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Original paper

Study on the production and use of biomass energy in the Timis County

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Abstract The use of renewable energy resources is gaining more and more ground, thanks to the continuous increase in the price of fossil energy and the decrease in stocks, and the management of waste from nuclear energy production, respectively. The implementation of an energy strategy to harness the potential of renewable energy sources (RES) is part of the coordinates of Romania's medium – and long-term energy development and provides the appropriate framework for the making of decisions on energy alternatives and the inclusion in the Community acquis in the field. In this respect, a study on the biomass potential of Timiş County and on the possibilities of producing unconventional energy from biomass has been carried out. The study is based on research, data collection from the literature, as well as from official documents or official websites, the processing and interpretation of the data and their quantitative and qualitative analysis. It was concluded that biomass is a promising renewable energy source for Romania, both in terms of potential and in terms of usability.

Keywords Energy, renewables, biomass, pellets.

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Introduction

Throughout its existence on this planet, humanity, in its evolution, has created an imbalance on the environment, degrading it, and this process of severe degradation of the environment as a whole result in a series of climate changes that endanger the quality of life on Earth and, possibly, even its existence.

Therefore, today, the main challenge of mankind regards the enormous risks posed by climate change (JURJESCU & al [2]).

Agriculture has been a vital activity; it depends on the food security of the population and on the balance of regional and local ecosystems (ROCKSTRÖM [2]). Plant propagation, natural or artificial, occurs on the basis of the capture and synthesis of solar energy, resulting annually in a terrestrial vegetative mass of about 120 billion tons of dry matter or about 60 billion Mtoe (ȘERBAN [10]).

The energy problem has become paramount in recent years because of the depletion of fossil fuel resources, their price variations, and political dependence on the nations that deliver them (OTIMAN [2]). In addition, climate change, as mentioned before, requires a reduction in greenhouse gas emissions (MATEOC & al [4]).

The implementation of an energy strategy to harness the potential of renewable energy sources (RES) is part of the coordinates of Romania's medium- and long-term energy development and provides the appropriate framework for the making of decisions on energy alternatives and the inclusion in the Community acquis in the field (TABĂRĂ [11]). In Romania, there is in force the law No. 220 from 2008 to establish the promotion of energy production from renewable energy sources by granting green certificates depending on the source used: biomass, wind, photovoltaic, hydro, geothermal (MATEOC & al [3]).

This paper presents part of the results of the research carried out in preparation of the doctoral thesis entitled "Study on the production and use of renewable energy in rural areas – approaches, policies, the legislation" and aims to provide a more complex image of the potential of biomass resources in Western Romania, offering solutions for their recovery and for the production of green energy in the area under investigation. The biomass resource area is looked at in order to raise awareness and stimulate those able to make appropriate use of them, both for sustainable rural development and out of respect for the environment because, in Western Romania, agricultural resources provide a rich and particularly attractive natural potential but, unfortunately, still improperly untapped (MIHALACHE [5]). This issue is all the more important because the leaders of the European Union set a target of 20% of the total energy consumption of EU countries by 2020 and, in 2018, it was set to increase by 2030 to 32% (VALIN & al [13]). Romania has a target of 25% of SREs by 2020, and the current state is 22.9% (EUROPE- 2020 [14]; E.C. [15]).

Materials and Methods

The study is based on research, data collection from literature, and from official documents or official websites, the processing and interpretation of the data, and their quantitative and qualitative analysis. The case study, as a research method, was also used.

Results and Discussion

Today, conventional fuels are the cheapest and most accessible energy resource for today's society, but there are major arguments that have triggered the economic interest in the sustainable development of modern society and, thus, in the promotion of renewable energy resources (CÂMPEANU [1]). These arguments relate to:

- the need for sustainable development that protects human health and the environment;
- depletion of conventional fuel resources in a very short time;
- security in energy supply;
- ensuring energy independence, as far as possible, in all countries.

In this respect, the current research theme aims to respond to the measures to be taken with a view to ensuring the energy resources necessary for sustainable development in the situation of depletion of conventional resources (PREDA [8]).

The energy obtained from biomass comes from the valorization of wastes from forestry and agricultural holdings, waste from wood processing activities, and other products; biogas is also the result of anaerobic fermentation of manure city water treatment plants.

It is important to remember that the biomass resources with the greatest energy potential in our country come from agriculture.

Biomass is, for Romania, a promising renewable energy source which, at the national level, has an energy potential as follows:

- 63.2% of agricultural wastes from vegetable scraps, cereals, maise stalks, vines;
- 7.7% of biogas;
- 6.4% of firewood and forest wastes;
- 15.5% of sawdust, wood wastes, and other wood scraps;
- 7.2% of household wastes and various urban wastes.

The potential of biomass in energy production depends on the type of use in the region:

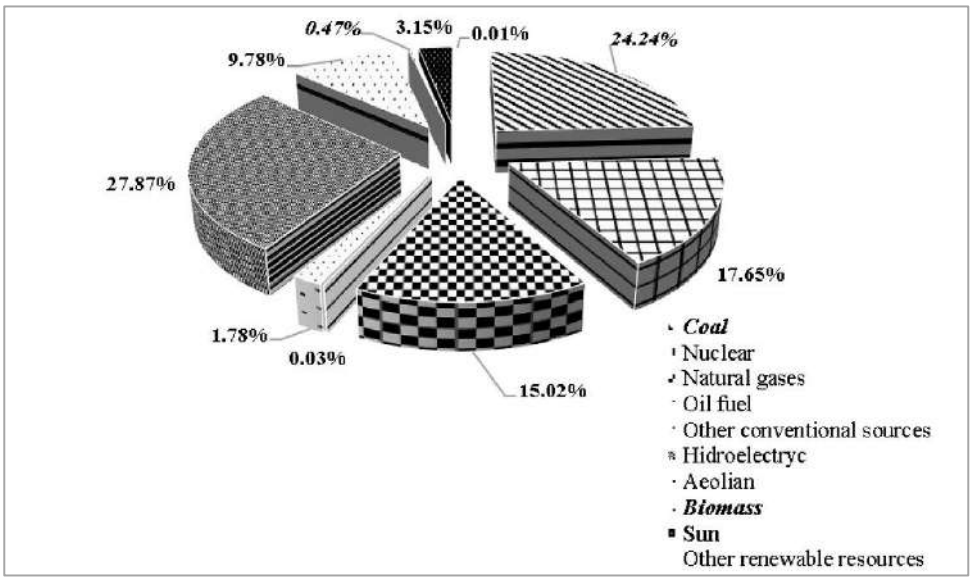


Figure 1. Electricity production in Romania, 2018

The Timis region covers an area of more than 869,665 ha, mainly used for agriculture. Note that Timis County, according to official data, ranks first in Romania with the richest potential in agricultural resources, i.e., 1,432 thousand tons, followed by Calarasi County with 934 thousand tons and Braila with 917 thousand tons. In Timis, the potential amounts to 21,336 TJ, of which 98.6% from agriculture and only 1.4% from the forestry industry.

As a result of large agricultural crops, a generous amount of vegetable wastes that can be an important and cheap source of energy for both heating living spaces and heating greenhouses where vegetables and flowers are produced (TABĂRĂ [11]; POP & al [7]).

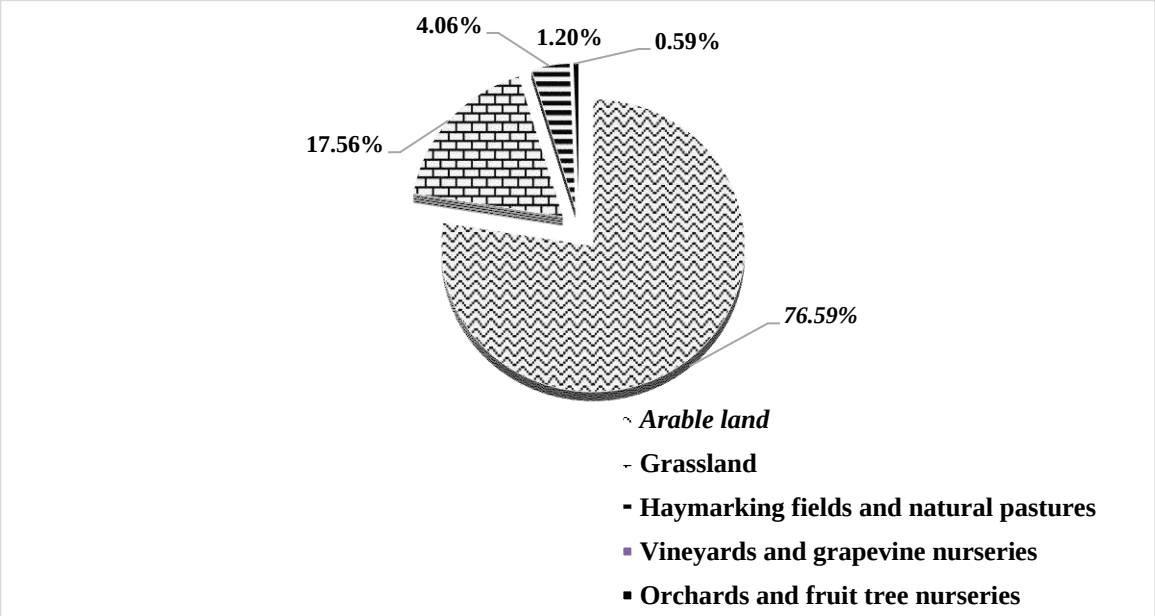
Based on these realities, it was taken into account that Timis County is a region where energy can be produced from biomass for the proper protection of the environment as well as for the quality of life of the population. There are also opinions that the land should be used for the production of food and feed, but some have embraced the theory that it is wrong for agricultural land to be used for biomass intended for the production of green energy. A proper assessment of the specifics of each area is needed aiming at exploiting its conditions optimally from all points of view: geographically, pedologically, agro-chemically, of the potential of the resources needed to produce green energy in terms of infrastructure, demographics and, obviously, socio-economically.

The plain Banat, instead, does not have wood resources, which is why wood is very expensive, and the price does not cease to increase: exploitation is limited as resources and transport from higher areas is expensive and is reflected in the price of this fuel. On the other hand, as a result of large agricultural crops, a generous amount of vegetable wastes that could be a cheap source of energy remains for both heating homes and protected areas in agriculture (greenhouses, solaria). Also, in Timiș County, there is an opportunity to produce feed, and briquette facilities can have a dual role. It is very important that the production of feed ensures a continuous flow of operation of briquette facilities, briquette feed having a multitude of advantages compared to unprocessed ones: less storage space (which means that the volume is smaller, the storage is easier), better nutritional value, not to mention the ever-better market, both in demand and, obviously, in price.

Table 1. Structure of the land fund in Timis County

Use category	Area (ha)
Agricultural lands, of which:	693094
• Arable land	530808
• Grasslands	121741
• Haymaking fields and natural pastures	28106
• Vineyards and grapevine nurseries	8334
• Orchards and fruit tree nurseries	4105
Animal husbandry buildings	2058
Degraded, unproductive lands	4190
Area of the forest funds managed by the Timiș Forestry Directorate	84370
Area of the forest funds managed by the R.P.L. Stejarul R.A. Forest Office	8812

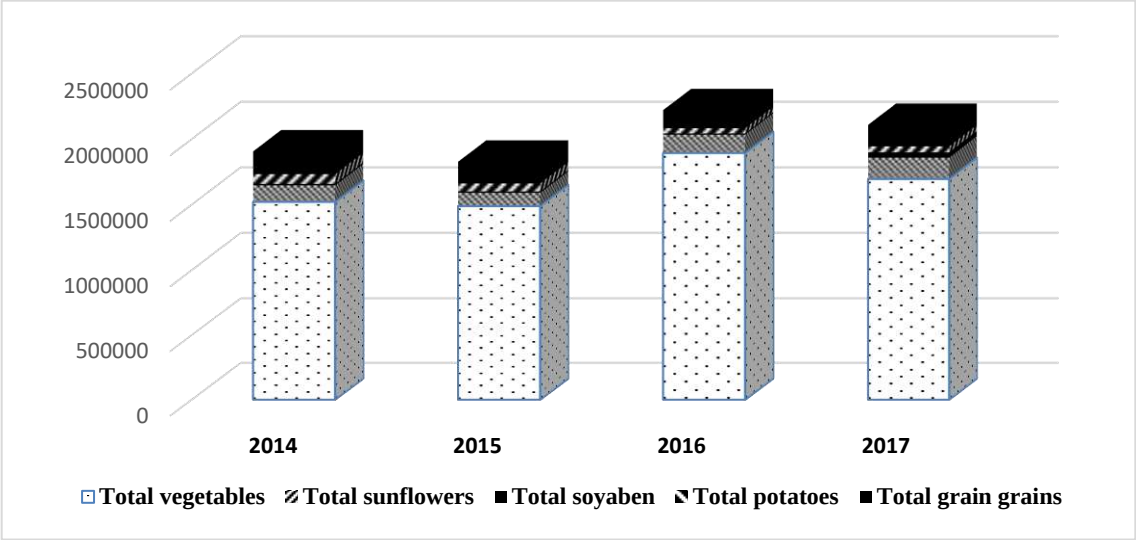
Source: Timiș County Agricultural Directorate, Timiș Forestry Directorate



Source: After the Country Report on the State of the Environment for 2017-Timis Country

Figure 2. Structure of agricultural areas by type of use in Timis Country.

According to Figure 2, the largest share of the area of Timiş County land (76.59%) is arable land. As regards the agricultural crop production obtained in Timiş County, we note that the highest yields are in cereal crops (mainly maise and wheat), but significant increases in 2017 are also recorded in sunflower and soybean crops, as shown in Figure 3.



Source: After the Timiş County Statistical Yearbook for 2017

Figure 3. Evolution of vegetable production in the main crop groups in Timis County.

In Romania, the long-awaited law is in force, which is intended to encourage the production of energy from SREs. This is Law No. 220 from 2008 **for the establishment of the promotion of the production of energy from renewable energy sources**, a law that has undergone various changes. Thus, by the provisions of Law No. 134 from 2012, the energy produced from wood biomass and vegetable wastes from alpine pastures or from green space toileting and roadside care benefits, in addition to the three certificates granted for 1 MW produced and delivered on the network, from an additional one. The most recent amendment of Law No. 220 from 2008 and some norms

in the same field, made with the aim of meeting the national target of achieving 25% SRE of the total energy that will be consumed in Romania in 2020. It should be noted that, depending on the type of waste used or the destination of consumption, the amount of heat resulting from the energy recovery of biomass has various weights in the balance of primary resources.

Table 2. The biomass energy potential of Timis County

Type of biomass	Theoretical potential (GWh/a)	Technical potential (GWh/a)	Potential to be materialised by 2020 (GWh/a)
Urban sludge	26	26	12
Waste water	58		
Urban wastes	872	315	315
Household organic wastes	314	314	314
Paper, cardboard, plastic sheets	59	59	59
Street wastes	6	6	6
Total organic wastes	10.004	5.002	5.002
Sugar beets	0.3	0.3	0.3
Tomatoes	173	173	173
Vegetables	61	61	61
Straws (Hay)	7.970	3.985	1.993
Swine	>1.800	>1.800	>1.800
Waste dumps	250	25	25

The use of biomass to obtain thermal energy needs to be improved in technology and efficiency. A pellet is a fuel in the form of a mini-briquette obtained by pressing wood chopping, agricultural crops, vegetable mass (vegetable wastes or sawdust resulting from the cutting of logs, or primary and secondary wood processing as well as wood chopping from wood waste).

An important raw material for the production of pellets is also biomass obtained from energy crops.

Pellets are a form of "clean"fuel for the environment that can be an alternative to natural gas, especially since the price of natural gas is on a rising trend and increasingly expensive. This fuel is 20-25% cheaper than natural gas, without posing a danger of explosion and using it as comfortably.

Compared to firewood, pellets are more cost-effective as combustion efficiency, calorific power, storage, handling, comfort, and safety in use.

High-performance biomass plants, i.e., pellet plants, can provide heat and hot water for schools, hospitals, administrative buildings, kindergartens, tourist hostels, greenhouses, and SMEs in both rural and urban areas. These power facilities have an installed power between 50 and 500 KW.

In relation to the subject of this study, i.e. the se of biomass from agriculture, for the production of green energy, means straw briquettes which are an environmentally friendly fuel very much used in European countries.

As shown above, these pellets use as raw materials all categories of wood and wastes from primary agriculture such as corn cobs and leaves, wheat straw, rice straw, nut and hazelnut shells, sunflower shells, etc.

The conversion of straw into briquettes is carried out by pressing finely chopped straw mixed with either sawdust or seed shells, in order to have a calorific power, because if the only straw is used, their calorific power is only 4.07 kW/kg, thus equal to half of the calorific power of the oil.

It has been demonstrated that briquettes give up to three times more energy than dry wood, eliminating a minimum amount of carbon dioxide and smoke and ash can be used as a natural fertiliser.

Calculations show that one ton of briquettes is equivalent to five cubic metres of wood, about one tonne of coal and prices are twice as low as coal and twice as much as 560 cubic metres of natural gas.

A ton of straw pellets is sold for a price starting at 500 lei. The user, therefore, pays about 20-30% less for the same amount of heat. A minimum of 4,500 Kcal/kg is produced from a 15 kg bag and, for example, an area of about 200 kg is used for a maximum of one tonne of pellets per month. The user, therefore, pays about 20-30% less for the same amount of heat.

Case study: Implementation of the heating system with pellets in Buziaş, Timiş County

For Buziaş, the use of biomass pellets would lead to a substantial reduction in heat costs because the costs are less than two and a half times those for gas heating, due to the advantageous price of this fuel. As regards the constituent localities of Buziaş, Silagiu and Bacova,

which comprise 683 households and a population of 2,438 inhabitants, households which are not currently connected to the natural gas distribution network and, therefore, can only use fossil fuel, namely coal and/or wood, heating by means of pellets would benefit all those households.

By studying the facilities on the market, a suitable biomass processing facility (coke, hay, straw, husks, scrap after threshing, etc.) from cereal plants, legumes, oil-seeds, herbs and plants from energy crops looks like has been identified, processing them into a good quality fuel in the form of pellets/agro-pellets.

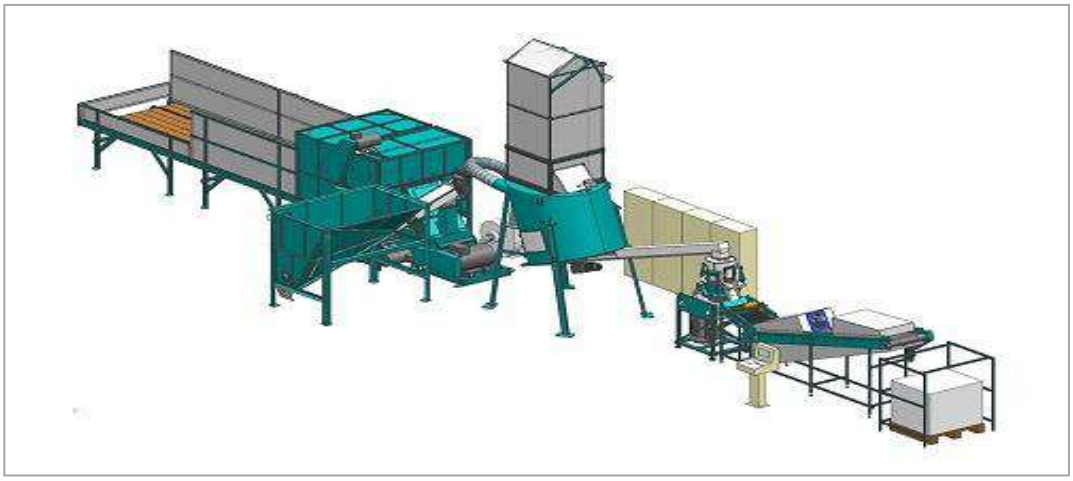


Figure 4. Pellet facility equipment

The facility consists of a dryer with an evaporation capacity which varies according to the desired product, i.e. the plant material subject to processing, machinery for the production of large straw bales/vegetable wastes and machinery for the production of fuel in the form of briquettes/pellets.

Agro-pellets are made from dry biomass, chopped in fine fractions and pressed as granules with a diameter of 6, 8 and 12 mm and a length of 20 to 40 mm. The granules obtained are very compact and have a material density of 1.4 kg/dm3 (much heavier, denser than wood).

Given that, for this type of investment, the raw material comes mainly from agriculture, the supply cannot raise any problems, since the facility will be built in Buziaş, Timiş County, the county with the largest area of arable land in the country. In addition to the vegetable wastes obtained from the care of green areas, wastes resulting from the toileting of trees, there is also the possibility of creating a supply network of raw materials with both large farms and farmers' associations or small farmers, through agreements, contracts or various forms of partnership.

For the processing of biomass resources, available to the Buziaş area, it is necessary to have them go through a technological flow with the role of bringing the biomass to the corresponding granulation state, i.e. about 4-15 mm and at a humidity of 15-17%. After obtaining these conditions, with the help of specialised presses and briquettes machines, the finished product, i.e. pellets or briquettes, is obtained. After obtaining the pellets, they will be packed in bags of different weights and stored.

Regarding the marketing of the final product, some of it, about 5-10%, can be intended for heating the premises that the city has in administration, and the rest can be sold through its own stores to citizens belonging to the local community. If it is not all locally opened production, Buziaş being close to Timisoara, there is the possibility of selling it through shops specialising in the marketing of fuels.

According to the technical data provided by the manufacturers, these are the basic technical parameters for the agro-pellet manufacturing facility at a capacity of about 700/1000/1400/2000 kg/hour of pre-cut wheat straw with a humidity of 14%:

- hay: about 600/850/1200/1700 kg/hour;
- straw: about 500/700/1000/1400 kg/hour;
- sawdust: about 350/500/700/1000 kg/hour.

It should be pointed out that the transport of raw biomass between machines is carried out without the release of dust into the atmosphere. New lines comply with the prescribed.

Conclusion

It was found that, from the point of view of biomass as a resource, bioenergy has the capacity to achieve the significant contribution required, taking into account its great, as yet untapped potential, which comes mainly from the areas of agricultural land available. Consequently,

biomass (with biofuels used in transport) constitutes the resource in more than 60% of the total SREs.

Both the provision of heating and its safety are the main social concerns, and studies recommend the search for technologies to make the use of biomass more efficient for the production of heat in the case of Romania also.

We believe that the individual heating system is still, for many years, the optimal solution for Romania, especially for the population in rural areas, and research shows that the pellets can be a cheaper and more efficient source of energy.

This biomass pelt manufacturing solution is also useful for solving the following problems:

1. Related to environmental protection,

- The fuel is clean;
- The resulting ash can be used as an environmentally friendly fuel;
- Less wood would be used for burning, so it would no longer need so much wood and protect the forest fund;
- Wood and agricultural wastes, once processed in the form of pellets, add value to the raw material that would otherwise be wasted and parks, roadsides and other green spaces would be cleaner;
- The process of manufacturing the pellets is not polluting.

2. Related to social issues, because:

- The problem of supplying the population with economically affordable fuel in relation to their purchasing power would be solved;
- Some of the unemployed persons receiving social aid from the state may carry out the work of collecting wastes and plant wastes;
- It would also create jobs directly (which do not involve a higher qualification of staff) or indirectly, as a consequence of the fact that the profitability of the heating systems of accommodation, food and other services specific to the activity of the resort in Buziaș would make those investments more efficient, for the benefit of the business environment and the socio-economic life of Buzias.

Conflict of Interest

The authors have no conflict of interest to declare.

References

1. CÂMPEANU V. Politica României în domeniul surselor regenerabile de energie, Energiile regenerabile încotro? Între „mituri” și realități post-criză din Europa și România. *RO: Universitară, Publishing House* (2014).
2. JURJESCU A., NAN A., MATEOC T., BACĂU C., MATEOC–SÎRB N. Study on cultivated areas and productions in Romania in the main crops in a European context. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 20 (3), (2020).
3. MATEOC-SÎRB N., BACĂU C., FEIER-DAVID SAIDA, MATEOC-SÎRB T., NAN A., SICOE-MURG O. Use of renewable energy sources in the context of sustainable development. *Fascicula: Protecţia Mediului*, XXXIII (2019).
4. MATEOC-SÎRB N., GAVRILESCU C., MATEOC T., NAN A., MĂNESCU C. Assessment of biofuel production efficiency on the agricultural farms in Romania. *Energy and Clean Technologies,* 18(4.1): 149-156 (2018).
5. MIHALACHE D., VRÎNCEANU N., TEODORESCU I., MIHALACHE M., BACĂU C. Evaluation of the effect of 15N-labeled fertilizert on maize plant. *Rom Biotechnol Lett*, 24(1): 193-199 (2019).
6. OTIMAN P.I. Nevoia de viitor a României. *Agricultura Banatului*, nr. 1, Timișoara (2019).
7. POP G., TABĂRĂ V., CIOLAC V. Improving oilseed rape technology. *Scientific Conference Energy efficiency and agricultural engineering,* Rousse-Bulgaria 5:301-305 (2006).
8. PREDA GH. Risipa de resurse natural.Bucharest, RO: *Fundația Universitară Internațională „Resurse naturale: prezent și viitor” Publishing House* (2006).
9. ROCKSTRÖM J. et al. A safe operating space for humanity. *Nature*, 461: 472-475 (2009).
10. ȘERBAN M.E. Bioeconomia. Noua unire cu natura. *RO: Universitară, Publishing House* (2013).
11. TABĂRĂ V. Cultivarea şi prelucrarea plantelor oleaginoase în scopul obţinerii de biocombustibili. *RO: Eurobit, Publishing House* (2009).
12. TABĂRĂ V. Fitotehnie, partea I, Plante tehnice, oleaginoase şi textile. *RO: Brumar, Publishing House* (2005).
13. VALIN H., D. PETERS M. VANDENBERG S. FRANK P. HAVLIK N. FORSELL and C. HAMELINCK. The land-use change impact of biofuels consumed in the EU: Quantification of area and greenhouse gas impacts. A cooperation of *Ecofys, IIASA and E4tech* (2015).
14. CE, Europe 2020 targets; Acord de Parteneriat propus de România pentru perioada de programare 2014-2020, vers. a II-a, martie (2014).
15. European Commissioner, Clean energy for all, Europeans (2019).