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Bioenergy Resources in Latvia

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Abstract. **The paper presents results of study aimed to evaluate issues of current development of bioenergy in Latvia, taking into account restrictions, which may affect future progress of main biomass sources. These restrictions are based on latest European Union (EU) regulations and recommendations; and worldwide concerns of scholars on sustainability, particularly environmental (e.g. biodiversity, ecosystem resilience, carbon sequestration) of bioenergy (biomass) development. The appropriate qualitative and quantitative research methods have been used in the process of study. The results of examination suggest that biomass possesses one of the greatest potentials for further increasing renewables production, particularly in Latvia. The characteristics and perspectives of main biomass sources' development are assessed for compliance with the EU latest regulations, recommendations and policies, particularly Common Agricultural Policy (CAP) 2014-2020, and they demonstrate [reveal?] several limitations. The restrictions under the CAP regulations' so-called 'greening' requirements mainly affect the production of energy crops, limiting monocultures' growing. For some types of biomass production (e.g. energy cultures, wood biomass), several limitations or restrictions are considered, in particular, those related to environmental issues such as biodiversity, soil properties, agro-ecosystems and landscape. Forest origin, non-food plants (e.g. perennial grasses) and different kind of residues and waste could be the most important, perspective and sustainable biomass sources in Latvia. Besides, the dominance of a single bioenergy source would be unsustainable in the long run, and diversifying of the energy system is preferred.**

Keywords: **bioenergy, biomass, energy crops, forests.**

I INTRODUCTION

The European Commission (EC) has set the mandatory target for the share of energy from renewable energy sources (RES) to be at least 20% of the total energy consumption in the European Union (EU) by 2020 and 40% in Latvia. Even though the intermediate savings target (34.1%) in Latvia was exceeded by 1.7%, reaching 35.8%, attaining the sustainable end target is under threat in the opinion of the EU experts. At the same time, the energy dependency must be lowered, as in Latvia (56.4%) it is higher than on average in the EU (53.3%).

Three following dimensions with main aspects of sustainability of renewable energy, *inter alia*, bioenergy, development can be distinguished: 1) economic - growth, efficiency and stability; 2) environment - resilience and biodiversity, natural resources and pollution; and 3) social – social inclusion and governance [1].

Along with the benefits of bioenergy generation, such as increased carbon sequestration and reduced greenhouse gas (GHG) emissions, the different negative influence caused by some types of bioenergy is also stressed [2; 3]. The majority of such objections are related to the biomass production from the agricultural lands and field crops [3], and also increasing levels of wood harvesting will lead to reductions of forest carbon stocks [4].

Taking into consideration the above mentioned, the aim of study was determined - to evaluate issues of current development of bioenergy in Latvia, taking into account restrictions, which may affect the further development of main biomass sources. These restrictions are based on the latest EU regulations and recommendations and worldwide concerns of scholars on sustainability, particularly environmental (e.g. biodiversity, ecosystem resilience, carbon sequestration) of bioenergy (biomass) development.

II MATERIALS AND METHODS

The principal materials used for the studies are as follows: different sources of literature, e.g. scholars' articles, research papers and the reports of institutions, including EC and governmental; published and unpublished data from Central Statistical Bureau of Latvia (CSB), data from Eurostat databases, data of the forest monitoring done by "Silava"; as well as unpublished data from the database of Latvian Rural Support Service (RSS); and the results of the survey of owners of biogas installations carried out in 2014.

The appropriate qualitative and quantitative research methods have been used in the process of study: monographic; analysis and synthesis, data grouping, correlation and regression, spatial analysis using GIS, logical and abstract constructive, expert, etc.

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III RESULTS AND DISCUSSION

The European Commission (EC) has set the mandatory target for the share of energy from renewable energy sources (RES) to be at least 20% of the total energy consumption in the European Union (EU) by 2020 and 40% in Latvia. Even though the intermediate savings target (34.1%) in Latvia was exceeded by 1.7%, reaching 35.8%, attaining the sustainable end target is under threat by opinion of EU experts. At the same time, the energy dependency must be lowered, as in Latvia (56.4%) it is higher than on average in the EU (53.3%).

In Latvia the energy dependency, however statistically insignificant, has decreased in the period from 2001 until 2012 as opposed to the European Union (EU) Member States (average) and Lithuania, in which statistically significant increase has observed (Table I). Estonia obtains better results and decreases import dependency significantly during the same period.

TABLE I

TRENDS OF ENERGY DEPENDENCY OF EU 28 (AVERAGE) AND BALTIC COUNTIES, 2001-2012

Country	r	α*
EU 28 (average)	r=0.85	α<0.01
Estonia	r=-0.89	α<0.01
Latvia	r=-0.44	α>0.05
Lithuania	r=0.86	α<0.01

* - significance level or critical probability value

Despite this trend, Latvia has failed to meet the targets of RES energy share in the total consumption of energy, and stronger efforts are necessary.

The RES include: solar energy, wind power, hydro power, tidal power or ocean energy, geothermal power and biomass, which is one of the oldest energy sources [5].

Considering the fact that the hydro resources have reached its peak, the bioenergy is more perspective and adjustable among other types of RES sources in Latvia [6]. The bioenergy is any form of energy derived from biomass - living organisms or their metabolic products [7].

On the EU level [8], 'biomass' has defined as "…the biodegradable fraction of products, wastes and residues from biological origin". The sources of different kind of biomass feedstocks could be divided in three groups: plants grown from land, residues and wastes (Fig. 1).

The fuelwood commands the biggest share of the primary energy consumption in Latvia (Fig. 2).

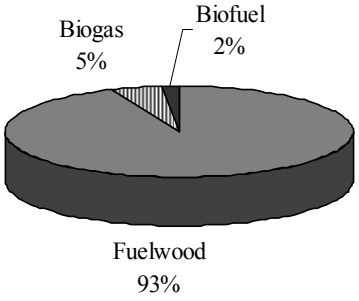


Fig. 2. Biomass energy primary consumption by the main types in Latvia, 2013

Biogas installations in rural areas

The Latvian RDP 2007-2013 targets bioenergy production from biomass of agricultural and forestry origins, where a total investment of EUR 45 million was predicted; besides, there are also additional opportunities for support of renewable energies in the farm modernization measures [3].

Pilvere [9], analyzing the potential of agricultural land area for bioenergy production, estimated that in Latvia are 302,000 hectares of unutilized agricultural area; and considered that 93,000 of them could potentially be used for agricultural production, *inter alia,* for biomass production.

She argues that in the medium-term perspective the number of biogas installations in Latvia could be increased by 2.3 times, reaching 250.

Moreover, it is believed that the long-term perspective number of biogas installations could reach 2400.

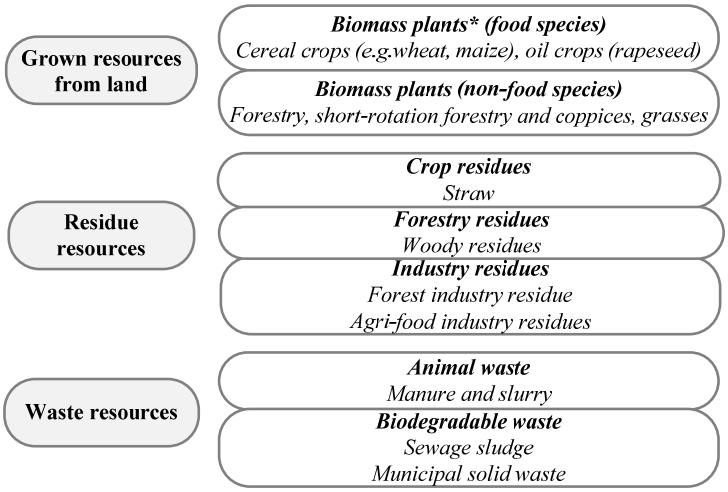
This possibility is threatened by several restrictions, with two of them being the most important.

Firstly, the decision of Ministry of Economy, which has introduced a moratorium on new tenders for the right to sell electricity within the scope of mandatory procurement and the acquisition of the right to receive a guaranteed fee for installed electric from 2011 May until 2016 [10].

Secondly, the new Common Agricultural Policy (CAP) 2014-2020, providing rules for payments granted directly to farmers, defined the mandatory agricultural practices [11].

These so-called 'greening' practices are beneficial for the climate and the environment, crop diversification; they maintain existing permanent grassland; and have an ecological focus area on the agricultural area [12].

For example, where the arable land of the farm covers more than 30 hectares there should be at least three different crops on that arable land; and the main crop should not cover more than 75% of that; besides arable land and the two main crops together should not cover more than 95% of that arable land.



* - so called energy crops

Fig. 1. Categories of biomass and specific resources or feedstocks of its

Bentsen and Felby [13] stressed that the assessments of the bioenergy potentials vary substantially due to methodological inconsistency and assumptions applied by individual authors.

Questioning the rapid development of biogas plants in the Latvia's rural areas, scholars offer a reasoned opinion [14], arguing that the biogas projects are usually characterised by long breakeven periods and the commercial benefits are small. One of the ways to make biogas plants profitable is the sales of digestate as a fertilizer [14].

In Latvia, apart from the plant biomass, especially maize, the main feedstock, used in rural biogas installations or plants is livestock manure, including slurry. The cattle manure is the most common and biggest by volume (71.6%), but pig - 23.5%, and poultry – 4.9%.

Energy cultures

The bioenergy production method with intensively managed monocultures of annual food crops have some negative environmental consequences, including the loss of habitat and the off-field impacts of fertilizer and pesticide runoff [15].

Conversely, the increasing grasslands' area has the environmental benefits of biodiversity and ecosystem as a whole [3; 15]. Besides, the diversification of crops provides an aesthetic value of the landscape [12].

The total sown area has not increased as rapidly and substantially ($r=0.69$; $\alpha>0.05$) in Latvia as areas of cereals (mainly wheat) and rape which have increased statistically significantly, $r=0.90$ ($\alpha<0.01$) and 0.95 ($\alpha<0.01$) respectively, in the last decade (Fig. 3). This leads to raising the proportion of monocultures in the sown area.

There is strong tendency observed that the larger farms boosted the proportion of arable land, especially utilizing the agricultural area (UAA). At the same time, the proportion of area of meadows and perennial grasses has decreased essentially (Fig. 4), particularly in the group of the largest farms. For example, farms with area of 500 ha and more do not grow permanent crops and have a very small proportion of meadows. Decreasing area of the perennial cultures affects biodiversity [3; 15].

Current EU bioenergy policy is focused on returning the unused UAA or surplus land in the production of feedstock, subsequently improving the quality of the environment, particularly, biodiversity and the landscape [3].

Lately biogas plants have been located chiefly in those territories of Latvia with highest proportion of UAA and the highest soil fertility [3], in which the area of maize has increased due to support of biogas projects (Fig. 5). This fact contradicts above mentioned policy framework.

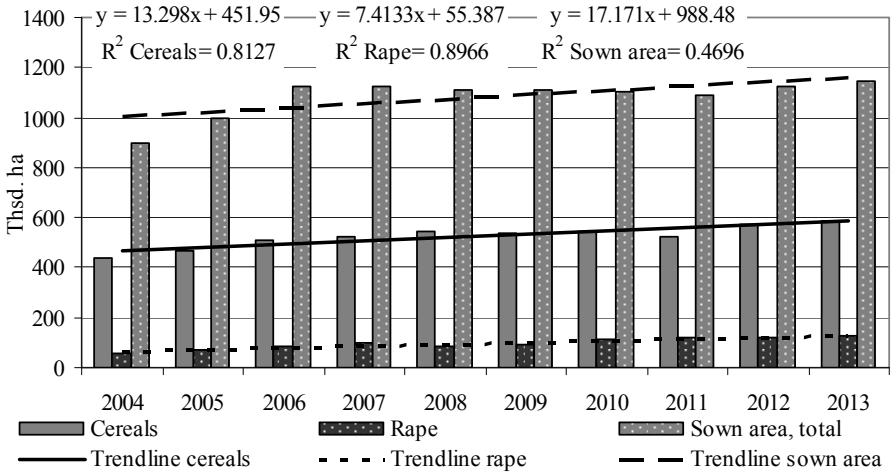


Fig. 3. Trends of total sown area and area of cereals and rape (thsd. ha) in Latvia, 2004-2013

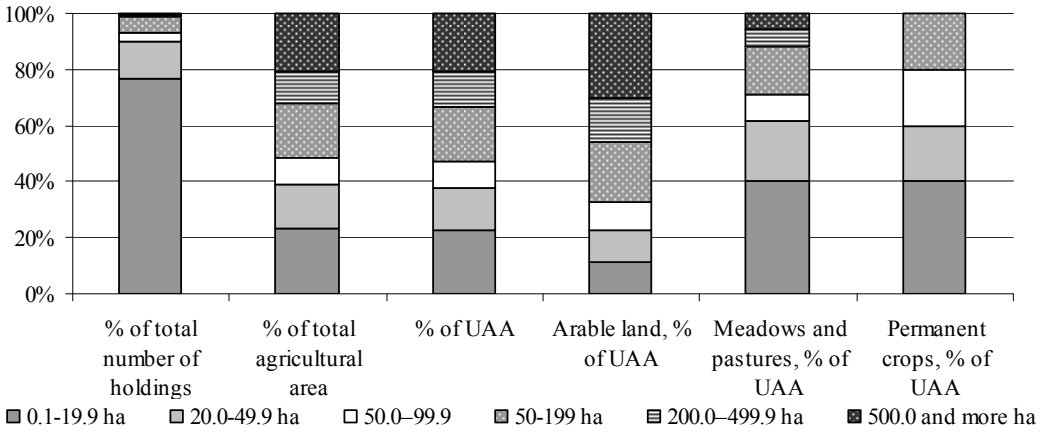


Fig. 4. Groups of agricultural holdings by agricultural area and its structure in Latvia, 2010

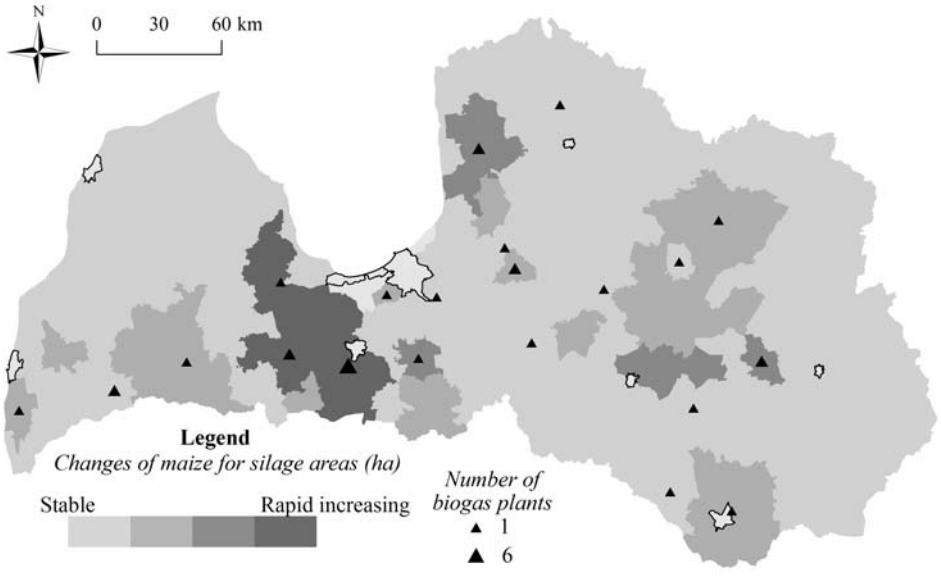


Fig. 5. Location of biogas plants in 2012 and changes of areas (ha) of maize for silage in Latvia's municipalities, 2007-2012 [3].

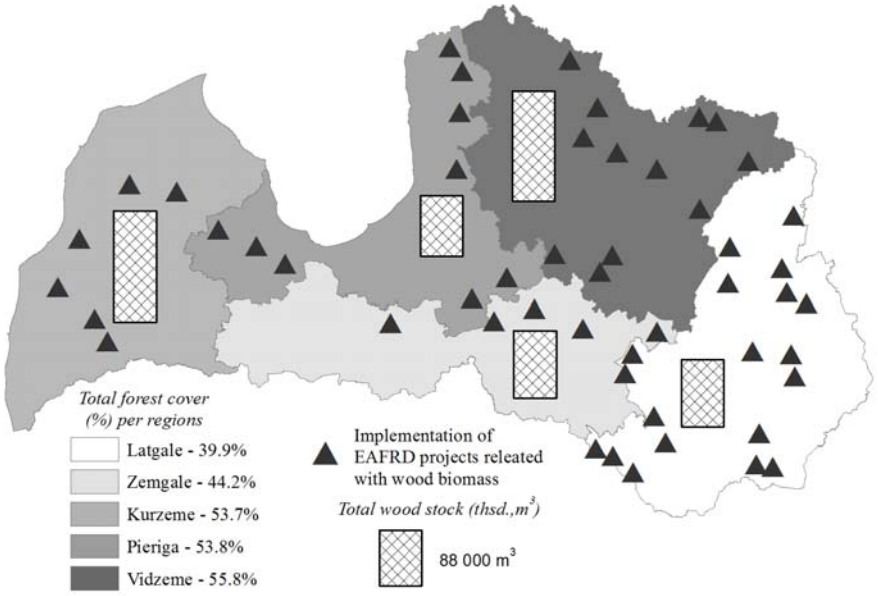


Fig. 6. Total forest cover (%) and total wood stock (thsd. m^3) per region and implemented EAFRD projects related wood biomass, 2013

The proposed potential non-food cultures in Poland, the Baltic countries (Estonia, Latvia, and Lithuania) and Nordic countries (Finland, Sweden) are: willow, poplar, reed canary grass, rape etc. [16], which could be cultivated on marginal or surplus land.

Although forest biomass, agricultural residues and energy crops constitute the three major sources of biomass for energy, the land use and the changes thereof is a key issue in sustainable bioenergy production as land availability is an ultimately limiting factor.

In future, the sustainable biomass production must be grown on the abandoned farmland and especially unused degraded land, which does not compete with other uses, and could be seen as comprehensive area potentially available for the cultivation of bioenergy plants.

Forest or wood biomass

The forestland (%), potential wood stock (thsd. m^3) and spatial distribution of RDP 2007-2013 projects supporting wood biomass production in the different regions, show that the potential for further development of the wood biomass output is observed in Vidzeme and Kurzeme (Fig. 6).

A growing number of scholars [17] argue that in the evaluation of potential of the forest resources, maintenance of forests' ecological processes could be taken into consideration as they are essential for ecosystems resilience. Particularly, the scholars stress the multiple uses and functions of the forests (e.g., wood production, collecting non-wood forest products, recreation, protection of soil and water resources, biodiversity conservation, carbon sequestration) which aim to provide various social, cultural, environmental and economic values [4; 17].

Nevertheless, Matthews with co-authors [4] argue that there is widespread recognition that increasing the levels of wood harvesting in 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 previous levels.

Moreover, it is argued that the forest bioenergy further development must be realized through increased utilization of harvest residues including poor-quality stem wood and trees, the use of sawmill co-products and recovered waste wood, avoiding the utilization of wood suitable for high value applications for biomass [4].

Other biomass resources such as perennial grasses and willow are investigated in Latvia. However, their development is in early stages and/or in negligible quantities, for example, willow was grown in small area, only 261 ha in 2012 [18]. Also, very small amounts of straw are used as feedstock. Besides, it is considered that the straw as a biomass source for energy has some following constraints: high concentration of ash and nitrogen, and the lack of suitable machinery and short season optimal to harvest [19].

Because perennial biomass crops could be grown on more marginal agricultural land and are non-food crops, they have the potential to offer sustainable bioenergy production [20]. Solid biomass from short rotation coppice (SRC) has been identified with high potential to significantly contribute to European renewable energy targets [21; 22]. SRC helps to improve water quality, enhance biodiversity, prevent erosion, reduce chemical inputs (fertilizers, pesticides) and mitigate climate change due to carbon storage [21].

The dominance of a single energy source and system, no matter how "perfect" it might be at a time, would be unsustainable in the long run. Before continuing our quest for a "perfect" solution for sustainable development and energy security, let us digress for a moment into other fields for enlightenment [23]. Diversification of energy systems should be anticipated to be healthy and beneficial for humanity and the environment as a whole, and energy diversity may be the key for sustainable development and energy security [23]. Potential sustainable resources of bioenergy, which are proposed on world and EU level, include different residues and wastes from agricultural, municipal, animal, food industry, and forestry sources [15].

IV CONCLUSIONS

The dominance of a single bioenergy source and system would be unsustainable in the long run, because each of them has beneficial and negative impact, mainly on the environment (biodiversity, ecosystem and landscape) and GHG emissions.

Besides, the sustainability of the various services in the rural areas, based on biodiversity, ecosystems, landscapes and the countryside, for example, recreation, leisure, tourism etc., must be taken into consideration for evaluation of further bioenergy supporting measures.

Diversification of energy systems should be anticipated to be healthy and beneficial for humanity and the environment as a whole, and energy diversity may be the key for sustainable development and energy security [23].

However, all biomass sources: wood biomass, field crops, inter alia short rotation coppice, uncultivated biomass such as sludge and manure, are significant for the further development of bioenergy in Latvia, the accent must be put on more sustainable types of them.

The non-food crops (plants) have the potential to offer sustainable biomass for the bioenergy production, when its cultivation will be realized on the abandoned farmland and especially unused degraded land, which does not compete with other uses.

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