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Tackling market opportunities for the biomass production in Romania

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Abstract. *The European Green Deal sets out a detailed vision for Europe to become a climate-neutral continent by 2050 by providing clean, secure, and affordable energy. Thus, with the aim of providing a market-oriented perspective on the economic potential of biomass-related activities, several data were analyzed in this research paper. The positive impact of the green transition is necessary to be studied both at macroeconomic and microeconomic levels. In this context, the research question addressed was: What is the impact of the green transition on farms' performance and national economy? A descriptive statistical analysis was carried out in order to prove the importance of specific crops, taking into consideration the movements in the energy market and the farmer's constraints in the era of the European Green Deal. The main objective of this research was to determine if biomass is one of the optimal solutions able to gather all these European desiderates. This conference paper identifies the best scenario for an agricultural farm using diversification activities and the macroeconomic impact of the biomass crops. Currently, the European context is the most favorable for resorting to biomass crops, especially if considering the recent global energy market dynamics. Additionally, there is a need for activities diversification at the farm level in order for them to become greener and to boost their socio-economic and environmental performance. Results confirm that there is considerable economic potential for biomass production in Romania. The added value of the paper is provided by both microeconomic and macroeconomic approaches.*

Keywords: biomass, circular economy, European Green Deal, energy, energy market

Introduction

Biomass is no longer a desiderate, but an agricultural-forestry activity with what appears to be tradition in several countries (Goldemberg & Teixeira Coelho, 2004; Tamire et al., 2018; Walter et al., 2006), a friendly environment culture, and a quite productive business (Shende et al., 2022).

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The main renewable energy sources (wind energy, solar energy, hydropower, ocean energy, geothermal energy, biomass, and biofuels) are alternatives to fossil fuels, helping to reduce greenhouse gas emissions, diversify energy supply, and to reduce dependence on conventional fuels, especially oil and gas. Biomass and biofuels play a particularly important role in meeting the objectives of the European Union (EU), as the Renewable Energy Directive (Directive (EU) 2018/2001) has set clear targets for their use in the field of energy.

This paper aims at showing the impact on the national economy of biomass culture for Romania, in a broader European context, from the both three sustainable development pillars at macroeconomic level, and the entrepreneurial perspective, at microeconomic level.

The purpose of the paper was to provide a faithful image of all three sustainable development pillars of biomass culture by proving data about environment, social and economic impact of such crops at both microeconomic level, and regional level, national and even wider. The research question was: What is the impact of the green transition upon farms' performance and national economy, in the context of the European Green Deal? The main objective of the paper was to determine the most performing scenario for biomass production for an agricultural farm and to tackle the macroeconomic impact of these types of business.

The tested hypotheses are: (a) there is a very favorable European context for biomass crops; (b) there is a need for activities diversification on farms' level in order for them to become greener and to boost their performance; (c) there is a considerable economic potential of the biomass production. Findings: This research identified that the biomass is needed by the energetic market, especially in the present situation and that the products diversification at the farm level will conduct to a more resilient activity. The added value of the paper is provided by the both microeconomic and macroeconomic approaches.

The European Context

The European Green Deal (COM (2019) 0640) sets out a detailed vision for Europe to become a climate-neutral continent by 2050 by providing clean, secure, and affordable energy (European Commission, 2019). The analysis of EU legislation on the promotion of renewable sources reveals a significant evolution in the last 15 years when it was established that by 2020, an amount of 20% of energy consumption will come from renewable sources. After achieving this goal, the next goal in the field of renewable energy is to reach a percentage of 32% of energy consumption from renewable sources by 2030.

In the case of Romania, the resource of plant biomass, energy and forestry crops, is an important renewable energy source, both in terms of potential and possibilities of use (Pătărlăgeanu et al., 2021; Voicu-Dorobanțu et al., 2021). On the other hand, in the case of Central European countries it was already proven (Bălan et al., 2021) that the agricultural biomass sector has positive environmental impact, as well as a real contribution to economic development (Andrei et al., 2021).

Moreover, a study run in 2022 by Šafařík et al. in Czech Republic indicates that the overall annual dendromass available until 2036 values 13473 million tons per year which is not sufficient for this country to achieve European targets in the field. Therefore, more studies need to be conducted in order to discover other possibilities and resources for a greener Europe.

For that, Thormann et al. (2021) provided methodological instruments in order for the public policy to reduce challenges met in circular economy and the period of transition to climate-neutral. Biofuel advantage (Mungodla et al., 2019), municipal waste smart management (Banacu et al., 2019) and packaging integrated solutions, in general (Teodor et al., 2020) may be directions for a low-carbon economy and circular economy real function. Although, energetic efficiency is

aimed by all countries and regions (Drăcea et al., 2020), nevertheless companies and organizations targeting resilience and performance (Ignat & Constantin, 2020), the solutions are no longer in the conventional practice, but in innovative perspectives, such as bioeconomy modelling (Biljuš & Basarac Sertić, 2021; Pyka et al., 2022). And why is that? Maybe because agriculture and food industry have a key position within the European economy, as they have an important labor productivity-enhancing impact (Beia et al., 2020; Cepoi et al., 2020; Ronzon et al., 2022).

Considering all the above arguments, biomass might be the path to energy independence and efficiency while it fulfills all sustainable development goals, especially when even the population embraces this approach (Kochanek, 2021). Land management is important (Schröder et al., 2022) because the very same land should concomitantly provide food safety and security, a low carbon economy, a beautiful landscape, meaning a sustainable development and a greener soil. In order to achieve these, all stakeholders should be involved, supply chains should become more flexible and resilient (Chivu et al., 2021; Pătărlăgeanu et al., 2020; Pavlou et al., 2016).

Energy Market Anaylsis

In the period 2000-2019, Romania experienced a reduction in energy production by over 14%. This decrease was offset by the increase in net imports (Figure 1). Changes in the structure of gross domestic consumption occurred during the analyzed period. However, this consumption is based on solid fossil fuels, oil and petroleum products and natural gas (from 31.3 megatons of oil equivalent in 2000 to 23.9 megatons of oil equivalent in 2019).

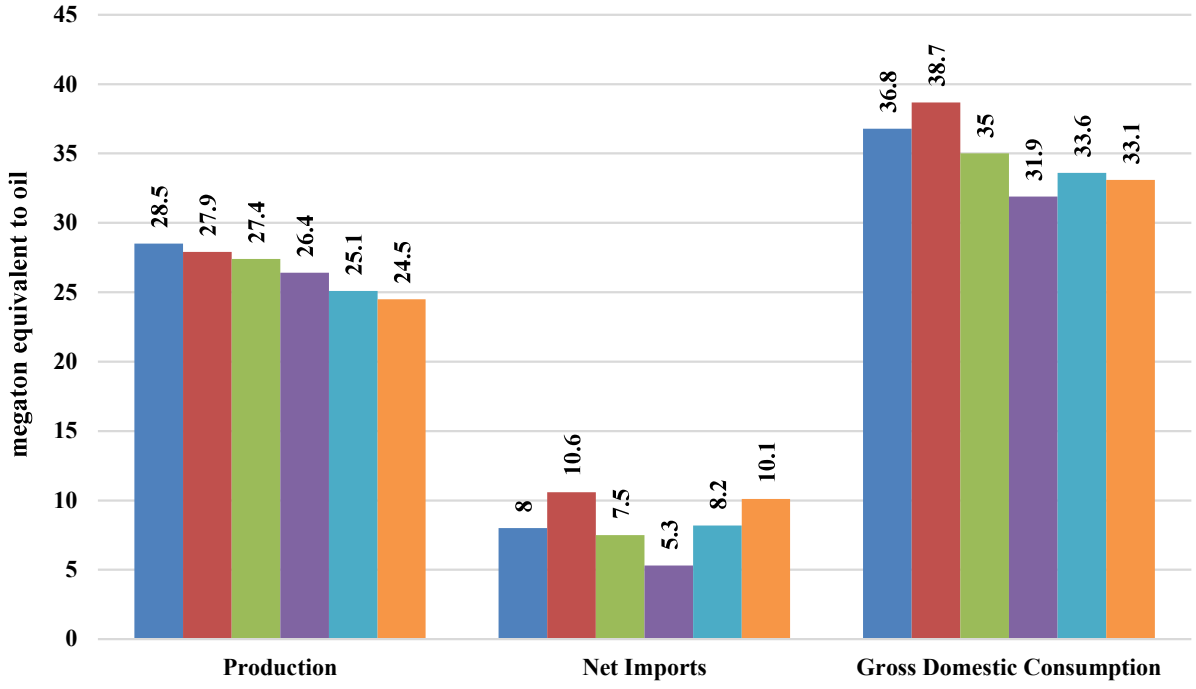


Figure 1. Evolution of production, net imports and gross domestic energy consumption

Source: Authors' own design.

Currently, biomass contributes approximately 14% to global primary energy consumption, which is why the Energy Strategy of Romania for the period 2016-2030 has taken into account the promotion of renewable energy sources, including the use of biomass for energy production. At

the level of 2021 in Romania, the structure of primary energy sources used to produce electricity consists of conventional sources 54.72% and renewable sources 45.28%. Thus, biomass becomes the only renewable resource that can replace these non-renewable resources currently used, being the most common source of energy, and the demand for biomass will increase, according to all estimates in the coming years.

According to a statistical research carried out by (Busu, 2020), there are not many entities active in the Romanian biomass sector and their concentration level was assessed as being very low, which could hint at many economic aspects: windows of opportunity for entrepreneurs in this sector (Lezaun, 2007) and poor economic competitiveness (Rodino et al., 2019). (Panaitescu et al., 2020) also argue for the Romanian market opportunity regarding the country's biomass potential.

Depending mainly on the source of organic matter production, but also on the purpose for which the biomass is used, it is classified as follows: (1) Biomass obtained from by-products: biomass resulting from primary residues obtained from agricultural crops or forest products; biomass resulting from secondary residues that become available after a biomass product has been used; biomass resulting from forest waste that can no longer be used in industrial or commercial purposes and is thus used for biomass to produce energy; (2) Biomass obtained from crops used specifically for this purpose and currently classified as energy crops (grassland or forestry crops): energy crops established with forest species with a high growth rate: poplar (Populus alba), willow (Salix sp.; Elaeagnus angustifolia -shrub species), eucalyptus (Eucalyptus globulus); princess tree (Paulownia sp.), etc; energy crops that produce a lot of agricultural biomass: sugar cane (Saccharum officinarum), rapeseed (Brassica napus oleifera, Brassica rapa oleifera), sugar beet (Beta vulgaris); soybean (Glycine max), camelina (Camelina sativa), Jerusalem artichoke (Helianthus tuberosus), etc.; perennial crops: miscanthus or Chinese reed or elephant grass (Miscanthus giganteus); grasshopper (Phalaris arundinacea), etc.

The choice of a farmer or a rural investor to produce biomass can make the farm or small local industry more competitive, while increasing its profitability. All this, all the more so as it is known that in our country, the employment rate in rural areas is only 23-25%. In other words, biomass is also an opportunity for economic recovery for rural development, which is why the European Union is expected to create about 300,000 new jobs in rural areas through the exploitation of biomass. Biomass production can ensure the stability of the national energy system, especially today when affordability is considered to be one of the main challenges of the energy system.

Biomass is also the raw material available in considerable quantities for use in biorefinery as part of the circular bioeconomy and can deliver for the economy the same products that are currently widely obtained from hydrocarbons: (bio) fuels as energy carriers; (bio) biodegradable or durable plastics; raw materials for the chemical industry (acetate, lactate, acetone, butanol, ethanol, polyhydroxy-alkanoates, succinate, esters, glycerol, etc.).

Future EU funding programs will focus on these elements to combat the effects of climate change, and from this perspective, energy producers will have to change the way they obtain their products. They will be required to have a modern approach so as to make them environmentally friendly. In these situations, producers of high-energy agricultural products will be strategic partners for energy producers. The decision to invest in such crops becomes an attractive one for any farmer. He will often have to choose between several ways of organizing production: (1) to practice only agriculture for food; (2) to practice agriculture for the energy market; or (3) to practice agriculture in a mixed system, both for the food market and for the energy market. A decision to this effect may be taken at microeconomic level, considering the elements specified in Table 1 and Table 2.

Table 1. The main differences between woody biomass and herbaceous biomass

	Woody biomass	Herbaceous biomass	
High lignin content	Forestry products and byproducts	Agricultural residues	Low lignin content
Low to medium ash content			High ash content
High ash melting temperature			Low ash melting temperature
Bulky	Wood processing byproducts		Very bulky
Decomposes slowly		Energy crops	Decomposes quickly
Continuouslyharvested	Woody agricultural byproducts		Seasonally harvested
Requires no binder to pelletise/briquette			Requires binder to pelletise/briquette

Source: (IRENA, 2019).

Table 2. Characteristics of agricultural residues and dedicated energy crops

Feedstock	Dry mass yield	Lower heating value	Energy produced	Water content at harvest	Ash content
	tone/hectar/an	MJ/kgDM	GJ/hectar	%	
Herbaceous biomass					
Straw	2-4	15-18.1	35-70	14.5	5.0
Herbaceous crops					
Miscanthus	8-32	17.5-18.1	140-560	15.0	3.7
Switchgrass	9-18	16.8-18.6	150-335	15.0	6.0
Giant reed	15-35	16.3-18	245-570	50.0	5.0
Canary grass	6-12	16.3	100-130	13.0	4.0
Woody crops					
Willow	8-15	16.7-18.5	280-315	53.0	2.0
Poplar	9-16	18.7	170-300	49.0	1.5
Black locust	5-10	18.5-19.5	100-200	35.0	N/A
Wood	3-14	18.7	56-262	50.0	1-1.5

Source: (IRENA, 2019).

Obviously, these decisions will be adjusted according to the public policies of the Member States and the measures in these markets. At the same time, European states will allocate funds to support these crops, in the above context. Therefore, investments, now at the beginning of the development of this market, will be supported by budget allocations and subsidies.

The climatic and edaphic natural resources highlight the potential of land available for energy crops, the extension of the areas with these crops is determined by the knowledge of the influence of favorable, restrictive, and limiting pedoclimatic factors, being an important aspect in choosing the measures to be taken. to improve the quality of life. From the point of view of the edaphic natural resource, Romania has at its disposal important areas of land with potential for energy crops.

In areas unsuitable for basic crops, with high humidity soils, it is recommended to cultivate woody species (poplar and willow) to obtain alternative fuel to ensure a significant income for farmers. Numerous researches being carried out in the direction of the use of degraded lands, poorly productive, of lower credit rating for agriculture and their introduction in crops, can also be used in the improvement of degraded soils.

Due to the characteristics of the local hybrids of poplar and willow, they are competitive in intensive crops, the ecological requirements having a decisive role in the spread on the territory of our country. Thus, poplar grows well on soils such as Gleiosols, Psamosols and Aluviosols, and willow prefers Aluviosols, Preluvosols, respectively, Eutricambosols.

Among the most widespread poplar species in the culture are Populus alba, Populus tremula, Populus nigra, the hybrid Populus x euramericana, Populus deltoides, and among the willows are the species: Salix alba, Salix fragilis, Salix caprea, Salix viminalis and Salix purpurea.

The establishment of an energetic acacia plantation (Robinia pseudoacacia) can bring considerable income. At one hectare of acacia, 350-400 tons of biomass are obtained in 20 years, currently, the reference price for biomass is that of the National Forests Authority, of 40 euros / tonne, and the production cost is somewhere at maximum 14 / euro per tonne.

At the level of Romania, the counties richest in potential forest resources to produce biomass are: Suceava, Harghita, Neamţ and Bacău, and at the opposite pole are Constanţa, Teleorman, and Galaţi.

In the case of poplar-specific investment, the annual revenue is EUR 2,588,506 on average (over 15 years) and the share of APIA grants in total revenue is 5.98% (average), which justifies an increased volume of income due to the economic potential of this crop.

With a declared uncultivated subsidized area (including protected areas) of 38,688.26 hectares in 2021 according to APIA, Romania could increase the degree of energy security by dedicating these areas to biomass-specific crops.

Thus, in the context in which these areas would be cultivated with poplars, (a) with a duration of 5 years per rotation, and (b) a productivity of 12.5 tonnes dry per hectare per year in the case of the first rotation and 14, 4 dry tons per hectare per year, in the first year of harvest would obtain a quantity of 483,603 tons, corresponding to 8,946,660 GJ. Economically capitalized, it could generate revenues of EUR 74,083,768, given that the price per tonne is EUR 153 and the price per GJ is EUR 8.3.

In addition to the economic and environmental benefits, these activities would involve more than 1,500 people in rural areas in order to cultivate the 38,688.26 hectares and achieve the estimated production of 483,603 tons, only in the first year of harvest. Against the background of energy price volatility, the allocation of as many hectares as possible for such crops is economically

appropriate, financially necessary, ensures sustainable development, and increases the level of energy security in Romania.

Conclusion

Biomass contributes to the storage of greenhouse gases and thus to the cessation of their harmful effects on the climate and is the only renewable resource that can replace the fossil reserves currently used in the petrochemical economy.

The main source of biomass or plant organic matter is that of agricultural origin, consisting of the secondary production of crops, such as: straw, corn, corn stalks, sunflower, soybeans, especially beet leaves, pods (soybeans, beans), shells (nuts, hazelnuts), kernels (plums, peaches, apricots). The source of forest biomass consists of the main or secondary organic matter, coming from the exploitation of forests and coniferous and deciduous plantations. Another source with important potential to produce biomass are lignocellulosic energy crops, represented by poplar, willow, etc.

According to European trends, Romania is obliged to develop the renewable energy sector by 2030. In this context, farmers must be supported by financial instruments provided for in the CAP, which is why in areas unsuitable for basic agricultural crops, with soils with a degree high humidity, it is recommended to cultivate woody species to obtain alternative fuel such as poplar and willow that promise a good income for farmers.

Regarding future research avenues, the framework proposed by this conference paper may be replicated at the European level, by introducing multinational aggregate data and proving information about the results at country or even regional level.

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