Technical and economic peculiarities of wood processing enterprises in modern conditions

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Abstract. This paper examines the key aspects of forest industry enterprises. These enterprises are important from both an economic and an ecological perspective. Forests are a vital element in the fight against climate change. The wood industry can and should play a leading role in the fight against global climate change. This paper sets out to study some technical and economic features and to develop relevant principles that should guide forestry enterprises in their activities in modern conditions. Descriptive and analytical methods were used to collect data for the research. Some data was obtained directly at the logging sites in the forest area. The structure of wood industry output is presented. Two key aspects of environmental impact are highlighted. Key directions for improving the efficiency of the industry are shown. The principles that should guide forestry enterprises in their activities in the modern conditions are proposed. The activity in the forest area is presented as one of the key directions of development. Timber waste is a valuable and underutilized resource that can significantly affect the economic performance of enterprises and improve the environmental situation in the forest area. It is therefore important that the modernization of wood processing enterprises is accompanied by changes in the approaches to the environment and forests on the part of the state, business and society.

1 Introduction

Wood processing enterprises play an important role in modern society, providing the production of a number of important resources and products necessary to meet the needs of society and various industries [1-3]. Their role in the economy of different countries varies from extremely small to a significant role in the structure of gross domestic product (e.g., Finland) [4]. The importance for the country is largely determined by the volume of timber reserves and the level of development of the forest industry. Wood industry enterprises are engaged in harvesting, processing and selling resources derived from woody biomass. The most important industries are sawmilling, pulp and paper, wood chemical production, production of various composite materials and wood fuel (pellets, briquettes) [5-9].

Wood processing enterprises contribute to the socio-economic development of regions [10, 11]: they provide jobs, implement social programs, make contributions to various

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budgets and funds, etc. In some cases, they are the largest production facilities in settlements, which determines their key role in the life of many territorial entities.

At the same time, it should be noted that the activities of wood processing enterprises are associated with negative environmental impact [12]. In addition to the formation of emissions and discharges from industrial facilities, which to a large extent can be neutralized by modern treatment facilities and equipment, it is necessary to emphasize two other key impacts.

1. Logging. Deforestation leads to reduction of forest area, degradation of natural resources and reduction of biodiversity in the forest area. It also disturbs the soil cover, increases the risks of fire hazards and disease development [13]. Fig. 1 shows an example of a logging site and the complexity of the impacts on nature.

Fig. 1. An example of the impact of a logging process on a forest area.

It is important to be aware that only a fraction of responsible loggers bring forest areas to a really good quality condition. However, even in this case, anthropogenically impacted areas will take many years to recover their original condition. In a significant number of cases, this may take about 100 years or more (harvesting coniferous timber).

2. Waste Generation. In the process of production activities, wood processing enterprises generate many tons of waste. Depending on the technologies and recycling, the percentage of useful output at the enterprises can be as low as 15% of the harvested wood [14, 15]. To a large extent, modern enterprises try to involve heterogeneous secondary wood resources in production. However, it is common for small and medium-sized enterprises to still utilize this valuable raw material. Process chips obtained from sawmill waste or other parts of wood biomass are most suitable for industrial use (Fig. 2).

Fig.2. Accumulation of process chips at a wood processing plant.

In accordance with these two directions of environmental impact, in the author's opinion, the policy of modern forestry enterprises should be formed. At the same time, it should be noted that the use of waste affects the economic results of enterprises, while responsible forest management leads to a reduced impact on nature. Thus, these two directions can be considered as the key directions for improving the activities of timber enterprises in modern conditions.

2 Materials and Methods

The purpose of this paper is to investigate some technical and economic features and to develop relevant principles that should guide forestry enterprises in their activities in modern conditions.

The research is based on descriptive (observation) and analytical methods. The author's team conducted the research on the territory of logging sites located in the Krasnoyarsk Krai (Russia). The works of a number of foreign and domestic authors, statistical information of FAO and Rosleskhoz were used in the work. Data processing was carried out in Microsoft Office software products.

3 Results and Discussion

The Russian wood industry, as noted above, is characterized by the production of many types of valuable products. At the same time, for the most part the production capacity is steadily expanding, which is accompanied by an increase in output (Table 1) [16].

Table 1. Volume of output by the Russian forestry sector in 2017 and 2021.

Production	Year		Growth rate
	2017	2021	
Unprocessed timber, mln dense cubic meters	139.876	148.299	6.022
Fuel wood, mln dense cubic meters	15.286	13.009	-14.896
Timber, longitudinally sawn or split, mln. cubic meters	25.161	32.106	27.602
Plywood, mln. cubic meters	3.763	4.550	20.914
Chipboard and similar boards made of	7.079	10.187	43.905

wood or other wood-based materials, mln. cubic meters			
Fiberboard made of wood or other wood-based materials, mln m^2	451.924	534.006	18.163
Fuel granules (pellets) made of wood processing waste, mln tons	1.433	2.585	80.391
Fuel briquettes from wood processing waste, thousand tons	74.693	209.133	179.990
Wood pulp and other fibrous pulp, mln tons	8.323	8.877	6.656
Paper and cardboard, mln tons	8.733	10.404	19.134

Analyzing the presented data, it should be said that the fastest growing sector of fuel pellets and briquettes has to some extent slowed down its development after the introduction of sanctions restrictions on the wood industry. Nevertheless, it is potentially one of the most promising areas in Russian wood industry.

Other directions of wood raw material utilization - pulp and paper, plywood, board will continue to develop systematically, based on the increased involvement in production of heterogeneous wood waste available at industrial sites [17]. An important trend in this direction is the decrease in the volume of products in the form of fuelwood, also present in Table 1. At the same time, the key resource that is underutilized for production is forest residues. They should be understood as branches, limbs, stumps, tops of trees, woody greenery, etc. These resources can and should be used to produce a wide range of products.

The main limitation in this case is the high cost of delivery of these raw materials from the forest area to large industrial sites. In accordance with this problem, the following directions for improving the activities of forestry enterprises can be formulated:

1. Search for optimal logistic solutions.
2. Organization of pre-treatment of logging waste on the forest territory.
3. Using modern logging complexes and machinery to increase productivity and possible volumes of semi-finished products for transportation (e.g., Fig. 3).

Fig.3. Modern forestry machinery.

It is important to be aware that logging must be accompanied by reforestation and forest protection measures. Without restoration of the damage caused, the exhaustion of natural resources will occur in the near future [18, 19]. At the same time, this direction also requires the maximum degree of efficiency improvement and automation. Modernization of reforestation is a part and task, including the state policy. Automated forest nurseries (Fig. 4), providing seedlings of various types of wood for planting in the forest area should

actively develop and expand the territories of their presence. The efficiency of reforestation depends on their quality and the volume of their work.

Fig.4. Growing planting stock in a forest nursery.

It is also important to note that reforestation and forest protection contribute to the reduction of illegal logging and conservation of forest resources as such.

In accordance with the presented approach, the following principles can be formed, which should guide forestry enterprises in their activities in modern conditions:

- maximum involvement of heterogeneous wood resources in production;
- use of modern high-performance equipment;
- automation of processes (from technological to technical and economic);
- optimization of logistic solutions;
- active reforestation and forest protection;
- development of deep processing of wood resources;
- expansion of forest residues involvement in production processes;
- involvement of specialized universities and research institutes in solving complex problems of enterprises;
- development of R&D at enterprises;
- improvement of personnel qualification and motivation, etc.

This list can be continued. The main attention, in the author's opinion, should be directed to improving the efficiency of multiple production processes and solving environmental issues. In many respects, these are interrelated tasks. At the same time, responsible environmental management, including in the forest area, will allow achieving high economic results and reducing the negative impact on the environment.

4 Conclusion

The study has shown the relationship between economic performance and responsible environmental management. Two key areas of improvement for wood processing enterprises are the improvement of multiple production processes in logging and the utilization of various wastes. These currently offer the greatest potential to impact the

bottom line of the industry. At the same time, responsible behavior of enterprises will reduce environmental impact and achieve many positive effects, including economic ones.

Reforming the industry is a complex task. Not only enterprises, but also the state and society as a whole should be actively involved in this process. Joint work in this direction will to a certain extent affect the attitude to environmental issues, attention to the protection of forests and their use for production and public needs. In the end, the products of the forest industry are used almost everywhere. However, forests, which are one of the guarantors of a quality environment, are cut down for their production.

Each of the principles shown by the results of the study, which should guide forestry enterprises in their activities, can be substantiated in detail and presented in the form of an action program. However, within the framework of this work, due to the large amount of information, it is not possible to give a detailed characterization of each of the principles. Nevertheless, the author's team will continue to work on detailing and approbation of the obtained results.

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