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Wood fuel supply, costs and home consumption in Lithuania

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Abstract

This paper examines the possibilities of increasing the use of wood from private forests in Lithuania for bioenergy purposes. Potential wood fuel supply and consumption were investigated using a literature review and analysis of statistical data. Costs of wood chips production were calculated applying economic simulation. The analysis showed that 0.6 Mm^3 (1.2 TWh) of firewood is produced and about 0.3 Mm^3 (0.6 TWh) of forest logging residues could be used annually for fuel in private forests. The available volume will increase in coming decades. In total, Lithuanian households had increased wood fuel consumption by five times during 10 years and exceeded 2.3 Mm^3 (4.6 TWh) in 2003. Firewood production for home consumption is one of the most important forest owners' objectives.

The cost of forest chips varied from 19 to 36 euro m^{-3} in pre-commercial thinnings and from 20 to 28 euro m^{-3} in final thinnings. The lack of specific policies supporting the use of natural resources is causing a lack of incentive to increase the use of local fuels.

Keywords: Supply; Costs; Home consumption; Wood fuel; Forest chips; Private forests; Lithuania

1. Introduction

Peculiarities regarding the supply of wood-based biomass for energy at the individual forest owner level in Lithuania are based on historical and socio-economic factors. The structure of forest ownership has been changing due to ongoing land reform processes since Lithuania regained independence in 1991. Privatisation brought a lot of changes to the forest sector, from ownership structure to forest management and use of forest resources. By 1st January 2006, the private forest sector constituted 218,000 private forest owners. Private forests occupied 717,000 ha, which was 34% of the total forest area. This proportion is projected to increase in the future.

Small-scale private forest properties are common in Lithuania. The average size of a forest estate is 3.4 ha [1]. Properties up to 5 ha account for 83% of the total number of private forest holdings in Lithuania. During recent years roundwood supply from private forest consistently increased. The felling volume of Lithuanian private forest was over 1.9 Mm^3 in 2002, 2.7 Mm^3 in 2003 and 2.7 Mm^3 in 2004 [2]. This is more than 40% of the total roundwood supply in Lithuania. The forest owners use part of the felled roundwood for fuel. Moreover, the potential for use of forest logging residues is very large. Currently, the supply of forest logging residues from the private forest sector is very low. This low supply is the result of the costs exceeding the income to the small estate owners.

In Lithuania, interest in biofuel has risen quite recently. After the commencement of construction of biofuel heating plants, private forest owners gained a possibility to earn extra income. Forest chips production began recently and to date it has not been clear what the production costs are.

The purpose of this paper is to analyse supply, costs and home consumption of wood fuel from the private forests of Lithuania.

2. Materials and methods

2.1. Study of supply and consumption of forest fuel from private forests

Possibilities for wood fuel supply from private forests and home consumption were analysed using a literature review and the analysis of statistical data.

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Information on logging volumes in Lithuania is provided by the State Forest Inventory and Management Institute. The institute calculated the prognosis for the use of forest resources including logging residues (tops, branches, stumps and bark) in the 21st century [3]. The forecasts were presented separately for state and private forests.

The forecast of wood fuel resources was carried out with the help of forest dynamics and use of the model "Kupolis", which simulates the use and dynamics of timber resources. The model has four subsystems: regeneration, stand growth, timber use and dynamics. Though the stand is the basic unit of simulation, any aggregated or sampled data can be used for simulation in cases for which the data structure is analogous to that for the stand. The smallest scale for model application is one compartment (stand). The biggest scale covers all forests in Lithuania, i.e. more than 1 million compartments.

The strategy for the forest regeneration subsystem can be described as planting of tree species according to valid silvicultural rules and goals. The modelling of stand growth is based on regression models developed for eight dominant tree species. The subsystem for thinnings generates a strategy that well complies with present silvicultural recommendations. The main requirements in the subsystem for final thinnings are continuing and sustainable use, and also smoothing of age class structure. The model "Kupolis" is described in more detail by Petrauskas and Kuliešis [4].

The Department of Statistics annually prepares Lithuania's energy balance. The most valuable data for our investigation are the data on firewood usage at the household level. In addition, several projects and studies dealing with wood fuel use have been carried out in Lithuania [5–7]. These studies contain information on biofuel resources in private forests and on consumption problems.

2.2. Study of forest chips profitability

The profitability of forest chips was studied using an economic simulation method. The cost of forest chips was compared with the market price. The market price was estimated using literature analysis and interviews with forest fuel suppliers. The cost was calculated for whole trees from pre-commercial thinnings and for logging residue chips from clear cuttings. The cost structure of forest chips depends on harvesting technology and site conditions. At present, two chips procurement methods [8] are used in Lithuania: comminution at landing and comminution at the stand (seldom and only on dry sites). Therefore, the comminution at landing method was chosen for analysis (Fig. 1). Whole trees were cut manually with a brush cutter, using a felling–piling technique. Trees were cut and piled beside the strip road as whole trees. Logging residues in clear thinnings were piled beside the strip road during roundwood logging. The tree or logging residue bunches were transported by farm tractor-based forwarder to the landing. Chipping was done with a drum chipper.

The cost of forest chips was calculated by evaluating four factors:

- volume of cut whole trees from pre-commercial thinnings or volume of logging residues from clear thinnings;
- forwarding distance;
- comminution;
- distance from comminution landing to heating plant.

The cost of forest chips (C) was calculated according to Eq. (1):

$$C = P + S(1 + p_1/100)(1 + p_2/100), \quad (1)$$

where P is the stumpage price of firewood (euro m^{-3}), S the production costs of forest chips (euro m^{-3}), p_1 the overheads (%) and p_2 is the profit (%).

The production costs of forest chips were calculated as

$$S = \sum(t_j \times d_j) + \sum(n_{ej} \times z_e), \quad (2)$$

where t_j is the time expenditure for performing the work j (h m^{-3}), d_j the labour costs per time unit (h), including social insurance (euro), n_{ej} the time expenditure for equipment e for performing the work j (h m^{-3}) and z_e is the operational costs of equipment e (euro h^{-1}).

The operational costs of equipments were calculated as

$$Z_e = (V_p - V_l)/E + R/E + \sum(D_{ed}k_d), \quad (3)$$

where Z_e is the operational costs per working hour of equipment e (euro h^{-1}), V_p the market price of equipment (euro), V_l the price for the equipment after its life cycle, up to 10% of market price (euro), E the duration of equipment exploitation, according to the regulations of the Lithuanian Government (h), R the costs for current repair and technical maintenance in percentage of market cost (euro), D_{ed} the consumption of fuel and lubricants per one working hour of equipment e (l h^{-1}) and k_d is the cost of fuel and lubricants for one unit (euro l^{-1}).

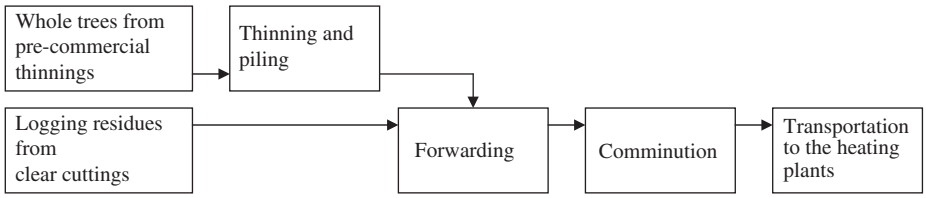

Fig. 1. Technology of forest chip production.