ISSUES OF SOLID WOOD BIOMASS DEVELOPMENT FOR BIOENERGY IN LATVIA

Ligita Melece, Agnese Krievina
Latvian State Institute of Agrarian Economics
ligita.melece@lvaei.lv

Abstract. Nowadays, seeking to replace fossil energy with renewable sources of energy, wood biomass emerges as the oldest renewable energy source, an important substitute for fossils used for heating purposes and to generate electricity. The aim of the study was to evaluate issues of the development of solid wood biomass or fuelwood in Latvia, taking into account limitation restrictions, which may affect the future development. Wood biomass can be used to produce heat or electricity separately or in combined heat and power (CHP) plants. Latvia is among the EU countries with large share of forest area that offers a great potential to develop the production of bioenergy and to meet the ambitious renewable energy targets. Moreover, Latvia also possesses the largest growing stock of forests among the Baltic countries, with growing increment in forests available for wood supply each year. There has been fast development of the production of different solid wood biomass or fuelwood (pellets, briquettes and chips) in Latvia in recent years, but the majority of fuelwood products were exported. Latvia exported 95.8 % of its produced pellets, 77.1 % of briquettes, and 25.4 % of chips in 2013, which makes the country one of the leading exporters of fuelwood in Europe and the world. Despite the rapid development of the production of bioenergy, including fuelwood, the total renewable consumption in Latvia is still below the interim target; thus achieving the set national targets is at the risk. Some negative effects (e.g., losses of GDP; decreasing of biodiversity of birds etc.) have been observed.

Keywords: fuelwood, biomass, forest, consumption, export.

Introduction

In order to achieve the European Union (EU) 2020 target of a 20 % reduction in greenhouse gas (GHG) emissions (compared to 1990) by 2020, the Member States (MS) committed to reach legally binding national targets by 2020 (compared to the situation in 2005) for emissions not covered by the EU Emissions Trading System [1]. Renewable energy or renewables will continue to play a key role in helping the EU meet its energy needs beyond 2020. EU countries have already agreed on a new renewable energy target of at least 27 % of final energy consumption in the EU as a whole by 2030. This target is part of the EU's energy and climate goals for 2030.

The main political objectives of the EU renewable strategy are decreased use of fossil energy, reduced carbon dioxide (CO_2) emissions and increased energy self-sufficiency. Wood-based bioenergy plays a central role in this strategy, and the potential increase in wood demand for bioenergy production is also of high interest for the EU forestry and forest industries [2].

Wood biomass or fuelwood is currently the most important source of renewable energy and now accounts for around half of the EU's total renewable energy consumption [3; 4]. According to the Renewable Energy Action Plans of the EU MS, wood biomass used for heating, cooling and electricity would supply about 42 % of the 20 % renewable energy target for 2020 [3].

In September 2013, the European Commission (EC) adopted a new EU Forest Strategy, the objective of which is to ensure and demonstrate by 2020 that all EU forests are managed in line with the principle of sustainable forest management and that the EU's contribution to promoting sustainable forest management and reducing deforestation at global level is strengthened [3].Recognizing that forests as a multifunctional system are serving various economic, social and environmental purposes, the EC [3] identifies the key principles needed to strengthen sustainable forest management and improve competitiveness and job creation, in particular in rural areas, while ensuring forest protection and delivery of ecosystem services.

In the forest sector, resource efficiency means using forest resources in a way that minimises the impact on the environment and climate, and prioritising the forest outputs that have higher added-value, create more jobs and contribute to a better carbon balance. The cascade use of wood fulfils these criteria. In some cases, different approaches may be necessary, e.g., in cases of changing demand or environmental protection [3].

Taking into consideration the above mentioned, the aim of the study was determined - to evaluate issues of the development of fuelwood in Latvia, taking into account limitation restrictions, which may affect the future development of the main wood biomass sources. These restrictions are based on the

latest EU regulations and recommendations, as well as worldwide concerns of scholars on sustainability, particularly environmental (e.g., biodiversity, ecosystem resilience, carbon sequestration) of wood biomass development.

Materials and methods

The principal **materials** used for the studies are as follows: different publications and papers, e.g., scholars' articles, research papers and the reports of institutions, including EC and governmental; data from the Central Statistical Bureau of Latvia (CSB) database [5]; from FAOSTAT [6] and Eurostat database [7], as well as the unpublished data from the database of the Rural Support Service and data of the forest monitoring retrieved from the Latvian State Forest Research Institute "Silava".

The appropriate qualitative and quantitative research **methods** have been used for various solutions in the process of study: monographic; analysis and synthesis; regression, spatial analysis using GIS, data grouping, logical and abstractive constructional etc. For analysis the resources and potential of wood for bioenergy, the data of eight EU countries that make up the Baltic Sea Region: Denmark, Finland, Germany, Estonia, Latvia, Lithuania, Poland and Sweden, facing several similar resources and challenges, were evaluated.

Results and discussion

The trend of the share of renewable energy source (RES) or renewables consumption in Latvia is not satisfactory, as Latvia is the only Baltic country failing to reach the interim target share; and the time trend shows the smallest increase, comparing with the others (Table 1). Moreover, it is stressed by the EC that only Latvia and Malta are below the interim target [8].

Table 1

Share of renewable energy (%) in gross final energy consumption, target (%) in 2020 and time trends of consumption share in EU 28 (average) and Baltic countries in the period 2004-2013

Country	Share, %	Target, %	Regression equation	Coefficient of determination (R^2)
EU 28	15.0	20.0	y = 0.0076x + 0.0712	R^2 = 0.9859
Estonia	25.6	25.0	y = 0.0119x + 0.147	R^2 = 0.8166
Latvia	37.1	40.0	y = 0.005x + 0.2994	R^2 = 0.3518
Lithuania	23.0	23.0	y = 0.0068x + 0.1533	R^2 = 0.8733

Considering the fact that the hydropower production increase is limited, biomass emerges as the most substantial source of increasing consumption of renewables. The share of fuelwood 25 % in the final consumption of Latvia's total energy resources (terajoules - TJ) traditionally has been significant due to its accessibility. Moreover, fuelwood is the most popular biomass energy resource in Latvia (Fig. 1).

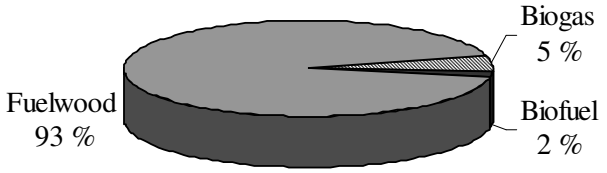

Fig. 1. **Primary consumption of biomass energy by the main types in Latvia, 2013**

In line with the new EU policy, the MS need to sustainably mobilize the existing forest resources and develop new ones according to the best practices [2]. The area of forests in Latvia has increased from 2820 thsd ha in 1994 to 3260 thsd ha in 2014. Latvia is the leader among the Baltic countries (Latvia – 54 %; Estonia – 52 %; Lithuania – 34 %) and significantly exceeds the average share of forest land in the EU - it boasts the fourth largest share (54 %) of the forest area in the EU after Finland (73 %), Sweden (69 %) and Slovenia (62 %) [9]. Latvia also has the largest growing stock of forests among the Baltic countries, with growing increment in forests available for wood supply each

year. As shown by the rather high indicator of growing forest stock per forest area (Table 2), there is larger density in forest growing in the Baltic countries as compared to Finland and Sweden, though Germany is the absolute leader among the Baltic Sea Region countries. About 68 % of net increment is felled in Latvia – it is the third most intensive felling rate among the analysed countries.

Table 2

Availability of forest resources in the EU Baltic Sea Region countries, 2010

Country	Total growing stock, million m^3	Total growing stock per forest area, m^3 per ha	Increment in forests available for wood supply, million m^3	Felling in percent of net increment
Germany	3,492	315	107	56
Sweden	3,358	119	96	84
Finland	2,189	99	91	65
Poland	2,049	219	69	59
Latvia	633	189	18	68
Lithuania	470	218	11	80
Estonia	449	203	11	51
Denmark	108	199	6	41
EU-28	24,271	152	779	63

Based on the EU Rural Development Programme (RDP) 2007-2013, the measure 312, which is directly focused on fuelwood production support (sub-measure 3 – fuelwood production in micro enterprises; sub-measure 12 - fuelwood production in farms) was implemented in Latvia. Until 2014 the total public support of EUR 7.6 million was allocated to 113 projects aimed to develop biomass production, mainly fuelwood [9]. The potential for further development of the wood biomass output is observed in Vidzeme and Kurzeme, where the forestland, potential wood stock are higher but the number or spatial distribution of implemented projects, supporting wood biomass production, is less concentrated (Fig. 2).

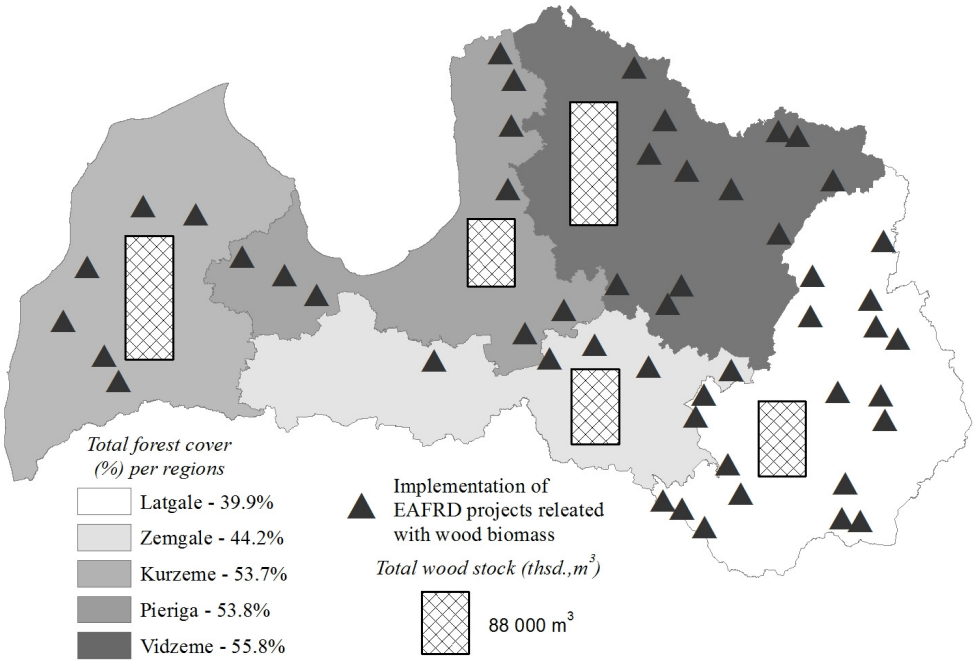

Fig. 2. **Total forest cover (%) and total wood stock (thsd m^3) per region and implemented EAFRD projects related wood biomass, 2013**

There is rapid development of the production of different fuelwood (pellets, briquettes and chips) in Latvia in recent years, but the majority of products were exported, which makes the country one of the leading exporters of fuelwood in Europe [10] and the world - Latvia is among the five leading exporting countries of fuelwood in the world [11]. In 2013 25.4 % of wood chips, 77.1 % of wood

briquettes and 95.8 % of wood pellets have been exported from Latvia [5]. The production and export of wood pellets has increased significantly, meanwhile the quantities of consumption, despite showing the growing trend, are negligible (Fig. 3).

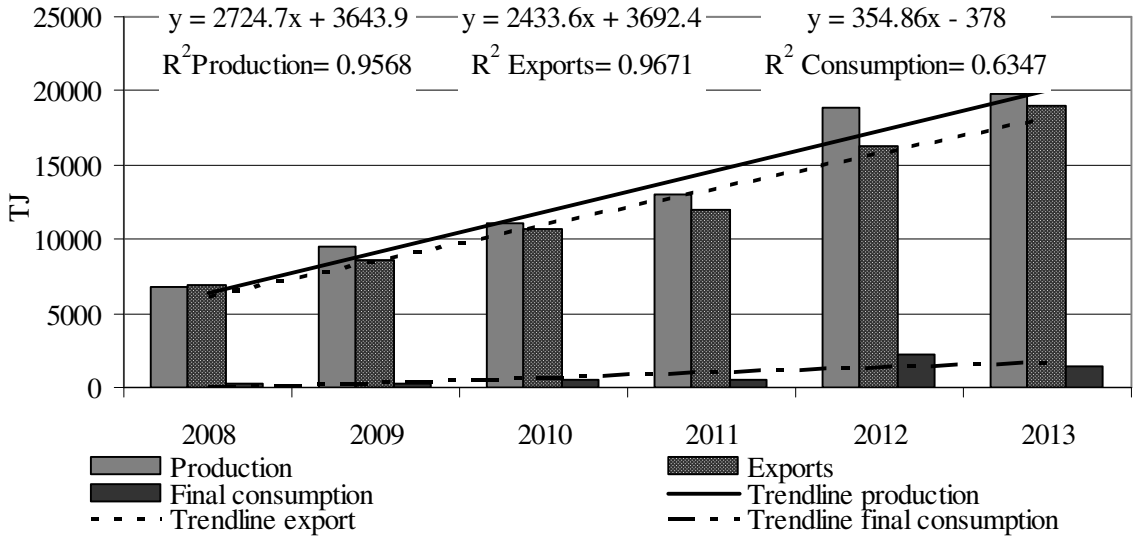

Fig. 3. **Trends of wood pellet production, export and consumption (TJ) in Latvia, 2008-2013**

Recently, the firewood (65 %) has emerged as the most common source of wood biomass in the final consumption of fuelwood but the share of wood briquettes and pellets is insignificant, 1 % and 4 %, respectively Fig. 4.

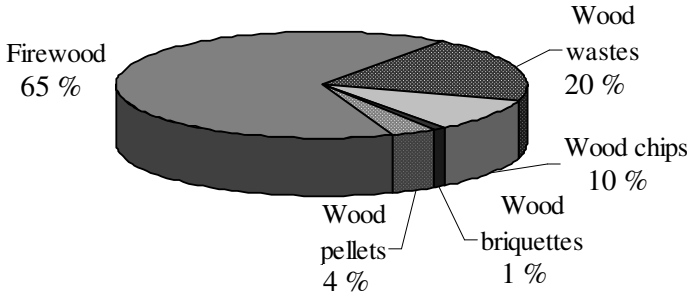

Fig. 4. **Final consumption (terajoules) by type of fuelwood (%) in Latvia, 2013**

Comparing the primary energy production, gross electricity production and heat consumption in million tons of oil equivalents (Mtoe) from solid (wood) biomass in the countries of the Baltic region and EU 28 (average), one notices in Table 3 that only Latvia produces more energy from wood biomass than consumes. Other countries are import oriented, despite the significant forest resources, for example, Sweden and Finland.

The advantages of wood pellets are in their increased consistency, bulk density, and energy efficiency compared to burning raw wood directly [10]. Klavs et al. [12] feel that the production of heat by wood-fuelled boiler houses is competitive with its production at boiler houses fuelled by natural gas or other fossil fuels [12]. Comparing the trends of prices (EUR/unit) of different energy sources in Latvia, one can consider that from 2006 until 2013 the price of natural gas, firewood and wood waste shows statistically significant increase, while at the same time the price of wood briquettes has decreased but the price of wood pellets is on the rise, although the increase is not statistically significant (Table 4).

The indicative target in 2020 requires a substantial increase in the district heat supply produced by utilising biomass (~2.5 times, reaching 10.8 PJ) [12]. Klavs et al. [12] argue that the electricity production from solid biomass is expected up to 642 GWh by 2020; and for this purpose new solid biomass CHP utilities of at least 105 MW total capacities will be set up.

Table 3

Primary energy production, gross electricity production and heat consumption from solid (wood) biomass in Baltic region countries and EU 28 (average), 2013

Country	Production and consumption, Mtoe			Difference, Mtoe
	Energy	Electricity	Heat	
EU 28	88.1	81.7	72.4	66.0
Denmark	1.5	3.0	2.1	3.6
Finland	8.1	11.5	6.4	9.8
Germany	10.9	11.6	8.0	8.7
Estonia	1.1	0.6	0.7	0.2
Latvia	1.8	0.2	1.1	-0.5
Lithuania	1.0	0.3	1.0	0.3
Poland	6.5	8.0	4.5	6.0
Sweden	9.2	9.6	7.6	8.0

Table 4

Average price (EUR/unit) of some energy resources for final consumers (excluding vat) in Latvia, 2006-2013

Resource	2006	2007	2008	2009	2010	2011	2012	2013	r*	α**
Natural gas, EUR per thsd m^3	162	211	313	339	275	300	381	374	0.85	α<0.01
Firewood, EU per m^3 solid	10	14	14	13	16	23	21	24	0.92	α<0.01
Wood wastes, EUR per m^3 loose	3	4	6	7	7	9	10	7	0.84	α<0.01
Wood chips, EUR per m^3 loose	6	7	9	7	7	9	9	11	0.80	α<0.05
Wood briquettes, EUR per ton	114	148	154	124	121	121	110	122	-0.44	α>0.05
Wood pellets EUR per ton	101	130	134	137	121	142	134	124	0.43	α>0.05

* - coefficient of correlation; ** - significance level

Moreover, on the EU level Latvia has been positioned as a negative example of how biomass could increase energy dependency, while creating "GDP leakage" [13]. AEBIOM [13] argued that Latvia is importing around 7 terawatt -hours of Russian natural gas at a price of EUR 55 per megawatt-hour, and is exporting the same amount of wood energy at EUR 13 per megawatt-hour, losing approximately EUR 280 million every year.

Also, Gough and Upsam [14] believe that the biomass produced within the EU operates within a legal framework for sustainable forestry and agriculture; and any significant expansion in biomass use is likely to lead to an increase in imports from further afield, requiring sustainability criteria which can be used by bioenergy importers across the EU. Many scholars [14; 15] emphasise that the GHG emissions reduction is under threat, because the Kyoto Protocol sets limits on greenhouse gas emissions by the countries that have agreed to it, but it incorporates the accounting error of ignoring all CO_2 emitted by burning biomass. They propose the CO_2 removal from the atmosphere as an important option for mitigating climate change. To become carbon negative, the biomass must be burned in power plants and manufacturing facilities equipped with systems that capture the CO_2 emitted before it leaves the smokestack and store it underground [15]. Bioenergy with carbon capture and storage (BECCS) is a greenhouse gas mitigation technology which produces negative CO_2 emissions by combining bioenergy (energy from biomass) use with geologic carbon capture and storage [14]. The concept of BECCS provides the application of carbon capture and storage via CO_2 injection into geological formations. Fuss et al. [16] argue that presently and in nearest future removal of CO_2 will be expensive, whereas emissions will remain cheap due to the lack of strong climate

policies, although determining that the negative emissions in the second half of this century to avoid dangerous climate change should be among top priorities.

The support measures in Latvia for the cogeneration plants (CP) [17], which use natural gas as process fuel, neglected the necessity to reduce GHG emissions, which should occur by increasing the use of renewable energy. Moreover, this practice contradicts the EU recommendations; and the Latvian Renewable Energy Federation (LREF) has submitted a complaint to the EC to address the Latvia's high and disproportionate state aid for large natural gas power stations in Latvia. As a result, Latvia's dependence on Russia's natural gas grows and fails to promote the use of local renewable energy resources. The EC [18] stresses that the typical and default values (gCO_2eq/MJ) of GHG emissions from burning of wood biomass are many times (~5-15) higher when the process fuel is natural gas but not wood (Table 5).

Table 5

Typical and default values ($gCO_2eq \cdot MJ^{-1}$) of GHG emissions for wood biomass if produced with no net carbon emissions from land use change [17]

Primary solid and gaseous biomass pathways	Typical	Default
Wood chips from forest residues	1	1
Wood chips from short rotation forestry	3	4
Wood briquettes or pellets from forest residues; wood as process fuel	2	2
Wood briquettes or pellets from forest residues; natural gas as process fuel	30	35
Wood briquettes or pellets from short rotation forestry; wood as process fuel	4	4
Wood briquettes or pellets from short rotation forestry; natural gas as process fuel	19	22

The estimates of LREF show that the termination of aid for natural gas CP with a capacity of more than four megawatts would reduce the mandatory procurement components by 46 %, while the electricity prices as a result would be reduced by 13% of the start rate and 10 % of the basic rate.

Regarding sustainability of fuelwood, a growing number of scholars [19; 20] argue that evaluation of the potential of forest resources could be considered maintaining of forest ecological processes, which are essential for maintaining ecosystem resilience. In particular, it emphasizes the multiple uses and functions of the forests (e.g., recreation, protection of soil and water resources, biodiversity conservation, carbon sequestration), which aim to provide various social, cultural, environmental and economic values [19; 20]. Nevertheless, Matthews with co-authors [20] argue that there is widespread recognition that increasing the levels of wood harvesting in the existing forest areas will, in most cases, lead to reductions in the overall levels of forest carbon stocks compared with the carbon stocks in the forests under the previous levels. Besides, some negative environmental effects are found in Latvia due to managing forests and production of wood biomass (felling activities). For example, ever since 2008 the sharp decrease of common forest birds' index was observed, explained by doubled felling volumes in this period [21].

Conclusions

1. The findings of the study have shown that the fuelwood is the main source of biomass in Latvia and its share, especially of wood pellets, is growing in renewable energy, inter alia, bioenergy production. However, the production of fuelwood is growing; the consumption is limited because fuelwood, particularly wood pellets, is exported. This fact is contrary to the practice of other EU Member States, which have high potential of wood resources, e.g., Finland and Sweden.
2. Until 2014, the total public support of EUR 7.6 million was allocated to fuelwood production. Despite the rapid development of bioenergy, particularly fuelwood (e.g., wood pellets, briquettes), in recent years, the total renewable consumption is still below the interim target, and the development of the fuelwood production mainly contributes to reaching the renewable targets for other countries, not Latvia, as it is mostly export oriented due to undeveloped local consumption; thus achieving the set national targets is at the risk.
3. Further development of fuelwood, particularly consumption, must be supported on governmental level through the support policy of bioenergy, and the rules and measures of sustainability

assurance not only of biomass production (e.g., carbon segregation, biodiversity, and ecosystems resilience) but also of consumption (e.g., GHG emissions, price, and energy dependency). More attention will be devoted to sustainable management of fellings, because some negative effects regarding biodiversity (birds) are observed.

References

1. European Commission. Renewable Energy: Progressing towards the 2020, COM (2011) 31 final, 31 January 2011. [online] [25.02.2015]. Available at: http://eur-lex.europa.eu/
2. Pelkonen P., Mustonen M., Asikainen A. et al. Forest Bioenergy for Europe. Joensuu, Finland: European Forest Institute (EFI), 2014, 110 p.
3. European Commission (2013). A new EU Forest Strategy: for forests and the forest-based sector. COM(2013) 659 final. [online] [25.02.2015]. Available at: http://ec.europa.eu/agriculture/forest/strategy/communication_en.pdf
4. Suttles S.A., Tyner W.E., Shively G., Sands R., Sohngen B. Economic effects of bioenergy policy in the United States and Europe: A general equilibrium approach focusing on forest biomass. Renewable Energy, vol. 36, 2014, pp. 428-436.
5. Central Statistical Bureau of Latvia (CSB). Database. [online] [11.02.2015]. Available at: http://www.csb.gov.lv/en/dati/statistics-database-30501.html
6. FAOSTAT. Data. [online] [11.02.2015]. Available at: http://faostat3.fao.org/faostat-gateway/go/to/download/F/FO/E
7. Eurostat. Database. [online] [11.02.2015]. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database
8. European Commission. Renewable energy progress report. COM/2013/0175 final. [online] [15.02.2015]. Available at: http://eur-lex.europa.eu
9. Melece L., Krievina A., Sproge I. Fuelwood Support: Results of Rural Development Programme in Latvia. SGEM2014 Conference on Political Sciences, Law, Finance, Economics and Tourism, Conference Proceedings, vol. 3, 2014, pp. 231-238.
10. Goetzl A. Developments in the Global Trade of Wood Pellets. Washington D.C.: U.S. International Trade Commission, 2015, 28 p.
11. FAO. Yearbook of Forest Products. Rome: FAO, 245 p., 2013.
12. Klavs G., Kudrenickis I., Kundzina A. Analysis of Competitiveness and Support Instruments for Heat and Electricity Production from Wood Biomass in Latvia. Latvian Journal of Physics and Technical Sciences, vol. 49 (2), 2012, pp. 3-13.
13. AEBIOM. Bioenergy: A Local and Renewable Solution for Energy Security, Brussels: AEBIOM. 8 p., 2015.
14. Gough C., Upham P. Biomass energy with carbon capture and storage (BECCS or Bio-CCS). Greenhouse Gases: Science and Technology, vol. 1 (4), 2011, pp. 324–334.
15. Searchinger T., Heimlich R. Avoiding Bioenergy Competition for Food Crops and Land Creating a Sustainable Food Future. Washington, DC: World Resources Institute, 2015, 44 p.
16. Fuss S., Canadell J.G., Peters G.P. et al. Betting on negative emissions. Nature Climate Change, 2015, pp. 1-4.
17. Freimane L. LAEF sagatavo pozīcijas dokumentu. (Latvian Renewable Energy Federation prepares position paper). (In Latvian). [online] [25.02.2015]. Available at: http://www.atjaunojam.lv/index.php/en/laika-ass/36-kategorija/laef-pazinojumi/107-laef-sagatavo-pozicijas-dokumentu
18. European Commission. On sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling. COM (2010)11 final. [online] [27.02.2015]. Available at: http://eur-lex.europa.eu/
19. Baycheva T., Inhaizer H., Lier M. et al. Implementing Criteria and Indicators for Sustainable Forest Management in Europe. Joensuu, Finland: European Forest Institute, 128 p., 2013.
20. Matthews R., Sokka L., Soimakallio S. et al. Review of literature on biogenic carbon and life cycle assessment of forest bioenergy. Farnham, UK: Forest Research, 300 p., 2014.
21. Auniņš A. Latvijas parasto putnu skaita pārmaiņas pēdējos septiņos gados (Changes of Common Birds Number in the Latest Seven Years), Putni dabā, 2013/1, pp. 10-13, 2013. (In Latvian).