (Medeiros et al. 2021).

For each plot, an estimate of its economic availability was calculated, and according to the results of these calculations, it was obtained that 1882 plots (19.1%) received a negative assessment (when considering the option of using low-quality wood as a raw material for the production of wood boards). One of the main factors influencing the level of accessibility was the species composition. Economically unavailable forest resources are mainly represented by plantations, in which the predominant species are spruce, birch, and aspen (Table 1) (Medeiros et al. 2021).

The highest share of economically unavailable timber resources in the total stock of the corresponding species was observed for the following species: alder (all plantations are economically unavailable), aspen, and spruce. The inclusion of spruce plantations in this list is due to various reasons that cause a decrease in the output of commercial products and an increase in the cost of logging and reproduction in these plantations:

Table 1. Characteristics of economically unavailable forest resources of Vilegodsky forestry

Predominant specie	Economically unavailable forest resources					Planting characteristics (percentage of stocks)
	Share in total stocks	Plots		Stocks		
		Quantity, pcs.	Share%	Volume, thousand m3	Share%	
Birch	15,7%	605	32,1%	1400,8	31,1%	2-4 bonitet class, removal distance is more than 40 km (90%)
Spruce	18,7%	775	41,2%	1661,7	36,9%	Bonitet class 5 and 5A, removal distance is more than 40 km (79%),
Alder	100,0%	22	1,2%	14,6	0,3%	Bonitet class 4, removal distance more than 60 km (14.5%)
Aspen	29,1%	270	14,3%	1090,5	24,2%	1-2 bonitet class, removal distance 10-60 km (100%)
Pine	4,9%	210	11,2%	333,3	7,4%	removal distance over 40 km (92.6%)
Total		1882	100%	4500,8	100%	

— A high proportion of spruce plantations remote from the junction points of plantations, since more than 29% of spruce plantations are located in 5 categories of taxa (removal distance from 60 to 80 km), while for other main rocks this indicator is in the range from 13% to 22%.
— A high proportion of low-bonitet spruce stands in the logging fund, spruce with a bonitet level of 5 and higher (41.3% in terms of reserves) compared to other species, so similar pine plantations form 16.5% of the reserve, birch - 0.2%, and other species of plantations of 5 bonitet are absent.
— A high proportion of soft-leaved wood in spruce plantations (on average almost 30%),
— A relatively high proportion of areas for which artificial reforestation is assigned (11.4% for spruce plantations, 9.8% for birch, 4.4% for pine), which negatively affects the level of economic availability of forest resources, due to the high level of costs for their reproduction.
Accounting for additional costs of payments for forest resources reduced the potential of economically available forest resources for entrepreneurs by 5.8% from 23.9 to 22.6 million cubic meters (Table 2) (Medeiros et al. 2021).

Accounting of payments for forest resources reduces the value of economically available wood from 312 rubles per cubic meter to 255 rubles per cubic meter. This was the amount of rent that forms an additional excess income of business entities engaged in forest management, which significantly exceeds the value of forest payments. This situation was formed under the conditions of the state setting of prices for forest resources when the price of standing timber in the Russian Federation is an order of magnitude lower than similar prices in neighboring Scandinavian countries. The fact was that these rates do not take into account the economic effect of consuming wood of different quality characteristics, they do not provide much incentive for the integrated use of wood resources, and are not related to reforestation conditions, which largely determine the costs of forest reproduction (Matsuoka et al. 2021).

Economic availability of forest resources was intended to be a tool that allows creating a system of economic incentives aimed at resolving one of the most significant contradictions in the system of forest relations of Russia - the contradiction between the economic interests of the forest resources owner (state) and the economic interests of forest users (tenants). Currently, this category was not used in forest planning practice, which determines the presence of overestimated planned values of forest use indicators in forest plans (Matsuoka et al. 2021). The main purpose of the forest accessibility category is forest management, which includes:
— Establishment of payments for forest resources;
— Determination of the allowable cut taking into account

the economic availability of forest resources;
— Determination of the degree of attractiveness of forest resources from the standpoint of their use;
— Development of incentive systems for the forests use;
— Substantiation of the optimal structure of forest resources consumption;
— Assessment of sectoral and regional forms of the forest sector development, and the results of activities on the use and forests reproduction.

It should be noted that using a system of special subsidies and subsidies for loggers, you can significantly increase the level of availability of forest resources, just as it happened in Japan (Matsuoka et al. 2021).

Table 2. Indicators for assessing the economic availability of forest resources of the Vilegodsky forestry

Index	Unit	Indicator values		Change index,%
		payments for forest resources are not taken into account	payments for forest resources are taken into account	
Aggregate assessment	mln. rub	6875,4	4963,3	72,2%
Specific assessment	rub / m3	242,3	174,9	72,2%
Assessment of economically available forest resources	mln. rub	7452,9	5764,6	77,3%
Volume of economically available forest resources	thousand m3	23870,4	22599,4	94,2%
Number of stands of economically available forest resources	pcs.	7973	7445	93,4%
Assessment of economically unavailable forest resources	mln. rub	-577,5	-801,3	138,8%
Volume of economically unavailable forest resources	thousand m3	4500,8	5771,8	128,2%
Number of stands of economically unavailable forest resources	pcs.	1882	2410	128,1%

The considered category of economic accessibility of forest resources can be widely used both by state regional and a federal executive authority that form forest policy, and by business structures that develop plans for forest development. In the first case, the role of the economically accessible forest resources category will be to optimize the system of payments for forest resources, to form the calculated cutting area, to set the planned volumes of forest management and forest reproduction, to form the investment program for the development of the forest sector, in the second it will serve as a tool for assessing the effectiveness of management decisions in the field of forest harvesting and wood processing (Matsuoka et al. 2021).

CONCLUSION

The findings of the present study suggests that the formation of assessments of the economic availability of forest wood resources on the basis of the above methodological approaches can be obtained in the framework of forest inventory. Since their assessment takes into account the standard costs of reproduction, conservation and protection of the forest, this will contribute to the formation of continuous sustainable forest management. By stimulating the growth of economically accessible forest resources, the state, as the owner of forests, will ensure an increase in the efficiency of their use while maintaining a balance of interests of participants in the sphere of forest relations.

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