BIOMASS VALUATION IN THE CONTEXT OF SUSTAINABLE AGRICULTURAL DEVELOPMENT IN ROMANIA

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A R T I C L E I N F O

Original Article

Received: *25 May 2020*

Accepted: *12 August 2020*

doi: 10.5937/ekoPolj2003699P

UDC 631.164:604.4]:502.131.1(498)

Keywords:

biomass, agriculture, compost, anaerobic digestion, sensitivity analysis, environment, renewables

JEL: *H23, N5, Q2*

A B S T R A C T

Achieving a sustainable agricultural development in Romania represents a major challenge in adapting to new environmental conditions and ecological efficiency. Agriculture has proven over time to be a sustainable producer of biomass, able to offer both in terms of main production of energy crops, and through secondary production or byproduct. In this context the main aim of the manuscript is to asses and analyzes the biomass valuation in the larger context of sustainable agricultural development in Romania. The results prove that biomass is an eligible candidate in valuing the agricultural potential and develop future mechanism in promoting renewables. Taking into consideration these aspects, the manuscript is in line with the current researches in field analyzing the biomass potential in developing new clean and sustainable energy production.

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Introduction

The evolution of contemporary societies is marked by a complex set of phenomena, of various natures and components, often with antagonistic manifestations and giving a long time, this care can imprint in front of economic countries and a structural society as a whole, model and behavior. In this context, climate change is a significant care challenge facing contemporary care society and can be avoided inevitably and hard to fight. As it is already argued in literature (Karl, T. R., & Trenberth, 2003; Jordan, A. et al., 2018; Yeganeh et al., 2020), one of the phenomena with major impact on human civilization is climate change, which is occurring with increasing intensity, is a serious cause for concern for all inhabitants of the planet.

The difficulties and complexity of climate change require a proper understanding of both the need to achieve substantial reductions in greenhouse gas emissions but also to identify new, less polluting and environmentally friendly energy sources (Vasilescu et al., 2010). The continuation and endorsement of polluting processes and processes is tantamount to the future need to impose much harsher and more costly adaptation measures for future generations. As it is shown in literature (Armeanu, D et al., 2018), there is a massive link between environmental pollution and economic growth, and promoting renewables may increase the intrinsic economic growth.

As it is presented in (Christensen, J. H et al., 2013), climate change that is currently taking place globally is reshaping the world today, increasing the risks of instability in all its forms and at all levels. The data published in the last decades by the competent authorities, highlight the years with the highest temperatures in the history of meteorological or known records. Also, in the same study (Christensen, J. H et al., 2013) is shown that the trend is obvious and the global warming substantially changes the environment and increases the frequency and intensity of extreme weather events. That is why it is essential that decision-makers at the global, regional or local level mobilize and take immediate action to combat climate change (available at: Christensen, J. H et al., 2013).

Strategies for adapting to new environmental requirements and for promoting green energies, cleaner and more adapted to daily needs, must be compatible and complementary and at the same time generate credible and sustainable achievements at the level of society (Andrei & Andreea, 2018). Reducing greenhouse gas emissions to tolerable and at the same time economically efficient target levels requires orientation towards biomass and other energy sources that in the past have been exploited at a lower level than potential.

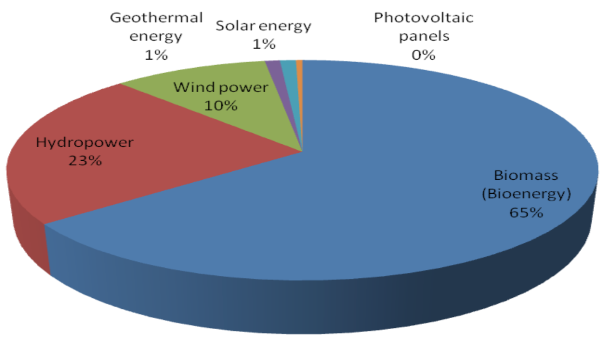
As (Allen et al., 2016) present, one of these actions could be the use of renewable energy resources. It is known that sustainable renewable energy sources contribute to climate change mitigation by reducing greenhouse gas emissions, environmental protection and the process of sustainable development (Allen et al., 2016). It is also well known the fact that the sustainable development of a country's national economy, and not only, requires a continuous and secure energy supply (Lehr et al., 2012). The growing demand for energy at the global, regional or local level makes energy supply a complex global problem, which could be solved on the basis of the use of renewable energy resources, such as energy obtained from biomass. Biomass is the biodegradable part of agricultural products, waste and residues, including plant and animal substances, forestry and related industries, as well as the biodegradable part of industrial and urban waste (available at: www.legex.ro).

However, there does not appear to be a unanimously accepted definition of biomass. There are bibliographic sources that claim that biomass is the set of non-fossil organic matter, which includes: wood, chaff, oils and vegetable waste from forestry, agriculture and industry, but also cereals and fruits, from which ethanol can be made (Gunaseelan, 2004; Dusmanescu et al., 2016). Biomass reserves are mainly wood waste, agricultural waste, household waste and energy crops (available at: www. revista.newprojects.org, Stoicescu M. et al., 2006). As it is presented in literature (Field, C. B et al., 2008; Abbasi, T., & Abbasi, S. A., 2010; Morato, T.,et al., 2019), without any exaggeration, it can be said that biomass is one of the most important renewable energy resources, being available for use all over the world. Continuing with presenting the advantages as in (www.energie.gov.ro), the affordable cost and the neutrality of greenhouse gas emissions make biomass a promising energy resource for energy supply in the future, but also now, anywhere in the world, including in our country (available at: www.energie.gov.ro). As in the case of fossil fuels, the combustion of biogas, obtained from biomass, also results in CO_2. The difference between the two fuels is given by the origin of carbon in biogas, which is taken from the atmosphere by plant activity, thus ensuring a neutral balance on greenhouse gas emissions. Hence the neutrality of biomass in relation to greenhouse gas emissions.

In accordance with European Commission (2018), the new demand for wood biomass could further diversify agricultural activities today, on up to 10% of EU agricultural land (available at: https://eur-lex.europa.eu). This will provide new opportunities to explore abandoned land, as well as to reconvert the land currently used for biofuels resulting from food crops. This will improve agricultural productivity and incomes and, most likely, the value of arable land will increase accordingly.

For Romania, biomass is a renewable energy source, with encouraging prospects, both in terms of potential and in terms of use. Thus, in Romania, biomass represents 65% of the renewable energy potential (Figure 1).

Figure 1. Distribution of renewable energy sources, thousands of tone - 2020 estimate.



Source: Authors' interpretation, based on data from *The Biomass Master Plan for Romania = Master Plan Biomasa pentru Romania*

The biomass energy potential, estimated at approximately 7.6 million tons / year or 318,000 TJ / year, represents approximately 19% of the total consumption from primary sources in Romania (available at: www. add-energy.ro)

Collecting the organic fraction from the production of vegetables and fruits, from livestock farming activities carried out by rural populations and mixing them with selected biomass in organic landfills is a solution to ensure the raw material of the anaerobic digestion process (Pagés-Díaz et al., 2014). Also, this strategy contributes to the process of sustainable development based on a reduction of the amount of waste, but also a reuse of biomass and its recovery. Thus, waste becomes raw materials. Until recently, the simple solution of composting bimass was adopted, but unfortunately it only partially brought benefits. This process was lengthy, at least three months, could be applied in all seasons only in closed halls, the leachate obtained being difficult to treat. The composting plant processes for average communities in Romania that have in agriculture as the only source of income biodegradable waste, on 2 streams, cumulated up to 3 ÷ 6 t / day (Bernal et al., 2017). In most of the agricultural regions in Romania there is no separate system for collecting biomass and implicitly for processing the biodegradable fraction. Another major disadvantage is the lack of trained personnel in the field of composting, legislative gaps in compost quality, composting technique that is often not adequate to the quality of the raw material, the difficulty of ensuring the raw material in constant quantity. For example, during the season there are large amounts of plant biomass while in the off-season, the amount is very small and must be stored to ensure a complete batch of raw material necessary for the proper functioning of the composting process (Rashad et al., 2010).

The area for which this study was conducted is representative of the rural agricultural activity in Romania. The number of inhabitants is 2950, and the individual agricultural activity is developed both in the field of vegetables and fruits and in the field of cereals specific to the climatic zone of Romania: wheat, barley and corn. Biomass management resulting from such an area is currently a challenge for Romania. Therefore, there were chosen different options that are part of the Waste Management Plan at the level of each county and which should capitalize on this biomass in the medium and long term. Mixing plant biomass with biomass resulting from household waste from the population is a current solution that prolongs the life of ecological landfills, increases the use of green energy, reduces pollution thus contributing to the sustainable development of a region. The regionalization of these concepts of biomass use is a national solution that can be subsequently transposed from a successful recipe, at the level of each area, through specific customization (available at: www.mmediu.ro).

In the present paper were analyzed the possibilities of capitalization of biomass resulting from household waste and vegetable waste from a rural community in Romania with approx. 3000 inhabitants. It should be mentioned that the agricultural activity of this community is intense, agriculture being the only source of income for the population in this area. Also, the chosen area is representative for Romania due to the specifics of the production of vegetables and cereals. Thus the approx. 70 ha of solariums represent the only activity and the only income of the inhabitants and, as such, their repeated exploitation leads to the generation of a quantity of biodegradable waste that are randomly deposited in the area or when they reach the ecological ramp thus unjustifiably occupying a large volume. The situation is similar in all associated localities (available at: www.mmediu.ro). The area where the project is located does not benefit from any system of selective collection of household waste and biodegradable waste. The typology of activities in the rural area and of the small entrepreneurs represented by vegetable growers in solariums lead to the obtaining of an important quantity of biodegradable waste, namely over 5900 tons of waste from these farms. For this waste there is no solution for taking over by the waste collection and transport operators or by the waste landfill operators. The non-existence of a fraction collection system actually derives from the lack of a biodegradable fraction processing solution in the county or in the region. Separate waste collection is an urgent need and should be applied especially in the area of collection of the organic fraction which is in large quantities and which represents an objective of the local authorities achieved to a small extent so far (Panaitescu et al., 2015, Marcikic et al., 2019). The paper discusses two scenarios, namely the technique of composting and fermentation applied to the chosen area. The application of fermentation techniques versus composting techniques makes this collection process attractive to the community and contributes to increasing farmers' incomes. In addition to incremental income, they gain important new social functions, such as energy suppliers and waste treatment operators. The biogas installations offer besides the obtained energy also a necessary component to the soil, namely the digestate which is a good fertilizer through the C / N ratio it has (Heo et al., 2004). Compared to the composting part, it also has the advantage of eliminating odors and occupying small production spaces (Anh et al., 2010, Cho et al., 1995). The advantages and disadvantages of performing one of the two scenarios and the combination of the two technologies are presented in the Table 1:

Table 1. The advantages and disadvantages of performing one of the two scenarios and the combination of the two technologies

Alternative	Benefits	Disadvantages
Anaerobic digestion	- reduced occupied space, leaving room for future developments (modularizations), necessary with the expansion of the collection area and the quantities collected; - optimal control of operating parameters; - non-existence of odors; - proven efficiency and viability; - training capacity in accordance with technological advances in the EU and in the world, important for the training of specialists in this field in Prahova;	- high initial capital; - more complicated operation and technology, presenting difficulties considering the lack of qualified labor force in Balta Doamnei and in the neighboring communes; - the existence of a large number of "proprietary technologies", patents, which makes it difficult to bid, especially since there are few specialists in the Region and in the county to carry out the specifications and evaluations;

Alternative	Benefits	Disadvantages
Composting	- very low initial capital; - easy access to all composting areas; - handling	- low odor control; - long composting time; - sensitivity to weather conditions (in the open field version);
The combination of the two technologies	- versatility, quality control of the compost; - very high capacity to train human resources; - high demonstration capacity	- operation more complicated than the variants in unique technological lines - high initial investment

Source: authors' own design based on literature survey

At the end of the study, the possibility of building the two installations is discussed so that all the advantages given to the maximum capitalization of biomass can be capitalized

Materials and methods

In order to be able to perform a cost-benefit analysis that would be the basis of a sensitivity analysis, it was necessary to conduct field studies carried out by the authors during eight years in which both the annual increases of individual productions and the drastic decreases of individual productions caused by meteorological imbalances were taken into account: floods, hail, drought. Therefore, the picture was complete, allowing the choice of the most appropriate procedure for capitalizing on biomass. In order to find an optimal biomass processing solution, the authors proposed two scenarios:

1. biomass processing in a composting station
2. biomass processing in an anaerobic digester.

We started from the premise that both scenarios can be applied simultaneously, when the quantity and quality of biomass allows it, or a single scenario can be chosen if the cost-benefit analysis shows that one of the two is the most favorable. Also, in this paper are presented the results regarding the generation of compostable waste from the chosen area, waste that will later be mixed with plant waste generated by individual agricultural producers. During the entire study, the quality of biomass subjected to composting and fermentation was analyzed; the results obtained encouraging future investments. The analyzed parameters of biomass analysis resulting from plant residues mixed with biomass resulting from the sorting of household waste are presented in Table 2.

Table 2. The analyzed parameters of biomass analysis

No	Performed analysis	U.M.
MANDATORY INDICATORS		
1.	pH	pH Units
2.	N max	%
3.	ORGANIC MATERIAL	%
4.	K_2O	mg/l
5.	P_2O_5	mg/l
6.	SALTS	g/l

No	Performed analysis	U.M.
7.	WATER CONTENT	%
8.	C/N	-
9.	IMPURITIES	%
OPTIONAL INDICATORS		
10.	EC	%
11.	Na soluble	mg/l

Source: authors` based on Zhang et al., 2007

The study of composting was performed through the furrow system, the duration of a composting process being three months.

The quality of the compost was monitored according to the composting phases, following the variation of the specific physico-chemical parameters. For each composting phase, presented in Table 3, daily measurements were made so that the parameters that did not have variations corresponding to the respective phase could be modified in due time without affecting the final quality of the compost.

Table 3. Composting phases and their general characterization

Composting phase	Temperature	Characteristics
A1. Mesophilic fermentation phase	20-40°C	Development of the microorganism population C: N can reach values up to 30
A2. Thermophilic phase	50-max.70°C	Decomposition reactions occur
A3. Maturation phase	Max. 22°C	Condensation and polymerization reactions, the degraded material is transformed into humus C: N can decrease to 15

Source: authors` based on Angelidaki et al., 2009

The composting process was monitored by analyzing the following parameters: pH, humidity, organic material content, nitrogen, C / N ratio, ammonium, nitrates, nitrites, P, K, Ca, Mg, Na, chlorine, sulfates, salinity, electrical conductivity and the content of impurities. The final stability of the compost was assessed by monitoring the appearance of pathogenic microorganisms, namely: salmonella, E. coli, C. perfrigens, listeria spp. To ensure optimal aerobic activity, throughout the experiment the strings were aerated using a system to turn the furrows and aeration. The oxygen supply brought during the aeration process, which contributes to the dynamics of the microorganisms, allows the water content to decrease and does not allow the limit of 70 ° C to be exceeded. The biomass characteristics required for the composting process are presented in Table 4.

Table 4. Desired characteristics for composting processes

No.	Characteristics	Reasonable variation	The desired variation
1.	Carbon: nitrogen ratio	20:1 – 40:1	25:1 – 30:1
2.	Humidity	40 – 65 %	50 – 60 %
3.	Oxygen content	> 6%	16 – 18,5 %
4.	pH	5,5 – 9	5,5 – 9
5.	Apparent density	< 640 kg/m3	
6.	Temperature	43 – 60 0C	54 – 60 0C
7.	Particle size	0,3 – 5 cm diameter	-

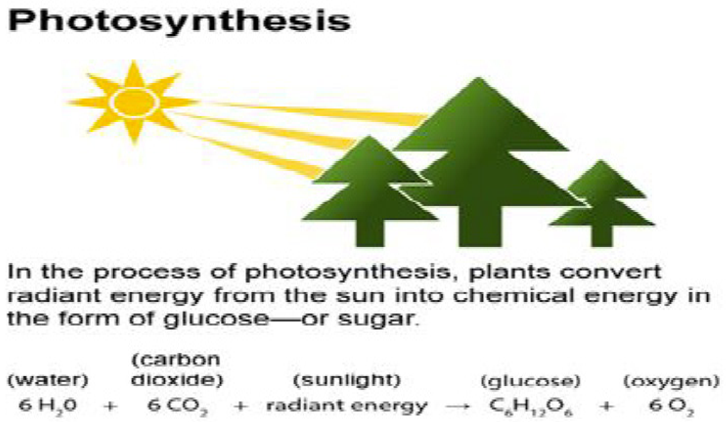
Source: authors' own analysis

In the process of anaerobic digestion, biogas results from the microbial degradation of biomass, formed by photosynthesis with the help of solar energy ES (Cho at al, 1995):

Carbon Dioxide + Water + Solar Energy => Sugar (Glucose) + Oxygen (1)

Biomass contains accumulated solar energy. Plants absorb solar energy in a process called photosynthesis (Figure 2). When biomass is burned, the chemical energy in the biomass is released in the form of heat. Biomass can be burned directly or transformed into liquid biofuels or biogas that can be burned as fuels.

Figure 2. Schematic of hephotosynthesis process



Source: authors' based on www. eia.gov.

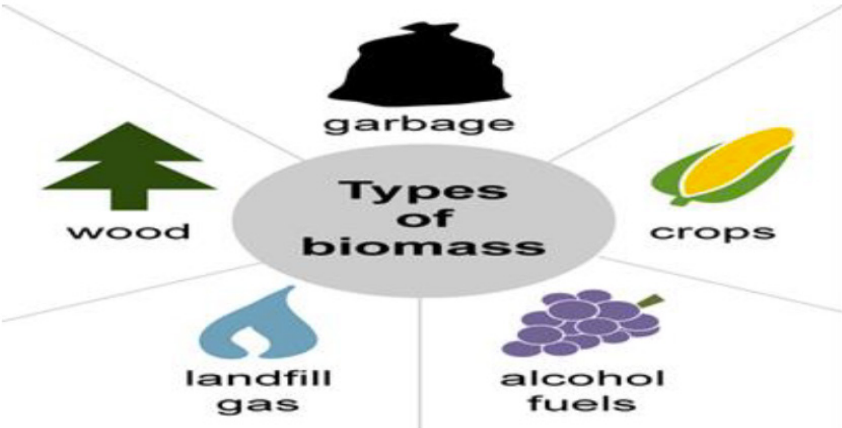
Biomass is represented by (available at: www.eia.gov):

- wood and waste resulting from wood processing;
- agricultural crops (cereals) and residual agricultural materials;
- garbage containing food, household and wood waste;
- manure.

The selection of biomass is done taking into account (available at: www.eia.gov):

- the organic material content must be adequate for the selected fermentation process;
- the nutritional value of organic material, therefore, the potential for biogas formation should be as high as possible;
- the substrate must be free of pathogens and other organisms should be made harmless before the fermentation process;
- the content of harmful substances and garbage must be low to allow the fermentation process to take place;
- biogas composition must be suitable for use for other purposes;
- fermentation residue composition must be usable for other purposes, for example as a fertilizer.

Figure 3. Types of biomass



Source: Authors' own adaptation based on The National Energy Education Project (public domain) (available at: www.eia.gov)

The cost-benefit analysis was based on an intensive collection of waste and biomass from the population, close to the national average. The financial model used was classic and is based on income and expenses. The calculation of the financial performances was made on the basis of the financial indicators and on the basis of the sensitivity evaluation (Cho at al. 1995). Economic variables include savings on landfilling (Lee at al., 2009). The internal rate of return (IRR) and the net present value (NPV) were calculated. The NPV indicator is calculated in the analysis at a discount rate of 5%, 8%, 10%, 12%, 15%. For the calculation of the indicators NPV, IRR, Benefits / Costs and ROI ("return on investment"), a total project budget estimated at valoarea was used. Net present value ("NPV") or VAN in Romanian language, is a measure of the volume of value created or added today by making an investment (Lajos, 2011).

- If NPV> 0, the investment can be made, there is profit generated
- If NPV <0, the investment is not profitable, there is no profit generated

$$NPV = -I_0 + \sum_{t=1}^{n} \frac{NCF_t}{(1+k)^t} + \frac{RV_n}{(1+k)^n} \quad (2)$$

where: I_0 = initial investment;

NCFt = net cash flow, to which are added the public benefits generated by the investment at time t;

RV = residual value of the investment project;

n = duration of operation of the investment project;

k = discount rate.

Another important financial indicator is IRR (Tang at al., 2007):

$$IRR = k + \left[\frac{NPV\ (k^{+})}{NPV\ (k^{+}) + |NPV\ (k^{-})|}\right] * (k^{-} - k^{+}) \quad (3)$$

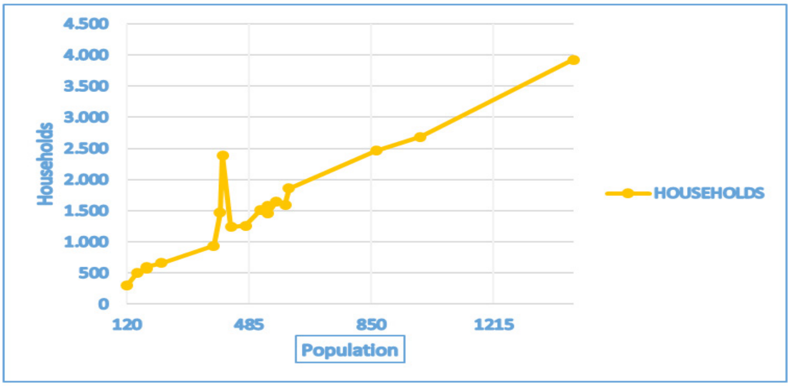
IRR must be interpreted in the context of a numerical value higher than the inflation rate.

Results and Discussions

The amount of compostable waste produced by the population in the studied region was related to the number of households and the population. The classification of households as well as their number in relation to the number of inhabitants respected the rural agglomerations in the studied area. From these quantities was evaluated the total amount of organic waste, the basis of the process of co-composting and anaerobic digestion (Figure 4 and Figure 5).

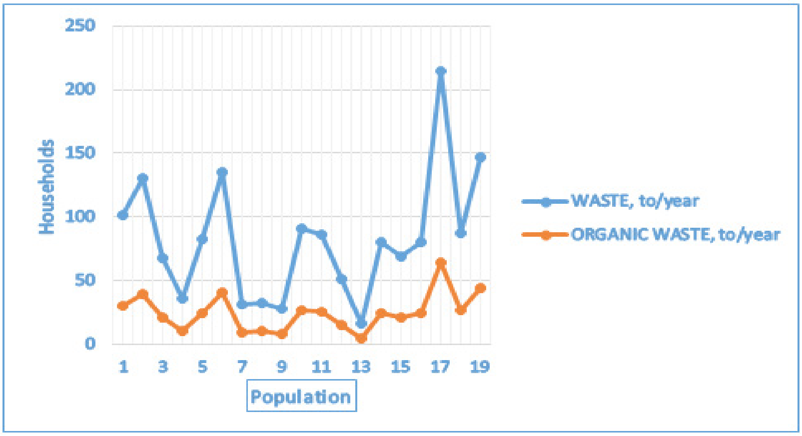
Analyzing the Figure 4 and Figure 5 it is observed that there is a total waste available of 1570 t / year, out of which the total amount of organic material generated is about 500 t / year, compared to a total population of 29000 coming from 9700 t / year households. Thus, calculating the percentage of organic material in the total amount of waste generated, it is 31.8%. This percentage makes the authors' proposal to capitalize on biomass obtained from waste mixed with plant biomass so that it is viable and applicable on an industrial scale.

Figure 4. The amount the population in the studied region in relation to the number of households



Source: Author's own calculations

Figure 5. The amount of compostable waste produced by the population in the studied region in relation to the number of households and the population



Source: Author's own calculations

The analysis of the biomass subjected to composting, the biomass coming from the mixing of the vegetal waste with the biomass collected selectively in the ecological ramp is presented in the Table 5.

Table 5. Minimum and maximum values obtained from analysis of physico-chemical parameters of biomass used as raw material for composting and anaerobic digestion

No.	Analysis performed	U.M.	Values obtained
MANDATORY INDICATORS			
1.	pH	pH Units	6.8-8.5
2.	N max	%	0.3-3.4
3.	ORGANIC MATERIAL	%	7.1-39

No.	Analysis performed	U.M.	Values obtained
4.	K_2O	mg/l	42-240
5.	P_2O_5	mg/l	41-768
6.	SALTS	g/l	1.6-2.8
7.	WATER CONTENT	%	22-44
8.	C/N	-	9-28
9.	IMPURITIES	%	1.2-11
OPTIONAL INDICATORS			
10.	EC	%	1.6-13
11.	Na soluble	mg/l	164

Source: authors' own analysis

In order to be able to process this biomass efficiently, the economic aspects of a composting plant must be discussed.

The appreciation of the investment of a composting station was reported at the existing prices in August 2020 on the specific market in Romania. Table 6 presents the cost estimates of this type of investment.

Table 6. Estimating the costs of building a composting plant

The construction works that will be carried out	Eur
Excavation	5000
Constructions: resistance (foundations, resistance structure) and architecture (exterior closures, partitions, finishes)	3214
Electrical installations	2790
Plumbing	300
Heating, ventilation, air conditioning, fire protection, radio-tv, intranet (exhaust / filter)	500
Natural gas supply installations	0,00
Telecommunication installations	400
Installation of technological machinery and equipment (composter and fan assembly)	2342
Technological machinery and equipment (front loader + rotary composter + fan)	188
Transport machinery and equipment (biodegradable transport garbage truck)	367
Equipment (containers for biodegradables + self-compacting container + measuring equipment)	1278
Water household	300
Pre-treatment plant and emission discharge installation	389
Fencing and protective curtain	318

Source: Author's calculations

The NPV and IRR values are presented in the table 7.

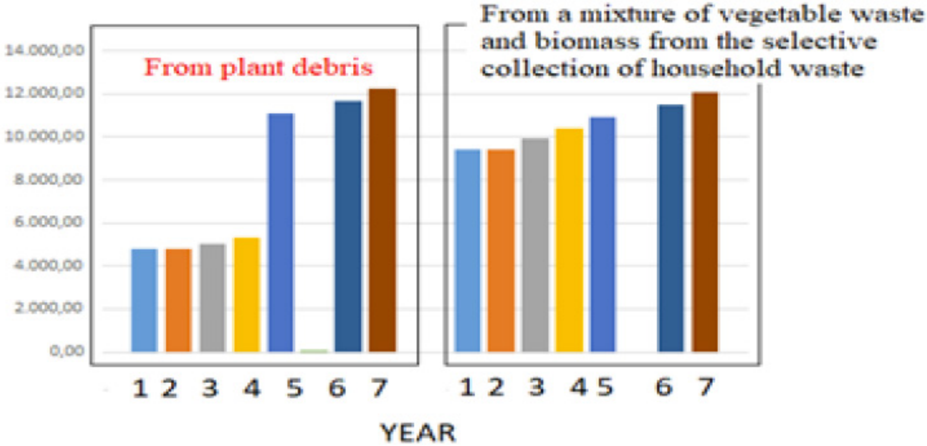
Table 7. The values of the main financial indicators necessary to assess the return on investment

IRR	-7,17%	
NPV (5%)	-1.185.514,74 €	5%
NPV (8%)	-1.190.001,25 €	8%
NPV (10%)	-1.180.150.49 €	10%
NPV (12%)	-1.164.513,19 €	12%
NPV (15%)	-1.137.415,95 €	15%
NPV (5%)(V)	844.832,30 €	5%
NPV (5%) (Ch)	812.378,00 €	5%

Source: Author's own calculations

The results of the financial analysis show that the internal rate of return is negative and quite low (-7.17%), which is common in such investments. The sale of compost will bring estimated revenues according to Figure 6. The projection was made over a period of 7 years.

Figure 6. The sale of compost

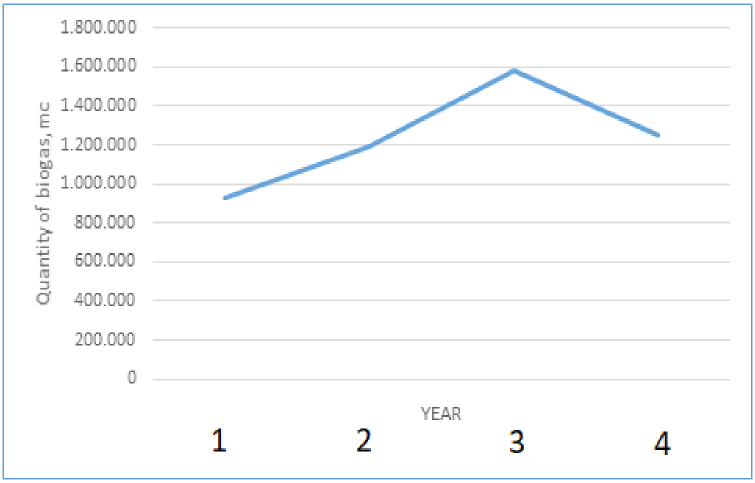


Source: Author's own calculations

The need for a selective collection period leading to low prices per ton of raw material is indicated. In this case, the waste collection operator must be motivated to be able to have the necessary quantities on time without additional costs. Analyzing the Net Present Value (NPV), it is observed that it is negative and close to the value of the investment. All these calculations show us clearly that the investment must be supported from national development funds and not from private capital as it is now being done at the level of the regions. In the European Union there are few such investments made entirely with private capital. Supporting these types of private equity investments will lead to failure in either operation or investment, which subsequently makes it unprofitable. The amortization of the investment can be made from the sale of the resulting compost and the extension of the operation period of the household waste landfill. Compost generators could be the ones who would get back the compost needed to produce vegetables and fruits. So in this case the market is covered.

The scenario in which the anaerobic digestion process is applied, the estimated amount of biogas is presented in Figure 7 (annual averages were calculated). The concentration of methane in the estimated amount of biogas is between 22% and 49.6%.

Figure 7. The amount of biogas resulting during four years of operation



Source: Author’s own calculations

The amount of biogas that will be consumed was calculated especially for the first five months of the year when there is large consumption both in the population and for greenhouse heating. The calculated values are presented in Figure 8.

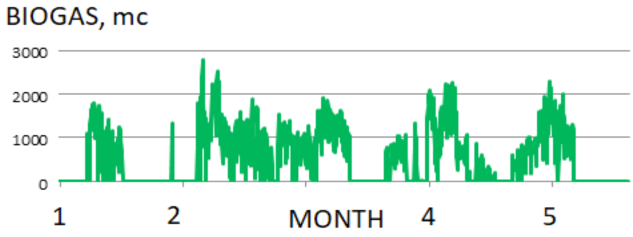
The sensitivity analysis was done taking into account the risk factors induced by the compost sales market. The risk variables, from a financial point of view (which were analyzed above) are:

- the price obtained per ton of compost;

- the amount of vegetable waste generated;

- the percentage of transformation of vegetable waste into compost.

Figure 8. The amount of biogas that will be consumed in the first five months of a climate-normal agricultural year



Source: Author's own calculations

The separate collection of the organic fraction is another source of uncertainty, given the same lack of experience. In other EU Member States, experience has shown that it is quite difficult to obtain a suitable organic fraction for composting. The sensitivity analysis includes the sensitivity of the IRR (RIR) to the variation of vegetal waste quantity generated annually presented in Figure 9.

As the amount of vegetable waste is higher, a return of the RIR value to zero is observed, which is beneficial for the cost analysis of the proposed investment. Following the results obtained, it can be said that the most favorable scenario is the anaerobic digestion system.

The present value of operating revenues equals the present value of operating expenses, which demonstrates the sustainability of the project. A risk and sensitivity analyses were also developed, assuming, among other things, lower prices per ton of compost.

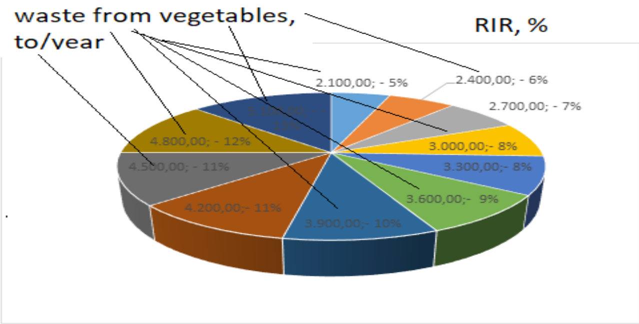
The simulated composting plant together with the anaerobic digestion plant that produces biogas will be located on an area of 21,000 square meters. The stratification of the foundation soil will be taken into account, which is necessary to have a complex clay layer on the surface (clays, dusty and sandy clays, clay powders). Also, sandy layers are interspersed, with thicknesses exceeding 6m.

At the end of this study, it was proposed to build the anaerobic digestion and cogeneration plant together with the biomass composting hall, the construction of which is underway.

The advantages of this investment are the following:

- The modular construction of the installations makes possible the economic operation in the conditions of a variation of biodegradable waste processed quantity;
- biodegradable waste is processed with the most suitable technology for the corresponding type;
- the management system is established with all components simultaneously: collection, transport, processing, marketing and sale of compost;
- the regional approach allows to ensure a sufficient flow of biodegradable waste for profitability.

Figure 9. IRR (RIR) sensitivity expressed in% reported
to the variation of vegetal waste quantity generated annually experienced in to / year



Source: Author's own calculations

Following the constant operation of the chosen solution, it can be seen that after three years of operation, the chosen scenario leads to an increase in cash flow and overcoming the zero profitability barrier.

Conclusions

The paper presents a study of biomass processing in order to reduce the impact on the environment and the transformation of plant biomass and waste into raw materials. The scenarios were taken into account, based on the two processes applicable to the area representative for Romania are: composting and anaerobic digestion. The average percentage of organic matter determined in the present study from the two sources of origin provides the basis for the composting process. Sustaining an investment from private funds is not possible according to the economic indicators determined in the paper. The sensitivity analysis took into account the risk factors and showed that it is efficient to combine the two processes and to build two installations. Such an investment can lead to the rural development of the targeted area.

Conflict of interests

The authors declare no conflict of interest.

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