THE ECONOMIC SUSTAINABILITY OF A MODEL THAT BALANCES ECOLOGICAL AND POWER SUPPLY NEEDS

SNEZANA KIRIN[1], PAVEL KOVAC[2], BORISLAV SAVKOVIC[2], SLADJANA MIRJANIC[3], LUBOMIR SOOS[4]

[1]University of Belgrade, Innovation Center Faculty of Mechanical Engineering, Belgrade, Serbia

[2]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia

[3]University of Banja Luka, Faculty of Science, Banja Luka, Bosnia and Herzegovina

[4]Slovak University of Technology in Bratislava, Faculty of Mechanical Engineering, Bratislava, Slovak Republic

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e-mail: snezanakirin@yahoo.com

Energy from biomass have a number of good features. These crops have a positive effect on the environment, ecology and environmental protection because they serve as a means of rebuilding the degraded area. This paper presents the Miscanthus plant that is for some time used as energetic. It also present a research that has carried on the degraded surface of the landfill. The establishment of plantations is to increase the quality of soil and the produced energy from biomass. The study found that there are some problems in the formation of energy crops in the territory of the landfill. The large dependence of the water because the soil is composed of various landfill construction, animal, municipal and industrial waste, and is quite porous.

KEYWORDS

Energy crops, degraded land, economic aspects, sustainable development

1 INTRODUCTION

Atmospheric CO_2 concentrations have increased because of increased combustion of fossil fuels and changes in land use, Grassland ecosystems comprise 25% of the global land area and have a high soil organic carbon content, [Yazaki 2004, Clifton-Brown 2007, and Agostini 2015]. Bioenergy is often promoted as a low-carbon (C) domestic energy source that provides development energy source that provides development opportunities for rural communities, [Nackley 2013, Anzoua 2015]. Because of that, there is widespread interest in biofuel crops as a solution to the world's energy needs, particularly in light of concerns over greenhouse gas emissions, [Schnitzler 2015, Robertson 2015].

The Directive of the European Parliament, [Directive 2009] on the promotion of the use of energy from renewable sources is a current and binding document to regulate the use and development of renewable energy in general, and thus the application of biomass energy technologies that use biomass to produce heat and electricity and for traffic.

Management of marginal lands, which include brown fields, contaminated sites, and land with a low agricultural value, has become a crucial concern in developed and densely populated countries. The management of this marginal land, which covers large surfaces, requires innovative and sustainable solutions to reduce human and environmental risks

Energy crops have more good features. Such crops have a positive effect on the environment, ecology and environmental protection because they serve as a means of rebuilding the degraded areas. Ecology researchers found that Miscanthus cropping enhances regeneration of soil microbiological functions and services in polluted soil by stimulating populations beneficial for soil fertility and crop production, [Bourgeois 2015].

In this paper is presented a plant of Miscanthus, which is in the world for some time used for energetic benefits and also experiment which is carried on the degraded landfill Prelići in Cacak, Serbia [Haines 2015].

The plant Miscanthus (Miscanthus x giganteus), or a giant Chinese silver grass represents an exotic, cold-tolerant, perennial species from East Asia that is used as a second generation biofuel and has a similar structure to bamboo. Miscanthus plants were spaced 84 cm apart at planting and can grow to a height of 3 m before harvest, [Kirin 2013]. It was created by crossing Miscanthus x Sacchariflours (diploid) and Miscanthus x sinensis (tetraploid).

After a description of Miscanthus reminiscent of wild sorghum and sugarcane Italian, but the difference is that Miscanthus grows up to 4 meters, with a lush interior of the leaf mass of a tree contains parenchyma which gives it strength [Fredebaugh-Siller 2013, Clifton-Brown 1997, and Jorgensen 1995].

Reproduction of plants from rhizomes and therefore does not spread uncontrollably in the neighboring area. Conversion of light energy through photosynthesis, Miscanthus biomass gives excellent.

Harvesting is done in late autumn or early spring before new shoots appear. This allows the nutrients back into the root system and the plant material is dried to moisture content of less than 15 %, prior to harvest Compared to other plants used for ethanol production, the giant Miscanthus grass produces more total weight, and more ethanol.

Another great advantage is that Miscanthus grass crop that is not used for food. It is known that ethanol can be obtained from corn, but in this way creates a fuel of the product that could be used for human or animal. When market forces changes in demand for corn could result in uncontrolled variations in price which strongly affect the price of food. Because Miscanthus grass is not a crop for food in the Western hemisphere, changes in demand will have a direct impact on the cost of food, unless the land used for food crops converted to grow this crop.

How old plant, aboveground biomass is developing faster in everything from the third season of growth. Full biomass growth is achieved in the second to the fifth year, depending on climatic conditions. It usually reaches a maximum yield in the second year in southern EU countries, in the north up to five years [Lewandowski 1998, Jorgensen 1997].

Miscanthus X giganteus does not require annual planting and processing, and is environmentally friendly, energy plants, reflected in several aspects. The advantages of its using are:

- High yield
- Increases soil fertility through the root system sucks up water and harmful substances from the deeper parts of the land to nourish;
- Improves morphological and microbiological characteristics of the land;
- Allows the accumulation of plant cover because it is a perennial plant;
- Excellent water holding capacity and filtering water;

- Significant reduction in greenhouse gas emissions compared to the conventional fuels;
- Provides habitat for birds and mammals through the lush vegetation, because there is no enemy because it is not a plant table, [Bassam 2001];
- It has zero emissions of CO_2 (CO_2 released during combustion in the same amount that it was necessary for the growth of biomass so maintain the natural balance);
- Carbon sequestration from land, [Nsanganwimana 2014, Semere 2007];
- Low maintenance cost, after the establishment of plantations (has a very low nutritional needs - effectively leverages nitrogen and therefore is able to grow on barren land without the aid of heavy fertilization).

The challenges that must be resolved to growing crops were commercially:

- Easy expansion (this hybrid is sterile and therefore spreads vegetative - via their rhizomes).
- Expensive establishing plantations
- Transportation of the harvested material
- Expensive storage.

In the United States are many types of Miscanthus grown as ornamental plants for more than 100 years, and today it is in the United States increasingly explore the possibilities of application of Miscanthus as a biomass energy and there are attempts to develop more effective, more commercial types of Miscanthus grass in order to reduce the nation's dependence on foreign oil. There are reports about the research possibilities of using Miscanthus as a raw material for plastics and other traditional petroleum products.

In Japan, Miscanthus varieties are successfully cultivated and used as building material for thousands of years. It is believed that the life of giant Miscanthus from 15 to 30 years.

According to A. Schnitzler and F. Essl, [Schnitzler 2015], the invasion potential of Miscanthus species needs to be thoroughly tested and monitored.

2 EXPERIMENTAL MATERIALS AND METHODS

2.1. *Economic indicators*

The experiment was conducted to establish the biomass is degraded surface landfill Prelići in Cacak, Serbia [Haines 2015]. The economic component of energy crops is based on the assumption that these plantations are exploited at least 20 years. Formation and planting is cheaper than the technology used for the exploitation of other renewable and alternative energy sources such as hydro, solar panels, wind generators and so on. The cost of procurement of materials and equipment for planting Miscanthus are given in Tab. 1.

DESCRIPTION	Value in Euro with VAT
Supply of rhizomes (EUR cent 0.17 / piece)	2404,35
Supply of herbicide and treatment	166,6
Tools, PPE and fuel for transport workers and watering	153,33
Total per hectare	2724,28

Table 1. Costs of procurement of materials and equipment for planting Miscanthus

The initial investment was 5.448 EUR. Net present value with a discount rate of 8% 32,083.02 €, with a discount rate of 12%, € 21,414.47. Internal rate of return of the project is 20%, and is an effective project because this rate is higher than the interest rates on the market. Based on planning assumptions refund period is about 7 years.

Figure 1. Biomass and pellets of Miscanthus, [Clifton-Brown 2007]

2.2. *Planting*

For planting this plant, it was necessary to prepare the land. It is recommended plowing to 30 cm depth. After the development and consideration of various parameters and references approached procurement rhizomes. For this tour purchased 28000 rhizomes Miscanthus X giganteus, which are covered in the landfill Prelići and a few experimental plants [Haines 2015].

The landfill Prelići planted 26130 pieces of rhizome. On the experimental plots for research and promotion of biomass with different characteristics of land and various altitudes planted in 1870 pieces of rhizome (Tab. 2).

No	Parcel	Surface, Ar	No of rhizomes	Altitude, m	Plant Orientation	The level of planting emergence %
1.	Zablaće	2	250	230	S	80
2.	Gornja Gorevnica	1	120	317	S-E	80-90
3.	Rošci 1	3	380	593	S-W	80
4.	Rošci 2	2	250	762	-	-
5.	Sime Sarage	1	120	242	W-E	90
6.	Slatina	2	250	263	W	60-70
7.	Trbušani	2	250	257	S-W	80

Table 2. Overview of experimental plots Miscanthus

The landfill was before planting, because of the large weeds, treated with total herbicide while other plots were not treated. Planting is done at all locations manually. The landfill could not be done due to mechanical planting large quantities of pebbles or gravel, soil and humus, which is used to cover the waste.

Soil analysis of landfills and other locations where Miscanthus is planted, it was found that it is not necessary to perform additional fertilization to increase yields to the soil acidity in terms that is tolerant.

3 RESULTS AND DISCUSSION

Land that was analyzed was taken from a depth of 0 to 30 cm, weight about 1.5 kg and on that occasion analyzed was soil properties such as acidity and the content of calcium carbonate

($CaCO_3$), humus, nitrogen (N), phosphorous pentoxide (P_2O_5) and potassium oxide (K_2O) [Haines 2015].

Based on the laboratory report on the chemical analysis of soil, it can be concluded that the value of land landfill is same as the value of the land on experimental plots or deviate to a lesser extent, from experimental plots or are within optimal values.

Tab. 3 shows the development of the plants, which were obtained by measuring the height and diameter of the tree, after two months.

Location	Parameter of chuck highness	Diameter of chuck
Landfill Prelići	12,11	0,52
G. Gorevnica	18,06	0,45
Trbušani	8,15	0,37
Rošci 1	7,62	0,37
Rošci 2	-	-
Slatina	17,12	0,46
Zablaće	16,98	0,59
Sime Sarage	21,15	0,59

Table 3. Parameters obtained in the period 14-22.06.2012.

The measurements are taken on marked plants, which serve as a sample. This table indicates that the location Rošci 2 has not received any plant, which means that the land above 593 meters above sea level is not suitable for plant Miscanthus.

On the basis of the calculated average yields lower energy plants Myscantus in the amount of 340 t / ha for the exploitation period of 20 years, a total of 2 hectares, with 600 tons produced Miscanthus to replace about 250 tons of coal or 280,000 gallons of oil, or about 280000 m3 of gas for heating.

Using biomass achieves a reduction of greenhouse gas emissions into the atmosphere and the greenhouse effect. It is important to point out that for every megawatt hour (MWh) of electricity consumed must dig more than 3 tons of coal whose burning in the thermal power plant in the atmosphere dropped 500 kilograms of ash more than 1,500 kilograms of carbon dioxide. Also this method of combustion is lost about 2 MWh of heat, which is equivalent to 200 cubic meters of natural gas.

In winter JKP "Komunalac" Čačak, benefits of electricity and gas for heating from his business premises. The average annual gas consumption for the building of the Management Board of the company for heating amounts to 12,000 m3 of gas. On the basis of the anticipated yield of miscanthus, it could be used instead of gas for a period of about 24 years. Extending miscanthus plantations from the current 2 hectares on 4 hectares would ensure the supply of heat to all rooms of Administration building which is now used the energy gas, as well as RJ "Cleanliness and maintenance" which is now heated with electrical furnaces.

4 CONCLUSIONS

Authors of accepted papers will be required to transfer copyrights to the publisher. Based on the results shown in practice can confirm the hypothesis that it is possible to establish the production of energy plantations in the landfill, or in other degraded sites. It was observed that Miscanthus should be planted above 593 meters above sea level. It can be concluded that it is justified use of biomass in order to reduce dependence on energy suppliers in order to reduce the use of fossil fuels with the aim of increasing energy efficiency and sustainable development.

As the price of production of 1 t of biomass pellets around 65.00 €/ t, while the price of one ton of pellets from biomass in the market is around € 140.00, based on the research results, based on an analysis of all costs were made during the formation of plantations and the planned costs for the 20 years of the crop, based on dynamic criteria for investment decisions, it was found that the production of energy biomass from Miscanthus is justified and economically acceptable.

The research found that there are certain problems in the formation of energy crops in the territory of the landfill. There was a heavy dependence on water because the ground landfills composed of various construction, animal, and industrial waste and is quite porous.

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CONTACTS:

Assoc. Prof. Snezana Kirin, Ph.D.
University of Belgrade,
Innovation Center Faculty of Mechanical Engineering
Kraljice Marije 16, 11000 Belgrade, Serbia
E-mail: snezanakirin@yahoo.com