Abstract— Plant and trees biomass is produced daily around us by incorporating solar energy that arrives in large quantities on our planet. Unfortunately, too large quantities of it remain unexploited although biomass especially in the form of wood always was a main source of energy for humans. About 500,000 years ago when the fire was the great discovery for humanity, essentially began also the course of human civilization. Energy consumption has been an integral part of this process and it grew explosively with the Industrial Revolution. But the energy crisis as occurred in the 1970s with longer visible depletion of fossil fuels and the respective detrimental environmental burden, led to the search for alternative energy sources. These are recent renewable energy sources including biomass. The biomass conversion technologies into solid, liquid and gas bio-fuels are now well developed. Numerous sources and types of biomass among which woody, produced by the fast-growing forest species. In recent years these crops have been studied enough and expanding worldwide. Second, even third and further generation bio-fuels try to utilize the high energy content of lignocellulosic biomass although they are still at an early stage to challenge their future wide application and economic exploitation. The utilization of short rotation forestry species (SRC) can contribute to achieving the EU and local targets on bio-fuels production and the replacement of fossil fuels. They can be a valuable source of timber and a continuous feed to the paper and chemical products industry. Even so, the application of these plantations should take into account a range of environmental, social and economic factors to ensure sustainable development with the least possible impact and the greatest benefits. Also, under certain conditions, can be a way to develop rural areas and contribute to the economic progress of each and our country as part of an overall plan for agro-development.

Keywords— biomass, SRC, energy and heat production, bio-fuels, renewable energy, chemical products.

I. INTRODUCTION

Short rotation forestry (the time from formation until harvesting of) has been studied in recent years and in particular since the 1960s. The interest has focused on the use as first material for energy production and wood products. The possibility of these crops for energy production was recognized because of their fast growth rates, high productivity, short period for harvesting and the ability of wood production for many years.

The course of human societies is linked to the consumption of vast amounts of energy in various forms and from various sources with a basic role for fossil fuels. That's why the unit for large amounts of energy is the TOE: : tone of oil equivalent ( 1 toe = 42 GJoules).

Bioenergy is characterized every form of energy, heat, electricity, etc. produced using biomass. It is a form of energy that is becoming increasingly important in the modern world and essentially it is the largest renewable energy source.

Biomass is the only renewable energy source which can be directly converted into bio-fuel. The growing demand of bio-fuels which penetrate in several intensive today’s activities such as in transportation, and the important development of bio-fuels production technology through the utilization of lignin and cellulose, turned the attention among others and in fast growing tree species which can cover part of these requirements. The calorific values of forest species plantations production may reach 4.3-4.8 kcal / g equivalent to 27 barrels oil per Ha-land.

Wood from trees was in the history of humanity not only the basic material for energy production but also the dominant building material. Man used the wood for transports, building, agriculture, shipbuilding and art. And today the wood has still an important place in human activities.

Paper is a material made from wood pulp or other fibers with a specific process that usually results in thin sheets. The development of technology has established wood as basic raw material. Today it is consumed about 50,000,000 m³ of wood per year for pulpwood production. These represent 90% of the raw material for paper production.

Processing lignin and cellulose of woody biomass for energy utilization can lead either via the main products or by-products in a range of useful chemical derivatives. Also, this can be accomplished by separate processes of biomass components.
Biomass characterized as a material of organic origin - "living matter" and describes products derived from living or recently living organisms.

Through the process of photosynthesis, the solar energy is stored in biomass.

It can be described by the following chemical equation:

\[ 6 \text{CO}_2 + 12 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 + 6 \text{H}_2\text{O} + 674 \text{cal} \]

Solar energy is converted into a chemical. So the term biomass describes a wide range of organic material produced directly or indirectly from plants. This includes and animal materials because the animals derive the energy required by eating plants. Eventually biomass is stored solar energy and is included in the renewable energy sources. One way of biomass estimation methods is its separation in 8 categories. Forest crops are one of these categories. There are also energy plantations of fast growing trees or short rotation coppice (SRC) as otherwise designated for the production of wood, coal or bio-fuels, and for continuous production of paper, furniture wood, and other industrial products. The other seven remaining categories are:

- Natural forests and woodlands
- Agro-industrial crops
- Trees outside forests and woodlands
- Agricultural crops
- Crop residues
- Treated waste
- Animal and municipal waste

The biomass from the trees has always been the most important and direct fuel in the world [1-194].

II. INGREDIENTS- CHARACTERISTICS OF FOREST BIOMASS

The typical grouping of the main components of forest biomass in individual categories are:

- moisture content,
- organic (or burning) part,
- inorganic part (or ash).

Building components are: polysaccharides (cellulose and hemicelluloses), lignin.

Cellulose: polysaccharide consisting of 10,000 glucose molecules that form straight chains. The cellulose chains are linked by hydrogen bonds to form beams which in turn are interwoven in strong grids.

Hemicelluloses: mixture of copolymers substances (glucose, mannose, xylose) and consists both of linear and branched parts.

Lignin: polymer of phenyl propane with three-dimensional structure.

The walls of the cells of a tree form a porous and cellular structure. Large macromolecules of cellulose and hemicelluloses interlocked together by adhesive lignin. The amount of lignin partially determines the mechanical strength of the structure. Thus the parts of the tree that are characterized by high mechanical strength such as large branches or trunks, will have a high lignin content and higher heating value than the other parts. Thus, the relatively high lignin content is a determining factor for the distinction of woody (ligno-cellulosic) from herbaceous biomass, making the woody materials suitable for use in thermochemical energy production processes, such as combustion of biomass from agricultural activities.

Non-structural components: fats, terpenes, pectins, resins and fatty acids. Ash: mainly composed of Ca, K, Mg, Fe, Mn

Picture 1. Three-dimensional imaging lignocellulose grids (8)
In short rotation forestry crops, where the biomass is harvested when the trees are young, the product solid fuel can contain large ash content. Depending on the harvesting technology, shredded wood from such plantations will usually have large quantities of bark, which also implies an increased ash content.

The heating value of the biomass is the thermal energy released during the complete combustion of 1kg fuel at 25 °C and where the products of combustion return to ambient temperature.

The effective (lower) heating value of a component is

$$q_{\text{NET}} = q_{\text{NET,DAF}} * (1-f_{\text{ASH}}) * (1-f_{W}) - 2.45 * f_{W} \text{ MJ/kg}.$$  

$q_{\text{NET,DAF}}$, DAF: heating value of the Dry, Ash-Free substance.

$f_{\text{ASH}}$: ash content, expressed as a percentage by dry mass.

$f_{W}$: moisture content (water), expressed as a percentage by mass, as is (in the liquid).

From the above equation it can be concluded that the most important element in the calculation of net heating value is the moisture and ash contents.

III. BIOMASS PRODUCTION FROM TREES

Generally the biomass productivity ranges between 8-35 tn / ha / year.

The most important factors affecting the production of biomass particular in fast-growing tree crops are:

- The forest species
- The variety, the origin, the clone
- The planting plan (the distance between plants), which should aim at maximizing biomass production and can help the dilution by timber harvesting.
- The design (mixed or pure plantations)
- The planting material (saplings, cuttings, size)
- The cultivation (fertilization, irrigation, dilution, pest management, milling) The supply via fertilization with nutrients is important because it affects the replacement of losses from harvesting, increasing the canopy cover, a high index of leaf area, high efficiency of light and low relation root / shoot.
- The environment (soil and climate)

Canopy: the shade that leaves on the ground, the crown (branches and leaves) of all the woodland trees when the sun falls vertically. Essentially concerns the extent of soil covered by vegetation.

LAI (Leaf Area Index) is a dimensionless quantity that characterizes the dome of an ecosystem. Defined as the ratio of the total area of one side of leaves per soil surface unit.

$$LAI = \frac{L A e \ f \ A e r \ o \ g \ n \ d \ G r \ o \ n \ d \ A r \ e}{[m^2/m^2]}$$

The fast-growing broadleaved species along with forestry methods can create fast closed canopy, high leaf area index LAI ~ 6 , early development of leaves in the Spring and strong growth. Thus, these species are characterized by efficient light use, similar to that of agricultural crops. These include poplar, willow, the Paulownia, eucalyptus and robinia pseudoacacia.

FOREST SPECIES

The forest species used in short rotation crops/coppice (SRC) need to gather some necessary features that are:

- Rapid development and rapid replenishment of biomass.
- Easy vegetative or intrinsic multiplication.
- Large ability vegetation of young executives after cutting the tree near the ground and capacity of new roots creation.
- Woody biomass production suitable for various uses included of course energy.

Willow (Salix spp.)

Scientific name is salix (spp = species pluralis; Latin abbreviation for many species) and derived from the Celtic word "sal" = near and "lis" = water because the willow grows in moist soils, in river banks and lake areas.
Benefits:
- High growth rate and productivity.
- Environmentally friendly and characterized as a renewable energy source (RES).
- Adaptability to different soils and high resistance to climatic changes.
- Low cost except the initial planting investment.
- More profitable land use than other crops.

Disadvantages:
- The high cost of the initial investment especially for large areas.
- The requirements to irrigation.

**Poplar (Populus spp.)**

It belongs to the class Salicales and the family Salicaceae. Characterized as the most rapidly growing trees in temperate zones.

Benefits:
- Rapid growth
- High productivity
- Resistance to climatic conditions and diseases

Disadvantages:
- Installation costs
- Reduced expertise
- Supply Chain Costs

**Eucalyptus (Eucalyptus spp.)**

It belongs to the class Myrtales and the family Myrtaceae. It is an evergreen upright tree, with rapid growth and it is characterized as the tallest flowering plant on earth. It has away lanceolate leaves. The distillate of the leaves can be used as an insect repellent as anti-parasitic and the ethereal oil obtained finds application in the pharmaceutical sector (decongestants, antitussive, antiseptic) and in cosmetics.

Benefits:
- High productivity
- Friendly to the environment with minimum lubrication
- Increased flexibility
- Small water requirements
- Large ability vegetation of young executives after cutting the tree near the ground all year

Disadvantages:
- Flexibility in harvest time
- High energy efficiency

**Robinia pseudoacacia**

It belongs to the class Fabales and the family Fabaceae. It is a leguminous vegetable, deciduous tree of medium size.

Benefits:
- The high growth rate
- High productivity
- Wide adaptability
- Small cultivation activities
- Wood quality (density, low humidity)

Disadvantages:
- Illnesses
- The nitrogen content of the biomass
- Supply chain costs.

**Paulownia spp.**

It is known as the "Imperial tree" or "tree of Princess" and it belongs to the class Lamiales and asexual family Paulowniaceae. It has been characterized as the fastest growing tree.

The particular characteristics of the wood have made the paulownia very desirable for cultivation and commerce for centuries.

Benefits:
- High development and production rate
- Relatively small cultivation care
- Adaptability and ability to thrive even in sandy soils without operating competitively with crops for food needs.
- Flexibility for logging time awaiting the most convenient wholesale prices and transforming the culture into a kind of savings

Disadvantages:
- Relatively large cultivation area so that it is economically profitable to invest
- Water requirements
- Lack of expertise
Table 2. Developmental characteristics of forest species (188)

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Annual Growth</th>
<th>Tree Height of Three Years</th>
<th>Maximum Height of a Mature Tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Paulownia spp.)</td>
<td>3 – 5 μ.</td>
<td>10,5 – 15,5 μ.</td>
<td>15 – 20 μ.</td>
</tr>
<tr>
<td>(Salix spp. hybrid)</td>
<td>1,5 – 4 μ.</td>
<td>7,5 – 12 μ.</td>
<td>15 – 25 μ.</td>
</tr>
<tr>
<td>(Populus deltoides)</td>
<td>2,5 – 3,5 μ.</td>
<td>9 – 12 μ.</td>
<td>20 – 30 μ.</td>
</tr>
<tr>
<td>(Eucalyptus polyanthemos)</td>
<td>2 – 2,5 μ.</td>
<td>6 – 9 μ.</td>
<td>10 – 15 μ.</td>
</tr>
</tbody>
</table>

IV. BIOENERGY-OTHER USES OF FOREST BIOMASS

The net amount of energy that can be recovered from the biomass depends on:
- The water content
- The amount remaining as ash after combustion (ash)

Substances forming the ashes do not generally have any energy value so the energy content is more affected by moisture, rather than by the kind of wood.

V. CHEMICAL REACTIONS IN PRODUCTION PROCESSES

Thermochemical treatment
- Combustion:
  - The basic chemical reaction that describes the biomass combustion are:

\[
C_{6n}(H_2O)_{5n} + 6nO_2 \rightarrow 6nCO_2 + 5nH_2O
\]
Gasification:
- Exothermic reactions:
  - $C_6H_5O_2 + O_2 \rightarrow CO_2$
  - $C_6H_5 + 1/2O_2 \rightarrow CO$
  - $H_2 + 1/2O_2 \rightarrow H_2O$
  - $CO + 1/2O_2 \rightarrow CO_2$
  - $C_6 + 2H_2 \rightarrow CH_4$
  - $CO + H_2O \rightarrow CO_2 + H_2$

- Endothermic reactions:
  - $C_6H_5+CO \rightarrow 2CO$
  - $C_6H_5+H_2 \rightarrow CO+H_2$
  - $CH_2H_5O+3H_2 \rightarrow CO+2H_2$

Carbonization:
The basic chemical reaction during carbonization of biomass is:

$$C_{6n}(H_2O)_{5n} \rightarrow 6nC + 5nH_2O$$

BIOLOGICAL TREATMENT
- Bioethanol

HYDROLYSIS

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

- Biodiesel

ALCOHOLIC FERMENTATION

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

- Biogas-anaerobic digestion

The typical chemical reaction for the anaerobic digestion of cellulose is:

$$\left(C_6H_{10}O_5\right)_n + nH_2O \rightarrow 3nCO_2 + 3nCH_4$$

SECOND GENERATION BIOFUELS

The technologies for the production of liquid (bioethanol, biodiesel, bio-oils) and gaseous (biogas) fuels utilize a part of the tendered biomass such as starch, sugars and fats and these fuels are characterized as first generation bio-fuels. However the lignocellulosic components which are the building blocks of plant cells and are found in large quantities, although they have a high energy content mostly remain unexploited.

![Figure-3. ratio of the three basic components of lignocellulosic biomass (8)](image)

The technologies for the utilization of lignocellulosic materials basically comprises of two main processes, biochemical and thermochemical. At the same time new efforts are evolving in order to improve them and also implement new.
The biochemical conversion of lignocellulosic biomass has as main objective the production of bioethanol. This process evolves in four basic steps:

1. **Pretreatment**: breaking the lignocellulosic structure.
2. **Hydrolysis**: Conversion of cellulose to glucose using acids or enzymes.
3. **Fermentation**: conversion of sugars into ethanol.
4. **Distillation / dehydration**: separation and purification of ethanol.

The thermochemical conversion of biomass includes direct combustion processes, pyrolysis and/or gasification. The technology BtL (Biomass to Liquid) combines the gasification of biomass to produce syngas (CO, H₂) and liquid fuels afterward.

Thus, BtL-ethanol and BtL-dimethylether (DME) can be produced. Also, the synthesis gas by catalytic Fischer-Tropsch process may be converted into a mixture of hydrocarbons called the second generation diesel or BtL-diesel or FT-diesel.

**TIMBER**

The properties of the wood which determine its use and applications are the hardness, density, also its resistance to weathering, moisture, fungi and insects. More useful wood properties include also its dimensional stability, possibility of impregnation, machining, ease of drying and bending.

The growth rate can affect the quality of the wood. Some of the fast-growing species such as poplar wood provides a lower quality compared to other slow-growing species such as oak species. However, what ultimately determines the difference is not the growth rate but the inherent differences of wood types (quality, abundance, appearance). The rapid growth has proved by research that it creates a wood of low density. Among trees of the same species, the factor that influences the density are genetic differences. Ultimately, the well-managed forests and plantations ensures healthy and productive trees. Also, the use of wood in comparison with other building materials such as iron or aluminium saves considerable amounts of energy.

**PAPER**

There is a move towards the use of broad-leaved species and more integrated management of wood processing residues. At the same time they are trying to use all parts of the plant and the recycling is becoming increasingly more important in paper manufacturing.

The technology seeks to improve the parameters that affect energy consumption, efficiency in pulp, protection of the environment by reducing the chemicals used at various stages of the paper production.

**OTHER INDUSTRIAL PRODUCTS**

The industrial processes of woody biomass utilization include the production of a series of products:

- **Cellulose products**:
  - Cellulose esters - use as made textile materials (rayon).
  - Ethers of cellulose; application as emulsifiers, stabilizers, solutions to the pharmaceutical and cosmetic industry.
  - Glucose; Produced by the hydrolysis of cellulose and is related with a large number of products - ascorbic acid, polymers, alcohols, ketones, organic acids, polyamides.

- **Hemicelluloses products** such as proteins, vitamins, fats, amino acids, ethanol, yeast, polyurethane, nylon 6.6, esters, plastics, synthetic resins, and polymers.

- **Products of Lignin** produced by cracking, hydrogenolysis, oxidation, hydrolysis and polymerization. They include syngas, methane, ethane, benzene, phenol, methanol, tar, vanillin, aldehyde, aromatic aldehydes, ketones, acids, dimethylsulfide, dimethylsulfoxide, phenols, cyclic hydrocarbons, creosote.

However, financial and technical problems are hindering at this moment the wider application and commercial exploitation of some of the above derivatives. A large amount of energy is required and the quantities of products from lignin are relatively small at some cases. On the other hand, the complex structure of the lignin molecules increases the requirements of technical facilities.

**V. IMPROVEMENT OF PLANTS- GENERATION OF NEW BIOTECHNOLOGY**

The growing worldwide interest for short rotation forestry crops strengthens the corresponding research effort to improve species and producing new. This may be achieved by genetic improvement via testing new clones and hybridization or by genetic modification.

The plants are propagated in two ways:

- **Intrinsic propagation** that is racial combination of a male and a female cell. The plant descendant combines the characteristics of both parent plants.

- **Vegetative propagation** which is made by the use of sections of the plant (tubers, rhizomes, vaccines, cuttings, stolons, sheets) without fertilization and creates genetically identical plants known as clones. In this way we can reproduce plants that will carry the desired characteristics which are detected in the parent plant.
On the other side, hybrids are plants resulting from the crossing of different varieties of the same species. The parents are both relatives that differ in one or more genes. Hybrids have certain diverse characteristics than the plants from which they originate. The junction is called hybridization.

Modern research is directed to improve the species, the comparison of different clones or species in order to maximize productivity by minimizing costs. So different parameters were studied on the speed of development, physiology, reproduction, cultivation needs, diseases, harvesting etc. Simultaneously, economic and social issues arising from the development of existing and new plantations and the respective type of applications were explored.

Genetic modification or genetic engineering is the process that changes the genetic material of an organism. This is achieved by adding, removing, suspending, exchanging or relocation of genes or the DNA sequences which can be derived from the same (cisgenic) or completely different type or from synthetic DNA (transgenic). The new creature is called genetically modified organism (GMOs).

The first genetically modified trees were created in 1987 and since 1998 there have been 116 confirmed tests. The objectives are:

- Increased resistance against insects (Bt gene)
- Resistance to herbicides such as glyphosate (systemic herbicide)
- Reduction or modification of lignin
- Faster growth

They have created genetically modified species eucalyptus that exhibited increased resistance to frost and made them suitable for cultivation even at hemi Arctic regions. Moreover, the introduction of a gene from weed "aravidopsis", created genetically modified species with 40% faster development. At the same time, they created genetically modified species poplar by introduction of a gene derived from the herb "Chinese angelica". The purpose was to change the structure of the lignin so that it decomposes easily. This overcomes tough, environmentally hazardous (chemical) and energy-intensive processes for the utilization of lignin and makes the wood more accessible for pulp production and for second generation bio-fuels.

VI. CURRENT SITUATION-OUTLOOK- EFFECTS

The biomass produced worldwide each year is about 172 billion tones dry mass with energy content about ten times of the energy consumed around the world every year. Today it is estimated that only about 1/7 of world energy consumption is covered by biomass and is focused mostly in traditional uses (firewood, charcoal etc.). So in developing countries precisely because of the traditional use, biomass has multiple penetration uses compared to the developed countries.

2014 EU Estimations:
- ~ 20% of renewable electricity from biomass (mainly CHP).
- 90% of renewable thermal energy from biomass.
- EU's largest producer of pellets with 13.5 million tones in 2014.
- Electricity generation from solid biomass reached 81,500 GWh.
- 14,500 biogas plants with a total output of 7.8GW.
- 99 bioethanol plants with a production capacity of 8,800,000 m³.
- The total turnover of RES (renewable energy sources) exceeding 56 billion €, and the bioenergy represents 40% of it.

One of the sources of biomass is the energy crops which have been already developed all over the world but also in Europe. The available cultivated areas are given in the following table.

<table>
<thead>
<tr>
<th>Available arable land (on 1000 Ha) for energy crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table-3.</td>
</tr>
<tr>
<td>(12)</td>
</tr>
</tbody>
</table>
These crops are categorized by the kind of plant and the crop target. So their distribution at EU level is reflected in the following drawing.

The annual available agricultural and forest residues have equivalent energy with 3-4 million tn of oil and account for 30-40% of the total amount of oil consumed annually in the country.

**CRITERIA - CONDITIONS FOR LOCATION OF SRC.**

The selection of suitable areas must meet the following criteria:

<table>
<thead>
<tr>
<th>Geographical and natural characteristics</th>
<th>Infrastructure &amp; technical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>microclimate</td>
<td>Distance from consumers</td>
</tr>
<tr>
<td>ground</td>
<td>area access</td>
</tr>
<tr>
<td>Natural dangers</td>
<td>electricity lines</td>
</tr>
<tr>
<td>Pests, insects, mammals</td>
<td>Existence of technological equipment</td>
</tr>
<tr>
<td>biodiversity</td>
<td></td>
</tr>
</tbody>
</table>

**TARGETS**

The EU aims by 2020 to increase the share of renewable energy as follows:

- 45% for electricity
- 37% on heating
- 18% in the transport sector

The targets for biomass for 2020 are:

- Electricity: 120,000 GWh or 9% of total electricity production in the EU.
- Heating / Cooling 80% RES or 29.6% of total.
- Transfers 90% of RES or 16.2% of total.
VII. ATMOSPHERIC CONTAMINATION GREENHOUSE GASES

The main gas responsible for the greenhouse effect is considered CO\textsubscript{2} which is released from the combustion of fossil fuels and biomass.

However, the biomass does not appear to aggravate the atmosphere with this dirt because during photosynthesis CO\textsubscript{2} is reblocked and the final balance is expected to be friendly to the environment.

Though many scientists still believe that SRC plantations threaten the balance of the global climate because they cause ultimately greater environmental impacts than the expected benefits.

The main reasons are:

- SRC plantations bind only 25% of the greenhouse gases comparatively with forests.
- When an area deforested in order to install a new cultivation, CO\textsubscript{2} which until that moment was tied in the trunks of plants, trees or shrubs, is released into the atmosphere.
- Energy and water consumption for the establishment of plantations must be taken into account and into the economy of SRCs.
- "Clean Development Mechanism" (CDM), countries that exceed their targets in CO\textsubscript{2} emissions can buy dirt from countries with higher emissions and offer finance for making SRC plantations in them.
- Fast-growing forest species release isoprene (Lancaster University).

VIII. DISCUSSION

Today the role of biomass is steadily growing as a main alternative and renewable energy source (RES). These sources already represent 70% of energy from RES in the EU. The wood and its derivatives become more and more the centre of interest as their use in various forms of fuel in order to produce heat and electricity.

Also, the continuous development of technology offers currently the possibility for the production of second generation bio-fuels and other bio-materials and chemicals.

At the same time the demand for timber remains and grows steadily. So it seems that the European and global interest in searching of biomass sources, especially for wood will increase in the coming years.

The plantation establishment of SRC affects not only the landscape and the environment but also has some social implications especially when the cultivation gets into a larger scale.

<table>
<thead>
<tr>
<th>criteria</th>
<th>rural areas</th>
<th>pastures</th>
<th>forest areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides</td>
<td>Potential use during installation and harvesting similar to conventional practices, not in the management phase.</td>
<td>Potential use during installation and harvesting similar to pasture, not in the management phase.</td>
<td>greater use</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Much less</td>
<td>Much less</td>
<td>Greater</td>
</tr>
<tr>
<td>soil erosion</td>
<td>Much less</td>
<td>Greater during installation and harvesting similar to pasture, not in the management period.</td>
<td>little more</td>
</tr>
<tr>
<td>biodiversity</td>
<td>usually more</td>
<td>it depends on the intensity of exploitation of pastures and the species</td>
<td>less</td>
</tr>
<tr>
<td>Climate</td>
<td>Equilibration of temperature, wind protection, reduction of pollutants and dust</td>
<td>Equilibration of temperature, wind protection.</td>
<td>Negative effects</td>
</tr>
<tr>
<td>Water</td>
<td>Greater evaporation and withholding</td>
<td>Greater evaporation</td>
<td>Negative effects</td>
</tr>
<tr>
<td>carbon sequestration</td>
<td>greater</td>
<td>Higher or the same, it depends on the management practices</td>
<td>less</td>
</tr>
</tbody>
</table>
These crops can generate significant benefits for local communities such as employment growth both in plantations and relevant industries and in other activities associated with them.

On the other hand, some problems may develop in the row. In many cases, they have created serious resistance and conflicts from local populations even with the use of force. The effect of SRC plantations in employment depends also on the land use and the woodworking process. The installation in fertile farmland will probably cut jobs compared with the previous activities.

However, the plantations can contribute to improving the level of local and nearby employment if they will be installed in abandoned, degraded or rural areas with small interest. This contribution appears to be greater when the cultivations are intended for timber production in relation to the pulp.

Today, there is even an increasing concern of political and economic institutions and organizations on the overall impacts of these plantations.

Organizations such as CIFOR and EU demand a series of criteria and indicators for the optimal management of these farms and better investigation of environmental, social and economic impacts.

Moreover, many consumers and buyers now require that the plantation products be accompanied by a certified, balanced and sustainable management. The development of fast growing tree species in Greece has developed on a small scale, so today it can create easily the conditions and the above requirements for their operation.

The further investigation of the effects and benefits of SRC will ensure a more balanced and sustainable development.

IX. CONCLUSIONS

The European and global interests in search of biomass sources, especially for wood will increase in future years for use as fuel in heat and power production, also in the exploitation of the second and further generation bio-fuels and other bio-materials and chemicals.

In Greece the SRC plantations are cultivated on a very small scale but simultaneously this situation creates margins and prospects for future actions and investments.

They can be a valuable alternative solution with a role complementary to existing crops. Proper and detailed assessment of the site and of the species can offer the farmer an additional income and a long-term investment.

Integration in the overall planning for a sustainable rural development model across the country it is possible.

Promotion of cooperative form farms that must be free of weights of the past and with the aim of isomers for mild development. This can give several perspectives especially today in conditions of the recent economic crisis.

Each state should help in this direction by creating infrastructure and providing incentives for the development of domestic research and cultivation.

There are real opportunities to participate in every country in a rational way in the development of bio-economy and bio-energy providing corresponding benefits for its citizens.

Further investigation of the impact may be necessary in order to ensure a more balanced and sustainable development.

The essential profit of this form of agricultural and industrial development is not only related to the direct cost and benefit but also with the long-term beneficial effects on nature, man and society as a whole.

It is of high interest for Europe and other countries to develop improved biomass technology with better energy and bio-fuel efficiencies. It is also within the future objectives to produce higher quality of lignin and other chemicals from SRC so that better properties for the final products can be achieved.

Acknowledgments

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