POTENTIAL AREAS OF LOW PRODUCTIVITY AGRICULTURE LANDS FOR SRC ENERGY WOOD PRODUCTION IN VIDZEME REGION

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Abstract
Aim of the paper is to identify low productivity lands distribution in Vidzeme region, identify enterprises that could use wood chips from willow plantations established on these lands as the main resource in electricity and heat production and calculate produced wood ash amount from these enterprises that could be used as fertilizer and could be recycled in SRC plantations.
For better soil fertility evaluation and economic turn predictions all agricultural lands are evaluated in quality units, where one quality unit in money is equal to 5.38 EUR or 70 kg of rye. According to studies, traditional farming in lands, which are below 38 quality units could be unproductive. In Vidzeme region are 501,880 ha of agriculture lands from which 206,574 ha (52%) are lands with quality assessment under 38 units. According to local farmers opinion, the real quality unit, below which economically profitable farming is impossible are 25 quality units. There are 87,900 ha of agricultural lands under 25 quality units, which represent 18% from all agricultural lands in region. These lands could be used by growing SRC plantations in 2013, the region has 48 enterprises that used wood chips, with total amount of 170,500 oven-dried tones per year. Wood chips from SRC plantation could be used in these enterprises. To fulfil the wood chip demand in the region, about 17,000 – 34,000 ha of agricultural land should be planted with SRC plantations. To increase the yields from these lands, fertilization is recommended. In this region are more than 300 enterprises, which use wood as the main resource for electricity or heat production leading to 14,000 oven-dried tons of wood ash production every year.
Key words: SRC, Vidzeme, SRC plantations, soil quality –fertility, biomass.

Introduction

From all renewable resources in Europe, almost 70% are biomass that makes it the largest renewable resource (EAA...2007). Short rotation coppice (SRC) is a part of biomass resources, and according to European renewable energy targets, its share in total energy consumption in future will grow (Styles et al., 2007). To meet the EU targets to increase the amount of renewable energy, SRC is considered to be a very promising system not only to meet the energy targets, but also social and economical EU targets (Dimitriou et al., 2014) Low productivity agriculture land use in SRC plantation establishment leads to new employment opportunities in the regions and carbon neutral energy source production (Volk et al., 2004; Campbell et al., 2011). Comparing to biofuel of food production SRC has lower carbon footprint (Heller et al., 2004).

Some studies show that SRC establishment on bare soils and in lands with high groundwater level could be more profitable than agriculture crops on the same lands, because of high and stable yields, despite poor soil quality (Stolarski et al., 2011). Lack of technical knowledge, high establishment costs and missing financial capital are main reasons (Marron et al., 2012) why many farmers are not involved in SRC plantation establishment on poor quality soils. SRC establishment needs high investments, which would pay back after some years. Cash flow is divided between harvest cycles, compared to traditional agriculture, where incomes are possible every season.

Vidzeme planning region covers 24 % of the territory in Latvia and is the biggest planning region with 15,257 km^2. Region has 25 local municipalities and one national "development center" city - Valmiera. According to the information from Rural Support Service (RSS), in 2013 more than 450 ha of short rotation coppice (SRC) plantations were applied for subsidies from EU funds, more than 230 ha were from Vidzeme region. Although the lands that could be available for SRC establishments are more than 90,000 ha, most of them are abandoned and not used in agriculture or any other activities. Long-range management plan could bring these lands in production and make them profitable. In the region, there are more than 300 enterprises that use wood as the main burning material for heat and electricity production, or use it in manufacturing; more than 40 enterprises from them use wood chips as the main burning material. If the SRC end product would be wood chips, it is possible to fulfil demand for it in the region. SRC is an option how to produce additional woody biomass efficiently in short time and sustainable way (Liesebach et al., 1999; Bentsen & Felby, 2012). SRC establishment would lead to more efficient land use in the region.

Materials and Methods

For better soil fertility evaluation and economic turn predictions, all agricultural lands are evaluated in quality units, where one quality unit in money is equal to 5.38 EUR or 70 kg of rye. Soil quality units for every single land area are estimated by State Land

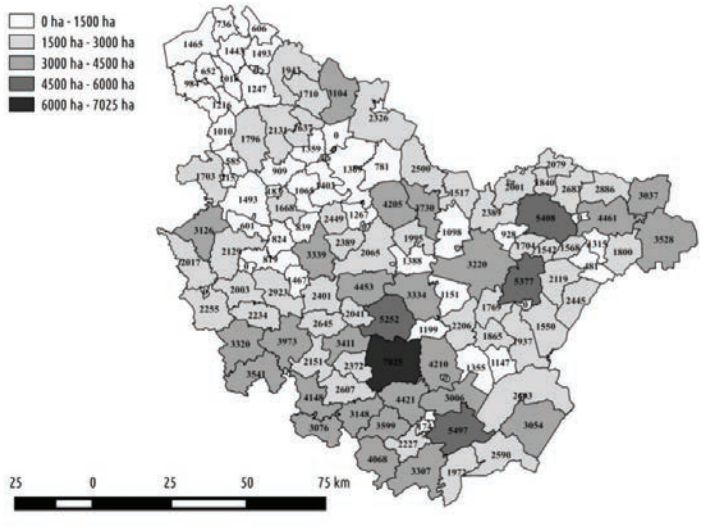

Figure 1. Agriculture lands in Vidzeme region with quality assessment under 38 units.

Service (SLS) specialists according to cartographic materials - agricultural land quality assessment base maps and soil maps. Assessment is made using maps without compulsory attendance in nature.

Soil quality units depend on many aspects related to a particular land area. Indicators that are taken into account for land quality unit determination are land amelioration conditions, soil type (clay, loam, sand), composition, microrelief and stoniness of the area, field contours and naturally existing obstacles that interfere land mechanical processing. From the year 2012 all agricultural lands according to quality units are divided in seven quality groups. Each group has a certain quality land base value in EUR per ha, which are used to calculate the land value and compare different agricultural land areas in different regions.

The base factors that affect land use for a certain economic activities are climatic conditions, land quality, location and infrastructure. Average weighted soil quality in Latvia is equal to 38 quality units (maximum rate is 100 quality units), which according to studies, taking into account the climatic conditions in Latvia is the minimum fertility level for agricultural land in order to ensure commercially viable farming. Farming in lands under this certain quality unit level may be unproductive and unprofitable (Zemes politikas..., 2008) (Land policy...., 2008). According to forestry experts evaluation, afforestation could be provided on agriculture uneconomic areas and unused agricultural lands if the land quality is under 25 units (Ex-ante novērtējums..., 2013) (E-ante assessment..., 2013. These two thresholds are taken into account to calculate availiable unused agricultural lands that could be used for Short Rotation Coppice (SRC) plantation establishment in Vidzeme region. Data for calculations are taken from Latvian Land Service (LLS) database about the year 2013.

All enterprises that have specific permission related to fuel using in manufacturing or energy production should give annual report to Latvian Environment, Geology and Meteorology Centre (LEGMC) about fuel amount and other requestet information. Data about enterprises that use wood chips for heating or electricity production are taken from LEGMC datbase.

Results and Discussion

In Latvia total agriculture land area in 2013 was 2,353,936 ha, from which 363,778 ha were lands below 25 quality units (15%) and 1,049.729 ha were lands below 38 quality units (45%).

In Vidzeme region, there are 501,880 ha of agriculture lands from which 206,580 ha (52%) are lands with quality assessment under 38 units. Large land areas with agriculture land quality assessment under 38 units are in Liezeres parish (7,025 ha), Alsviku parish (5,408 ha), Belavas parish (5,377 ha) and Jaunpiebalgas parish (5,497 ha). (Fig.1).

Not all these lands are abandoned and not used in agriculture. Some of them, especially slightly below 38 quality units are used in traditional agriculture, like arable lands and pastures. If the lands are close to existing agriculture fields, in most of the cases they are used in traditional farming in spite of low productivity. In many cases, because of good agricultural land lack in some regions, some poor soil lands are also used in agriculture. Many farmers tend to increase continuous agriculture lands adding to the existing fields nearest bare soil lands.

Some land owners presumption is that not all lands under 38 quality units are unproductive. Some owners consider that lands a bit under 38 units, under good management plan and latest management techniques, still could be enough productive to be profitable. According to their observations, the threshold under

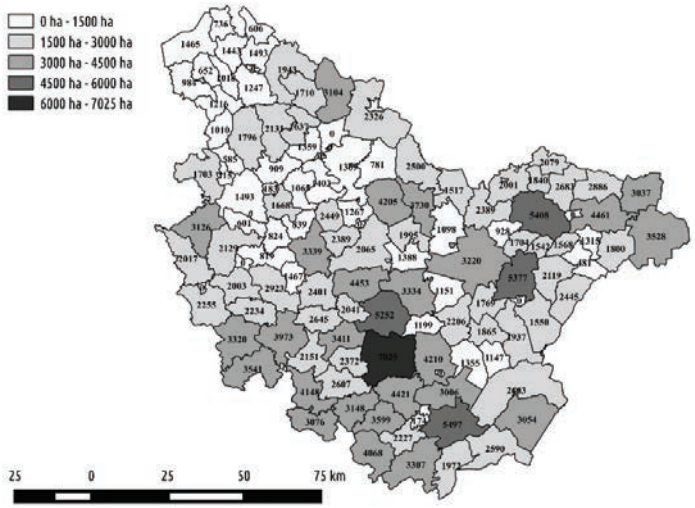

Figure 2. Agriculture lands in Vidzeme region with quality assessment under 25 units.

which the land could be called unproductive in traditional farming is below 25 quality units. Also, according to forestry experts' recommendations, land afforestation could be provided if the land quality is under 25 quality units. In response to these allegations, lands under these particular quality units in Vidzeme region were calculated.

In Vidzeme region, there are 501,880 ha of agriculture lands from which 87,900 ha (18%) are lands with quality assessment under 25 units. Large land areas with agriculture land quality assessment under 25 units are in Liezeres parish (3,190 ha), Alsviku parish (2,735 ha), Jaunpiebalgas parish (2,638 ha) and Skujenes parish (2,533 ha) (fig.2.).

Lands under 25 quality units are more available for SRC plantations, because there is higher possibility that they are not currently used as agriculture lands.

To obtain incomes from lands that are not used in agriculture and are abandoned, SRC willow plantations for wood chips production could be established on these lands. Average SRC plantation yields in Latvia are close to 5 – 10 odt^{-1} of wood chips per year from 1 ha (Kunze et al., 2006; Lazdina et al., 2010; Mola-Yudego, 2010; Lindegaard et al., 2011).

In Vidzeme region, there are 48 enterprises that use wood chips as the main burning material for heat and electricity production. Wood chip consumption in enterprises differs from15 odt^{-1} in the smaller boiler houses till 32,745 odt^{-1} in the biggest enterprises per year. Small scale enterprises are local boiling houses that supply heat to local municipalities, middle class enterprises are boiler houses that are located in the biggest cities and provide heat to city municipalities. The biggest companies are cogeneration plants (CHP)

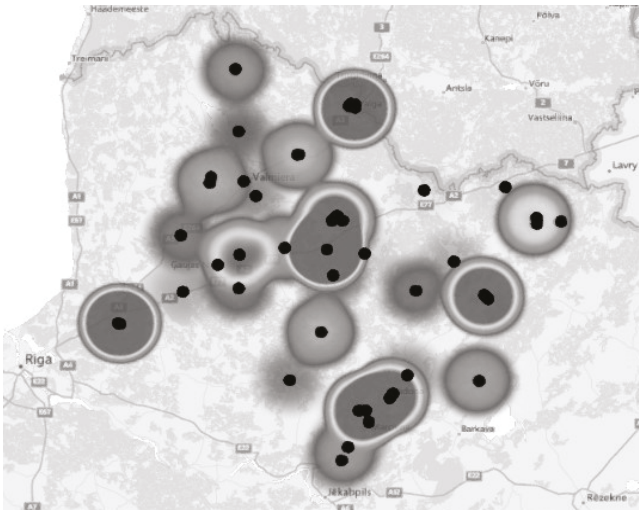

Figure 3. Heat map with enterprises that use wood chips as burning material for heat and electricity production in Vidzeme region.

and pellet factories. Total wood chips consumption in Vidzeme region is about 170,000 odt^{-1} per year.

Although enterprise distribution in the region is quite even, there are some spots on the map, where enterprises with the biggest wood chip demand are located. Biggest enterprises are located in Valka (CHP plant), Incukalns (pellet factories, woodworking enterprises, CHP plants), Smiltene (pellet factories, woodworking enterprises, CHP plants), Madona (big scale boiler houses for city and municipalities) and Gulbene (pellet factory, woodworking enterprises, big scale boiler house for city) (Fig.3).

To meet the wood chip demand in the region, about 17,000 - 34,000 ha of low productivity agricultural land should be planted with SRC plantations if the average yields are 5-10 odt^{-1} per hectare. To fulfil the regional demand for wood chips, 8 - 12 % of all agriculture lands under 38 quality units and 19 - 39 % of agriculture lands under 25 quality units should be planted with SRC willow plantations.

To increase the yields from low quality lands, fertilization is recommended. According to previous studies, wood ash is one of accessible fertilizer for low quality lands (Lazdina et al., 2011). Fertilization with wood ashes simultaneously solves soil fertility problems and ash waste problem. Boiler houses could offer ashes as fertilizer for farmers and share the utilization expenses with them instead of paying the storage and deposition costs themselves. Total amount of produced ashes in Vidzeme region only from wood chips in 2013 was 6,800 odt^{-1}. With this amount of ashes it is possible to fertilize 680 - 1,360 ha of low productivity agriculture lands if the fertilizer dose is 5 - 10 odt^{-1} ha. (Kārklu plantācijas...2005) (Willow planations…2005). If all ashes from wood-chips used enterprises would be used as fertilizer, it would be possible to fertilize less than 1% of all lands under 38 quality units about 1% of all lands under 25 quality units.

Total amount of ashes, produced in the whole Vidzeme region from all kinds of wood products (wood chips firewood, pellets, wood residues, etc.) used in manufacturing, heating and electricity productions in 2013 were 14,000 odt^{-1}. With this amount of ashes it is possible to fertilize 1,400 - 2,700 ha of low productivity agriculture lands, which is slightly above 1% of all lands under 38 quality units and about 3% of all lands under 25 quality units.

SRC plantation establishment on non-used agriculture and bare soil lands gives a possibility to manage these lands in a profitable way, meet the wood chip demand in region and help local entrepreneurs get rid of wood ashes, which could be used in a sustainable way as fertilizer in acid or poor soil lands.

Conclusions

In Vidzeme planning region, there are more than 87,000 ha of agriculture lands with quality assessment under 25 units and 206,580 ha of agriculture lands with quality assessment under 38 units. In the region 48 enterprises use wood chips as the main burning resource for heat and electricity production with total consumption of 170,000 odt^{-1} per year. To fulfil the wood chips demand in the region, depending on the average yields (5-10 odt^{-1} per hectare), 34,000 - 17,000 hectares of SRC plantations needed to be plant.

Yearly produced wood ash amount from all enterprises in Vidzeme planning region is about 14,000 odt^{-1} (including 6,800 odt^{-1} from wood-chips) that are obtained from manufacturing processes, heat and electricity production. With that amount of ashes it is possible to fertilize about 2,700 - 1,400 ha (fertilizer dose 5-10 odt^{-1} ha) of bare agriculture land.

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